

A12 Chelmsford to A120 widening scheme

TR010060

9.11 A12 JUNCTION 19 SURFACE WATER DRAINAGE DESIGN

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A12 Chelmsford to A120 widening scheme
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1 Introduction

1.1.1 The A12 between Junction 19 and Junction 25 in Essex is to be upgraded and is referred to as the “proposed scheme” hereafter. An application for Development Consent Order (DCO) will be made as this is a Nationally Significant Infrastructure Project (NSIP). The DCO submission is programmed for Summer 2022. The project is currently at the preliminary design stage.

1.1.2 This report outlines the drainage design development process involved in arriving at the current highway drainage design solutions for the proposed scheme in the vicinity of Junction 19. This report has been developed to address the concerns of the affected landowners regarding the landtake requirements for the proposed highway drainage which were raised during the consultation process. The report is aimed at the affected Junction 19 landowners and their supporting technical representatives. Therefore, it is assumed that with the support of the technical representatives the Junction 19 highway drainage design information presented in this report can be read and understood by all the aforementioned parties. This report describes the following (in the order of discussion within the report):

- **Section 2** - Describes the highway improvement works in the vicinity of Junction 19 as part of the proposed scheme. The highway improvement works primarily involve online highway widening works;
- **Section 3** - Describes the existing highway drainage in the vicinity of Junction 19 in general terms to provide background on how the existing highway drainage outfall locations and existing catchment areas have informed the proposed highway drainage design;
- **Section 4** - Presents the proposed highway drainage design rational and design criteria including the climate change guidance followed, the drainage design standards and guidance followed, the allowable discharge rate calculation methodology, the attenuation storage sizing criteria and the proposed outfall discharge hierarchy which informs the proposed outfall locations.
- **Section 5** – Describes the design development of the proposed highway drainage solutions for the proposed scheme in the vicinity of Junction 19. These proposed highway drainage solutions encompass six proposed highway drainage catchments, namely the proposed S1-OU1, S1-OU7A, S1-OU10, S1-OU10A, S1-OU11 and S1-OU12 catchments.
- **Section 6** – Describes the attenuation storage (i.e. attenuation ponds and underground geocellular attenuation storage systems) design principles and constraints that inform the resulting attenuation storage areal footprints / landtake requirements. This includes criteria such as attenuation pond side slopes, design depth constraints, the presence of site constraints (e.g. nearby floodplains, steep terrain, etc.) and so forth.
- **Section 7** – Describes the design development process involved in determining the selected attenuation storage locations and the design

constraints that resulted in the alternative attenuation storage locations being discounted.

2 Proposed Highway Improvement Works in the Vicinity of Junction 19

2.1.1 At the time of writing this report, the existing Junction 19 is being improved as part of the Beaulieu Park development. The changes are being made by the Developer of the Beaulieu Park development, and the construction is due to be completed by early 2023. As construction of the highway improvements required for the Beaulieu Park are due to be completed before construction of the proposed scheme begins, these improvements have been taken into account in the proposed scheme design proposals. The proposed A12 scheme would deliver additional highway improvements to Junction 19, including:

- Additional lanes on Boreham Bridge (i.e. symmetrical widening);
- Additional lanes on Generals Farm Roundabout;
- Additional lanes on Generals Lane Roundabout and adjoining access roads;
- Realigned A131 (Radial Distributor Road – RDR);
- Online widening of the A12 mainline southbound carriageway to the north and south of Junction 19;
- Online widening of the A12 mainline northbound carriageway to the north of Junction 19;
- Online widening of the adjoining Main Road (B1137) heading east towards Boreham;
- Online widening of the Junction 19 southbound on-slip road;
- Online widening of the Junction 19 southbound off-slip road;
- Online widening of the A138 side road located along the northern side of Junction 19;
- Addition of paved area to Payne’s Lane WCH (Walking, Cycling and Horse Riding) route; and
- Addition of the Junction 19 northbound on-slip road (i.e. adjoining General’s Lane Roundabout).

2.1.2 The proposed A12 scheme highway improvement works in the vicinity of Junction 19 are illustrated and labelled in Plate 2.1 below.

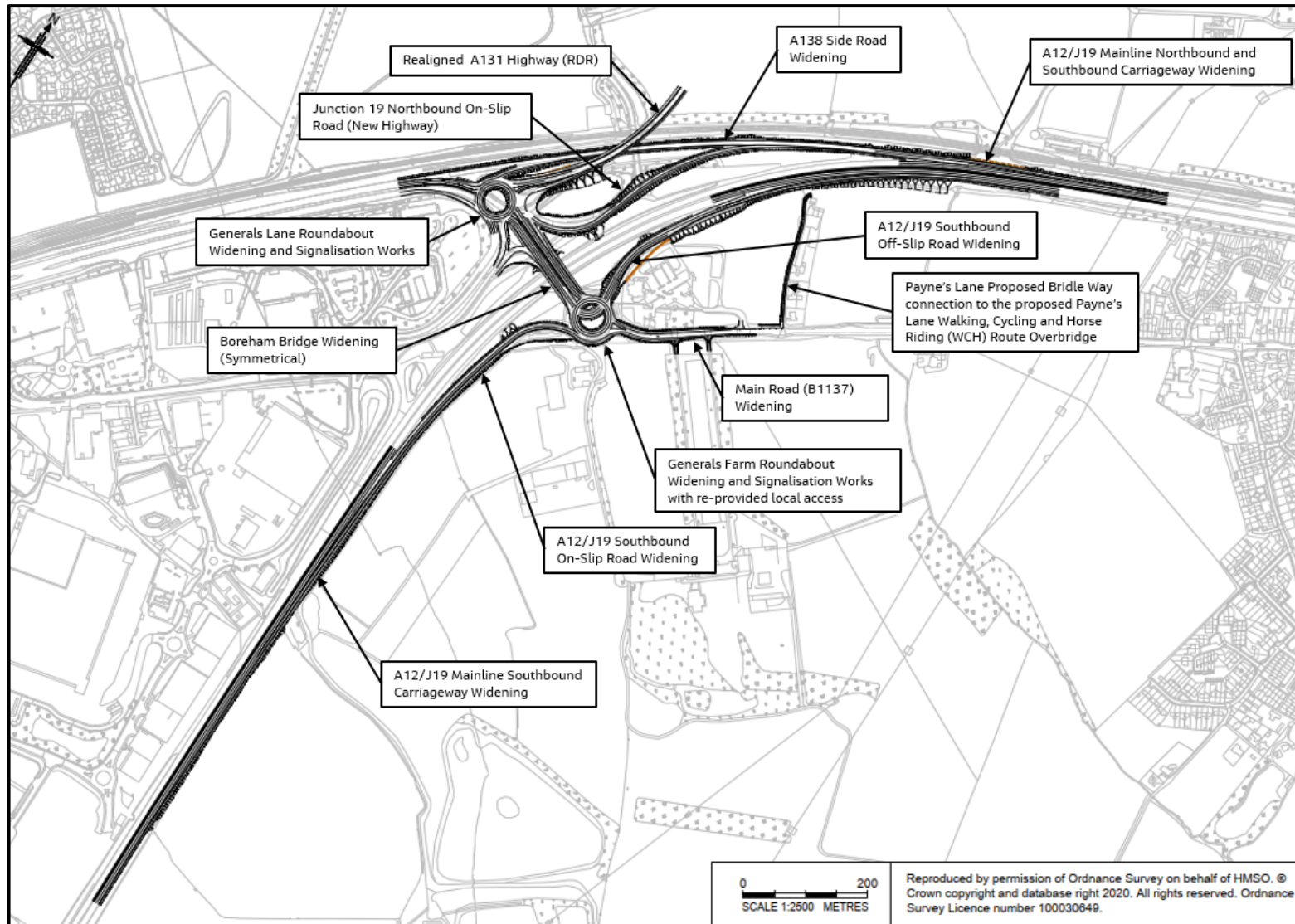


Plate 2.1 Proposed Highway Improvement Works in the Vicinity of Junction 19

3 Existing Highway Drainage

- 3.1.1 The existing highway drainage information for the A12 in the vicinity of Junction 19 has been obtained primarily from drainage surveys (i.e. drainage connectivity and condition assessment surveys (CCTV surveys)) that were undertaken prior to the preliminary design stage. Other sources of information related to existing highway drainage included the National Highways' Drainage Data Management System (i.e. HADDMS), available drainage construction drawings/As-Built drainage records and limited topographical survey information for existing outfalls and watercourse alignments in the vicinity of existing outfalls. These combined sets of information were used to determine the existing highway drainage features, drainage catchments, outfall arrangements and existing culvert crossings within the footprint of the proposed scheme extent.
- 3.1.2 Using the existing drainage information sources described above the existing highway drainage catchment extents and associated outfalls have been identified in the vicinity of Junction 19. Based on the assessment of the aforementioned drainage information sources the primary drainage elements identified within the proposed scheme extent at Junction 19 includes the following surface water drainage edge collection features:
- Concrete surface water channels with catchpit gratings at regular intervals;
 - Kerb inlet gullies and traditional kerb / gully drainage arrangements;
 - Combined kerb drainage alignments; and
 - Filter drains.
- 3.1.3 The existing highway drainage systems within the proposed scheme extent in the vicinity of Junction 19 are generally found to have outfalls discharging to nearby watercourses (either Ordinary Watercourses or Main Rivers) depending on their proximity to the highway or existing highway drainage systems.
- 3.1.4 As described in Section 2 the highway drainage currently being constructed by the Developer of the Beaulieu Park development on Junction 19 will be retained as part of the existing highway drainage for the proposed scheme. The highway drainage being constructed by the Developer includes two underground attenuation storage systems located within the Generals Lane Roundabout and Generals Farm Roundabout respectively. These underground geocellular attenuation storage systems will be retained as part of the proposed scheme highway drainage.
- 3.1.5 The Junction 19 existing highway drainage catchment extents, the associated outfalls and receiving watercourses are illustrated in Plate 3.1 below

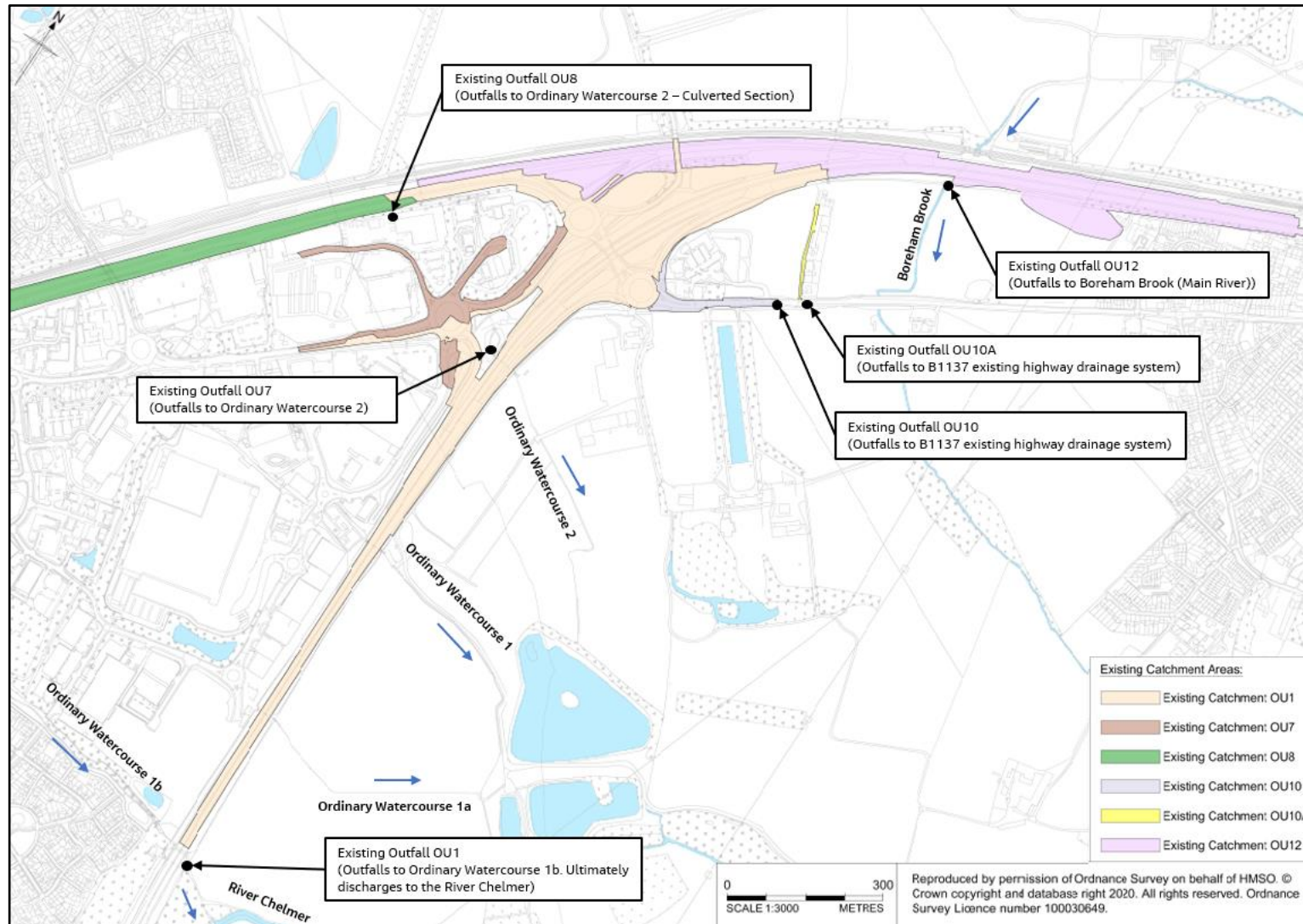


Plate 3.1 Existing Highway Drainage Catchments and Outfall Locations in the Vicinity of Junction 19

4 Proposed Highway Drainage Design Rational and Design Criteria

4.1 Highway Drainage Design Rational

4.1.1 The highway drainage design for the proposed scheme has primarily been developed in accordance with the Design Manual for Roads and Bridges (DMRB), *CG 501 Design of Highway Drainage Systems*. The proposed scheme highway drainage design has also been supplemented with the following industry standard guidance:

- The SuDS Manual C753 (CIRIA, 2015);
- Rainfall Runoff Management for Developments (Report No: SC030219) from the Environment Agency (2013);
- Sewerage Sector Guidance Appendix C - Version 2.1 (Water UK, 2021);
- The Manual of Contract Documents for Highway Works (MCHW) (National Highways, 2021); and
- Essex County Council SuDS Design Guide (Essex County Council, 2020);

4.1.2 For the proposed scheme highway drainage, where practicable, the existing highway drainage and outfalls are to be retained. Otherwise, the proposed highway drainage will be provided as described below.

4.1.3 For surface water collection on open highway unimpeded by junction it is proposed to use concrete lined surface water channels and / linear slot drainage at the road edges and concrete lined surface water channels and / or slot drainage along the central reserve. For surface water collection in the vicinity of kerbed sections of the highway at intersections with local roads, highway drainage through underpasses, road sections through urban areas, etc. it is proposed to use combined kerb drainage and/or trapped gullies. With regard to slip roads, where there is no kerblines proposed then a form of linear drainage will be required to drain the proposed highway which could be either linear slot drainage, filter drains, surface water channels or over-the-edge drainage. In the instances where the verge is spatially constrained a linear slot drainage system may be required to collect surface water runoff.

4.1.4 The collected surface water runoff will be conveyed by either carrier drains or combined filter drains in most locations. Combined filter drains are used where the proposed highway is located in cutting in order to collect the surface water runoff from the proposed highway, intercept groundwater seepage from within the highway cutting slopes in addition to conveying the collected surface water and groundwater flows downstream to a nearby watercourse.

4.2 Outfalls Discharge Hierarchy

4.2.1 Outfalls are required at the downstream end of each highway drainage system on the proposed scheme in order to discharge the collected surface water runoff into a nearby receiving watercourses. For the proposed scheme highway drainage in the vicinity of Junction 19, where practicable, the existing outfalls are

to be retained. In situations where a proposed new outfall location is required due to proposed highway geometry or site specific constraints the following outfall discharge hierarchy (in order of preference) is followed:

- Groundwater (subject to the outcome of further ground investigation to confirm ground infiltration rates, groundwater levels, potential contaminated land presence, etc.);
- Nearby watercourses;
- Existing highway drainage system, where available, in the absence of a nearby watercourse; and
- Existing foul sewer or combined sewer, where available, in the absence of the above discharge options.

4.3 Sustainable Drainage Systems (SuDS)

4.3.1 Surface water drainage systems developed in line with the principals of sustainable development are collectively referred to as Sustainable Drainage Systems (SuDS). The objective of SuDS techniques is to minimise the impacts from a proposed development on the quantity and quality of the surface water runoff and to maximise the amenity and biodiversity opportunities. The Lead Local Flood Authority (LLFA), Essex County Council, require that SuDS are included within a proposed highway drainage design in accordance with the Essex County Council SuDS Design Guide (Essex County Council, 2020).

4.3.2 The SuDS Manual C753 (CIRIA, 2015) has been consulted to establish the most suitable SuDS techniques for the proposed scheme. The SuDS techniques that have been used for the proposed scheme highway drainage in the vicinity of Junction 19 include attenuation ponds, underground geocellular attenuation storage systems and filter drains and are discussed in more detail in the site specific proposed highway drainage catchment descriptions in Section 5.

4.3.3 It should be noted that the available preliminary Ground Investigation (GI) information indicates that infiltration techniques are unlikely to be feasible due to the local geological ground conditions that prevail in the vicinity of Junction 19. Therefore, a highway drainage design has been developed with an assumption of “no infiltration” at the preliminary highway drainage design. As further GI information becomes available as the project progresses the feasibility of infiltration will be re-visited on a site-by-site basis.

4.4 Climate Change Allowance

4.4.1 During the lifetime of the proposed scheme, surface water runoff rates and volumes from the proposed carriageway paved surfaces may increase as a result of the expected increase in rainfall intensity due to climate change. The effects of climate change will have to be mitigated to minimise the risk of surface water drainage flooding in the future. Climate change has been accounted for in the proposed highway drainage design by increasing the peak rainfall intensity by a climate change allowance of 20% for the 2080's (i.e. central estimate for the 2080's, 2070 to 2115, time interval). This is in accordance with current Environment Agency (EA) climate change guidance (Environment Agency, 2021)

as of the October 2021 update and the requirement for a 20% climate change allowance as stated in DMRB *CG 501 Design of Highway Drainage Systems* (National Highways, 2020a).

- 4.4.2 In addition to a climate change allowance of 20% for all design storm events a 40% climate change allowance has been simulated as a sensitivity test for the consequences of exceedance. This also in accordance with DMRB *CG 501 Design of Highway Drainage Systems* (National Highways, 2020a).

4.5 Piped Drainage

- 4.5.1 In accordance with the requirements set out in DMRB *CG 501 Design of Highway Drainage Systems* (National Highways, 2020a), surface water carrier drains and filter drains within the proposed highway drainage systems are designed to accommodate a 1 in 1 year return period storm event in-bore without surcharge over the crown of the pipe. A design check is carried out to ensure that a 1 in 5 year return period storm event would not cause chamber surcharge levels to exceed the level of the chamber covers. In both cases a climate change allowance is applied to the piped drainage design as described in Section 4.4.
- 4.5.2 The proposed highway drainage system as a whole must be assessed for the consequences of exceedance flows associated with the 1 in 100 year return period storm event plus climate change allowance. Any surface water drainage flooding associated with the aforementioned design event is to be contained within the proposed scheme permanent acquisition of land boundary at depths and velocities that would not represent a safety risk for road users.

4.6 Allowable Discharge Rates

- 4.6.1 The proposed scheme in the vicinity of Junction 19 will result in an increase in paved area due to the proposed online widening works and proposed offline highway additions. Without mitigation, this has the potential to increase the surface water runoff rates realised locally. Therefore, mitigation is required to be incorporated within the proposed highway drainage systems such that local flood risk is not increased. The allowable discharge rates at proposed highway drainage outfalls are determined using the following approaches depending on the proposed highway options:
- *Offline Highway Route Alignment* – Proposed offline highway options will largely be developed on greenfield sites. Therefore, it will be required that the allowable discharge rates from the proposed highway drainage systems be restricted to the existing site condition greenfield runoff rates for events up to and including the 1 in 100 year return period storm event plus climate change allowance (stated in Section 4.4).
 - *Online Highway Route Alignment* – Proposed online highway options will involve the widening of the existing A12 highway alignment. Therefore, the allowable discharge rates are to be restricted to existing site condition surface water runoff rates for a range of design events determined for the existing highway drainage catchments. The existing surface water runoff rates are estimated for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period storm events by developing hydraulic models of the existing highway drainage

systems. No allowance for climate change has been applied in determining the allowable discharge rates given that current climatic conditions inform the discharge rates for the proposed highway drainage systems.

- 4.6.2 Currently the minimum practicable allowable discharge rate used to inform the proposed highway drainage design is 5l/s based on a minimum flow control diameter of 100mm for both vortex flow control and orifice plate flow control devices to reduce the risk of blockage. This is the minimum acceptable flow control diameter according to Sewerage Sector Guidance (V2.1) (Water UK, 2021), the replacement guidance for Sewers for Adoption which states:
- 4.6.3 *“Where debris can enter the control (e.g. where the upstream system is open or where the inlets are gullies), static controls should have a minimum opening size of 100 mm.”*
- 4.6.4 This is also the minimum acceptable flow control diameter according to Environment Agency Guidance – Rainfall Runoff Management for Developments (SC030219) (On the UK Government GOV.UK website <https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/rainfall-run-off-management-for-urban-developments>) which states:
- 4.6.5 *“Minimum limit of discharge rate: A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level. This limit is set at 5 litres per second, using an appropriate vortex or other flow control device.”*

4.7 Attenuation Storage

- 4.7.1 To mitigate the expected increased surface water runoff rates and associated potential increase in surface water flood risk to and from the proposed scheme, attenuation storage systems are provided within the proposed highway drainage design. The attenuation storage systems will be sized for design events up to and including the 1 in 100 year return period storm event with a climate change allowance applied to the chosen design storm to account for the anticipated increase in rainfall intensity due to climate change. Attenuation storage is to be provided in the form of attenuation ponds, underground geocellular attenuation storage systems and oversized pipes depending on the site constraints. As described in Section 4.4 of this report, in addition to a climate change allowance of 20% for all design storm events a 40% climate change allowance has been tested as a sensitivity test for the consequences of exceedance for the 1 in 100 year return period storm event plus 40% climate change allowance. Attenuation ponds are the preferred means of attenuation storage where there is sufficient space available given that they are grassed SuDS features at the ground surface as opposed to being buried underground (i.e. more accessible for periodic maintenance compared to underground geocellular attenuation storage systems and oversized pipes). This is in line with the drainage design guidance in the SuDS Manual (CIRIA C753, 2015) and the requirements set out within the ECC SuDS Design Guide (Essex County Council, 2020) that both promote the maximising of landscape, biodiversity and amenity opportunities.

4.8 Exceedance Flow Assessment

- 4.8.1 The performance of the proposed highway drainage systems are assessed against extreme rainfall events to ensure that the level of flood risk is acceptable for road users and that there is no potential surface water drainage flooding impacts to third party land outside the proposed scheme permanent acquisition of land boundary. This process is referred to as an exceedance flow assessment.
- 4.8.2 To meet the level of service described in Sections 4.4, Section 4.5 and Section 4.7 the proposed highway drainage systems have been assessed for the following design events in the exceedance flow assessment:
- The 1 in 100 year return period storm event (plus 20% climate change allowance) for storm durations ranging from 15 minutes to 24 hours to establish the critical storm duration.
 - The 1 in 100 year return period storm event (plus 40% climate change allowance) for storm durations ranging from 15 minutes to 24 hours as a sensitivity test for the consequences of exceedance.

4.9 Water Quality

- 4.9.1 In order to protect the receiving waterbodies from a potential increased pollution risk as a result of the proposed scheme, water quality treatment measures are provided within the proposed highway drainage systems for some drainage catchments in line with the principles of SuDS, where practicable.
- 4.9.2 Water quality assessments have been undertaken for the proposed scheme in accordance with the National Highways (previously Highways England) Water Risk Assessment Tool (HEWRAT) and the standards outlined in DMRB, with specific reference to DMRB *LA 113: Road Drainage and the Water Environment (RDWE) Revision 1* (National Highways, 2020b), to assess the potential risk to the water quality of receiving waterbodies and provide recommendations for mitigation measures as appropriate.
- 4.9.3 In addition to the water quantity and biodiversity benefits, the inherent nature of some of the proposed SuDS features used on the proposed scheme in the vicinity of Junction 19, namely attenuation ponds and combined filter drains, will provide treatment of surface water runoff prior to discharge to the receiving watercourse. The SuDS features incorporated within the proposed scheme highway drainage systems can provide the following surface water treatment benefits:
- **Attenuation Ponds** – Sediment forebays are to be provided at the inlet of all proposed attenuation ponds which will provide effective pre-treatment (i.e. removal of coarse sediments) and ensure ease of maintenance during the removal of any such collected coarse sediments.
 - **Combined Filter Drains** – Combined filter drains should provide some treatment by filtering out fine sediments, metals, hydrocarbons and other pollutants as the surface water runoff percolates down through the trench fill material overlying the perforated filter drain.
- 4.9.4 Elsewhere, where space constraints prevent the use of attenuation ponds, underground geocellular attenuation storage systems have been employed.

These systems do not have the same water quality benefits as described above for attenuation ponds.

5 Proposed Highway Drainage Solutions Development

5.1 Proposed Drainage Design Development Approach

5.1.1 The proposed scheme highway drainage design solutions in the vicinity of Junction 19 have been developed in line with the proposed drainage design rational and drainage design criteria described in Section 4. The impacts from the proposed highway improvement works in the vicinity of Junction 19 have been identified (i.e. increase in paved area) including their interface with the existing highway drainage system. The existing drainage catchments and outfall arrangements have been retained where practicable. New outfalls have been introduced where the proposed highway drainage design solutions (i.e. informed by the proposed highway geometry) were found to have site specific constraints and as a result the existing outfalls/drainage catchment arrangements could not be retained. It should be noted that the highway drainage currently being constructed by the Developer on Junction 19 as part of the Beaulieu Park development has been taken into account in the development of proposed scheme highway drainage solutions.

5.1.2 As described in Section 2, the proposed scheme in the vicinity of Junction 19 will result in an increase in paved area due to the proposed online widening works and proposed offline highway additions. This will potentially increase the surface water runoff rates which would therefore need to be restricted to mitigate the potential increase in flood risk. To mitigate the expected increased surface water runoff rates and the associated potential increase in surface water flood risk to and from the proposed scheme, attenuation storage is introduced at appropriate locations within the proposed highway drainage systems. Where required an appropriate flow control device is proposed immediately downstream of the proposed attenuation storage that will restrict the discharge rates to achieve the required allowable discharge rates. Flow controls typically proposed include vortex flow control devices, orifice plates, reduced diameter outlet pipes or a vortex flow control device / orifice plate combination. In the vicinity of Junction 19 attenuation storage is primarily achieved in the form of above ground attenuation ponds and underground geocellular attenuation storage systems depending on the site specific constraints. Oversized pipes have been used to offer online attenuation storage for proposed scheme locations that are subject to spatial constraints.

5.1.3 The attenuation storage locations have been sized for design events up to and including the 1 in 100 year return period storm event with a climate change allowance applied to the chosen design storm to account for the anticipated increase in rainfall intensity due to climate change. The volume of the attenuation storage required throughout the proposed scheme is optimised by running simulations in the MicroDrainage software package for the 1 in 100 year return period storm event plus climate change allowance (and various storm durations from 15 minutes up to and including 24 hours) to establish the critical storm

event(s). The proposed scheme discharge rates (i.e. allowable discharge rates) are restricted to the existing site condition surface water runoff rates where the existing drainage outfall arrangements have been retained and are estimated as described in Section 4.6. As described in Section 4.6 a minimum practicable allowable discharge rate of 5 l/s is used to inform the proposed highway drainage design. As described in Section 4.8, in addition to a climate change allowance of 20% for all design storm events a 40% climate change allowance has been simulated as a sensitivity test for the consequences of exceedance.

- 5.1.4 It should also be noted that where the existing highway drainage network is affected by the online highway widening works and / or the highway upgrade/modifications, such highway interventions have been largely kept within the proposed highway improvement works footprint (i.e. where the construction of new paved areas are required) so as to minimise the impact from the proposed scheme. The proposed highway drainage solutions have also been developed to minimise the potential impact to existing underground services which could require potential service diversions and thereby impact the adjacent land.
- 5.1.5 The proposed highway drainage catchment extents, the associated outfalls and receiving watercourses are illustrated in Plate 5.1 below. In Plate 5.1 the modelled fluvial floodplain extents shown for the Boreham Brook are for the 1 in 100 year return period storm event plus 65% climate change allowance as per Environment Agency (EA) guidance (Environment Agency, 2021) as of the October 2021 update. The Boreham Brook has been modelled in the vicinity of the A12 mainline due to the proposed highway widening works in the vicinity. The fluvial flood extents shown for the River Chelmer are based on EA flood zones 2 and 3. The River Chelmer flood extents have not been specifically modelled for the proposed A12 scheme as the proposed highway works do not extend to the River Chelmer as shown in Plate 5.1. The proposed highway drainage system layouts are presented in Appendix A – Junction 19 Proposed Drainage System Layouts. The proposed case hydraulic modelling results for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year storm return period design events including the climate change allowance requirements described in Section 4.4 are presented in Appendix B – Junction 19 Proposed Drainage System Hydraulic Modelling Results.
- 5.1.6 The design development process for the proposed highway drainage catchments shown in Plate 5.1, including the potential alternative locations assessed for the attenuation storage locations, are described further in the subsequent sub-sections, namely Section 5.2 to Section 5.4. It should be noted that the existing highway drainage catchments S1-OU7 and S1-OU8 are not affected by the proposed highway improvement works in the vicinity of Junction 19 and are therefore not assessed further in the development of the proposed highway drainage design solutions.

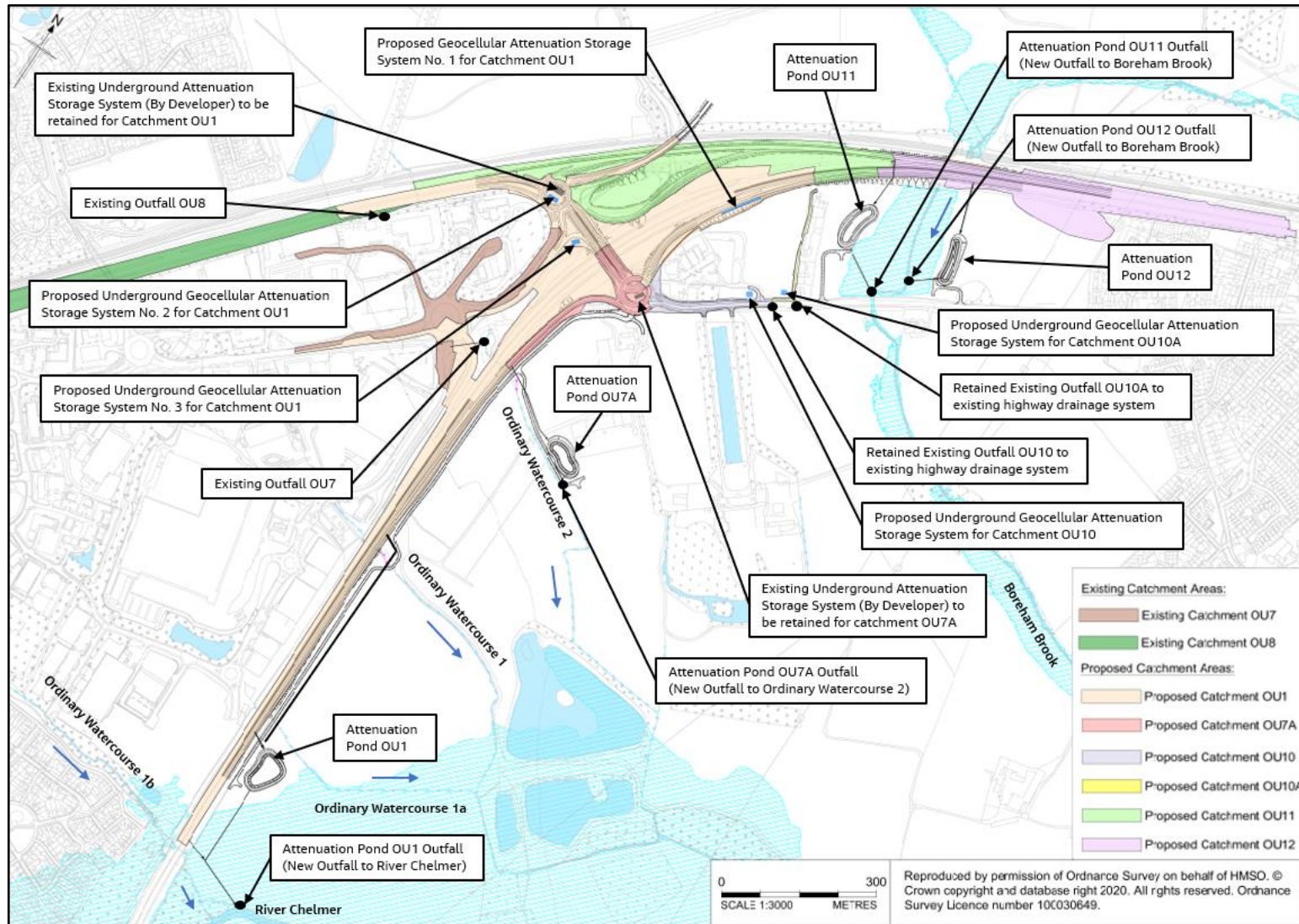


Plate 5.1 Proposed Scheme Highway Drainage Catchments / Outfall Locations / Attenuation Storage Locations in the Vicinity of Junction 19

5.2 Proposed Catchment S1-OU1 and OU7A

5.2.1 As described in Section 2, the proposed S1-OU1 catchment is comprised of a portion of the A12 mainline, the Junction 19 southbound off-slip road, the Junction 19 northbound off-slip road, sections of the existing Boreham Interchange Roundabout and the adjoining A130 located to the south-east, the southbound lane of the A130 between the existing Boreham Interchange Roundabout and Generals Lane Roundabout, Generals Lane Roundabout, the A138 adjoining Generals Lane Roundabout and the proposed A131 (Radial Distributor Road - RDR). The A12 mainline southbound carriageway, the Junction 19 southbound off-slip road, Generals Lane Roundabout and the adjoining A130 are all subject to online widening works. The proposed S1-OU7A catchment is comprised of Boreham Bridge, Generals Farm Roundabout and the Junction 19 southbound on-slip road from the Generals Farm Roundabout to its tie-in with the A12 mainline further south. The aforementioned proposed highways are all subject to online widening works. The proposed S1-OU7A drainage catchment was part of the existing S1-OU1 drainage catchment. However, it is now separated out due to potential spatial constraints in providing attenuation storage for the S1-OU7A catchment and other site-specific constraints. The aforementioned site specific constraints associated with the proposed S1-OU7A catchment are described in further detail in Sections 5.2.3 to 5.2.8.

5.2.2 The existing and proposed site condition paved areas and any permeable catchment areas draining into the proposed highway drainage systems for the proposed S1-OU1 and S1-OU7A catchments are presented in Table 5.1 below.

Table 5.1 Paved Area Summary for the Proposed S1-OU1 and S1-OU7A Catchments

Proposed Catchment	Existing Paved Area*	New Paved Area	Total Proposed Paved Area*	Total Proposed Permeable Area**	Catchment Specific Comments
	(ha)	(ha)	(ha)	(ha)	
S1-OU1	7.356 (6.726)	0.984	7.710	5.403	The existing paved area (7.356ha) is associated with the existing S1-OU1 catchment that has been divided up between the proposed S1-OU1 catchment and the proposed S1-OU7A catchment (i.e. 6.726ha will be retained within the proposed S1-OU1 catchment boundary while 0.63ha will be drained to the proposed S1-OU7A catchment)

Proposed Catchment	Existing Paved Area*	New Paved Area	Total Proposed Paved Area*	Total Proposed Permeable Area**	Catchment Specific Comments
	(ha)	(ha)	(ha)	(ha)	
S1-OU7A	0 (0.630)	0.210	0.840	0.565	The existing paved area is associated with the existing S1-OU1 catchment portion contained within the proposed S1-OU7A catchment boundary (see the catchment specific comments for the proposed S1-OU1 catchment)

* The total proposed paved area is the sum of the existing paved area (adjusted existing paved area presented in brackets, where applicable) to be retained and the additional new paved area which will form the proposed highway drainage catchment areas in the vicinity of the proposed Junction 19.

** Permeable catchment areas include grassed verges, grassed roundabout centre islands, cut slopes, embankment slopes, etc. that drain into the proposed highway drainage systems.

Proposed Catchment S1-OU7A Necessity

Whole Proposed S1-OU1 Catchment

5.2.3 An initial assessment of the proposed S1-OU1 catchment (referred as the “whole proposed S1-OU1 catchment”, prior to requiring the catchment split into the proposed S1-OU1 and proposed S1-OU7A catchments) was undertaken with a view to retain the existing S1-OU1 catchment and outfall arrangement. The hydraulic model for the whole proposed S1-OU1 catchment was tested with all of the additional paved area from the online widening works introduced as part of proposed scheme and with the works currently being undertaken at Junction 19 by the developer of the Beaulieu Park development (i.e. including the underground attenuation storage systems at Generals Lane Roundabout and Generals Farm Roundabout as these drainage works would be retained as part of the proposed scheme). The hydraulic performance of the whole proposed case S1-OU1 catchment was assessed against the drainage design criteria described in Section 4 and the proposed drainage design assessment approach discussed in Section 5.1. It is noted that the existing northbound carriageway and central reserve of the A12 mainline throughout the whole proposed S1-OU1 catchment are outside the proposed highway works extents. Therefore, the associated existing highway drainage systems would be unaffected and are proposed to be retained.

5.2.4 The proposed highway drainage interventions for Junction 19 and the associated slip roads (i.e. in the form of the upgrade and replacement of the existing highway drainage and associated attenuation storage requirements) were kept local to mitigate/restrict the increased surface water flows to the A12 mainline existing highway drainage system as a result of the proposed widening works and climate change allowance. Providing such local interventions and limiting the surface water flow rates locally prior to connecting back into the existing A12 mainline

highway drainage prevented the exacerbation of the surface water flood risk within the wider catchment and reduced a significant amount of existing highway drainage replacement works. The local highway drainage interventions provided within the proposed S1-OU1 and S1-OU7A catchments are shown in Plate 5.2 and summarised in the following bullet points below.

- **Junction 19 Southbound Off-Slip Road** – The existing Junction 19 southbound off-slip road, proposed to be widened and extended along the A12 mainline southbound carriageway, currently drains into the existing A12 mainline highway drainage system. The existing drainage connection/discharge from the Junction 19 southbound off-slip road catchment has been retained. The increased surface water flows as a result of the highway widening works and climate change allowance have been attenuated in the form of an underground geocellular attenuation storage system (shown as proposed geocellular attenuation storage system no. 1 in Plate 5.2). The attenuated flows have been restricted with the use of an orifice flow control device prior to discharging back into the existing highway drainage system serving the A12 mainline.
- **Generals Lane Roundabout** – The existing underground attenuation storage system located within Generals Lane Roundabout is to be retained to provide mitigation for the increased paved area associated with the proposed highway improvement works and climate change impact in the vicinity of the Generals Lane Roundabout. In addition to retaining the aforementioned existing underground attenuation storage system, an additional proposed underground geocellular attenuation storage system (i.e. shown as proposed geocellular attenuation storage system no. 2 in Plate 5.2) is proposed within the southern portion of the roundabout to mitigate the increased surface water flows from the southern portion of the roundabout and the adjoining A138 to the west. The introduction of further underground geocellular attenuation storage (shown as proposed geocellular attenuation storage system no. 3 in Plate 5.2) is required downstream of the two previously described underground attenuation storage systems to provide additional attenuation to the surface water flows from the roundabout sub-catchment prior to discharging to the existing highway drainage located along the A130 to the south of Generals Lane Roundabout.
- **A12 Mainline** – The proposed S1-OU1 catchment attenuation pond is provided to mitigate for the increased paved area due to the proposed widening of the A12 mainline southbound carriageway located to the south of Junction 19 and to account for the climate change allowance. This enables the proposed S1-OU1 catchment to be discharged to the River Chelmer at discharge rates not exceeding those of the existing case S1-OU1 catchment.

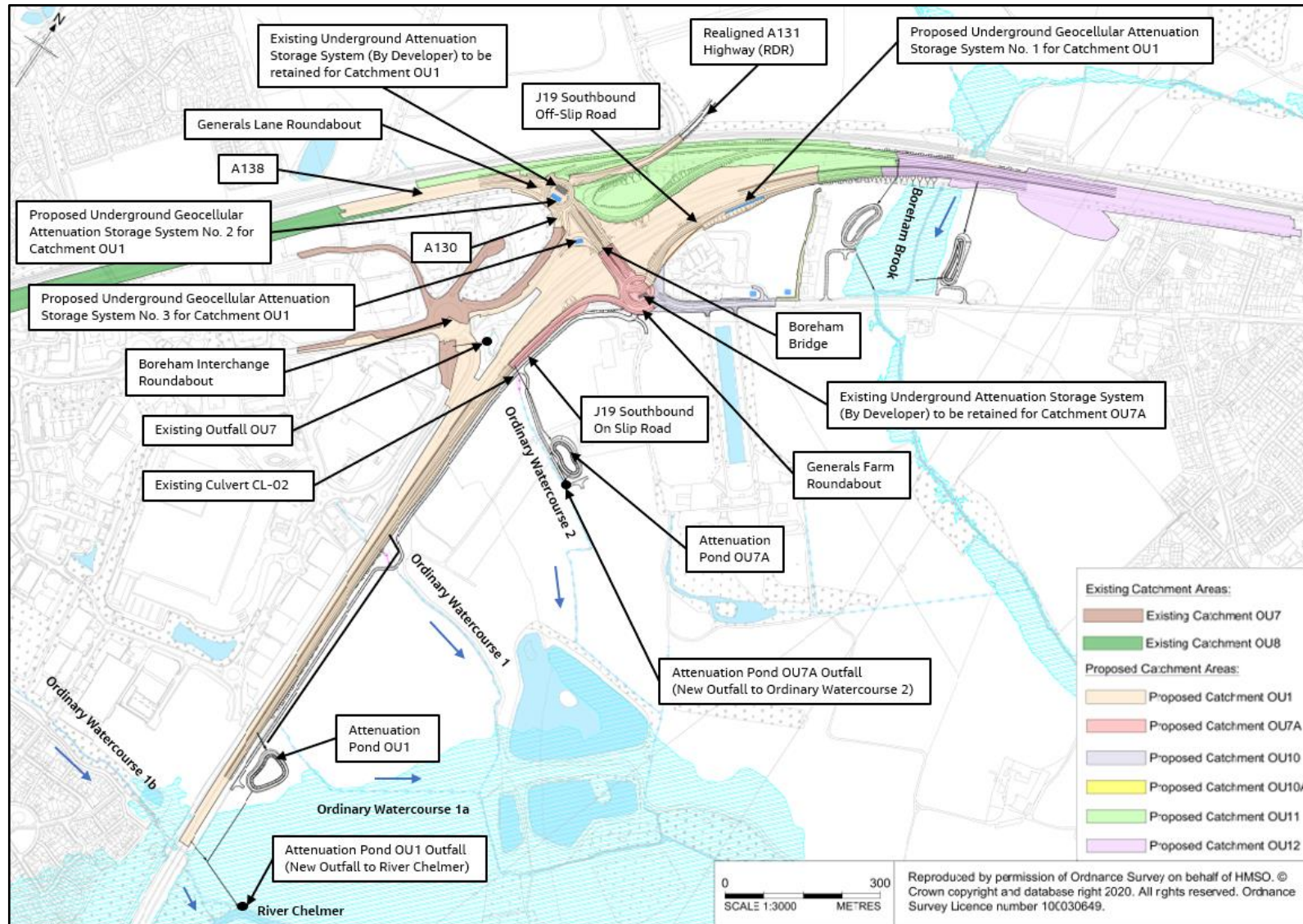


Plate 5.2 Drainage Interventions for the Proposed S1-OU1 and S1-OU7A Catchments

Proposed S1-OU7A Catchment Separated Out from the Whole Proposed S1-OU1 Catchment

5.2.5

The above-described highway drainage design approach of using local highway drainage interventions was assessed for the proposed S1-OU7A catchment while it was considered as part of the whole proposed S1-OU1 prior to the eventual proposed catchment separation. However, this approach was found to be unfeasible and therefore a new outfall arrangement for the proposed S1-OU7A catchment was required for the following reasons / constraints:

- **Junction 19 Southbound-On Slip Road Highway Widening Works** - The existing highway drainage serving Generals Farm Roundabout and the Junction 19 southbound on-slip road could not be retained and would need to be replaced due to the online highway widening works. The existing highway drainage serving the south-eastern slip road required upgrading due to the proposed increased paved areas on Boreham Bridge, the Generals Farm Roundabout and along the proposed Junction 19 southbound on-slip road. These upgrade works to the existing highway drainage system along the Junction 19 southbound on-slip road was hydraulically tested with a connection back into the A12 mainline highway drainage system as per the existing case (i.e. existing slip road highway drainage connects into an existing chamber located in the A12 mainline central reserve). Due to the increased surface water flows discharging to the A12 mainline highway drainage system in the proposed case compared to the existing case, this would result in an increased flood risk from the A12 mainline highway drainage system. This increased flood risk would be unacceptable as it does not comply with the surface water drainage design criteria described in Section 4 and would also potentially put road users at increased risk.
- **Unfeasible Junction 19 Southbound On-Slip Road Highway Drainage Connection into the A12 Mainline Highway Drainage** – An alternative solution to extend the proposed highway drainage from the Junction 19 southbound on-slip road and connect it into the proposed highway drainage serving the A12 mainline southbound carriageway was found to be unfeasible. This was due to a potential limited vertical clearance issue (i.e. potential clash) with an existing culvert crossing (i.e. existing Culvert CL-02 shown in Plate 5.2). Potential clashes with existing underground utilities were also identified that would have a significant impact on the utilities and require complex utility diversions and associated increased landtake requirements adjacent to the A12 mainline for new utility corridors.
- **Inadequate Online Attenuation Storage Capacity within the Junction 19 Southbound On-Slip Road Highway Drainage** - The upgrades to the Junction 19 southbound on-slip road highway drainage would not provide adequate online attenuation storage to mitigate for the increased paved area associated with the highway widening works. The additional surface water flows arising from the increased paved area and the applied climate change allowance could not be sufficiently attenuated through the use of online storage in oversized pipework and the existing underground attenuation storage system built by the developers as part of the Beaulieu Park development. The discharge of unattenuated increased surface water flows

from the proposed Junction 19 southbound on-slip road to the existing A12 mainline highway drainage would exceed the capacity of the existing highway drainage system, resulting in larger exceedance flows and increased surface water drainage flood risk. This increased flood risk would be unacceptable as it does not comply with the drainage design criteria described in Section 4 and would also potentially put road users at increased risk. Also, it should be noted that if online attenuation storage in oversized pipework was provided for a portion of the increased surface water flows, the depth of the proposed highway drainage system would need to increase to accommodate the larger diameter pipework. The increase in the depth of the proposed highway drainage system would prevent the connection of the proposed highway drainage to the A12 mainline highway drainage system as per the existing case (i.e. existing slip road highway drainage connects into an existing chamber located in the A12 mainline central reserve) thereby making the proposal of using oversized pipes unfeasible.

- 5.2.6 Due to the above-described site specific constraints, Boreham Bridge, Generals Farm Roundabout and the Junction 19 southbound on-slip road have been separated out from the original whole proposed S1-OU1 catchment to create a new catchment (i.e. proposed S1-OU7A catchment) with an outfall to Ordinary Watercourse 2 (See Plate 5.2). As the proposed S1-OU7A catchment is a new catchment with a new outfall location, a minimum practicable allowable discharge rate of 5 l/s has been utilised (as defined in Section 4.6) to mitigate flood risk to the receiving watercourse and to size the attenuation pond for the proposed S1-OU7A catchment. The outfall discharge rate will be controlled by a vortex flow control device with the flow backing up into the proposed highway drainage system and into the proposed attenuation pond. The design options taken into account to inform the proposed attenuation pond potential locations are discussed in Section 7.3.
- 5.2.7 The new proposed S1-OU1 catchment (minus the above-described proposed S1-OU7A catchment) will largely retain the existing catchment arrangement, however, it will require a new outfall to the River Chelmer to provide a positive outfall downstream of the proposed attenuation pond. The existing case brownfield allowable discharge rates associated with the existing S1-OU1 catchment have been determined through the hydraulic modelling of the relevant existing highway drainage systems to inform the proposed highway drainage design requirements (including the attenuation storage volumes). It is proposed to attenuate the surface water runoff from the proposed S1-OU1 catchment through the provision of an attenuation pond as shown in Plate 5.2. Refer to Appendix C which presents the proposed discharge rates, the attenuation storage volumes and the flow control device types / diameters to be employed for the proposed S1-OU1 and S1-OU7A catchment highway drainage systems.
- 5.2.8 The proposed drainage system layout plans are presented in Appendix A – Junction 19 Proposed Drainage System Layouts. The proposed case hydraulic modelling results for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events plus climate change allowance are presented in Appendix B – Junction 19 Proposed Drainage System Hydraulic Modelling Results.

5.3 Proposed Catchment S1-OU10 and S1-OU10A

5.3.1 The proposed S1-OU10 catchment is associated with the existing B1137 (Main Road) near Boreham which spurs off Junction 19 and heads east. As described in Section 2 the B1137 local road here is subject to widening works from Junction 19 to its eventual tie-in to the existing B1137 carriageway approximately 230m east from Junction 19. The proposed S1-OU10A catchment is associated with the proposed Payne's Lane access road that is to be removed and replaced to provide a new bridleway access to a proposed WCH overbridge near the A12 mainline carriageway (i.e. north of the B1137) as shown in Plate 5.1. The existing and proposed site condition paved areas and any permeable catchment areas draining into the proposed highway drainage systems for the proposed S1-OU10 and S1-OU10A catchments are presented in Table 5.2 below.

Table 5.2 Paved Area Summary for the Proposed S1-OU10 and S1-OU10A Catchments

Proposed Catchment	Existing Paved Area*	New Paved Area	Total Proposed Paved Area*	Total Proposed Permeable Area**	Catchment Specific Comments
	(ha)	(ha)	(ha)	(ha)	
S1-OU10	0.531	0.127	0.658	0.102	Proposed online widening works on the B1137 local road. The existing paved area is associated with the existing B1137 local road footprint contained within the proposed S1-OU10 catchment boundary
S1-OU10A	0.011	0.099	0.110	0.014	Proposed online highway improvement works to Payne's Lane. The existing paved area is associated with the existing Payne's Lane footprint contained within the proposed S1-OU10A catchment boundary

*The total proposed paved area is the sum of the existing paved area (adjusted existing paved area presented in brackets, where applicable) to be retained and the additional new paved area which will form the proposed highway drainage catchment areas in the vicinity of the proposed Junction 19.

**Permeable catchment areas include grassed verges, grassed roundabout centre islands, cut slopes, embankment slopes, etc. that drain into the proposed highway drainage systems.

5.3.2 The proposed S1-OU10 and S1-OU10A catchments will discharge to chambers located on the existing highway drainage system serving the B1137 (Main Road) as shown in Plate 5.1 previously. The existing case brownfield allowable discharge rates to be used for the proposed S1-OU10 and S1-OU10A catchments have been determined through the hydraulic modelling of the relevant existing highway drainage systems to inform the proposed highway drainage design requirements including the attenuation storage volumes.

- 5.3.3 It is proposed to attenuate the surface water runoff from the proposed S1-OU10 and S1-OU10A catchments with the provision of offline underground geocellular attenuation storage systems as shown in Plate 5.2. Offline underground geocellular attenuation storage systems are required due to spatial constraints within the proposed scheme permanent acquisition of land boundary and land take restrictions to the east and south of the proposed B1137 highway widening works. These spatial constraints and landtake restrictions are described in further detail in Section 7.4 and Section 7.5. The discharge rates at the outfalls for both the proposed S1-OU10 and S1-OU10A catchments will be controlled by an orifice plate flow control device with the flow backing up into the proposed highway drainage system and into the aforementioned offline underground geocellular attenuation storage systems located immediately north of the proposed highway widening works. Refer to Appendix C which presents the proposed discharge rates, the attenuation storage volumes and the flow control device types / diameters to be employed for the proposed S1-OU10 and S1-OU10A catchment highway drainage systems.
- 5.3.4 The proposed drainage system layout plans are presented in Appendix A – Junction 19 Proposed Drainage System Layouts. The proposed case hydraulic modelling results for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events plus climate change allowance are presented in Appendix B – Junction 19 Proposed Drainage System Hydraulic Modelling Results.
- ## 5.4 Proposed Catchment S1-OU11 and S1-OU12
- 5.4.1 The proposed S1-OU11 catchment is comprised of a portion of the A12 mainline, the proposed Junction 19 northbound on-slip road, a portion of the A138 side road adjoining the A12 mainline and a small portion of the proposed realigned A131 highway (RDR) as described in Section 2 previously. The A12 mainline carriageway and the A138 side road are subject to highway widening works. The proposed Junction 19 northbound on-slip road and the proposed realigned A131 highway (RDR) introduce additional offline new paved areas. The proposed S1-OU12 catchment extends for an approximate 460m length of the A12 mainline from the northern end of Junction 19 to the end of the proposed highway works at a location in the vicinity of the western boundary of Boreham. Highway widening works are required for this localised portion of the A12 mainline to accommodate the adjoining proposed Junction 19 southbound off-slip road.
- 5.4.2 The existing and proposed site condition paved areas and any permeable catchment areas draining into the proposed highway drainage systems for the proposed S1-OU11 and S1-OU12 catchments are presented in Table 5.3 below.

Table 5.3 Paved Area Summary for the Proposed S1-OU11 and S1-OU12 Catchments

Proposed Catchment	Existing Paved Area*	New Paved Area	Total Proposed Paved Area*	Total Proposed Permeable Area**	Catchment Specific Comments
	(ha)	(ha)	(ha)	(ha)	
S1-OU11	0 (0.942)	0.670	1.612	4.17	The existing paved area is associated with the existing S1-OU12 catchment contained within the proposed S1-OU11 catchment boundary (see catchment specific comments for the proposed S1-OU12 catchment)
S1-OU12	3.409 (2.467)	0.068	2.535	2.386	The existing paved area (3.409ha) is associated with the existing S1-OU12 catchment that has been divided up between the proposed S1-OU11 catchment and the proposed S1-OU12 catchment (i.e. 2.467ha will be retained within the proposed S1-OU12 catchment boundary while 0.942ha will be drained by the proposed S1-OU11 catchment)

* The total proposed paved area is the sum of the existing paved area (adjusted existing paved area presented in brackets, where applicable) to be retained and the additional new paved area which will form the proposed highway drainage catchment areas in the vicinity of the proposed Junction 19.

** Permeable catchment areas include grassed verges, grassed roundabout centre islands, cut slopes, embankment slopes, etc. that drain into the proposed highway drainage systems.

Proposed Catchment S1-OU11 Necessity

Whole Proposed S1-OU12 Catchment

5.4.3 An initial assessment of the proposed S1-OU12 catchment (referred as the “whole proposed S1-OU12 catchment”), prior to requiring the catchment split into the proposed S1-OU11 and proposed S1-OU12 catchments, was undertaken with a view to retain the existing S1-OU12 catchment and outfall arrangement. The hydraulic model for the whole proposed S1-OU12 catchment was simulated with all the new additional paved areas from the online highway widening works and the new additional offline paved areas introduced by the proposed A12 scheme in the vicinity of Junction 19. The hydraulic model performance of the whole proposed case S1-OU12 catchment was assessed against the highway drainage design criteria described in Section 4 and the proposed drainage design assessment approach discussed in Section 5.1. It is noted that the A12 mainline northbound and southbound carriageways to the east of the whole proposed S1-OU12 catchment are located outside the proposed highway works extents.

Therefore, the associated existing highway drainage systems serving the aforementioned northbound and southbound carriageway outside the proposed scheme extents would be unaffected and is proposed to be retained.

- 5.4.4 The proposed highway drainage interventions for Junction 19 and the associated adjoining slip roads (i.e. in the form of the upgrade and / or replacement of existing highway drainage and new highway drainage for new proposed offline highway sections) were to mitigate and restrict the increased surface water flows discharging to the A12 mainline existing highway drainage system due to the proposed highway widening works, the additional new paved area for proposed offline highway sections and to accommodate the increased flows resulting from climate change. The provision of the proposed attenuation ponds to limit the discharge rates to the nearby Boreham Brook would mitigate the increased flood risk from the increased paved area associated with the above-described proposed highway works and climate change. The highway drainage interventions provided within the proposed S1-OU11 and S1-OU12 catchments are shown in Plate 5.3 and summarised in the subsequent bullet points below.

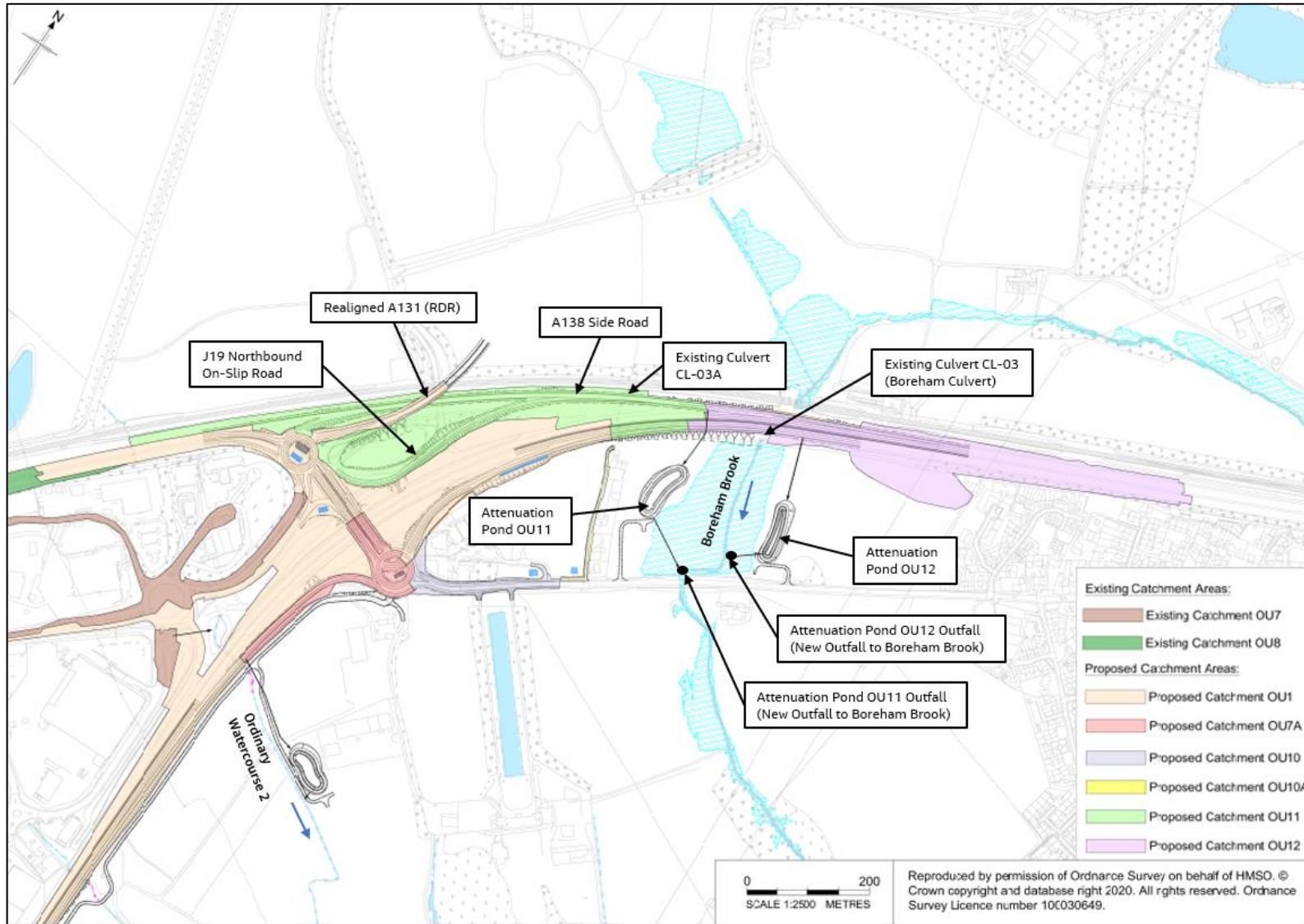


Plate 5.3 Drainage Interventions for the Proposed S1-OU11 and S1-OU12 Catchments

Proposed S1-OU11 Catchment Separated Out from the Whole Proposed S1-OU12 Catchment

5.4.5 The highway drainage design approach of providing a single attenuation pond as the means of surface water flow attenuation was assessed for the proposed S1-OU11 catchment while it was originally considered as part of the above-described whole proposed S1-OU12 catchment prior to the eventual proposed catchment separation. However, the approach of providing a single attenuation pond was found to be unfeasible and therefore a new outfall arrangement was required for the following reasons / constraints:

- **Unfeasible to Provide Single Large Attenuation Pond to Attenuate the Combined Proposed S1-OU11 and S1-OU12 Catchments** - The provision of a single large attenuation pond to provide attenuation storage for the combined proposed S1-OU11 and S1-OU12 catchments was found to be unfeasible as the large attenuation pond footprint required to accommodate the significant attenuation storage volume would encroach into the nearby fluvial flood zones associated with the Boreham Brook (the blue hatched areas shown on Plate 5.3). Also, locating a single large attenuation pond further outside the Boreham Brook fluvial flood zones was found to be unfeasible as it would position the attenuation pond in steeper terrain which would create a deeper attenuation pond which would have increased health and safety risks during the construction and operational phases. For example, during the construction stage the increased excavation depth for the proposed attenuation pond would result in larger cutting slopes thereby presenting an increased risk of slope instability. During the operational stage the increased attenuation pond depth could result in an increased risk of drowning during maintenance operations.

In addition, there is potentially a shallow groundwater table in the vicinity. The excavation of a larger and deeper attenuation pond could potentially intercept the shallow groundwater table which could result in groundwater intrusion to the proposed attenuation pond or require the proposed attenuation pond to be lined with an impermeable liner.

- **Unfeasible to Connect and Discharge the Proposed S1-OU11 Catchment Highway Drainage into the Proposed S1-OU12 Highway Drainage** - The existing highway geometry has a low point in the vicinity of the Boreham Brook. Therefore, to achieve a single large attenuation pond for the combined S1-OU11 and S1-OU12 catchments, would result in significant ground cover depths above the proposed S1-OU11 highway drainage pipework. This would be the case as it would require the proposed S1-OU11 highway drainage pipework to be replaced/upgraded and to run against the grade in order to connect into the proposed S1-OU12 catchment highway drainage. The deeper proposed highway drainage system would also have limited vertical clearance to the existing Boreham Brook culvert (Culvert CL-03) and could present an increased risk to the structural integrity of the existing Boreham Brook Culvert. Also, it should be noted that an increase in the depth of the proposed highway drainage system would also result in a potential clash with an existing culvert (Culvert CL-03A) thereby making this proposal unfeasible.

- **Inadequate Online Attenuation Storage Capacity within the Proposed S1-OU11 Catchment Highway Drainage System** - The upgrades to the existing highway drainage serving the A12 mainline and adjoining slip roads / side roads would not provide adequate online attenuation storage to mitigate for the increased paved area associated with the highway widening works. The additional surface water flows arising from the increased paved area and the applied climate change allowance could not be sufficiently attenuated through the use of online storage in oversized pipework. This would result in increased surface water flows discharging to the A12 mainline highway drainage compared to the existing case and therefore increased surface water flood risk. This increased surface water flood risk would be unacceptable as it does not comply with the drainage design criteria described in Section 4 and would also potentially put road users at increased risk.

5.4.6 Due to the above-described site specific constraints, the proposed A131 highway (RDR), the A138 side road, the Junction 19 northbound on-slip road and a portion of the A12 mainline located to the east of Junction 19 have been separated out from the whole proposed S1-OU12 catchment to create a new catchment (i.e. proposed S1-OU11 catchment) with an outfall to Boreham Brook (See Plate 5.3). As this is primarily an existing catchment, existing case brownfield allowable discharge rates have been utilised to limit the discharge rate accordingly in the proposed case, to size the attenuation storage for the proposed S1-OU11 catchment and thereby mitigate flood risk. The proposed S1-OU11 catchment will require a new outfall to Boreham Brook to provide a positive outfall downstream of the proposed attenuation pond. The proposed S1-OU11 catchment outfall discharge rate will be controlled by a vortex flow control device with the flow backing up into the proposed highway drainage system and into the proposed attenuation pond. The design options taken into account to inform the proposed attenuation pond potential locations are discussed in Section 7.6.

5.4.7 The new proposed S1-OU12 catchment (minus the above-described proposed S1-OU11 catchment) will largely retain the existing catchment arrangement, however, it will require the attenuation of the increased surface water flows as a result of the climate change allowance requirements (See Section 4.4). The existing case allowable discharge rates associated with the existing S1-OU12 catchment have been determined through the hydraulic modelling of the relevant existing highway drainage systems to inform the proposed highway drainage design requirements (including the attenuation storage volumes). It is proposed to attenuate the surface water runoff from the proposed S1-OU12 catchment through the provision of an attenuation storage pond as shown in Plate 5.3. A new outfall to Boreham Brook will be required to provide a positive outfall downstream of the proposed attenuation pond. It should be noted that the allowable discharge rates for the proposed S1-OU11 and S1-OU12 catchments have been adjusted to manage the mitigation requirements for attenuation storage due to the site specific constraints described above. The proposed adjusted allowable discharge rates have been limited to proposed catchments with the same receptors (i.e. Boreham Brook in the case of the proposed S1-OU11 and S1-OU12 catchments) ensuring that there is no overall increase in the discharge rates to the watercourse above the existing condition and therefore no adverse flood risk impact. Despite the requirement for the new S1-OU12

catchment outfall to drain the proposed highway, the existing S1-OU12 catchment outfall (i.e. shown in Plate 3.1 previously) will be retained to maintain the positive discharge of the existing earthworks slope drainage serving the A12 mainline. Refer to Appendix C which presents the proposed discharge rates, the attenuation storage volumes and the flow control device types / diameters to be employed for the proposed S1-OU11 and S1-OU12 catchment highway drainage systems.

- 5.4.8 The proposed drainage system layout plans are presented in Appendix A – Junction 19 Proposed Drainage System Layouts. The proposed case hydraulic modelling results for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events plus climate change allowance are presented in Appendix B – Junction 19 Proposed Drainage System Hydraulic Modelling Results.

6 Attenuation Storage Design Principles and Associated Landtake

6.1 Attenuation Ponds

6.1.1 The landtake requirements and areal footprints for the attenuation pond locations presented in Section 5 have been informed by the following best practice drainage design criteria in accordance with DMRB and the CIRIA SuDS Manual C753 (CIRIA, 2015):

- In general, the attenuation pond maximum top water level design depth of 0.90m and additional 0.30m freeboard is informed by the 1 in 100 year return period storm event plus 20% climate change allowance. As described in Section 4.4, climate change allowance is applied to account for the potential increase in rainfall intensity over the design life of the proposed scheme and therefore minimise the risk of overtopping and flooding. However, there may be a need to depart from this depth criterion due to site specific constraints such as the topography, minimising the excavation depth and earthworks balancing between cut and fill;
- The total design depth of the proposed attenuation ponds (i.e. generally, 0.9m design water depth plus 0.3m freeboard) has been assumed to be provided above the proposed attenuation pond outlet pipe invert level where practicable;
- An additional water depth of 0.3m has been allowed for in the base of the attenuation ponds (i.e. below the attenuation pond outlet pipe invert level) to create a “wetland” feature to achieve further water quality treatment and biodiversity benefits. The additional water depth below the attenuation pond outlet pipe invert also provides some further mitigation for potential increased flood volumes due to climate change. During dry weather periods before heavy rainfall events the aforementioned additional water depth will likely have partially evaporated thereby providing some additional attenuation storage volume;
- The attenuation pond earthworks side slopes are 1 in 4 where there are no spatial constraints. In spatially constrained locations earthworks side slopes of 1 in 3 are used. A crest width of 4m is provided around the proposed attenuation ponds for maintenance access;
- Proposed attenuation ponds will have sediment forebays provided at the inlet to allow the gravity separation of suspended sediments contained within the incoming surface water flows;
- Attenuation ponds are situated outside the 1 in 100 year return period (including an allowance for climate change) modelled fluvial floodplain for Boreham Brook and the EA flood zones 2 and 3 fluvial flood extents for the River Chelmer;
- The attenuation ponds are to be surrounded by fencing to prevent unauthorised access and ensure the safety of the general public; and

- To provide a safe means of access and egress to the attenuation ponds for general maintenance located off the proposed highway alignment, access tracks are provided.

6.2 Underground Geocellular Attenuation Storage Systems

6.2.1 The landtake requirements and areal footprints for the underground geocellular attenuation storage systems presented in Section 5 have been informed by the following best practice drainage design criteria in accordance with DMRB and the CIRIA SuDS Manual C753 (CIRIA, 2015):

- The Stormbloc geocellular attenuation storage product by Hydro International was assumed at the preliminary design stage to inform the proposed highway drainage design. The standard geocellular units have dimensions of 0.66m (H) x 0.80m (L) x 0.80m (W). The shallow geocellular units have dimensions of 0.36m (H) x 0.80m (L) x 0.80m (W). The geocellular units have a void ratio of 0.95.
- In general, the underground geocellular attenuation storage system size is informed by the 1 in 100 year return period storm event plus 20% climate change allowance. As described in Section 4.4, climate change allowance is applied to account for the potential increase in rainfall intensity over the design life of the proposed scheme and therefore minimise the risk of surcharging and flooding from the underground attenuation storage;
- At the preliminary design stage, a minimum design cover depth for proposed underground geocellular attenuation storage systems was assumed to be 1.00m as this is typical. The site specific minimum cover depth requirements will be assessed in detail at the detailed design stage.
- The underground geocellular attenuation storage systems are to be surrounded by fencing to prevent unauthorised access and ensure the safety of the general public; and
- To provide a safe means of access and egress to the proposed underground geocellular attenuation storage systems for general maintenance located off the proposed highway alignment, access tracks are provided.

7 Selected and Alternative Attenuation Storage Locations

7.1 Overview

7.1.1 Regarding the positioning of the attenuation storage locations, it should be noted that the selected attenuation storage locations, as described in Section 5 and shown in Plate 5.2 and Plate 5.3 previously, are considered the most suitable and feasible solutions. Following on from the proposed highway drainage solutions described in Section 5 and the attenuation storage design principles (and associated landtake implications) described in Section 6, the key design considerations that informed the selection of the attenuation storage locations are as follows:

- Accommodating, where practicable, the consultation feedback received from local landowners;
- The proposed highway drainage system hydraulic performance requirements. The proposed highway drainage systems are designed to ensure that the proposed highways can be drained by gravity without the requirements for a pumped discharge solution;
- Consideration of the local topography at the attenuation pond and underground geocellular attenuation storage system locations in avoiding their positioning in the vicinity of steep terrain where practicable. This is to avoid excessive earthworks and provide stable side slopes;
- Minimising the risk of drowning by reducing the depth of attenuation ponds and underground geocellular attenuation storage systems;
- Locating the attenuation ponds and underground geocellular attenuation storage systems close to the proposed highway alignment where practicable to minimise longer pipework alignments that could potentially create deeper attenuation storages;
- Attenuation ponds and underground geocellular attenuation storage systems are situated outside the fluvial floodplain so as not to occupy areas of fluvial flood storage and therefore to mitigate increasing the fluvial flood risk locally. This design criteria also ensures that the attenuation ponds and underground geocellular attenuation storage systems are not inundated with fluvial floodwater and remain operational during major storm events;
- The presence of existing and proposed underground utilities (e.g. gas pipelines, electricity cables, telecommunications cables, drainage systems, etc.) has been factored in the attenuation storage locations to minimise the number of complex utility diversions required;
- Minimising the adverse impacts on the current landuse (e.g. the S1-OU1 and S1-OU7A attenuation ponds have been positioned to minimise the impact on the current use of land for the Chelmsford car-boot sale site);
- The attenuation pond and underground geocellular attenuation storage system locations have been optimised and co-ordinated with the

environmental mitigation required on the proposed A12 Scheme where possible. The environmental mitigation required includes compensation tree planting, creating ecological mitigations for local wildlife, etc. and so the attenuation storage locations have been optimised to limit the creation of disjointed environmental mitigation provisions.

7.1.2 The alternative attenuation storage locations were initially considered in the development of the proposed highway drainage design proposals with the attenuation storages located closer to the A12 mainline along the southbound carriageway (i.e. south of Junction 19). However, these alternative attenuation storage locations were discounted on the basis of the design criteria described above and has taken into account the discussions with local landowners and their representatives during the highway drainage design development process. The site specific design development process for the proposed S1-OU1, S1-OU7A, S1-OU10, S1-OU10A, S1-OU11 and S1-OU12 catchment attenuation storage locations is described further in Section 7.2 to Section 7.6 below.

7.2 Proposed Catchment S1-OU1

Selected Attenuation Pond Location

7.2.1 The selected S1-OU1 attenuation pond location (shown in Plate 7.1 below) is the chosen design solution as its positioning maximises the amount of the proposed S1-OU1 catchment which drains to the attenuation pond prior to discharging to the nearby River Chelmer. Therefore, this ensures that the selected attenuation pond location provides the required attenuation storage volume for the total proposed catchment and maximises the volume of surface water runoff from the proposed highway that can be subjected to the pollution treatment measures provided by the attenuation pond (described in Section 4.9 previously). As described in Section 5.2 previously the proposed S1-OU1 catchment will continue to discharge to the River Chelmer at existing site condition brownfield discharge rates. This reduces the attenuation storage volume required and therefore reduces the proposed attenuation pond volume / areal footprint.

7.2.2 The various alternative attenuation pond locations assessed for the proposed S1-OU1 catchment are all located on the eastern side of the A12 mainline along the southbound carriageway. This is due to the spatial constraints provided by the dense urbanised areas on the western side of the A12 mainline and to retain the existing highway drainage outfalls located on the eastern side of the A12 mainline.

Alternative Attenuation Pond Location “A”

7.2.3 The S1-OU1 alternative attenuation pond location “A” was initially considered as a potential location but was discounted due to the site specific design implications regarding the attenuation pond positioning and the associated provision of a new outfall location. The site specific design implications that resulted in the discounting of this alternative attenuation pond location are as follows:

- The S1-OU1 alternative attenuation pond location “A” would require the new outfall to be located on a different watercourse compared to that which the existing S1-OU1 catchment discharges to (i.e. River Chelmer). Therefore, the

new outfall location would be required to discharge at greenfield runoff rates as opposed to the greater existing case S1-OU1 catchment brownfield discharge rates. The reduction in allowable discharge rates to greenfield discharge rates would result in a larger attenuation pond thereby requiring a larger landtake.

- Positioning the attenuation pond at the S1-OU1 alternative attenuation pond location “A” would result in a section of the A12 mainline alignment (i.e. located between the selected S1-OU1 attenuation pond location and the S1-OU1 alternative attenuation pond location) bypassing the S1-OU1 alternative attenuation pond location “A”. This would therefore require the provision of a second smaller proposed attenuation pond to enable the attenuation of surface water runoff for the aforementioned A12 mainline highway alignment that would bypass the S1-OU1 alternative attenuation pond location. The provision of two attenuation ponds would therefore increase the landtake requirement thereby resulting in the discounting of the S1-OU1 alternative attenuation pond location “A”.
- Water quality treatment measures would also be better served at the selected attention pond location given that it can intercept the entire proposed S1-OU1 catchment. As stated in the previous bullet point, the S1-OU1 alternative attenuation pond location “A” would require the provision of a second smaller attenuation pond further downstream thereby requiring water quality treatment measures at two attenuation pond locations as opposed to one location.

Alternative Attenuation Pond Location “B”

7.2.4 The S1-OU1 alternative attenuation pond location “B” was initially considered as a potential location but was discounted due to the site specific design and landuse implications regarding the attenuation pond positioning and the associated provision of a new outfall location. The site specific design implications that resulted in the discounting of this alternative attenuation pond location are as follows:

- The S1-OU1 alternative attenuation pond location “B” was discounted due to the location being used by the Chelmsford Car Boot Sale. Through the A12 consultation process a request was received from the landowners to maintain the current use of this land as a car boot sale site.
- Similar to the S1-OU1 alternative attenuation pond location “A”, the proposed case discharge rates would have to be limited to greenfield runoff rates as a new outfall would need to be located on a different watercourse compared to that which the existing S1-OU1 catchment discharges to (i.e. River Chelmer). The reduction in allowable discharge rates to greenfield discharge rates would result in a larger attenuation pond thereby requiring a larger landtake.
- Similar to the S1-OU1 alternative attenuation pond location “A”, positioning the attenuation pond at the S1-OU1 alternative attenuation pond location “B” would result in a section of the A12 mainline alignment (i.e. located between the selected S1-OU1 attenuation pond location and the S1-OU1 alternative attenuation pond location “B”) bypassing the S1-OU1 alternative attenuation pond location. This would therefore require the provision of a

second smaller proposed attenuation pond to enable the attenuation of surface water runoff for the aforementioned A12 mainline highway alignment that would bypass the S1-OU1 alternative attenuation pond location.

- Similar to the S1-OU1 alternative attenuation pond location “A”, water quality treatment measures would also be better served at the selected attention pond location given that it can intercept the entire proposed S1-OU1 catchment. As stated in the previous bullet point, the S1-OU1 alternative attenuation pond location “B” would require the provision of a second smaller attenuation pond further downstream thereby requiring water quality treatment measures at two attenuation pond locations as opposed to one location.

Alternative Attenuation Pond Location “C”

7.2.5

The S1-OU1 alternative d attenuation pond location “C” was initially considered as a potential location but was discounted due to the site specific design implications regarding the attenuation pond positioning and the associated provision of a new outfall location. The site specific design implications that resulted in the discounting of this alternative attenuation pond location are as follows:

- The S1-OU1 alternative attenuation pond location “C” positioned the attenuation pond at a greater distance from the A12 mainline highway. This would require greater lengths of highway drainage pipework to convey the collected surface water runoff to the attenuation pond location.
- The topography in the vicinity of the S1-OU1 alternative attenuation pond location “C” is generally steep terrain. Therefore, the steep terrain would result in a further increase in the depth of the earthworks required to form the attenuation pond at this location.
- Similar to the S1-OU1 alternative attenuation pond locations “A” and “B”, the proposed case discharge rates would have to be limited to greenfield runoff rates as a new outfall would need to be located on a different watercourse compared to that which the existing S1-OU1 catchment discharges to (i.e. River Chelmer). The reduction in allowable discharge rates to greenfield discharge rates would result in a larger attenuation pond thereby requiring a larger landtake.
- Similar to the S1-OU1 alternative attenuation pond locations “A” and “B”, positioning the proposed attenuation pond at the S1-OU1 alternative attenuation pond location “C” would result in a section of the A12 mainline alignment (i.e. located between the selected S1-OU1 attenuation pond location and the S1-OU1 alternative attenuation pond location “C”) bypassing the S1-OU1 alternative attenuation pond location. This would therefore require the provision of a second smaller attenuation pond to enable the attenuation of surface water runoff for the aforementioned A12 mainline highway alignment that would bypass the S1-OU1 alternative attenuation pond location. Similar to the S1-OU1 alternative attenuation pond locations “A” and “B”, water quality treatment measures would also be better served at the selected attenuation pond location given that it can intercept the entire proposed S1-OU1 catchment. As stated in the previous bullet point, the

S1-OU1 alternative attenuation pond location "C" would require the provision of a second smaller attenuation pond further downstream thereby requiring water quality treatment measures at two attenuation pond locations as opposed to one location.

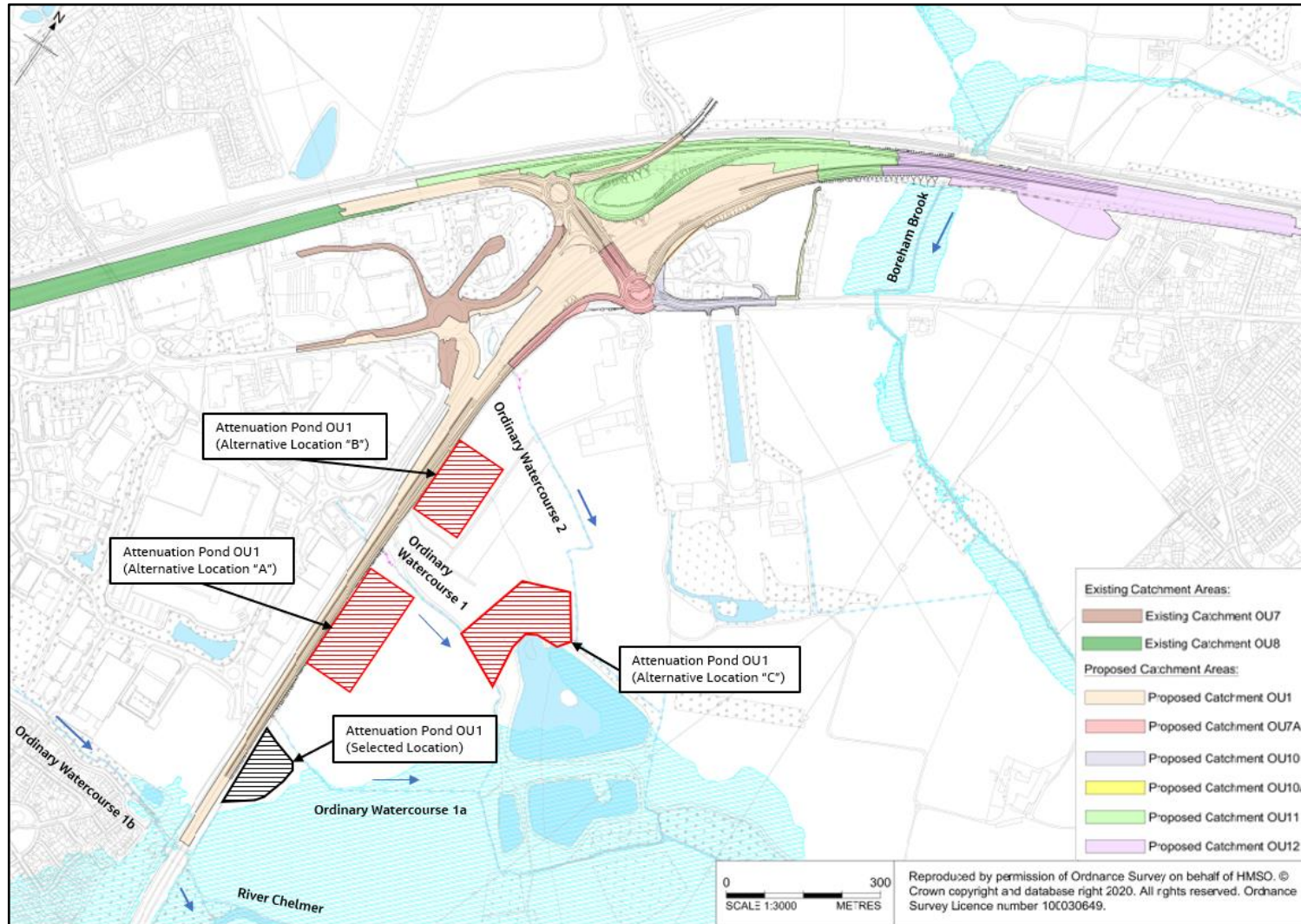


Plate 7.1 Proposed S1-OU1 Catchment Selected and Alternative Attenuation Pond Locations

7.3 Proposed Catchment S1-OU7A

Selected Attenuation Pond Location

- 7.3.1 The selected S1-OU7A attenuation pond location (shown in Plate 7.2 below) is the chosen design solution as its positioning maximises the amount of the proposed S1-OU7A catchment which drains to the attenuation pond prior to discharging to the nearby Ordinary Watercourse 2. Therefore, this ensures that the selected attenuation pond location provides the required attenuation storage volume for the total proposed catchment and maximises the volume of surface water runoff from the proposed highway that can be subjected to the pollution treatment measures within the attenuation pond (described in Section 4.9 previously).
- 7.3.2 The various alternative attenuation pond locations assessed for the proposed S1-OU7A catchment are all located on the eastern side of the A12 mainline. This is due to the spatial constraints provided by the dense urbanised areas on the western side of the A12 mainline.

Alternative Attenuation Pond Location “A”

- 7.3.3 The S1-OU7A alternative attenuation pond location “A” was initially considered as a potential location but was discounted due to the site specific landuse implications regarding the attenuation pond positioning. The site specific design implications that resulted in the discounting of this alternative attenuation pond location are as follows:
- The S1-OU1 alternative attenuation pond location “A” was discounted due to the location being currently used by the Chelmsford Car Boot Sale. Through the A12 consultation process a request was received from the landowners to maintain the current use of this land as a car boot sale site.

Alternative Attenuation Pond Location “B”

- 7.3.4 The S1-OU7A alternative attenuation pond location “B” was initially considered as a potential location but was discounted due to the site specific landuse implications regarding the attenuation pond positioning. The site specific design implications that resulted in the discounting of this alternative attenuation pond location are as follows:
- The S1-OU7A alternative attenuation pond location “B” and outfall arrangement was not feasible hydraulically. The option would require the attenuation pond inlet pipe to be culverted underneath the nearby Ordinary Watercourse 2 which would result in a deeper attenuation pond and associated greater areal footprint / landtake requirement.
 - The S1-OU7A alternative attenuation pond location “B” positioned the attenuation pond at a greater distance from the A12 mainline highway. This would require greater lengths of highway drainage pipework to convey the collected surface water runoff to the attenuation pond location. This would result in a deeper attenuation pond and associated larger areal footprint / landtake requirement.

- Due to the above-described design implications the S1-OU7A alternative attenuation pond location “B” is not selected as it would not be possible to drain the attenuation pond via gravity to Ordinary Watercourse 2 and a pumping station would be required

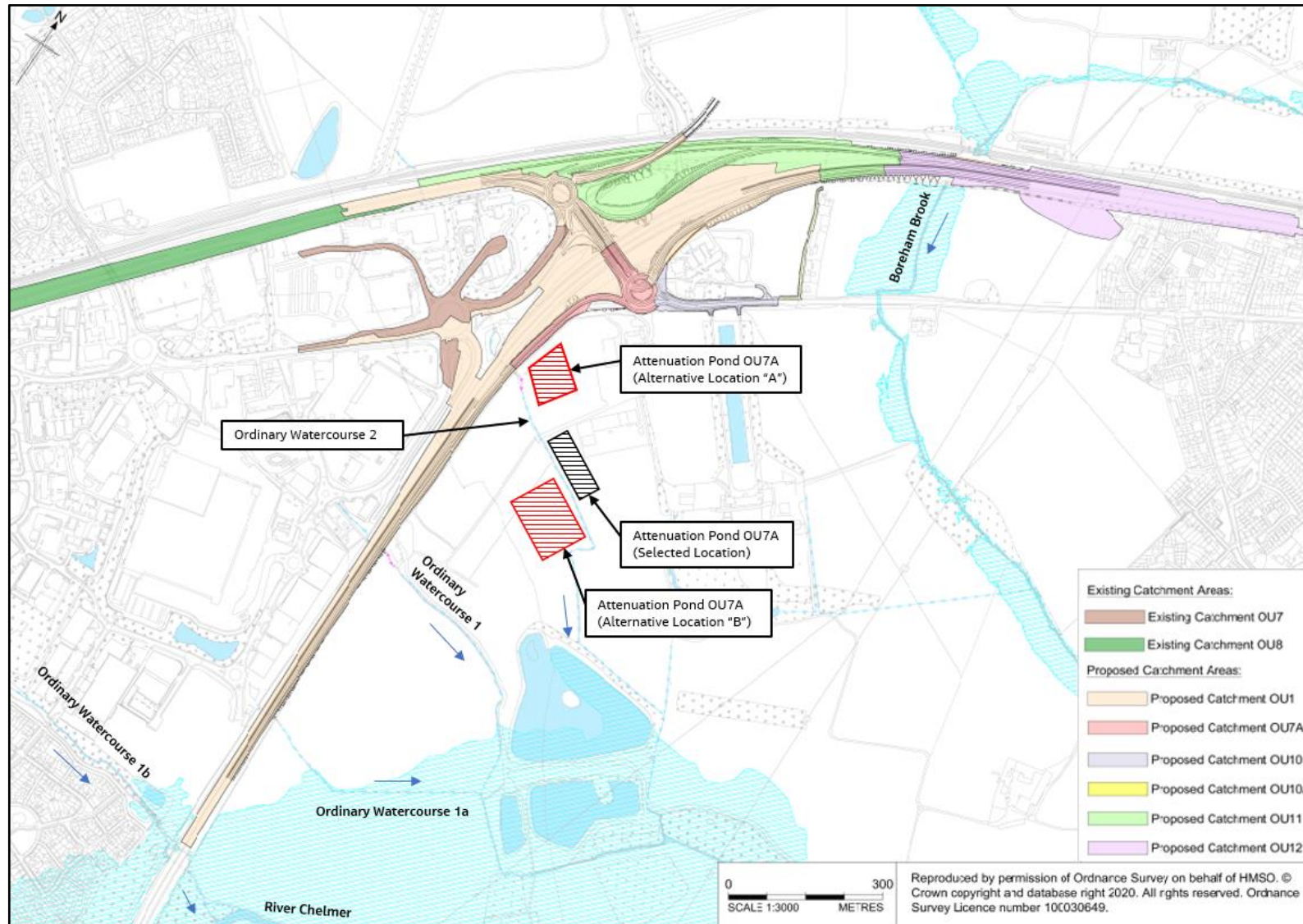


Plate 7.2 Proposed S1-OU7A Catchment Selected and Alternative Attenuation Pond Locations

7.4 Proposed Catchment S1-OU10

Selected Underground Geocellular Attenuation Storage System Location

7.4.1 An attenuation pond solution was discounted early in the design development process for the proposed S1-OU10 catchment due to the deep design depth required at the downstream end of the proposed S1-OU10 drainage system at the outfall location. The depth required is to maintain the connectivity of deeper existing highway drainage systems in the vicinity as part of the proposed works. The deep design depth would result in an excessively large attenuation pond for a relatively small catchment area thereby resulting in a larger landtake. Additionally, there would be an increased drowning risk during periodic maintenance works. Therefore, the selected and alternative underground geocellular attenuation storage location solutions are presented below.

7.4.2 The selected S1-OU10 underground geocellular attenuation storage system location (shown in Plate 7.3 below) is the chosen design solution as its close proximity to the proposed highway minimises the depth of the aforementioned attenuation storage and avoids the environmental, ecological, existing utilities and heritage (i.e. Boreham House) impacts described subsequently for the discounted S1-OU10 alternative underground geocellular attenuation storage locations “A” and “B”. As described in Section 5.3 previously the proposed S1-OU10 catchment will discharge at existing case allowable discharge rates to the existing highway drainage system serving the B1137 (Main Road) via a new outfall. Therefore, this enables the underground geocellular attenuation storage system to discharge at the existing case brownfield allowable discharge rates as opposed to greenfield runoff rates. This reduces the attenuation storage volume required and therefore reduces the underground geocellular attenuation storage system volume / areal footprint.

Alternative Underground Geocellular Attenuation Storage Location “A”

7.4.3 The S1-OU10 alternative underground geocellular attenuation storage system location “A” was initially considered as a potential location but was discounted due to the site specific landuse implications regarding the attenuation storage positioning. The site specific design implications that resulted in the discounting of this alternative attenuation storage location are as follows:

- The S1-OU10 alternative attenuation storage location “A” was initially considered as a potential location but was discounted due to the available land being part of the private Boreham House. Boreham House is a Grade 1 listed building and also contains a Registered Park and Garden.
- Positioning the proposed underground geocellular attenuation storage system at this location would result in a section of the proposed B1137 highway (i.e. located between the selected S1-OU10 attenuation storage location and the S1-OU10 alternative attenuation storage location) bypassing the S1-OU10 alternative attenuation storage location “A”. This would therefore require the provision of a second smaller underground geocellular attenuation storage system to enable the attenuation of surface water runoff for the

aforementioned B1137 highway alignment that would bypass the S1-OU10 alternative attenuation storage location “A”. The provision of two underground geocellular attenuation storage systems would therefore increase the landtake requirement thereby resulting in the discounting of the S1-OU10 alternative attenuation storage location “A”.

Alternative Underground Geocellular Attenuation Storage Location “B”

7.4.4 The S1-OU10 alternative underground geocellular attenuation storage system location “B” was initially considered as a potential location but was discounted due to the site specific design implications regarding the aforementioned attenuation storage positioning. The site specific design implications that resulted in the discounting of this alternative attenuation storage location are as follows:

- The S1-OU10 alternative attenuation storage location “B” was discounted due to the presence of mature trees within the land parcel. The loss of the aforementioned mature trees would have a negative impact on the visual amenity and ecology in the vicinity in addition to the loss of a carbon sink.
- Existing underground utilities (e.g. telecommunications cables, electrical cables, gas pipeline, etc.) are present within the S1-OU10 alternative attenuation storage location “B” which would require utility diversions. Utility diversions would increase the proposed case landtake requirement as new utility corridors would be required

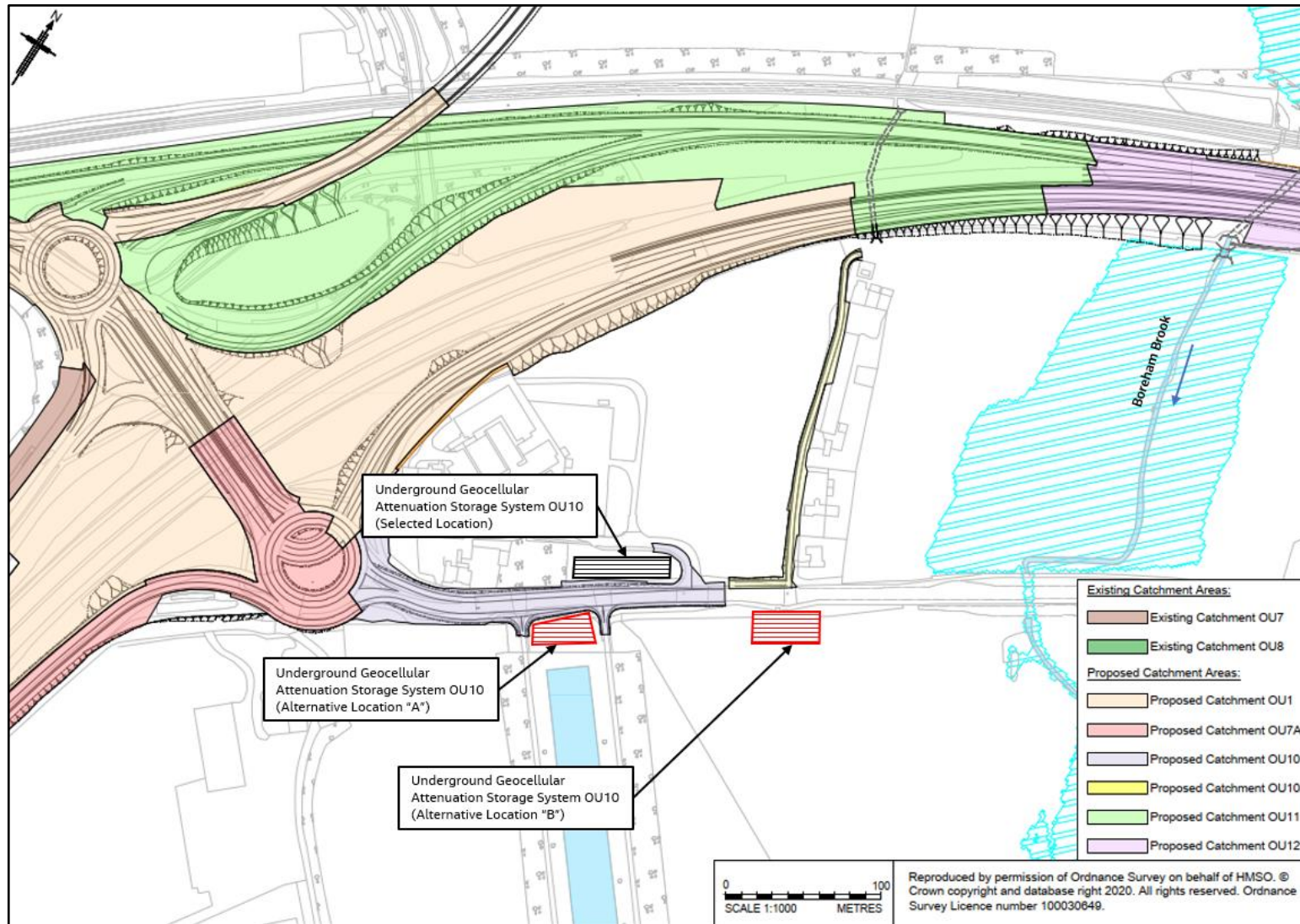


Plate 7.3 Proposed S1-OU10 Catchment Selected and Alternative Underground Geocellular Attenuation Storage Locations

7.5 Proposed Catchment S1-OU10A

Selected Underground Geocellular Attenuation Storage System Location

7.5.1 The selected S1-OU10A underground geocellular attenuation storage system location (shown in Plate 7.4 below) is the chosen design solution as its close proximity to the proposed Payne's Lane minimises the depth of the aforementioned attenuation storage in addition to avoiding the environmental, ecological and existing utilities impacts described subsequently for the discounted S1-OU10A alternative attenuation storage location "A". As described in Section 5.3 previously the proposed S1-OU10A catchment will discharge at existing case allowable discharge rates to the existing highway drainage system serving the B1137 (Main Road). Therefore, this enables the underground geocellular attenuation storage system to discharge at the existing case brownfield allowable discharge rates as opposed to greenfield runoff rates. This reduces the attenuation storage volume required and therefore reduces the underground geocellular attenuation storage system volume / areal footprint.

Alternative Underground Geocellular Attenuation Storage Location "A"

7.5.2 The S1-OU10A alternative underground geocellular attenuation storage system location "A" was initially considered as a potential location but was discounted due to the site specific design implications regarding the aforementioned attenuation storage positioning. The site specific design implications that resulted in the discounting of this alternative attenuation storage location are as follows:

- The S1-OU10A alternative attenuation storage location "A" was discounted due to the presence of mature trees within the land parcel. The loss of the aforementioned mature trees would have a negative impact on the visual amenity and ecology in the vicinity in addition to the loss of a carbon sink.
- Existing underground utilities (e.g. telecommunications cables, electrical cables, gas pipeline, etc.) are present within the S1-OU10A alternative attenuation storage location "A" which would require utility diversions. Utility diversions would increase the proposed case landtake requirement as new utility corridors would be required.

7.5.3 No other alternative underground geocellular attenuation storage system locations were considered for the proposed S1-OU10A catchment due to the spatial constraints to the east of Payne's Lane. Also, it is not practicable to locate the proposed underground geocellular attenuation storage system in the available land further west of Payne's Lane as it would increase the depth of the proposed highway drainage system and become more remote from a potential outfall location to the B1137 (Main Road) highway drainage system. It should be noted that an attenuation pond solution was discounted during the design development process for the proposed S1-OU10A catchment due to landtake constraints imposed by the proposed scheme permanent acquisition of land boundary. The proposed Payne's Lane WCH route (see Plate 2.1 and Plate 7.4) was developed late in the preliminary design stage after the consultation process such that the proposed scheme permanent acquisition of land boundary was

fixed at the time. Therefore, an attenuation pond solution could not be accommodated within the available land parcel. Hence, the selected and alternative underground geocellular attenuation storage location solutions are presented below.

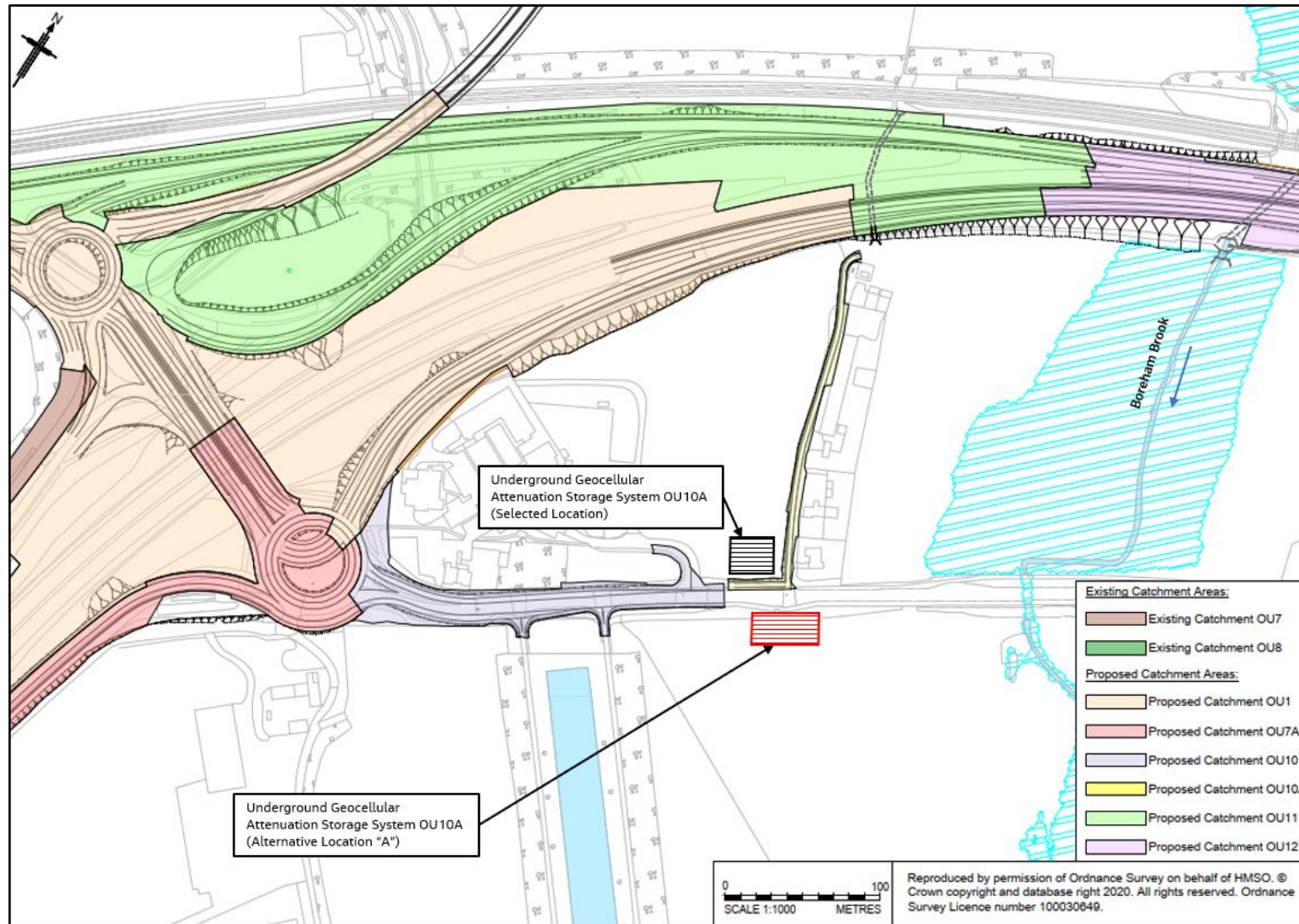


Plate 7.4 Proposed S1-OU10A Catchment Selected and Alternative Underground Geocellular Attenuation Storage Locations

7.6 Proposed Catchments S1-OU11 and S1-OU12

Selected Attenuation Pond Location

- 7.6.1 The selected S1-OU11 and S1-OU12 attenuation pond locations (shown in Plate 7.5 below) are the chosen design solutions as their positioning maximises the amount of the proposed S1-OU11 and S1-OU12 catchments which drain to the attenuation ponds prior to discharging to the nearby Boreham Brook. Therefore, this ensures that the selected attenuation pond locations provide the required attenuation storage volume for the total catchment and maximises the volume of surface water runoff from the proposed highway that can be subjected to the pollution treatment measures within the attenuation pond (described in Section 4.9 previously). The selected S1-OU11 and S1-OU12 attenuation pond locations are not located immediately adjacent to the A12 mainline as the terrain is higher and steeper near the highway and falls away to the south. Hence, the selected S1-OU11 and S1-OU12 attenuation pond locations are located further south of the A12 mainline to take advantage of the flatter ground and thereby reduce the depth of the attenuation ponds. As described in Section 5.4 previously the proposed S1-OU11 and S1-OU12 catchments will continue to discharge to the Boreham Brook (similar to the existing site condition) via new outfalls due to site constraints associated with the proposed highway geometry and attenuation pond positioning. Therefore, this enables the attenuation ponds to discharge at the existing case brownfield allowable discharge rates as opposed to reduced greenfield runoff rates. This reduces the attenuation storage volume required and therefore reduces the attenuation pond volumes / areal footprints.
- 7.6.2 The alternative attenuation pond locations assessed for the proposed S1-OU11 and S1-OU12 catchments are all located on the southern side of the A12 mainline. This is to retain similar highway drainage outfall location arrangements to the existing site condition and due to spatial constraints provided by the Great Eastern Main Line railway embankment.

S1-OU11 and S1-OU12 Alternative Underground Geocellular Attenuation Storage Locations “A”

- 7.6.3 The S1-OU11 and S1-OU12 alternative attenuation pond’ locations “A” were initially considered as potential locations but were discounted due to the site specific design and fluvial floodplain implications regarding the attenuation storage positioning. The site specific design implications that resulted in the discounting of these alternative attenuation storage locations are as follows:
- The S1-OU11 and S1-OU12 alternative attenuation pond locations “A” were discounted due their encroachment into the fluvial flood zones associated with Boreham Brook. Encroaching into the floodplain could increase fluvial food risk locally and potentially adversely impact the operation of the attenuation storage ponds during major storm events.
- 7.6.4 Locating the S1-OU11 and S1-OU12 alternative attenuation pond locations “A” further outside the Boreham Brook fluvial flood zones was found to be unfeasible as it would position the attenuation ponds in steeper terrain. This would create deeper attenuation ponds which has more associated health and safety risks (i.e. as stated in Section 7.1) and would also result in a larger landtake.

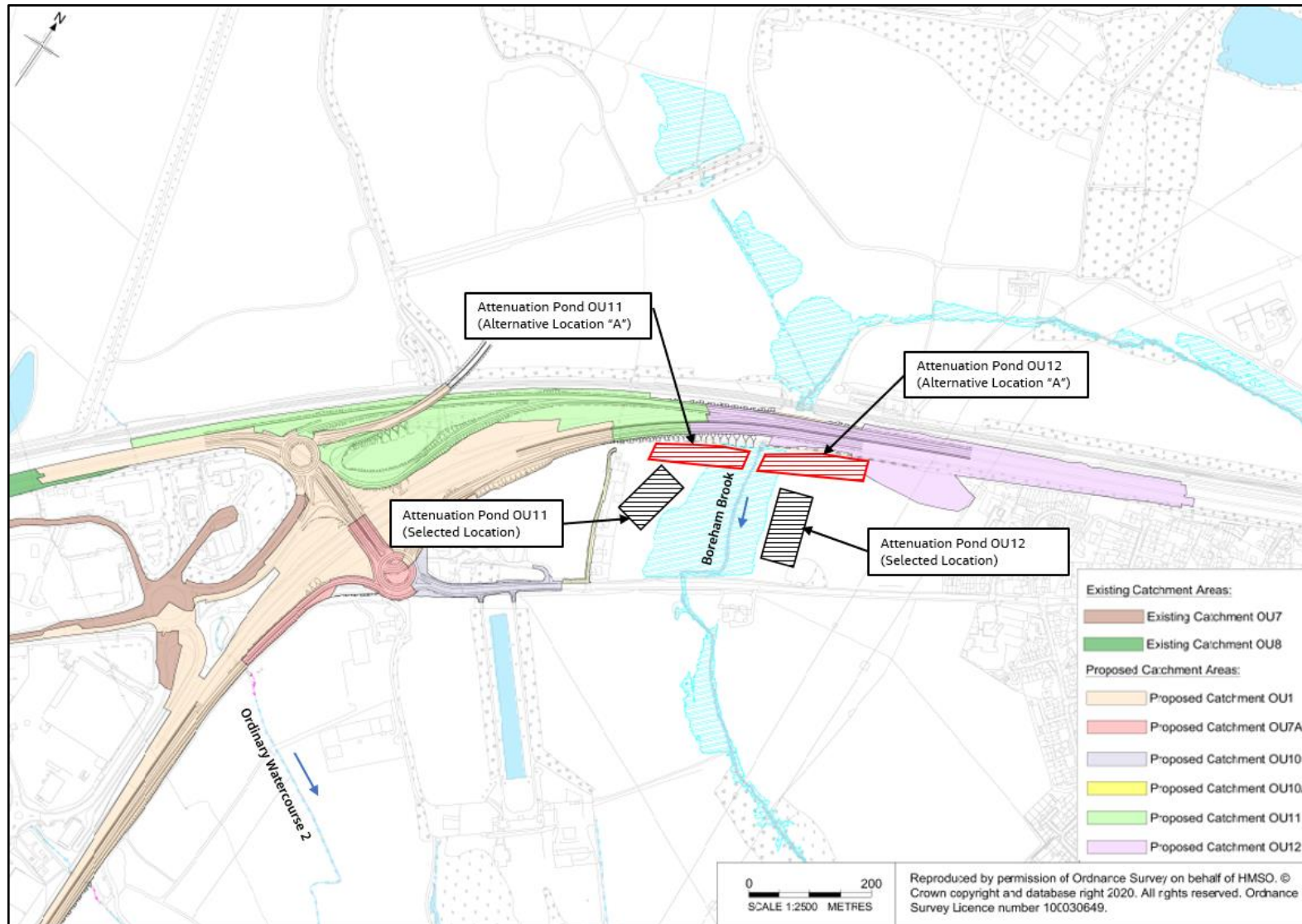


Plate 7.5 Proposed S1-OU11 and S1-OU12 Catchments Selected and Alternative Attenuation Pond Locations

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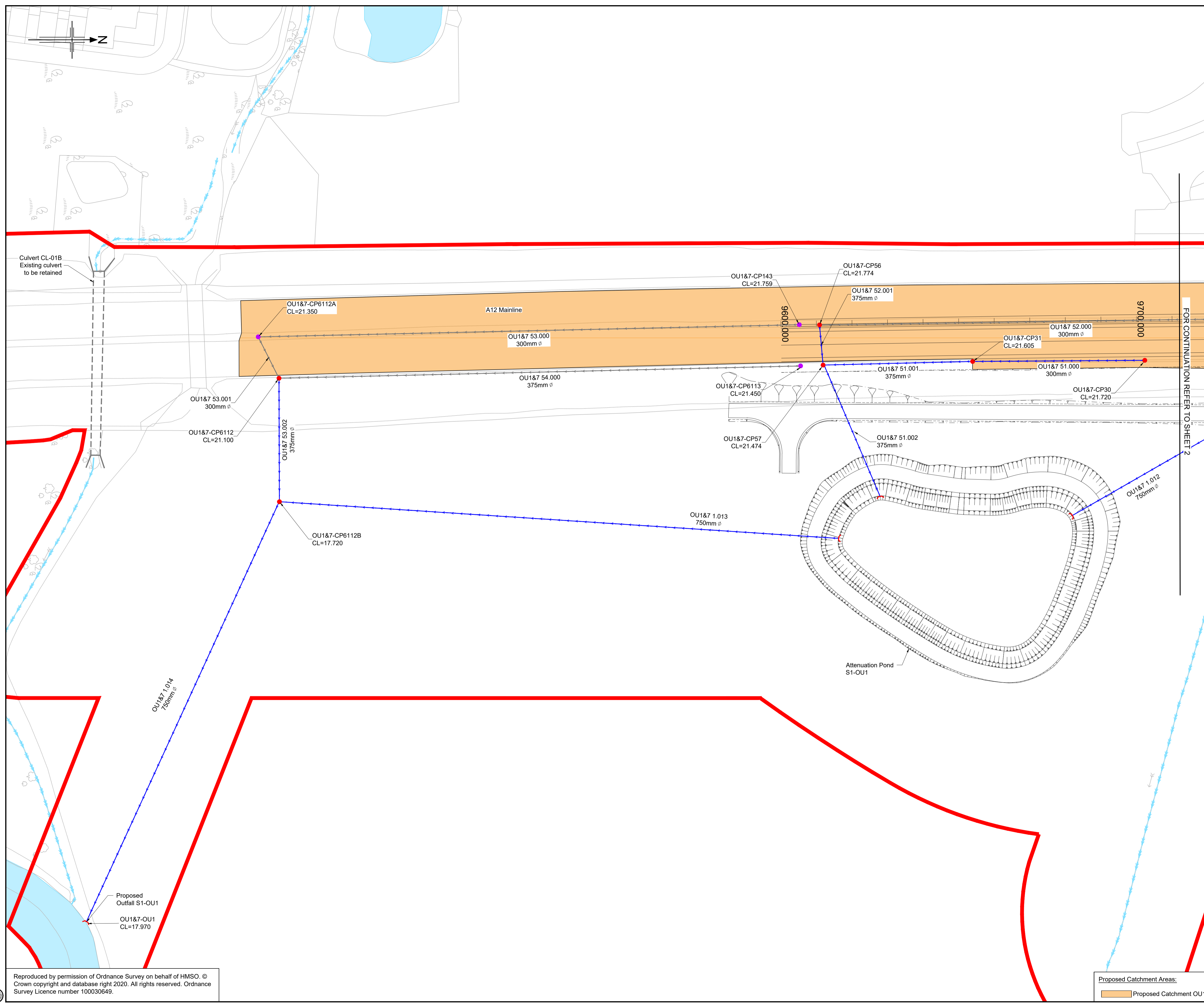
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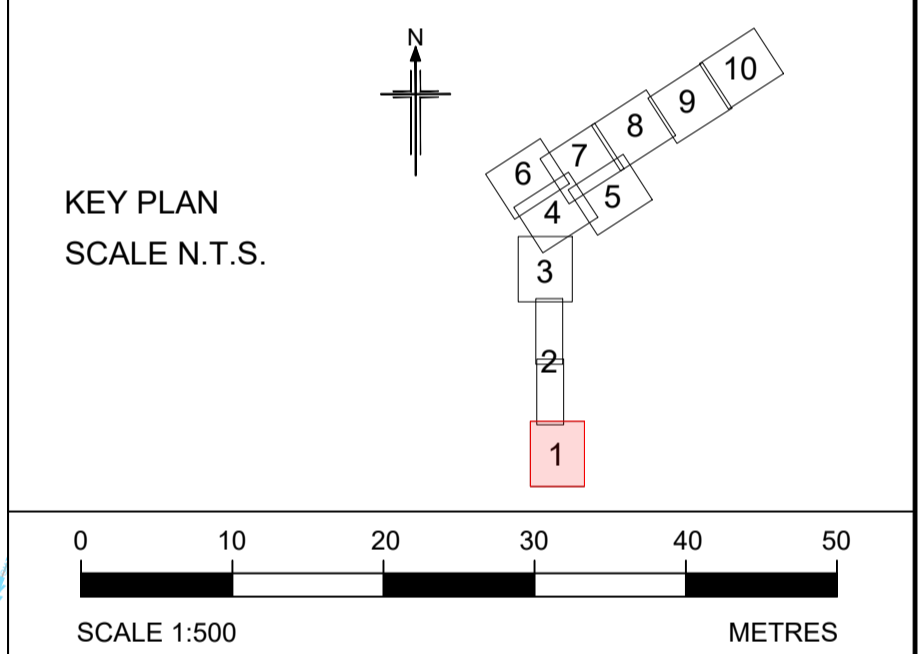
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Appendix A - Junction 19 Proposed Drainage System Layouts



- NOTES**
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
 2. LEVELS ARE IN METRES ABOVE ORDNANCE DATUM (mAOD).
 3. SYMBOLS USED ARE SCHEMATIC AND NOT REPRESENTATIVE OF SIZE.
 4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH SURFACE WATER DRAINAGE DESIGN REPORT (DOCUMENT REF HE551497-JAC-HDG-S1_J19-RP-D-0001), WITH SPECIFIC REFERENCE TO APPENDIX B FOR THE PROPOSED HIGHWAY DRAINAGE SYSTEM HYDRAULIC MODELING RESULTS.
 5. THE DRAINAGE DESIGN SOLUTIONS HAVE BEEN DEVELOPED BASED ON THE INFORMATION AVAILABLE FROM THE DRAINAGE SURVEYS AT THE PRELIMINARY DRAINAGE DESIGN STAGE. IT SHOULD BE NOTED THAT APPROPRIATE ASSUMPTIONS HAVE BEEN MADE WHERE THE DRAINAGE SURVEYS WERE FOUND TO HAVE GAPS IN THE INFORMATION AND/OR WERE FOUND TO BE INCOMPLETE. THESE ASSUMPTIONS INCLUDING THE POTENTIAL IMPACT TO THE CURRENT DRAINAGE DESIGN WILL BE REVIEWED AT DETAILED DESIGN STAGE.

- LEGEND**
- ORDER LIMITS
 - EXISTING CARRIER DRAIN TO BE RETAINED
 - EXISTING FILTER DRAIN TO BE RETAINED
 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
 - PROPOSED CHAMBER TO BE RETAINED
 - DUMMY / GHOST NODE
 - EXISTING GULLY TO BE RETAINED / PROPOSED GULLY
 - PROPOSED HEADWALL
 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
 - PROPOSED CULVERT
 - PROPOSED ATTENUATION POND
 - PROPOSED ATTENUATION POND ACCESS TRACK
 - PROPOSED GEOCELLULAR ATTENUATION STORAGE
 - MINOR WATERCOURSE (TO BE RETAINED)
 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Appr'd
P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT

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 www.jacobs.com

Client: **national highways**

Project: REGIONAL DELIVERY PARTNERSHIP
 A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title: **PROPOSED DRAINAGE NETWORK LAYOUT JUNCTION 19 - SHEET 1 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

State Code	Preliminary
Project Stage	PCF3
Scale	1:500
Jacobs No.	B36601D1
Client no.	HE551497

DO NOT SCALE
Rev P01

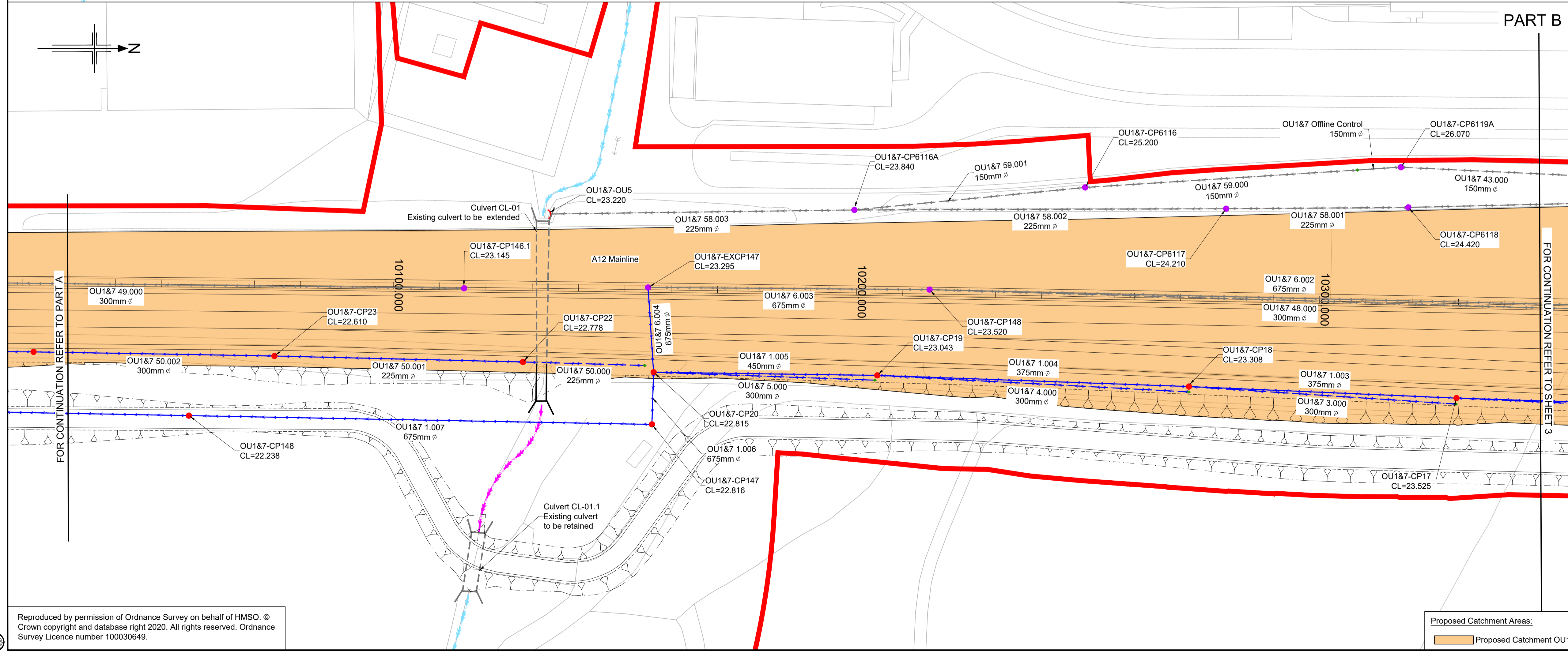
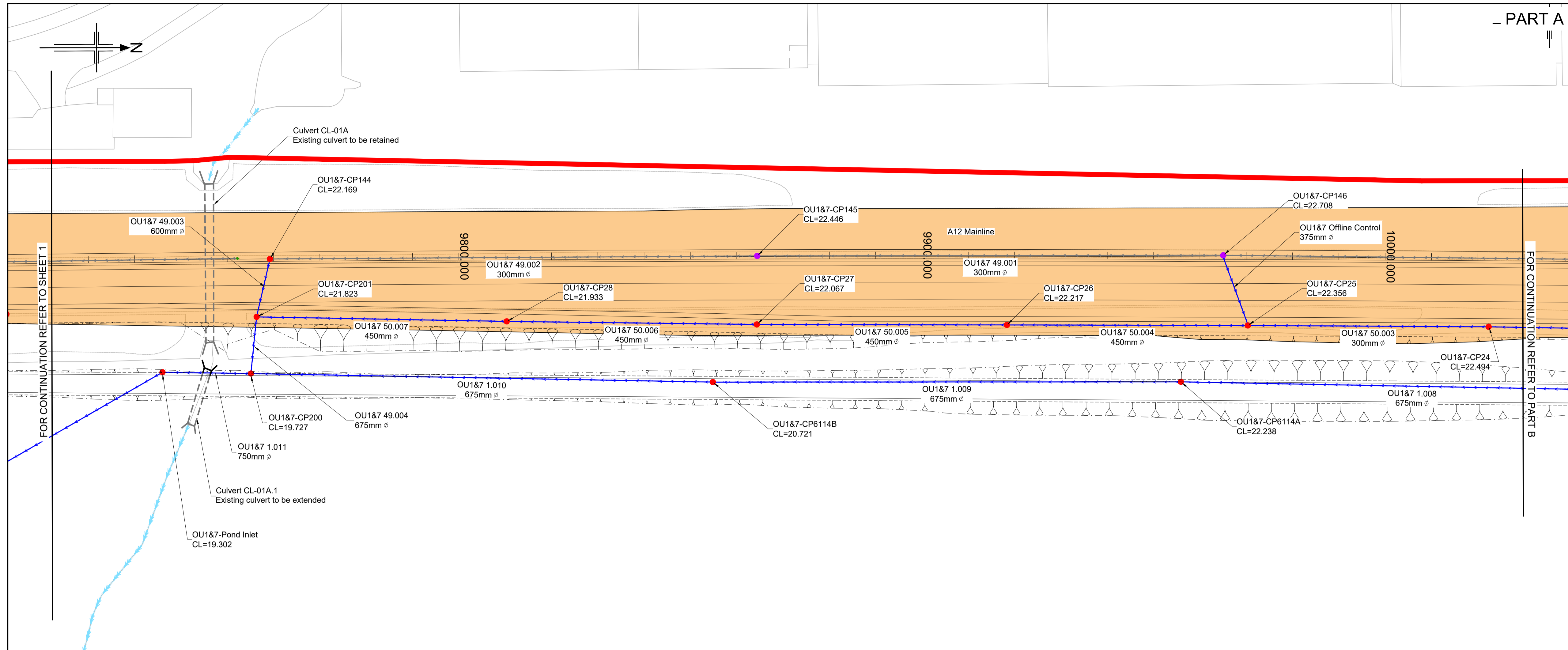
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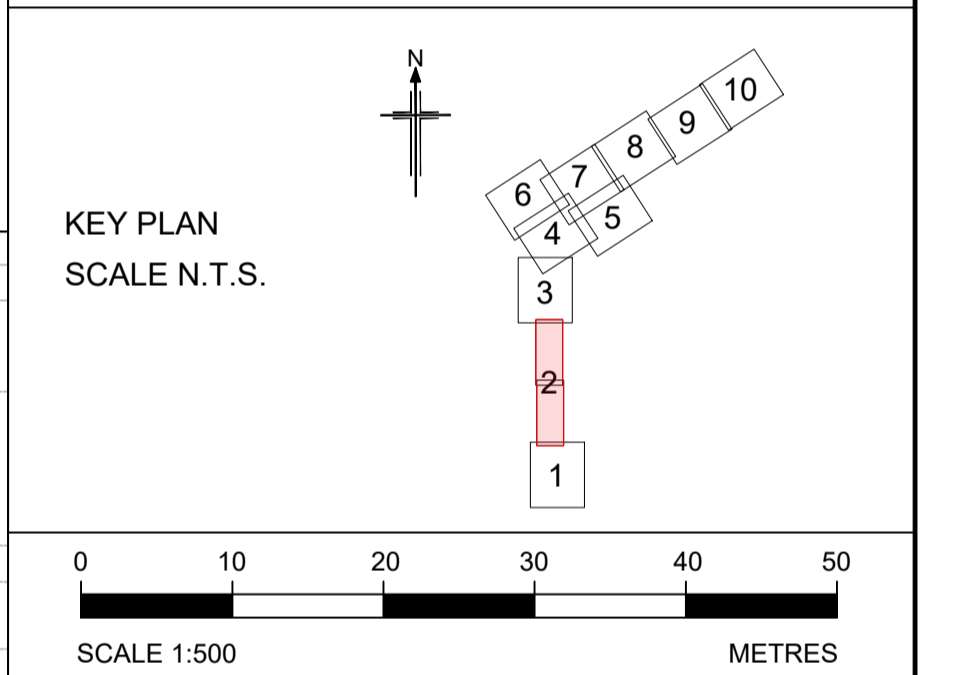
Proposed Catchment Areas:
 Proposed Catchment OU1

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 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
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 - PROPOSED ATTENUATION POND
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 - PROPOSED GEOCELLULAR ATTENUATION STORAGE
 - MINOR WATERCOURSE (TO BE RETAINED)
 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



0 10 20 30 40 50
SCALE 1:500 METRES

Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd
P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT

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Client: **national highways**

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title: **PROPOSED DRAINAGE NETWORK LAYOUT JUNCTION 19 - SHEET 2 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

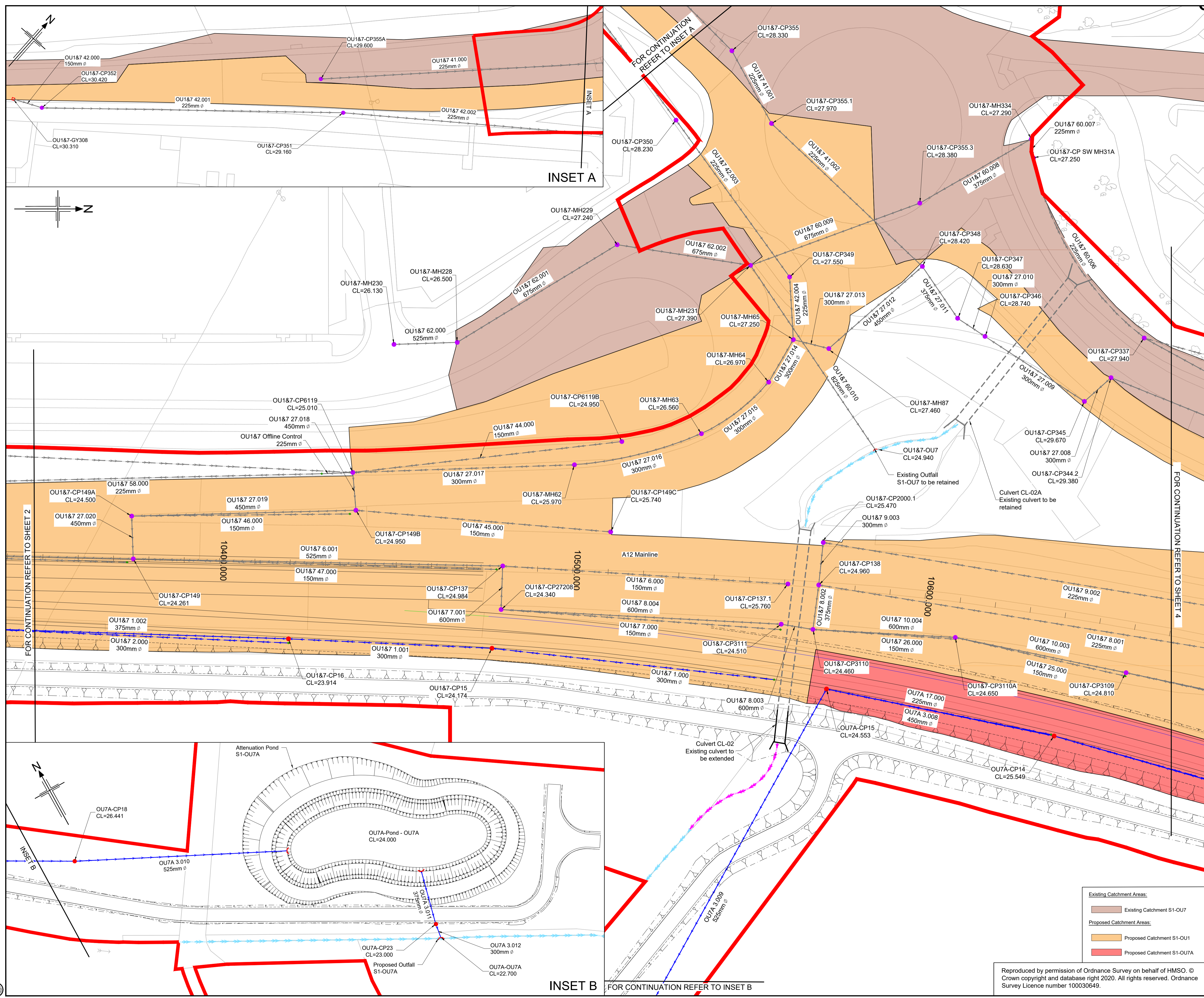
State Code	Preliminary	DO NOT SCALE
Project Stage	PCF3	Rev
Scale	1:500	P01
Jacobs No.	B36601D1	
Client no.	HE551497	

Drawing number	HE551497 - JAC - HDG - S1 J19	Originator	JAC	Volume	-DR- D -0002
Location		Type		Role	Number

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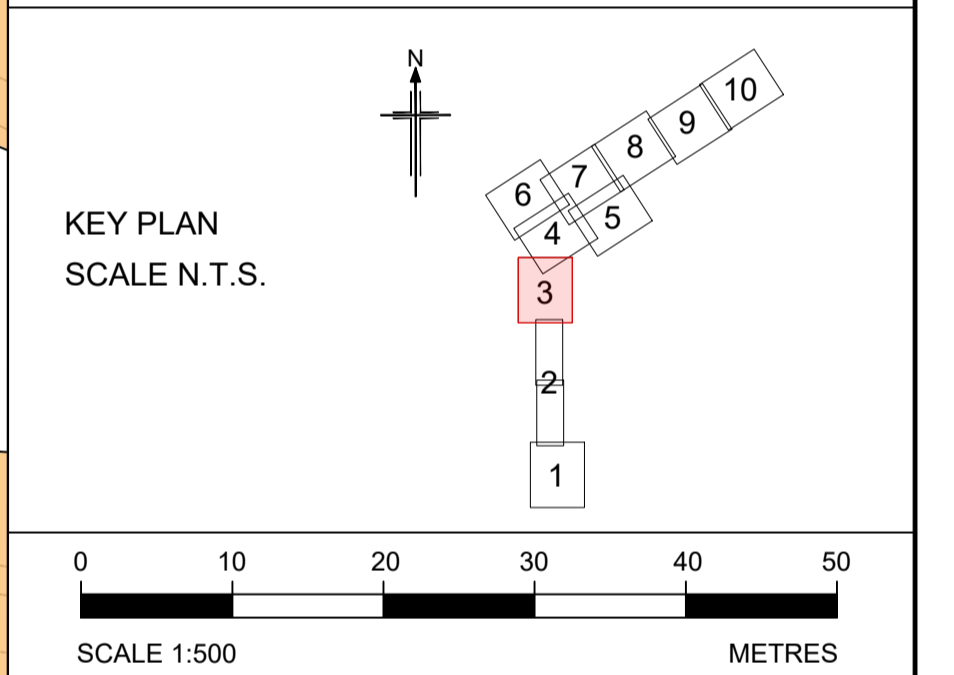
Proposed Catchment Areas:

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- NOTES**
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
 2. LEVELS ARE IN METRES ABOVE ORDNANCE DATUM (mAOD).
 3. SYMBOLS USED ARE SCHEMATIC AND NOT REPRESENTATIVE OF SIZE.
 4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH SURFACE WATER DRAINAGE DESIGN REPORT (DOCUMENT REF HE551497-JAC-HDG-S1_J19-RP-D-0001), WITH SPECIFIC REFERENCE TO APPENDIX B FOR THE PROPOSED HIGHWAY DRAINAGE SYSTEM HYDRAULIC MODELING RESULTS.
 5. THE DRAINAGE DESIGN SOLUTIONS HAVE BEEN DEVELOPED BASED ON THE INFORMATION AVAILABLE FROM THE DRAINAGE SURVEYS AT THE PRELIMINARY DRAINAGE DESIGN STAGE. IT SHOULD BE NOTED THAT APPROPRIATE ASSUMPTIONS HAVE BEEN MADE WHERE THE DRAINAGE SURVEYS WERE FOUND TO HAVE GAPS IN THE INFORMATION AND/OR WERE FOUND TO BE INCOMPLETE. THESE ASSUMPTIONS INCLUDING THE POTENTIAL IMPACT TO THE CURRENT DRAINAGE DESIGN WILL BE REVIEWED AT DETAILED DESIGN STAGE.

- LEGEND**
- ORDER LIMITS
 - EXISTING CARRIER DRAIN TO BE RETAINED
 - EXISTING FILTER DRAIN TO BE RETAINED
 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
 - PROPOSED CHAMBER
 - EXISTING CHAMBER TO BE RETAINED
 - DUMMY / GHOST NODE
 - EXISTING GULLY TO BE RETAINED / PROPOSED GULLY
 - PROPOSED HEADWALL
 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
 - PROPOSED CULVERT
 - PROPOSED ATTENUATION POND
 - PROPOSED ATTENUATION POND ACCESS TRACK
 - PROPOSED GEOCELLULAR ATTENUATION STORAGE
 - MINOR WATERCOURSE (TO BE RETAINED)
 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd

Contractor: **COSTAIN** Designer: **Jacobs**
2nd Floor Cottons Centre, Cottons Lane
London SE1 2QG. Tel: +44 (0)203 9802000
www.jacobs.com

Client: **national highways**

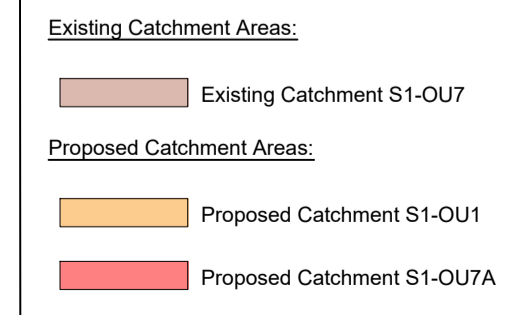
Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title: **PROPOSED DRAINAGE NETWORK LAYOUT JUNCTION 19 - SHEET 3 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

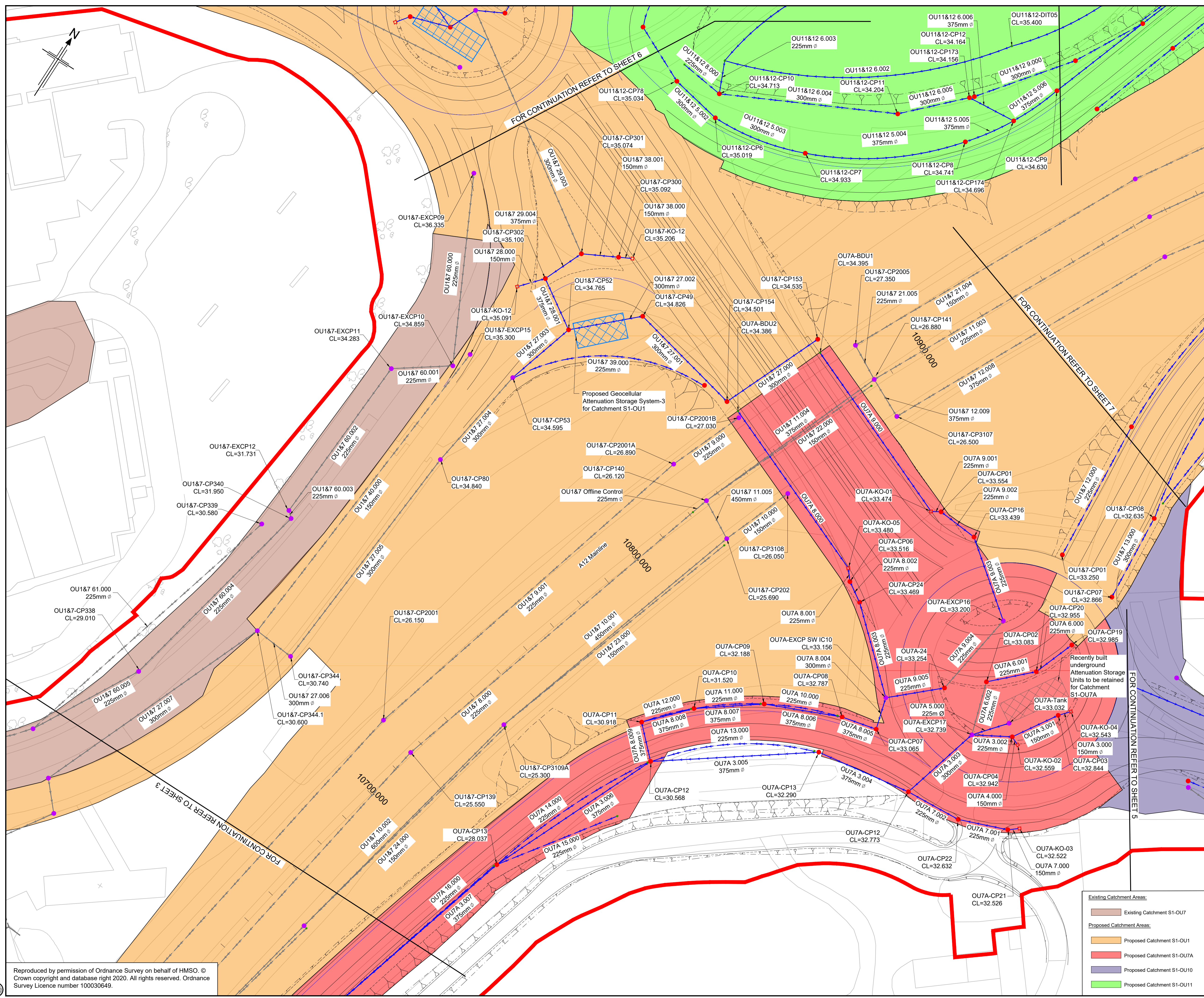
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Project Stage	PCF3	
Scale	1:500	Rev
Jacobs No.	B36801D1	P01
Client no.	HE551497	

Drawing number	PN	Originator	Volume
HE551497 - JAC - HDG - S1_J19			
Location	Location	Type	Role



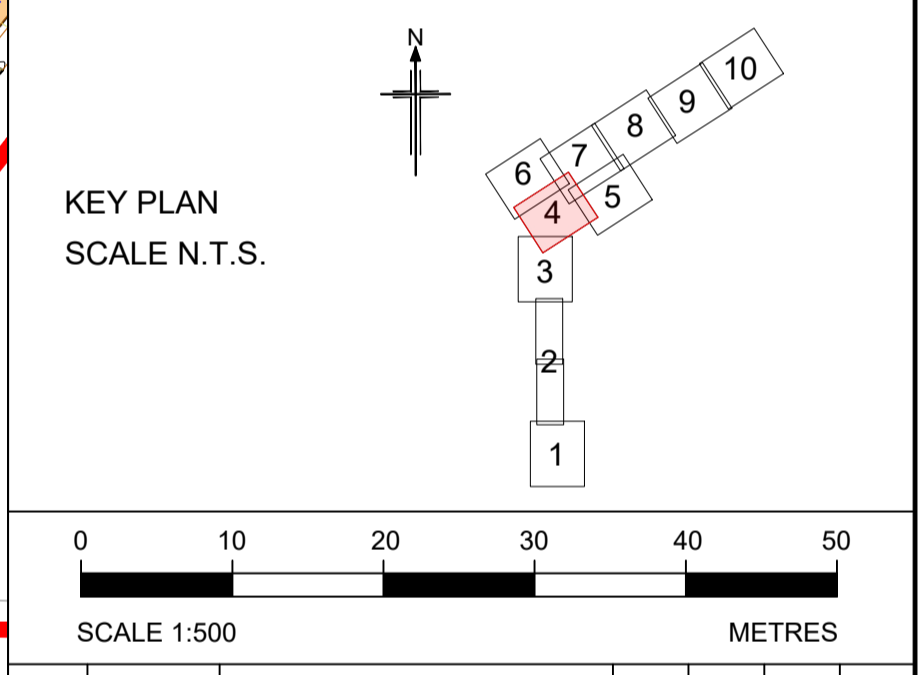
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- ORDER LIMITS
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 - EXISTING FILTER DRAIN TO BE RETAINED
 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
 - PROPOSED CHAMBER
 - EXISTING CHAMBER TO BE RETAINED
 - DUMMY / GHOST NODE
 - EXISTING GULLY TO BE RETAINED / PROPOSED GULLY
 - PROPOSED HEADWALL
 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
 - PROPOSED CULVERT
 - PROPOSED ATTENUATION POND
 - PROPOSED ATTENUATION POND ACCESS TRACK
 - PROPOSED GEOCELLULAR ATTENUATION STORAGE
 - MINOR WATERCOURSE (TO BE RETAINED)
 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd
P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT

Contractor: **COSTAIN** Designer: **Jacobs**
 2nd Floor Cottons Centre, Cottons Lane
 London SE1 2QG. Tel: +44 (0)203 9802000
 www.jacobs.com

Client: **national highways**

Project: REGIONAL DELIVERY PARTNERSHIP
 A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title: **PROPOSED DRAINAGE NETWORK LAYOUT JUNCTION 19 - SHEET 4 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

State Code	Preliminary	DO NOT SCALE
Project Stage	PCF3	
Scale	1:500	Rev P01
Jacobs No.	B36601D1	
Client no.	HE551497	

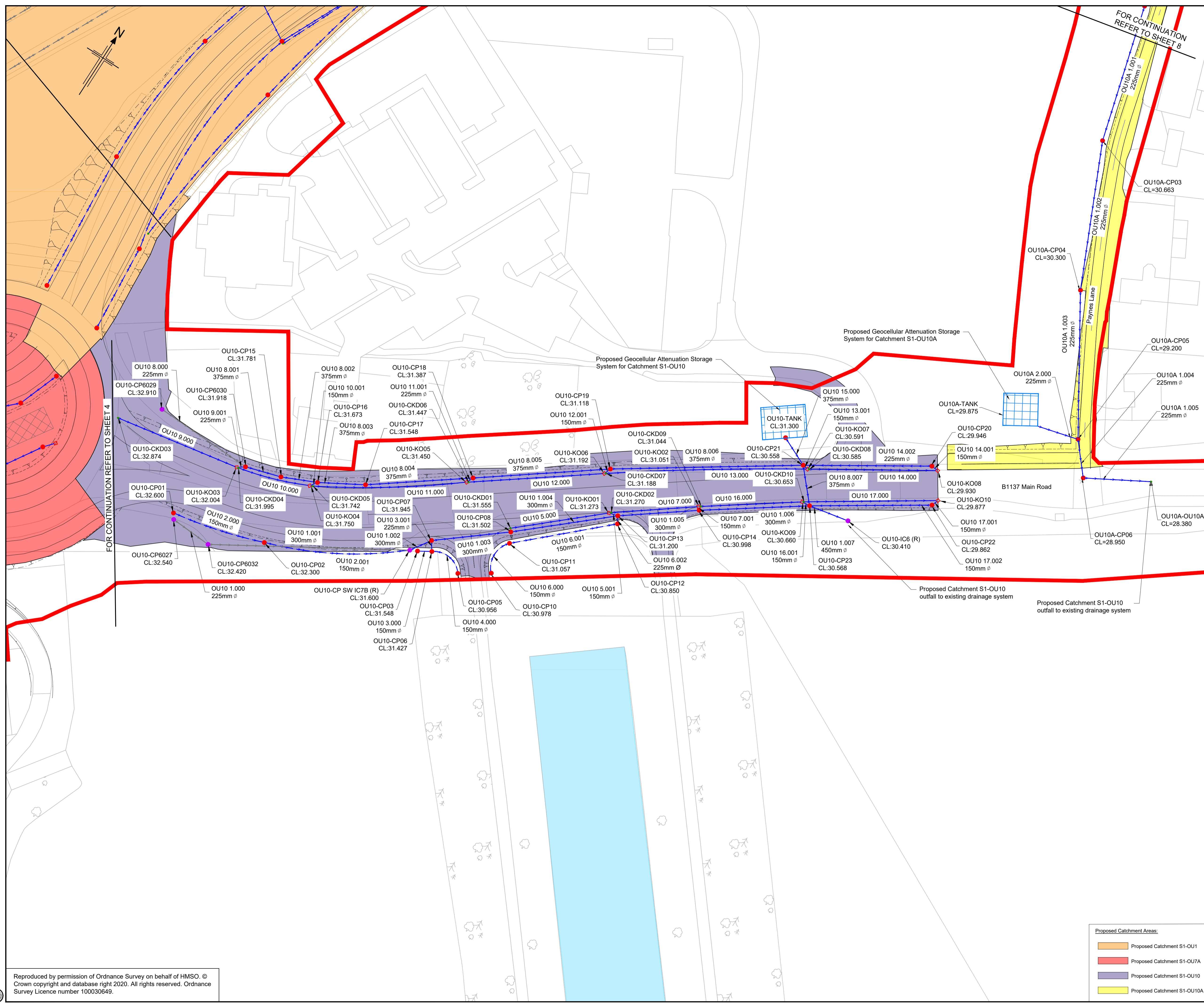
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Originator: JAC Volume: -HDG-
 Location: S1 J19 Type: Role: Number: -DR- D - 0004

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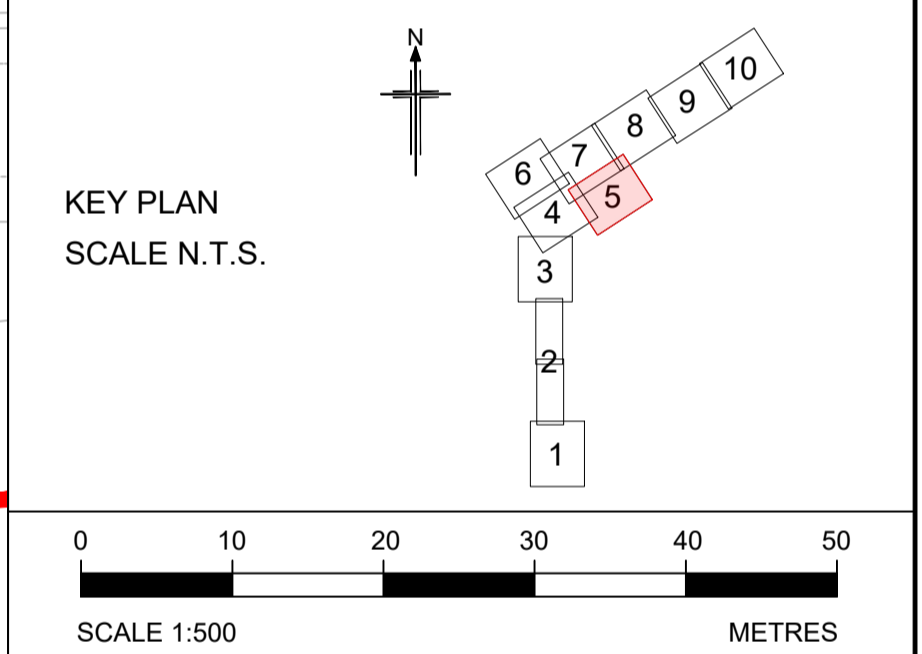
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- LEGEND**
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 - EXISTING CARRIER DRAIN TO BE RETAINED
 - EXISTING FILTER DRAIN TO BE RETAINED
 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
 - PROPOSED CHAMBER
 - EXISTING CHAMBER TO BE RETAINED
 - DUMMY / GHOST NODE
 - EXISTING GULLY TO BE RETAINED / PROPOSED GULLY
 - PROPOSED HEADWALL
 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
 - PROPOSED CULVERT
 - PROPOSED ATTENUATION POND
 - PROPOSED ATTENUATION POND ACCESS TRACK
 - PROPOSED GEOCELLULAR ATTENUATION STORAGE
 - MINOR WATERCOURSE (TO BE RETAINED)
 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



0 10 20 30 40 50
SCALE 1:500 METRES

P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd

Contractor: **COSTAIN** Designer: **Jacobs**
2nd Floor Cottons Centre, Cottons Lane
London SE1 2QG. Tel: +44 (0)203 9802000
www.jacobs.com

Client: **highways england**

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title: **PROPOSED DRAINAGE NETWORK LAYOUT JUNCTION 19 - SHEET 5 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

State Code	Preliminary	DO NOT SCALE
Project Stage	PCF3	
Scale	1:500	Rev P01
Jacobs No.	B36601D1	
Client no.	HE551497	

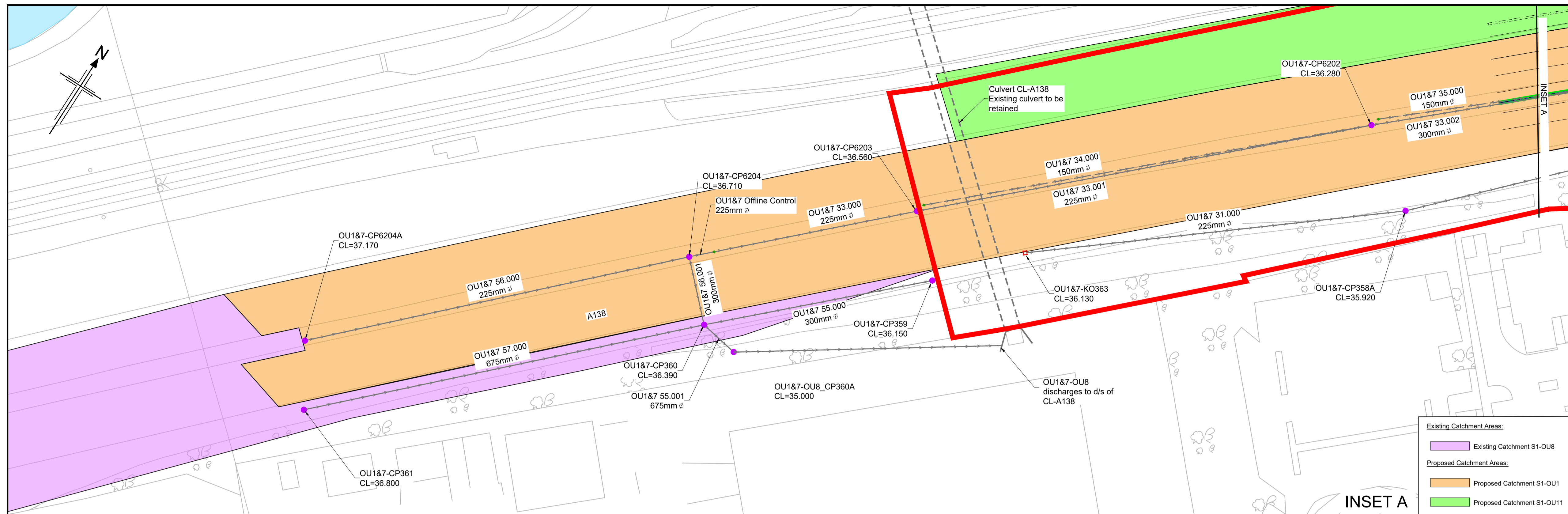
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PIN: HE551497 - JAC - HDG - S1_J19
Originator: JAC
Volume: -DR- D - 0005
Location: S1_J19
Type: Role | Number

- Proposed Catchment Areas:**
- Proposed Catchment S1-OU1
 - Proposed Catchment S1-OU7A
 - Proposed Catchment S1-OU10
 - Proposed Catchment S1-OU10A

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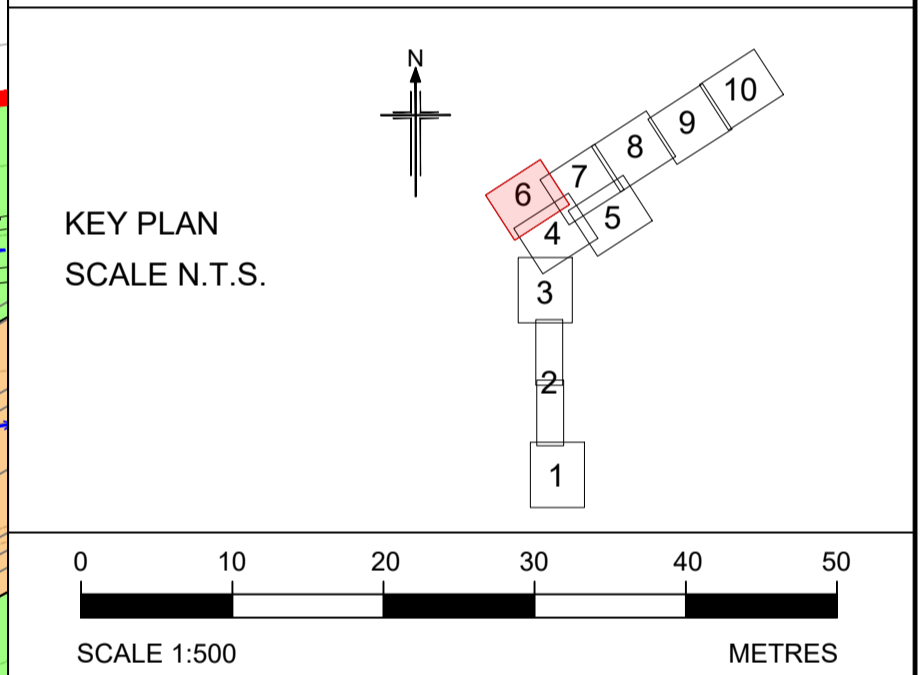
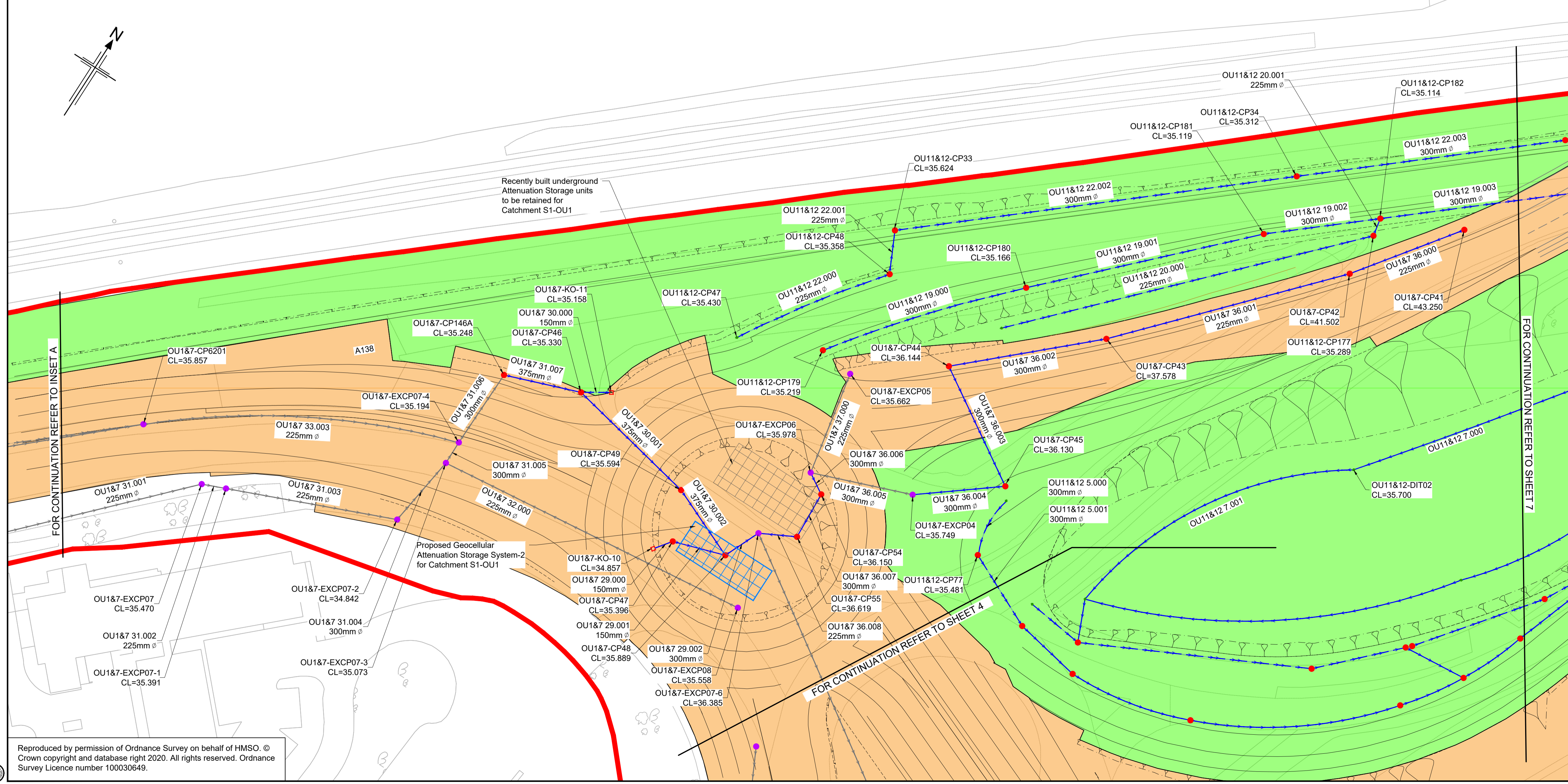
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 - EXISTING FILTER DRAIN TO BE RETAINED
 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
 - EXISTING CHAMBER TO BE RETAINED
 - DUMMY / GHOST NODE
 - EXISTING GULLY TO BE RETAINED / PROPOSED GULLY
 - PROPOSED HEADWALL
 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
 - PROPOSED CULVERT
 - PROPOSED ATTENUATION POND
 - PROPOSED ATTENUATION POND ACCESS TRACK
 - PROPOSED GEOCELLULAR ATTENUATION STORAGE
 - MINOR WATERCOURSE (TO BE RETAINED)
 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd

Contractor: **COSTAIN** Designer: **Jacobs**
2nd Floor Cottons Centre, Cottons Lane
London SE1 2QG. Tel: +44 (0)203 9802000
www.jacobs.com

Client: **highways england**

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title: **PROPOSED DRAINAGE NETWORK LAYOUT JUNCTION 19 - SHEET 6 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

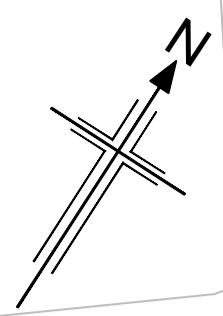
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Project Stage	PCF3	Rev
Scale	1:500	P01
Jacobs No.	B36601D1	
Client no.	HE551497	

Drawing number: HE551497 - JAC - HDG - S1_J19 - DR - D - 0006
Originator: JAC Volume: -HDG-
Location: S1_J19 Type: Role: Number

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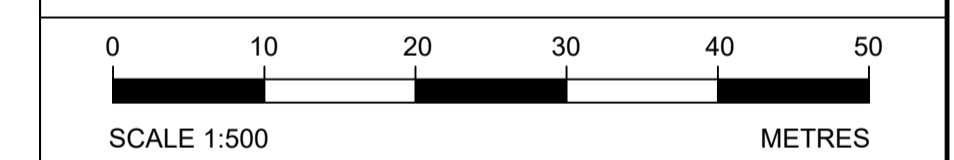
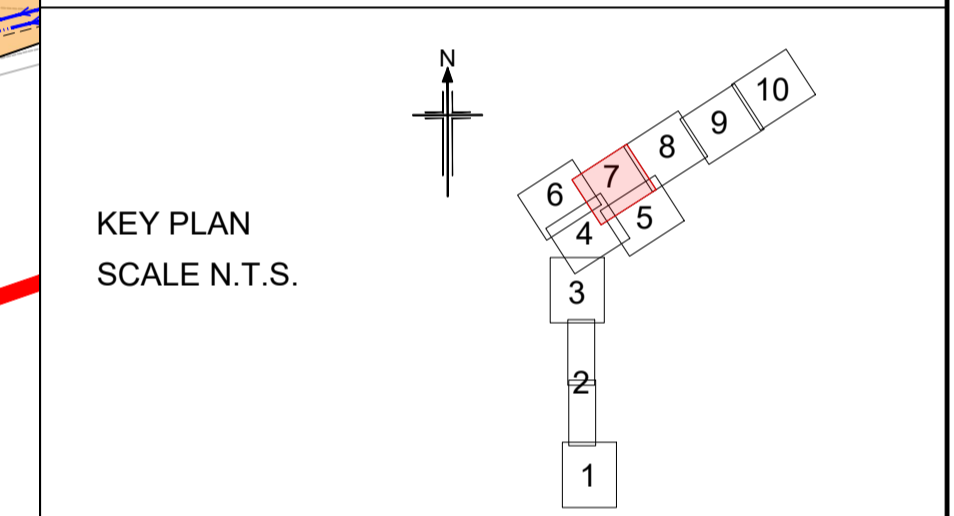
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- ORDER LIMITS
 - EXISTING CARRIER DRAIN TO BE RETAINED
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 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
 - PROPOSED CHAMBER
 - EXISTING CHAMBER TO BE RETAINED
 - DUMMY / GHOST NODE
 - EXISTING GULLY TO BE RETAINED / PROPOSED GULLY
 - PROPOSED HEADWALL
 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
 - PROPOSED CULVERT
 - PROPOSED ATTENUATION POND
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P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT
Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd

Contractor: **COSTAIN** Designer: **Jacobs**
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 London SE1 2QG. Tel: +44 (0)203 9802000
 www.jacobs.com

Client: **highways england**

Project: REGIONAL DELIVERY PARTNERSHIP
 A12 CHELMSFORD TO A120 WIDENING SCHEME

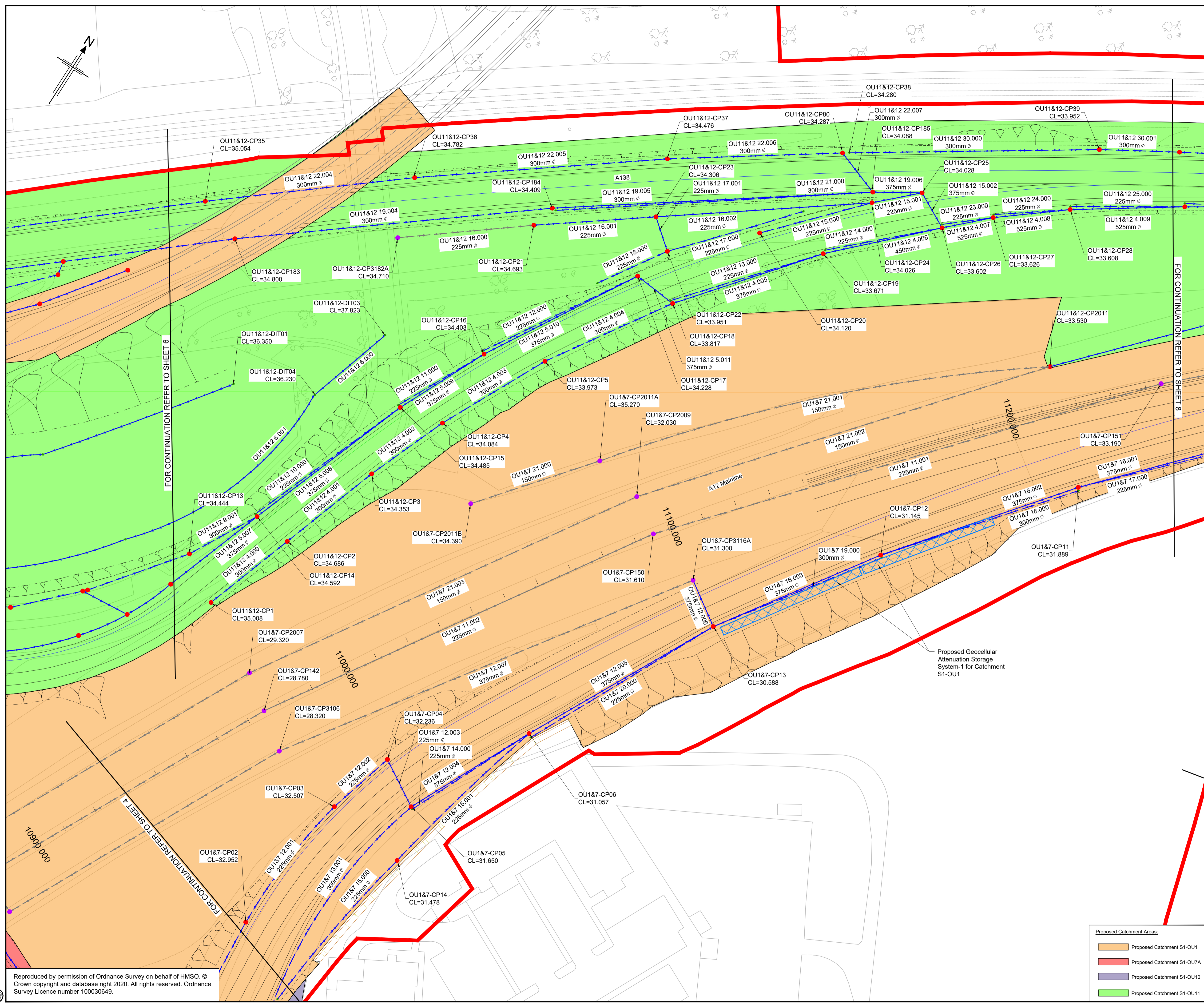
Drawing title: **PROPOSED DRAINAGE NETWORK LAYOUT JUNCTION 19 - SHEET 7 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

State Code	Preliminary	DO NOT SCALE
Project Stage	PCF3	
Scale	1:500	Rev
Jacobs No.	B36601D1	P01
Client no.	HE551497	

Drawing number: HE551497 - JAC - HDG - S1 J19 - DR - D - 0007
 Originator: JAC Location: S1 J19
 Volume: -DR- D - 0007
 Type: Role: Number

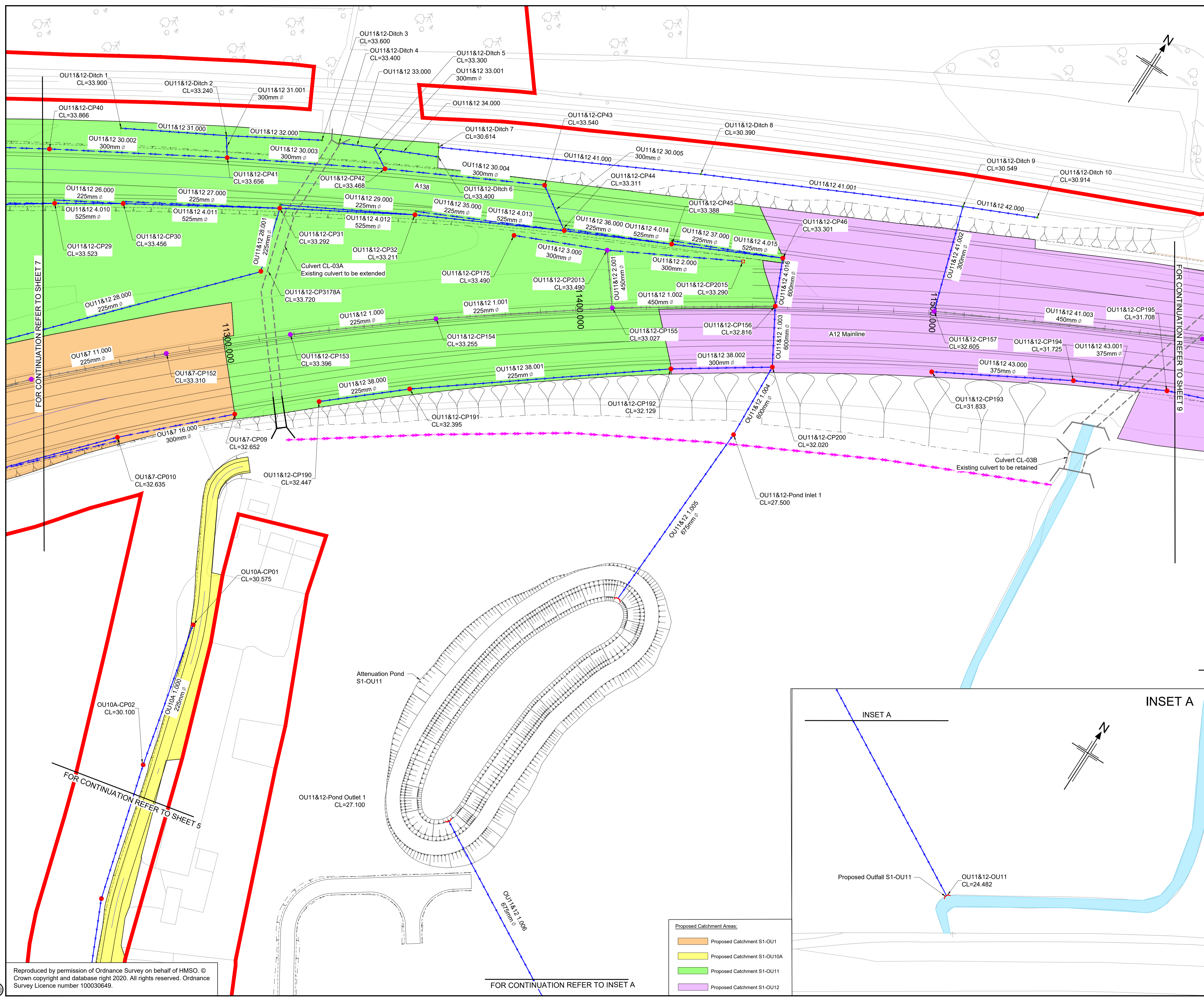
- Proposed Catchment Areas:**
- Proposed Catchment S1-OU1
 - Proposed Catchment S1-OU7A
 - Proposed Catchment S1-OU10
 - Proposed Catchment S1-OU11



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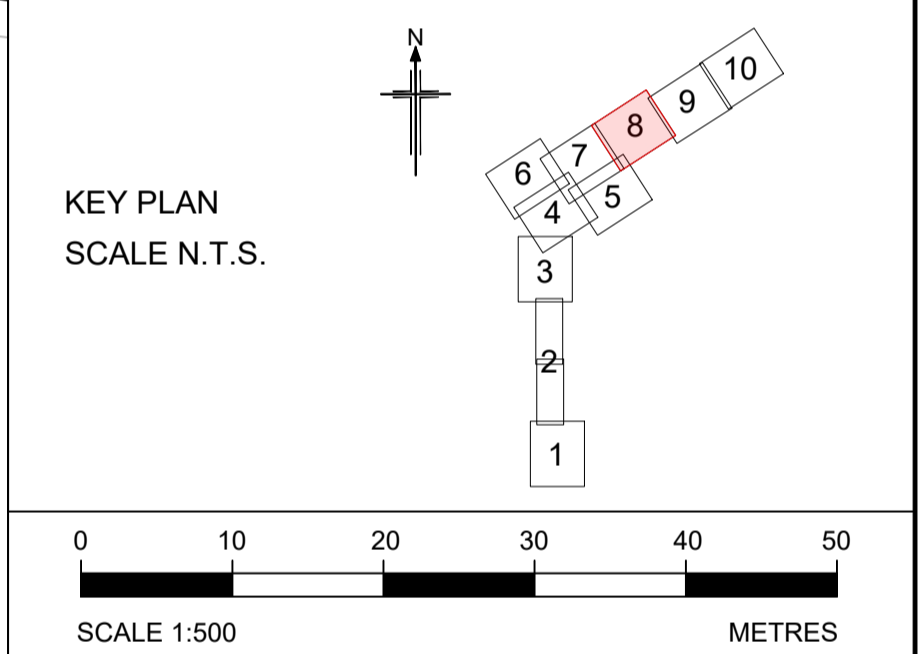
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P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT
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 www.jacobs.com

Client: **highways england**

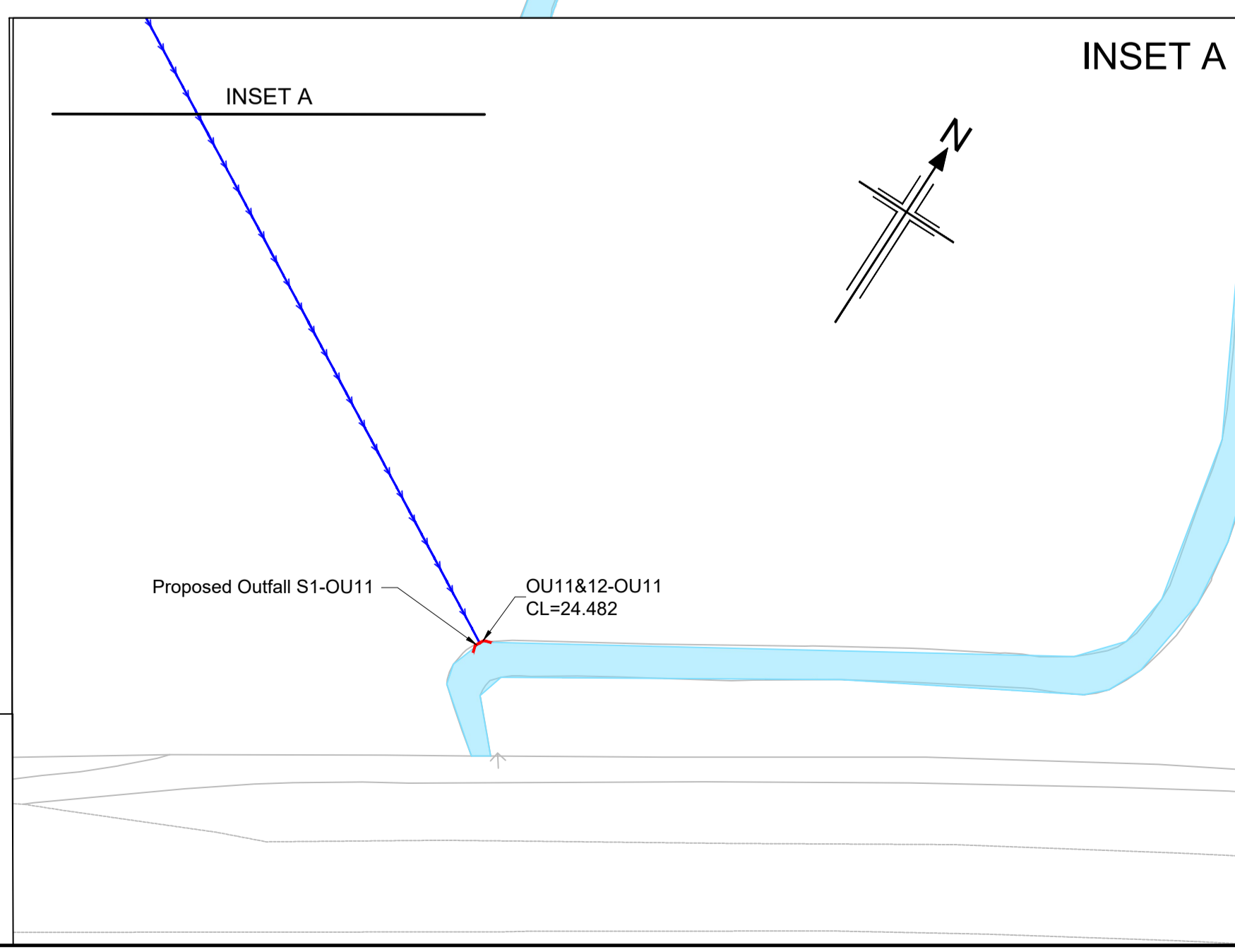
Project: REGIONAL DELIVERY PARTNERSHIP
 A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title:
**PROPOSED DRAINAGE NETWORK LAYOUT
 JUNCTION 19 - SHEET 8 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

State Code	Preliminary	DO NOT SCALE
Project Stage	PCF3	
Scale	1:500	Rev
Jacobs No.	B36601D1	P01
Client no.	HE551497	

Drawing number: HE551497 - JAC - HDG - S1_J19 - DR - D - 0008
 Originator: JAC - HDG - S1_J19
 Volume: -DR- D - 0008
 Location: S1_J19
 Type: -DR- D - 0008
 Number: -DR- D - 0008

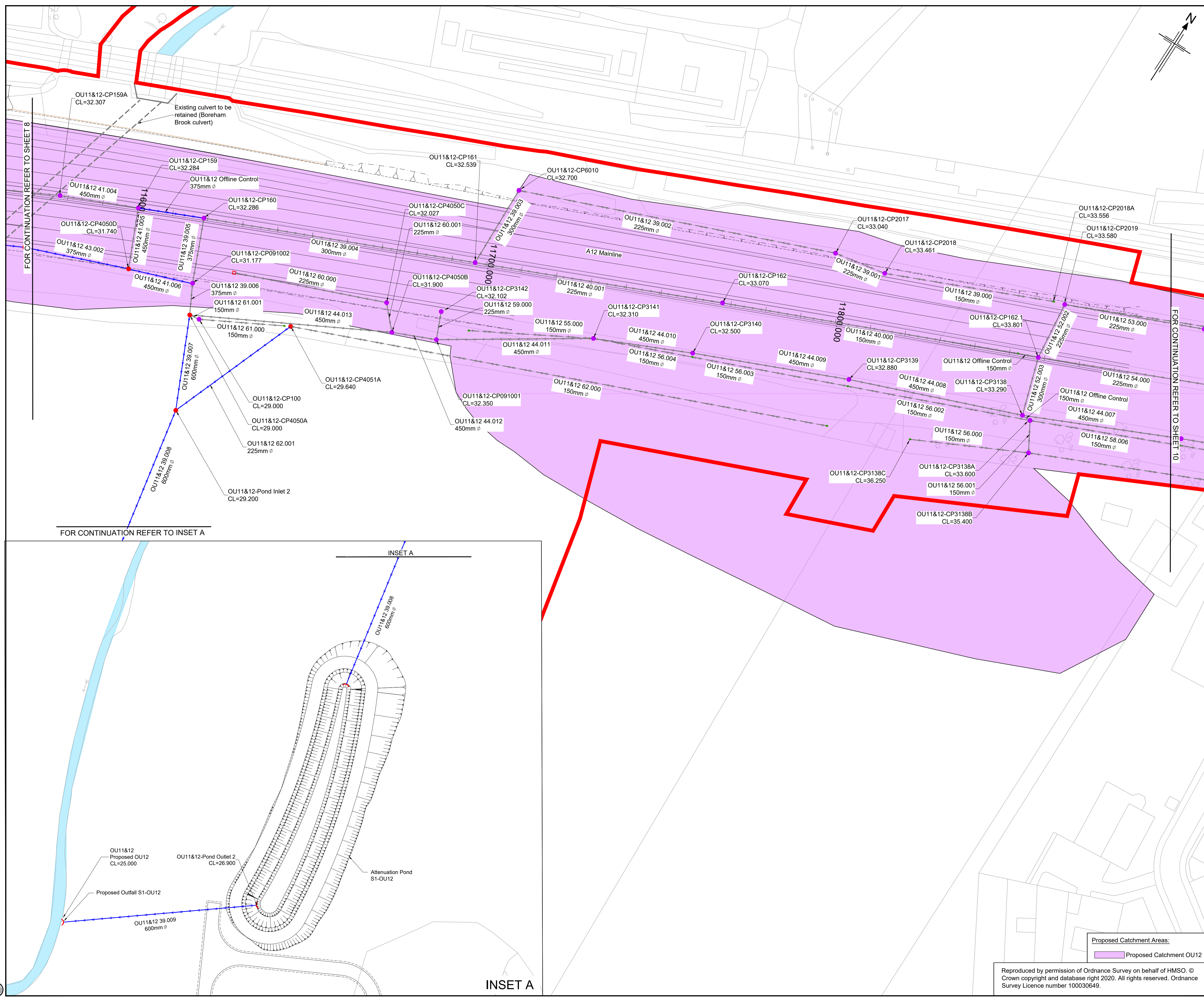


- Proposed Catchment Areas:**
- Proposed Catchment S1-OU1
 - Proposed Catchment S1-OU10A
 - Proposed Catchment S1-OU11
 - Proposed Catchment S1-OU12

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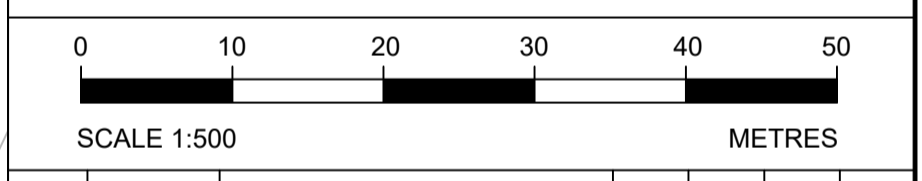
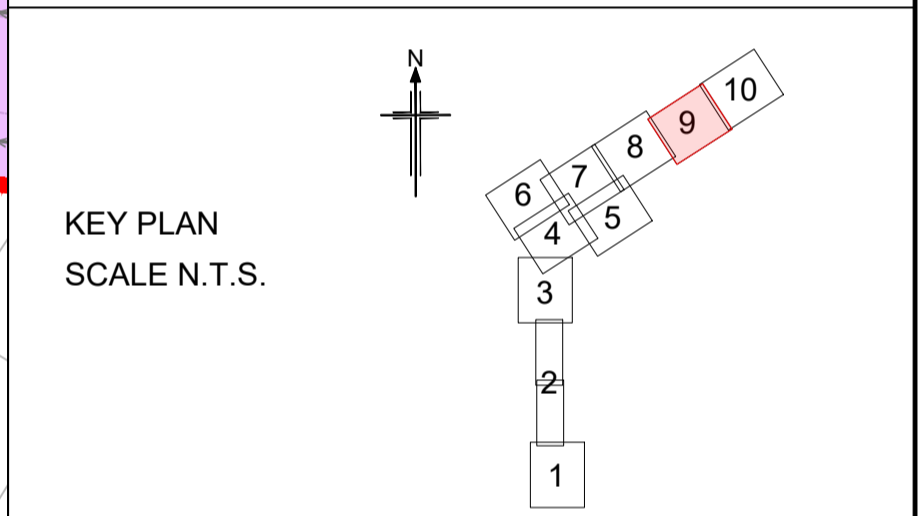
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- NOTES**
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
 2. LEVELS ARE IN METRES ABOVE ORDNANCE DATUM (mAOD).
 3. SYMBOLS USED ARE SCHEMATIC AND NOT REPRESENTATIVE OF SIZE.
 4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH SURFACE WATER DRAINAGE DESIGN REPORT (DOCUMENT REF HE551497-JAC-HDG-S1_J19-RP-D-0001), WITH SPECIFIC REFERENCE TO APPENDIX B FOR THE PROPOSED HIGHWAY DRAINAGE SYSTEM HYDRAULIC MODELING RESULTS.
 5. THE DRAINAGE DESIGN SOLUTIONS HAVE BEEN DEVELOPED BASED ON THE INFORMATION AVAILABLE FROM THE DRAINAGE SURVEYS AT THE PRELIMINARY DRAINAGE DESIGN STAGE. IT SHOULD BE NOTED THAT APPROPRIATE ASSUMPTIONS HAVE BEEN MADE WHERE THE DRAINAGE SURVEYS WERE FOUND TO HAVE GAPS IN THE INFORMATION AND/OR WERE FOUND TO BE INCOMPLETE. THESE ASSUMPTIONS INCLUDING THE POTENTIAL IMPACT TO THE CURRENT DRAINAGE DESIGN WILL BE REVIEWED AT DETAILED DESIGN STAGE.

- LEGEND**
- ORDER LIMITS
 - EXISTING CARRIER DRAIN TO BE RETAINED
 - EXISTING FILTER DRAIN TO BE RETAINED
 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
 - EXISTING CHAMBER TO BE RETAINED
 - DUMMY / GHOST NODE
 - EXISTING GULLY TO BE RETAINED / PROPOSED GULLY
 - PROPOSED HEADWALL
 - EXISTING CULVERT TO BE RETAINED
 - EXISTING CULVERT TO BE EXTENDED
 - PROPOSED CULVERT
 - PROPOSED ATTENUATION POND
 - PROPOSED ATTENUATION POND ACCESS TRACK
 - ▒ PROPOSED GEOCELLULAR ATTENUATION STORAGE
 - MINOR WATERCOURSE (TO BE RETAINED)
 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd
P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT

Contractor: **COSTAIN** Designer: **Jacobs**
 2nd Floor Cottons Centre, Cottons Lane
 London SE1 2QG. Tel: +44 (0)203 9802000
 www.jacobs.com

Client: **highways england**

Project: REGIONAL DELIVERY PARTNERSHIP
 A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing title:
**PROPOSED DRAINAGE NETWORK LAYOUT
 JUNCTION 19 - SHEET 9 OF 10**

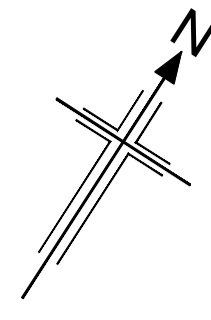
Drawing status: **S2 - SUITABLE FOR INFORMATION**

State Code	Preliminary	DO NOT SCALE
Project Stage	PCF3	
Scale	1:500	Rev
Jacobs No.	B36601D1	P01
Client no.	HE551497	

Drawing number: HE551497 - JAC - HDG - S1_J19
 Originator: JAC
 Volume: -DR- D -0009
 Location: S1_J19
 Type: -DR- D -0009
 Role: Number

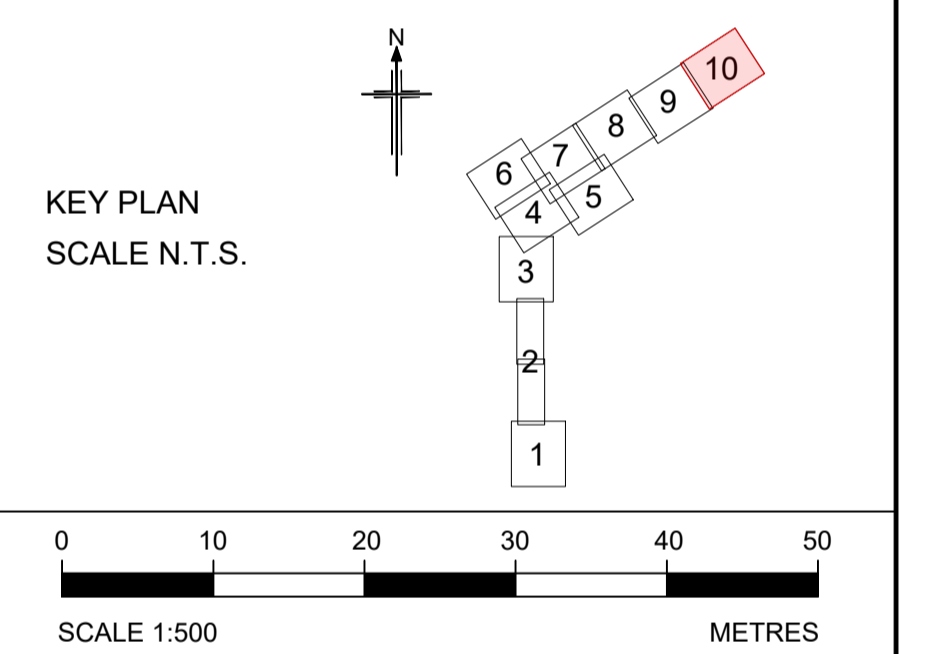
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- NOTES**
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
 2. LEVELS ARE IN METRES ABOVE ORDNANCE DATUM (mAOD).
 3. SYMBOLS USED ARE SCHEMATIC AND NOT REPRESENTATIVE OF SIZE.
 4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH SURFACE WATER DRAINAGE DESIGN REPORT (DOCUMENT REF HE551497-JAC-HDG-S1_J19-RP-D-0001), WITH SPECIFIC REFERENCE TO APPENDIX B FOR THE PROPOSED HIGHWAY DRAINAGE SYSTEM HYDRAULIC MODELING RESULTS.
 5. THE DRAINAGE DESIGN SOLUTIONS HAVE BEEN DEVELOPED BASED ON THE INFORMATION AVAILABLE FROM THE DRAINAGE SURVEYS AT THE PRELIMINARY DRAINAGE DESIGN STAGE. IT SHOULD BE NOTED THAT APPROPRIATE ASSUMPTIONS HAVE BEEN MADE WHERE THE DRAINAGE SURVEYS WERE FOUND TO HAVE GAPS IN THE INFORMATION AND/OR WERE FOUND TO BE INCOMPLETE. THESE ASSUMPTIONS INCLUDING THE POTENTIAL IMPACT TO THE CURRENT DRAINAGE DESIGN WILL BE REVIEWED AT DETAILED DESIGN STAGE.

- LEGEND**
- ORDER LIMITS
 - EXISTING CARRIER DRAIN TO BE RETAINED
 - EXISTING FILTER DRAIN TO BE RETAINED
 - PROPOSED CARRIER DRAIN
 - PROPOSED FILTER DRAIN
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 - EXISTING CHAMBER TO BE RETAINED
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 - MINOR WATERCOURSE (PROPOSED DIVERSION)
 - EXISTING WATERBODIES/ MAIN RIVER



Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Apprv'd
P01	08/06/22	FIRST ISSUE	LM	AM	AM	DT

Contractor: **COSTAIN** Designer: **Jacobs**
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Client: **highways england**

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

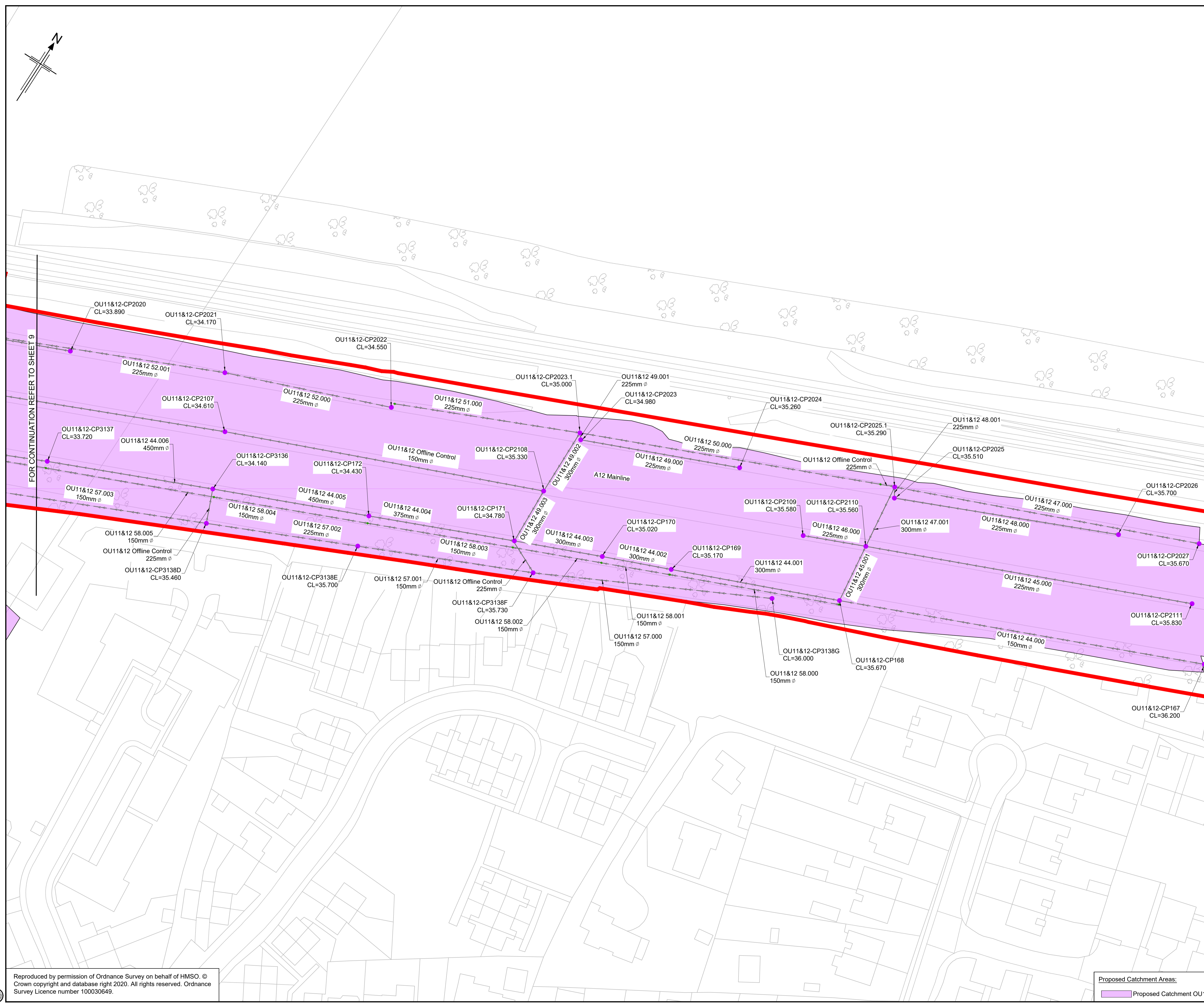
Drawing title:
**PROPOSED DRAINAGE NETWORK LAYOUT
JUNCTION 19 - SHEET 10 OF 10**

Drawing status: **S2 - SUITABLE FOR INFORMATION**

State Code	Preliminary
Project Stage	PCF3
Scale	1:500
Jacobs No.	B36601D1
Client no.	HE551497

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Rev P01

Drawing number	HE551497 - JAC - HDG - S1_J19	Originator	JAC	Volume	-DR- D -0010
Location		Type		Role	
Number					



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Proposed Catchment Areas:
Proposed Catchment OU12

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Appendix B - Junction 19 Proposed Drainage System Hydraulic Modelling Results

Project Name	A12 Chelmsford to A120 widening scheme
Project Number	HE551497

File Number	HE551497-JAC-HDG-S1_J19-CA-D-0001				
Document Description	MICRODRAINAGE MODELLING RESULTS FOR PROPOSED CATCHMENT S1-OU1				
Purpose of Issue	S2 - SUITABLE FOR INFORMATION	Status Code	S2		
Current Revision	P01				
Calculation Number	1	Index Page	1 of 34	Sheet Nos (incl. cover sheet)	34

P01	FIRST ISSUE	DG	AM	AM	DT	07/06/22
Rev	Comments	Originated	Checked	Reviewed	Approved	Date

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Summary

This calculation sheet documents the Microdrainage modelling results (1D analysis) for the proposed highway drainage catchment "Section 1 - Outfall 1 (S1-OU1)" for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events.

It should be noted that the Microdrainage modelling results have been summarised by "the maximum water level for critical storm duration" for all design events meaning that the discharge rates presented from the Microdrainage modelling results may vary slightly from the proposed discharge rates documented within Appendix C - Table C.1 of the surface water drainage design report (Document Ref. HE551497-JAC-HDG-S1_J19-RP-D-0001).

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3 FEH19...

Designed by DG
Checked by AM

Innovyze

Network 2020.1.3

Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	OU1	17.970	15.970	15.820	2000	2000

Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
55.001	OU8/CP360A	35.000	33.827	0.000	1200	0

Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
58.003	OU5	23.220	21.795	0.000	0	0

Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
60.010	OU7	24.940	23.430	0.000	1800	0

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3 FEH19...

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Checked by AM

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Network 2020.1.3

Online Controls for Proposed Network S1-OU1&7

Orifice Manhole: CP13, DS/PN: 12.006, Volume (m³): 21.2

Diameter (m) 0.243 Discharge Coefficient 0.600 Invert Level (m) 28.713

Orifice Manhole: EXCP07, DS/PN: 31.002, Volume (m³): 4.0

Diameter (m) 0.171 Discharge Coefficient 0.600 Invert Level (m) 33.630

Hydro-Brake® Optimum Manhole: CP55, DS/PN: 36.008, Volume (m³): 4.8

Unit Reference	MD-SHE-0056-2000-2090-2000	Objective	Minimise upstream storage	Invert Level (m)	32.950
Design Head (m)	2.090	Application	Surface	Minimum Outlet Pipe Diameter (mm)	75
Design Flow (l/s)	2.0	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	56		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.090	2.0	Flush-Flo™	0.248	1.3	Kick-Flo®	0.504	1.1	Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	0.500	1.1	1.200	1.6	2.000	2.0	3.000	2.4	5.000	3.0	7.000	3.5	9.000	3.9
0.200	1.3	0.600	1.1	1.400	1.7	2.200	2.0	3.500	2.5	5.500	3.1	7.500	3.6	9.500	4.0
0.300	1.3	0.800	1.3	1.600	1.8	2.400	2.1	4.000	2.7	6.000	3.2	8.000	3.7		
0.400	1.2	1.000	1.4	1.800	1.9	2.600	2.2	4.500	2.8	6.500	3.4	8.500	3.8		

Orifice Manhole: CP53, DS/PN: 27.004, Volume (m³): 7.7

Diameter (m) 0.238 Discharge Coefficient 0.600 Invert Level (m) 30.987

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Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3 FEH19...

A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



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Network 2020.1.3

Storage Structures for Proposed Network S1-OU1&7

Cellular Storage Manhole: CP13, DS/PN: 12.006

Invert Level (m) 28.713 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	240.0	0.0	0.660	240.0	0.0	0.661	0.0	0.0

Cellular Storage Manhole: CP48, DS/PN: 29.002

Invert Level (m) 32.639 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	140.0	0.0	1.320	140.0	0.0	1.321	0.0	0.0

Cellular Storage Manhole: CP55, DS/PN: 36.008

Invert Level (m) 32.950 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	228.0	0.0	0.600	228.0	0.0	1.200	228.0	0.0	1.800	0.0	0.0	2.400	0.0	0.0
0.100	228.0	0.0	0.700	228.0	0.0	1.300	228.0	0.0	1.900	0.0	0.0	2.500	0.0	0.0
0.200	228.0	0.0	0.800	228.0	0.0	1.400	0.0	0.0	2.000	0.0	0.0			
0.300	228.0	0.0	0.900	228.0	0.0	1.500	0.0	0.0	2.100	0.0	0.0			
0.400	228.0	0.0	1.000	228.0	0.0	1.600	0.0	0.0	2.200	0.0	0.0			
0.500	228.0	0.0	1.100	228.0	0.0	1.700	0.0	0.0	2.300	0.0	0.0			

Cellular Storage Manhole: CP52, DS/PN: 27.003

Invert Level (m) 31.503 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	100.0	0.0	0.660	100.0	0.0	0.661	0.0	0.0

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3 FEH19...

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Network 2020.1.3

Tank or Pond Manhole: Pond Outlet, DS/PN: 1.013

Invert Level (m) 16.820

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	2000.0	0.900	2611.4	1.200	2833.3	2.099	3552.5

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3 FEH19...

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 4 Number of Offline Controls 5 Number of Storage Structures 5 Number of Time/Area Diagrams 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.282 F (1km) 2.556
FEH Rainfall Version 1999 D2 (1km) 0.257 Cv (Summer) 1.000
Site Location GB 574850 208550 TL 74850 08550 D3 (1km) 0.212 Cv (Winter) 1.000
C (1km) -0.023 E (1km) 0.314

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CPDN07	15 Summer	1	+20%					23.390	-0.167	0.000	0.36			21.2	OK	
1.001	CP15	15 Summer	1	+20%					23.140	-0.109	0.000	0.72			42.4	OK	
1.002	CP16	15 Summer	1	+20%					22.199	-0.223	0.000	0.32			39.7	OK	
2.000	CPDN09	15 Summer	1	+20%					22.866	-0.097	0.000	0.79			44.8	OK	
1.003	CP17	15 Summer	1	+20%					21.904	-0.142	0.000	0.68			77.8	OK	
3.000	CPDN10	15 Summer	1	+20%					22.441	-0.140	0.000	0.55			26.5	OK	
1.004	CP18	15 Summer	1	+20%					21.709	-0.120	0.000	0.77			91.5	OK	
4.000	CPDN11	15 Summer	1	+20%					22.226	-0.145	0.000	0.52			27.4	OK	
1.005	CP19	15 Summer	1	+20%					21.370	-0.189	0.000	0.64			107.6	OK	
5.000	CPDN15	15 Summer	1	+20%					21.922	-0.182	0.000	0.33			18.6	OK	
6.000	CP137.1	15 Summer	1	+20%	1/15 Summer				24.032	0.842	0.000	1.64			19.4	SURCHARGED	
7.000	CPDN6	15 Summer	1	+20%	1/15 Summer				24.309	0.999	0.000	1.60			21.6	FLOOD RISK	
8.000	CPDN1	15 Summer	1	+20%	1/15 Summer				24.688	0.183	0.000	0.85			22.7	SURCHARGED	
8.001	CP139	15 Summer	1	+20%	1/15 Summer				24.527	0.412	0.000	1.19			36.2	SURCHARGED	
9.000	CP2001B	15 Summer	1	+20%					25.281	-0.174	0.000	0.12			3.9	OK	
9.001	CP2001A	15 Summer	1	+20%					25.232	-0.083	0.000	0.62			23.4	OK	
9.002	CP2001	15 Summer	1	+20%	1/15 Summer				24.530	0.005	0.000	1.01			29.7	SURCHARGED	
9.003	CP2000.1	15 Summer	1	+20%					23.633	-0.147	0.000	0.51			29.6	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3 FEH19...

Designed by DG
Checked by AM

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
8.002	CP138	15 Summer	1	+20%					23.269	-0.206	0.000	0.42			65.8	OK	
10.000	CP3108	15 Summer	1	+20%					24.311	-0.039	0.000	0.88			20.2	OK	
11.000	CP152	15 Summer	1	+20%					31.707	-0.178	0.000	0.09			3.7	OK	
11.001	CP151	15 Summer	1	+20%					31.519	-0.056	0.000	0.78			36.2	OK	
11.002	CP150	15 Summer	1	+20%					29.936	-0.049	0.000	0.92			69.2	OK	
11.003	CP142	15 Summer	1	+20%	1/15 Summer				27.711	0.476	0.000	1.10			79.4	SURCHARGED	
12.000	CP01	15 Summer	1	+20%					32.198	-0.152	0.000	0.23			8.4	OK	
12.001	CP02	15 Summer	1	+20%					31.897	-0.155	0.000	0.21			9.6	OK	
12.002	CP03	15 Summer	1	+20%					31.437	-0.170	0.000	0.14			9.7	OK	
12.003	CP04	15 Summer	1	+20%					30.855	-0.181	0.000	0.08			9.9	OK	
13.000	CP07	15 Summer	1	+20%					31.644	-0.195	0.000	0.26			15.0	OK	
13.001	CP08	15 Summer	1	+20%					31.544	-0.191	0.000	0.28			35.9	OK	
12.004	CP05	15 Summer	1	+20%					29.964	-0.261	0.000	0.20			44.8	OK	
14.000	CPDN05	15 Summer	1	+20%					30.570	-0.146	0.000	0.26			13.7	OK	
15.000	CPDN06	15 Summer	1	+20%					31.498	-0.199	0.000	0.03			2.0	OK	
15.001	CP14	15 Summer	1	+20%					30.399	-0.179	0.000	0.09			3.7	OK	
12.005	CP06	15 Summer	1	+20%					29.416	-0.216	0.000	0.37			61.5	OK	
16.000	CP09	15 Summer	1	+20%					31.548	-0.226	0.000	0.14			16.1	OK	
16.001	CP010	15 Summer	1	+20%					30.901	-0.309	0.000	0.07			16.3	OK	
17.000	CPDN01	15 Summer	1	+20%					31.391	-0.107	0.000	0.54			24.1	OK	
16.002	CP11	15 Summer	1	+20%					30.125	-0.264	0.000	0.19			39.9	OK	
18.000	CPDN02	15 Summer	1	+20%					30.762	-0.179	0.000	0.34			34.8	OK	
16.003	CP12	15 Summer	1	+20%					29.430	-0.215	0.000	0.38			73.4	OK	
19.000	CPDN03	15 Summer	1	+20%					30.009	-0.193	0.000	0.27			25.4	OK	
20.000	CPDN04	15 Summer	1	+20%					29.999	-0.101	0.000	0.59			21.5	OK	
12.006	CP13	60 Summer	1	+20%					29.010	-0.078	0.000	0.30		34	46.8	OK	
12.007	CP3116A	30 Summer	1	+20%					28.697	-0.236	0.000	0.28			63.2	OK	
12.008	CP3106	30 Summer	1	+20%					26.597	-0.238	0.000	0.29			81.3	OK	
12.009	CP3107	30 Summer	1	+20%					24.222	-0.153	0.000	0.66			81.3	OK	
21.000	CP2011B	15 Summer	1	+20%					33.124	-0.066	0.000	0.37			5.0	OK	
21.001	CP2011A	15 Summer	1	+20%	1/15 Summer				33.092	0.200	0.000	1.10			14.9	SURCHARGED	
21.002	CP2011	15 Summer	1	+20%	1/15 Summer				31.667	0.337	0.000	0.86			15.9	SURCHARGED	
21.003	CP2009	15 Summer	1	+20%	1/15 Summer				30.340	0.840	0.000	1.08			20.6	SURCHARGED	
21.004	CP2007	15 Summer	1	+20%	1/15 Summer				28.333	0.673	0.000	1.13			28.0	SURCHARGED	
21.005	CP2005	15 Summer	1	+20%					25.179	-0.116	0.000	0.47			28.0	OK	
11.004	CP141	15 Summer	1	+20%					24.166	-0.089	0.000	0.94			185.9	OK	
22.000	CPDN2	15 Summer	1	+20%					25.252	-0.048	0.000	0.80			14.4	OK	
11.005	CP140	15 Summer	1	+20%	1/15 Summer			0	23.572	0.022	0.000	1.15	0.0		194.3	SURCHARGED	
10.001	CP202	15 Summer	1	+20%	1/15 Summer				23.295	0.095	0.000	1.17			197.9	SURCHARGED	
23.000	CPDN3	15 Summer	1	+20%	1/15 Summer	1/15 Summer			25.692	1.502	2.118	2.21			23.4	FLOOD	3
10.002	CP3109A	15 Summer	1	+20%					22.838	-0.254	0.000	0.62			219.2	OK	
24.000	CPDN4	15 Summer	1	+20%	1/15 Summer				25.207	1.407	0.000	1.94			23.2	FLOOD RISK	

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Section 1
Proposed Network S1-OU1&7



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File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3 FEH19...

Designed by DG
Checked by AM

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap.	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
10.003	CP3109	15 Summer	1	+20%					22.514	-0.326	0.000	0.43		224.4	OK	
25.000	CPDN5	15 Summer	1	+20%	1/15 Summer				23.628	0.318	0.000	1.72		14.8	SURCHARGED	
10.004	CP3110A	15 Summer	1	+20%					22.150	-0.319	0.000	0.45		226.7	OK	
26.000	CP3110B	15 Summer	1	+20%	1/15 Summer				23.211	0.061	0.000	1.16		12.0	SURCHARGED	
8.003	CP3110	15 Summer	1	+20%					21.985	-0.175	0.000	0.85		293.7	OK	
8.004	CP3111	15 Summer	1	+20%					21.917	-0.113	0.000	0.77		291.4	OK	
7.001	CP27208	15 Summer	1	+20%	1/15 Summer				21.747	0.007	0.000	1.52		292.6	SURCHARGED	
6.001	CP137	15 Summer	1	+20%	1/15 Summer				21.682	0.047	0.000	1.07		291.5	SURCHARGED	
27.000	CP153	15 Summer	1	+20%					33.196	-0.139	0.000	0.55		45.8	OK	
27.001	CP154	15 Summer	1	+20%					33.021	-0.100	0.000	0.76		62.8	OK	
27.002	CP49	15 Summer	1	+20%					32.794	-0.106	0.000	0.75		72.9	OK	
28.000	KO-12	15 Summer	1	+20%					33.621	-0.088	0.000	0.36		10.2	OK	
29.000	KO-10	15 Summer	1	+20%					34.269	-0.037	0.000	0.91		22.0	OK	
29.001	CP47	15 Summer	1	+20%					34.073	-0.083	0.000	0.41		22.1	OK	
30.000	KO-11	15 Summer	1	+20%					34.496	-0.111	0.000	0.15		4.2	OK	
31.000	KO363	15 Summer	1	+20%					35.487	-0.118	0.000	0.43		22.9	OK	
31.001	CP358A	15 Summer	1	+20%					34.599	-0.101	0.000	0.57		33.6	OK	
31.002	EXCP07	15 Summer	1	+20%	1/15 Summer				34.184	0.329	0.000	0.85		29.2	SURCHARGED	
31.003	EXCP07-1	15 Summer	1	+20%	1/15 Summer				33.943	0.148	0.000	0.86		35.2	SURCHARGED	
31.004	EXCP07-2	15 Summer	1	+20%	1/15 Summer				33.745	0.135	0.000	0.52		40.4	SURCHARGED	
32.000	EXCP08	15 Summer	1	+20%					34.096	-0.129	0.000	0.37		19.7	OK	
31.005	EXCP07-3	15 Summer	1	+20%	1/15 Summer				33.637	0.137	0.000	0.87		53.2	SURCHARGED	
33.000	CPDN7	15 Summer	1	+20%					35.329	-0.116	0.000	0.07		1.0	OK	
33.001	CP6203	15 Summer	1	+20%					35.326	-0.089	0.000	0.58		17.5	OK	
34.000	CP6203	15 Summer	1	+20%					35.674	-0.096	0.000	0.28		2.2	OK	
33.002	CP6202	15 Summer	1	+20%					34.925	-0.165	0.000	0.41		32.4	OK	
35.000	CP6202	15 Summer	1	+20%					35.320	-0.120	0.000	0.09		1.2	OK	
33.003	CP6201	15 Summer	1	+20%	1/15 Summer				34.451	0.346	0.000	1.26		54.5	SURCHARGED	
31.006	EXCP07-4	15 Summer	1	+20%	1/15 Summer				33.552	0.092	0.000	1.35		107.4	SURCHARGED	
31.007	CP146A	15 Summer	1	+20%					33.228	-0.110	0.000	0.84		108.1	OK	
30.001	CP46	15 Summer	1	+20%					33.158	-0.072	0.000	0.90		108.2	OK	
30.002	CP49	30 Summer	1	+20%					33.059	-0.030	0.000	0.92		98.7	OK	
29.002	CP48	30 Summer	1	+20%	1/15 Summer				32.999	0.060	0.000	2.27	24	76.5	SURCHARGED	
36.000	CP41	15 Summer	1	+20%					42.212	-0.138	0.000	0.32		39.2	OK	
36.001	CP42	15 Summer	1	+20%					40.478	-0.124	0.000	0.41		55.3	OK	
36.002	CP43	15 Summer	1	+20%					36.488	-0.190	0.000	0.28		65.2	OK	
36.003	CP44	15 Summer	1	+20%					34.886	-0.058	0.000	0.99		65.2	OK	
36.004	CP45	15 Summer	1	+20%					34.736	-0.083	0.000	0.86		64.2	OK	
36.005	EXCP04	15 Summer	1	+20%					34.600	-0.100	0.000	0.78		64.2	OK	
37.000	EXCP05	15 Summer	1	+20%					34.590	-0.135	0.000	0.33		16.8	OK	
36.006	EXCP06	15 Summer	1	+20%					34.350	-0.190	0.000	0.29		80.6	OK	
36.007	CP54	15 Summer	1	+20%	1/15 Summer				33.354	0.074	0.000	1.98		85.1	SURCHARGED	

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Section 1
Proposed Network S1-OU1&7



Designed by DG
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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
36.008	CP55	720 Summer	1	+20%	1/30 Summer				33.350	0.175	0.000	0.02		714	1.3	SURCHARGED	
29.003	EXCP07-6	30 Summer	1	+20%					32.826	-0.089	0.000	0.82			77.1	OK	
38.000	KO-12	15 Summer	1	+20%					34.585	-0.070	0.000	0.55			23.5	OK	
38.001	CP300	15 Summer	1	+20%					34.108	-0.084	0.000	0.40			23.3	OK	
29.004	CP301	30 Summer	1	+20%					32.282	-0.131	0.000	0.75			80.4	OK	
28.001	CP302	60 Summer	1	+20%					32.192	-0.148	0.000	0.68			81.7	OK	
27.003	CP52	60 Summer	1	+20%					31.796	-0.007	0.000	0.55		11	84.8	OK	
39.000	CPDN10	15 Summer	1	+20%					33.303	-0.200	0.000	0.03			2.3	OK	
27.004	CP53	60 Summer	1	+20%	1/15 Summer				31.627	0.340	0.000	0.74			85.3	SURCHARGED	
27.005	CP80	15 Winter	1	+20%					30.744	-0.143	0.000	0.53			93.8	OK	
27.006	CP344	15 Summer	1	+20%	1/15 Summer				28.976	0.096	0.000	2.41			93.9	SURCHARGED	
40.000	EXCP15	15 Summer	1	+20%					31.845	-0.115	0.000	0.12			3.3	OK	
27.007	CP344.1	30 Summer	1	+20%					28.656	-0.144	0.000	0.52			110.0	OK	
27.008	CP344.2	30 Summer	1	+20%	1/15 Summer				26.973	0.983	0.000	1.29			102.2	SURCHARGED	
27.009	CP345	30 Summer	1	+20%	1/15 Summer				26.824	0.994	0.000	0.91			100.2	SURCHARGED	
27.010	CP346	30 Summer	1	+20%	1/15 Summer				26.519	1.139	0.000	3.14			99.4	SURCHARGED	
27.011	CP347	30 Summer	1	+20%	1/15 Summer				26.365	0.950	0.000	2.86			99.0	SURCHARGED	
41.000	CP355A	15 Summer	1	+20%					28.235	-0.165	0.000	0.16			8.5	OK	
41.001	CP355	15 Summer	1	+20%					26.957	-0.168	0.000	0.14			8.4	OK	
41.002	CP355.1	15 Summer	1	+20%					26.536	-0.119	0.000	0.44			30.2	OK	
27.012	CP348	30 Summer	1	+20%	1/15 Summer				26.299	0.819	0.000	0.43			109.3	SURCHARGED	
27.013	MH87	30 Summer	1	+20%	1/15 Summer				26.145	1.101	0.000	1.50			108.8	SURCHARGED	
42.000	GY308	15 Summer	1	+20%					29.601	-0.109	0.000	0.17			6.1	OK	
42.001	CP352	15 Summer	1	+20%					28.978	-0.137	0.000	0.31			20.9	OK	
42.002	CP351	15 Summer	1	+20%					27.191	-0.124	0.000	0.39			19.8	OK	
42.003	CP350	15 Summer	1	+20%					26.206	-0.099	0.000	0.58			37.4	OK	
42.004	CP349	30 Summer	1	+20%	1/15 Summer				25.985	0.610	0.000	0.53			33.7	SURCHARGED	
27.014	MH65	30 Summer	1	+20%	1/15 Summer				25.958	1.068	0.000	2.32			127.8	SURCHARGED	
27.015	MH64	30 Summer	1	+20%	1/15 Summer				25.693	0.853	0.000	1.39			128.1	SURCHARGED	
27.016	MH63	30 Summer	1	+20%	1/15 Summer				25.286	0.676	0.000	1.55			130.7	SURCHARGED	
27.017	MH62	30 Summer	1	+20%	1/15 Summer				24.679	0.349	0.000	1.19			132.7	SURCHARGED	
43.000	CP6119A	15 Summer	1	+20%		1/15 Summer	24		24.752	-0.118	0.000	0.10	1.6		1.6	OK	
44.000	CP6119B	15 Summer	1	+20%	1/15 Summer				24.075	0.325	0.000	1.37			12.8	SURCHARGED	
27.018	CP6119	30 Summer	1	+20%		1/15 Summer	13		23.410	-0.160	0.000	0.74	5.0		132.2	OK	
45.000	CP149C	15 Summer	1	+20%					24.435	-0.105	0.000	0.19			3.0	OK	
27.019	CP149B	30 Summer	1	+20%					23.203	-0.267	0.000	0.35			132.7	OK	
46.000	CPDN9	15 Summer	1	+20%	1/15 Summer				24.447	0.847	0.000	1.69			21.9	SURCHARGED	
27.020	CP149A	15 Summer	1	+20%					22.236	-0.210	0.000	0.56			139.5	OK	
47.000	CPDN10	15 Summer	1	+20%					23.353	-0.127	0.000	0.06			0.7	OK	
6.002	CP149	30 Summer	1	+20%					21.039	-0.176	0.000	0.87			415.2	OK	
48.000	CPDN11	15 Summer	1	+20%	1/15 Summer				23.136	0.116	0.000	1.08			63.7	SURCHARGED	
6.003	CP148	30 Summer	1	+20%					20.256	-0.319	0.000	0.55			425.0	OK	

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Section 1
Proposed Network S1-OU1&7



Date 15/12/2021
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Designed by DG
Checked by AM

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.004	EXCP147	30 Summer	1	+20%	1/15 Summer				20.022	0.017	0.000	2.45			425.4	SURCHARGED	
1.006	CP20	30 Summer	1	+20%					19.652	-0.328	0.000	0.52			458.4	OK	
1.007	CP147	30 Summer	1	+20%					19.269	-0.236	0.000	0.75			457.3	OK	
1.008	CP148	30 Summer	1	+20%					18.789	-0.216	0.000	0.80			455.6	OK	
1.009	CP6114A	30 Summer	1	+20%					18.349	-0.218	0.000	0.79			453.9	OK	
1.010	CP6114B	30 Summer	1	+20%					17.906	-0.219	0.000	0.79			452.4	OK	
49.000	CP146.1	15 Summer	1	+20%					22.709	-0.156	0.000	0.41			40.2	OK	
49.001	CP146	15 Summer	1	+20%			0		21.552	-0.078	0.000	0.80	0.0		51.6	OK	
49.002	CP145	15 Summer	1	+20%					21.213	-0.057	0.000	1.00			64.1	OK	
49.003	CP144	15 Summer	1	+20%					20.435	-0.459	0.000	0.13			64.1	OK	
50.000	CPDN	15 Summer	1	+20%					21.811	-0.139	0.000	0.31			9.9	OK	
50.001	CP22	15 Summer	1	+20%					21.445	-0.145	0.000	0.26			9.8	OK	
50.002	CP23	15 Summer	1	+20%					21.129	-0.154	0.000	0.45			23.3	OK	
50.003	CP24	15 Summer	1	+20%					21.036	-0.119	0.000	0.67			36.2	OK	
50.004	CP25	15 Summer	1	+20%					20.740	-0.277	0.000	0.30			46.0	OK	
50.005	CP26	15 Summer	1	+20%					20.614	-0.264	0.000	0.35			55.4	OK	
50.006	CP27	15 Summer	1	+20%					20.475	-0.249	0.000	0.41			63.7	OK	
50.007	CP28	15 Summer	1	+20%					20.258	-0.312	0.000	0.20			71.6	OK	
49.004	CP201	15 Summer	1	+20%					19.280	-0.526	0.000	0.11			142.7	OK	
1.011	CP200	30 Winter	1	+20%					17.598	-0.165	0.000	0.84			477.9	OK	
1.012	Pond Inlet	30 Winter	1	+20%					17.540	-0.140	0.000	1.00			476.6	OK	
51.000	CP30	15 Summer	1	+20%					20.298	-0.224	0.000	0.14			14.8	OK	
51.001	CP31	15 Summer	1	+20%					19.772	-0.266	0.000	0.18			29.4	OK	
52.000	CPDN12	15 Summer	1	+20%					20.638	-0.128	0.000	0.49			25.9	OK	
52.001	CP56	15 Summer	1	+20%					20.188	-0.307	0.000	0.07			25.8	OK	
51.002	CP57	15 Summer	1	+20%					19.442	-0.273	0.000	0.17			53.9	OK	
1.013	Pond Outlet	120 Summer	1	+20%					17.160	-0.410	0.000	0.42			250.7	OK	
53.000	CP143	15 Summer	1	+20%					20.286	-0.134	0.000	0.47			31.9	OK	
53.001	CP6112A	15 Summer	1	+20%					19.621	-0.209	0.000	0.20			31.9	OK	
54.000	CP6113	15 Summer	1	+20%					19.465	-0.250	0.000	0.21			33.7	OK	
53.002	CP6112	15 Summer	1	+20%					19.298	-0.282	0.000	0.13			71.5	OK	
1.014	CP6112B	180 Summer	1	+20%					16.597	-0.376	0.000	0.50			254.5	OK	
55.000	CP359	15 Summer	1	+20%					35.111	-0.219	0.000	0.16			14.0	OK	
56.000	CP6204A	30 Summer	1	+20%	1/15 Summer				35.728	0.205	0.000	1.45			35.1	SURCHARGED	
56.001	CP6204	30 Summer	1	+20%			0		35.068	-0.182	0.000	0.33	0.0		40.0	OK	
57.000	CP361	30 Winter	1	+20%					35.258	-0.342	0.000	0.49			279.5	OK	
55.001	CP360	30 Winter	1	+20%					34.678	-0.407	0.000	0.33			323.6	OK	
58.000	CPDN18	30 Summer	1	+20%					23.367	-0.158	0.000	0.18			4.6	OK	
58.001	CP6118	30 Summer	1	+20%					22.987	-0.168	0.000	0.15			4.8	OK	
58.002	CP6117	30 Summer	1	+20%					22.766	-0.159	0.000	0.19			4.9	OK	
59.000	CPDN19	15 Summer	1	+20%					24.624	-0.119	0.000	0.09			1.6	OK	
59.001	CP6116	15 Summer	1	+20%					23.821	-0.119	0.000	0.10			2.4	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
58.003	CP6116A	15	Summer	1	+20%				22.474	-0.166	0.000	0.15			6.5	OK	
60.000	EXCP09	15	Summer	1	+20%				34.090	-0.155	0.000	0.21			12.7	OK	
60.001	EXCP10	15	Summer	1	+20%				33.275	-0.165	0.000	0.16			16.9	OK	
60.002	EXCP11	15	Summer	1	+20%				32.385	-0.140	0.000	0.30			28.8	OK	
60.003	EXCP12	15	Summer	1	+20%				30.582	-0.143	0.000	0.28			28.9	OK	
60.004	CP340	15	Summer	1	+20%				30.065	-0.130	0.000	0.37			39.1	OK	
60.005	CP338	15	Summer	1	+20%	1/15 Summer			27.930	0.565	0.000	1.00			44.3	SURCHARGED	
61.000	CP339	15	Summer	1	+20%				28.796	-0.199	0.000	0.03			2.0	OK	
60.006	CP337	15	Summer	1	+20%	1/15 Summer			27.680	0.595	0.000	1.34			58.3	FLOOD RISK	
60.007	CP SW MH31A	15	Summer	1	+20%	1/15 Summer			26.606	0.121	0.000	1.95			58.2	SURCHARGED	
60.008	MH334	15	Summer	1	+20%				26.167	-0.098	0.000	0.85			110.9	OK	
60.009	CP355.3	15	Summer	1	+20%				25.575	-0.480	0.000	0.18			257.1	OK	
62.000	MH230	15	Summer	1	+20%				24.130	-0.525	0.000	0.00			0.0	OK	
62.001	MH228	15	Summer	1	+20%				24.030	-0.585	0.000	0.02			9.8	OK	
62.002	MH229	15	Summer	1	+20%				23.992	-0.445	0.000	0.08			36.4	OK	
60.010	MH231	15	Summer	1	+20%				23.970	-0.489	0.000	0.34			267.1	OK	

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A12 Chelmsford to A120widening
 Section 1
 Proposed Network S1-OU1&7



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Network 2019.1

Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.014	OU1	17.970	15.970	15.820	2000	2000
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Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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55.001	OU8/CP360A	35.000	33.827	0.000	1200	0
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Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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58.003	OU5	23.220	21.795	0.000	0	0
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Free Flowing Outfall Details for Proposed Network S1-OU1&7

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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60.010	OU7	24.940	23.430	0.000	1800	0
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Online Controls for Proposed Network S1-OU1&7

Orifice Manhole: CP13, DS/PN: 12.006, Volume (m³): 21.2

Diameter (m) 0.243 Discharge Coefficient 0.600 Invert Level (m) 28.713

Orifice Manhole: EXCP07, DS/PN: 31.002, Volume (m³): 4.0

Diameter (m) 0.171 Discharge Coefficient 0.600 Invert Level (m) 33.630

Hydro-Brake® Optimum Manhole: CP55, DS/PN: 36.008, Volume (m³): 4.8

Unit Reference	MD-SHE-0056-2000-2090-2000	Objective	Minimise upstream storage	Invert Level (m)	32.950
Design Head (m)	2.090	Application	Surface	Minimum Outlet Pipe Diameter (mm)	75
Design Flow (l/s)	2.0	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	56		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.090	2.0	Flush-Flo™	0.248	1.3	Kick-Flo®	0.504	1.1	Mean Flow over Head Range	-	1.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	0.500	1.1	1.200	1.6	2.000	2.0	3.000	2.4	5.000	3.0	7.000	3.5	9.000	3.9
0.200	1.3	0.600	1.1	1.400	1.7	2.200	2.0	3.500	2.5	5.500	3.1	7.500	3.6	9.500	4.0
0.300	1.3	0.800	1.3	1.600	1.8	2.400	2.1	4.000	2.7	6.000	3.2	8.000	3.7		
0.400	1.2	1.000	1.4	1.800	1.9	2.600	2.2	4.500	2.8	6.500	3.4	8.500	3.8		

Orifice Manhole: CP53, DS/PN: 27.004, Volume (m³): 7.7

Diameter (m) 0.238 Discharge Coefficient 0.600 Invert Level (m) 30.987

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Storage Structures for Proposed Network S1-OU1&7

Cellular Storage Manhole: CP13, DS/PN: 12.006

Invert Level (m) 28.713 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	240.0	0.0	0.660	240.0	0.0	0.661	0.0	0.0

Cellular Storage Manhole: CP48, DS/PN: 29.002

Invert Level (m) 32.639 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	140.0	0.0	1.320	140.0	0.0	1.321	0.0	0.0

Cellular Storage Manhole: CP55, DS/PN: 36.008

Invert Level (m) 32.950 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	228.0	0.0	0.600	228.0	0.0	1.200	228.0	0.0	1.800	0.0	0.0	2.400	0.0	0.0
0.100	228.0	0.0	0.700	228.0	0.0	1.300	228.0	0.0	1.900	0.0	0.0	2.500	0.0	0.0
0.200	228.0	0.0	0.800	228.0	0.0	1.400	0.0	0.0	2.000	0.0	0.0			
0.300	228.0	0.0	0.900	228.0	0.0	1.500	0.0	0.0	2.100	0.0	0.0			
0.400	228.0	0.0	1.000	228.0	0.0	1.600	0.0	0.0	2.200	0.0	0.0			
0.500	228.0	0.0	1.100	228.0	0.0	1.700	0.0	0.0	2.300	0.0	0.0			

Cellular Storage Manhole: CP52, DS/PN: 27.003

Invert Level (m) 31.503 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	100.0	0.0	0.660	100.0	0.0	0.661	0.0	0.0

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Tank or Pond Manhole: Pond Outlet, DS/PN: 1.013

Invert Level (m) 16.820

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	2000.0	0.900	2611.4	1.200	2833.3	2.099	3552.5

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 4 Number of Offline Controls 5 Number of Storage Structures 5 Number of Time/Area Diagrams 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Pipe Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CPDN07	15 Summer	2	+20%	100/15 Summer	100/15 Summer			23.387	-0.170	0.000	0.35	20.4	20.4	OK	2
1.001	CP15	15 Summer	2	+20%	100/15 Summer	100/15 Summer			23.135	-0.114	0.000	0.69	40.7	40.7	OK	1
1.002	CP16	15 Summer	2	+20%	100/15 Summer				22.196	-0.226	0.000	0.31	38.1	38.1	OK	
2.000	CPDN09	15 Summer	2	+20%	5/15 Summer	100/15 Summer			22.860	-0.103	0.000	0.76	43.0	43.0	OK	3
1.003	CP17	15 Summer	2	+20%	100/15 Summer				21.898	-0.148	0.000	0.66	74.8	74.8	OK	
3.000	CPDN10	15 Summer	2	+20%	100/15 Summer				22.437	-0.144	0.000	0.53	25.5	25.5	OK	
1.004	CP18	15 Summer	2	+20%	100/15 Summer				21.702	-0.127	0.000	0.74	88.1	88.1	OK	
4.000	CPDN11	15 Summer	2	+20%	100/15 Summer				22.222	-0.149	0.000	0.50	26.3	26.3	OK	
1.005	CP19	15 Summer	2	+20%	100/15 Summer				21.364	-0.195	0.000	0.62	103.7	103.7	OK	
5.000	CPDN15	15 Summer	2	+20%					21.919	-0.185	0.000	0.31	17.9	17.9	OK	
6.000	CP137.1	15 Summer	2	+20%	2/15 Summer	100/15 Summer			23.945	0.755	0.000	1.59	18.7	18.7	SURCHARGED	5
7.000	CPDN6	15 Summer	2	+20%	2/15 Summer	5/15 Summer			24.191	0.881	0.000	1.54	20.8	20.8	SURCHARGED	12
8.000	CPDN1	15 Summer	2	+20%	2/15 Summer	5/15 Summer			24.628	0.123	0.000	0.82	21.9	21.9	SURCHARGED	8
8.001	CP139	15 Summer	2	+20%	2/15 Summer	5/15 Summer			24.405	0.290	0.000	1.16	35.2	35.2	SURCHARGED	12
9.000	CP2001B	15 Summer	2	+20%	100/15 Summer				25.280	-0.175	0.000	0.11	3.7	3.7	OK	
9.001	CP2001A	15 Summer	2	+20%	100/15 Summer	100/15 Summer			25.228	-0.087	0.000	0.60	22.5	22.5	OK	5
9.002	CP2001	15 Summer	2	+20%	5/15 Summer	100/15 Summer			24.505	-0.020	0.000	1.00	29.3	29.3	OK	5
9.003	CP2000.1	15 Summer	2	+20%	100/15 Summer				23.631	-0.149	0.000	0.51	29.3	29.3	OK	
8.002	CP138	15 Summer	2	+20%	100/15 Summer				23.267	-0.208	0.000	0.41	64.5	64.5	OK	
10.000	CP3108	15 Summer	2	+20%	5/15 Summer	100/15 Summer			24.307	-0.043	0.000	0.85	19.4	19.4	OK	3

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Network 2019.1

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
11.000	CP152	15 Summer	2	+20%	5/15 Summer				31.706	-0.179	0.000	0.09		3.6	OK	
11.001	CP151	15 Summer	2	+20%	5/15 Summer	100/15 Summer			31.515	-0.060	0.000	0.75		34.7	OK	7
11.002	CP150	15 Summer	2	+20%	5/15 Summer	100/15 Summer			29.930	-0.055	0.000	0.88		66.5	OK	8
11.003	CP142	15 Summer	2	+20%	2/15 Summer	100/15 Summer			27.556	0.321	0.000	1.07		77.3	SURCHARGED	10
12.000	CP01	15 Summer	2	+20%					32.197	-0.153	0.000	0.22		8.1	OK	
12.001	CP02	15 Summer	2	+20%					31.896	-0.156	0.000	0.20		9.2	OK	
12.002	CP03	15 Summer	2	+20%					31.436	-0.171	0.000	0.13		9.3	OK	
12.003	CP04	15 Summer	2	+20%					30.854	-0.182	0.000	0.08		9.5	OK	
13.000	CP07	15 Summer	2	+20%					31.642	-0.197	0.000	0.25		14.4	OK	
13.001	CP08	15 Summer	2	+20%					31.541	-0.194	0.000	0.27		34.4	OK	
12.004	CP05	15 Summer	2	+20%	100/15 Summer				29.961	-0.264	0.000	0.19		43.1	OK	
14.000	CPDN05	15 Summer	2	+20%	100/30 Summer				30.568	-0.148	0.000	0.25		13.2	OK	
15.000	CPDN06	15 Summer	2	+20%					31.498	-0.199	0.000	0.03		2.0	OK	
15.001	CP14	15 Summer	2	+20%	100/30 Summer				30.398	-0.180	0.000	0.09		3.6	OK	
12.005	CP06	15 Summer	2	+20%	100/15 Summer				29.413	-0.219	0.000	0.36		59.1	OK	
16.000	CP09	15 Summer	2	+20%					31.546	-0.228	0.000	0.13		15.5	OK	
16.001	CP010	15 Summer	2	+20%					30.899	-0.311	0.000	0.07		15.6	OK	
17.000	CPDN01	15 Summer	2	+20%	100/15 Summer				31.388	-0.110	0.000	0.52		23.2	OK	
16.002	CP11	15 Summer	2	+20%	100/15 Summer				30.123	-0.266	0.000	0.18		38.3	OK	
18.000	CPDN02	15 Summer	2	+20%	100/15 Summer				30.759	-0.182	0.000	0.32		33.4	OK	
16.003	CP12	15 Summer	2	+20%	100/15 Summer				29.427	-0.218	0.000	0.36		70.5	OK	
19.000	CPDN03	15 Summer	2	+20%	100/15 Winter				30.006	-0.196	0.000	0.26		24.4	OK	
20.000	CPDN04	15 Summer	2	+20%	100/15 Summer	100/30 Summer			29.996	-0.104	0.000	0.56		20.7	OK	
12.006	CP13	120 Summer	2	+20%	5/30 Summer	100/30 Summer			29.039	-0.049	0.000	0.35		53.7	OK	5
12.007	CP3116A	120 Summer	2	+20%	100/15 Summer				28.703	-0.230	0.000	0.31		69.7	OK	
12.008	CP3106	120 Summer	2	+20%	100/15 Summer				26.599	-0.236	0.000	0.29		83.7	OK	
12.009	CP3107	120 Summer	2	+20%	5/15 Summer	100/30 Summer			24.226	-0.149	0.000	0.68		83.7	OK	8
21.000	CP2011B	15 Summer	2	+20%	5/15 Summer	100/15 Summer			33.103	-0.087	0.000	0.36		4.8	OK	10
21.001	CP2011A	15 Summer	2	+20%	2/15 Summer	100/15 Summer			33.045	0.153	0.000	1.07		14.6	SURCHARGED	3
21.002	CP2011	30 Summer	2	+20%	2/15 Summer	100/15 Summer			31.553	0.223	0.000	0.83		15.5	SURCHARGED	9
21.003	CP2009	30 Summer	2	+20%	2/15 Summer	100/15 Summer			30.307	0.807	0.000	1.07		20.3	SURCHARGED	11
21.004	CP2007	30 Summer	2	+20%	2/15 Summer	100/15 Summer			28.300	0.640	0.000	1.12		27.8	SURCHARGED	11
21.005	CP2005	30 Summer	2	+20%	100/15 Summer				25.178	-0.117	0.000	0.47		27.8	OK	
11.004	CP141	30 Summer	2	+20%	5/15 Summer				24.165	-0.090	0.000	0.93		185.2	OK	
22.000	CPDN2	15 Summer	2	+20%	5/15 Summer	100/15 Summer			25.249	-0.051	0.000	0.76		13.8	OK	3
11.005	CP140	30 Summer	2	+20%	2/15 Summer		100/30 Summer	9	23.567	0.017	0.000	1.14	0.0	192.1	SURCHARGED	
10.001	CP202	30 Summer	2	+20%	2/15 Summer				23.283	0.083	0.000	1.16		197.2	SURCHARGED	
23.000	CPDN3	15 Summer	2	+20%	2/15 Summer	2/15 Summer			25.692	1.502	1.767	2.21		23.4	FLOOD	20
10.002	CP3109A	30 Summer	2	+20%	100/15 Summer				22.837	-0.255	0.000	0.62		217.3	OK	
24.000	CPDN4	15 Summer	2	+20%	2/15 Summer	5/15 Summer			25.067	1.267	0.000	1.87		22.3	FLOOD RISK	12
10.003	CP3109	30 Summer	2	+20%	100/15 Summer	100/30 Summer			22.515	-0.325	0.000	0.43		224.5	OK	5
25.000	CPDN5	15 Summer	2	+20%	2/15 Summer	100/15 Summer			23.590	0.280	0.000	1.65		14.2	SURCHARGED	9

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



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Network 2019.1

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
10.004	CP3110A	30 Summer	2	+20%	100/15 Summer				22.151	-0.318	0.000	0.45		227.4	OK	
26.000	CP3110B	15 Summer	2	+20%	2/15 Summer	100/15 Summer			23.191	0.041	0.000	1.12		11.6	SURCHARGED	5
8.003	CP3110	30 Summer	2	+20%	5/15 Summer	100/30 Summer			21.982	-0.178	0.000	0.84		291.1	OK	6
8.004	CP3111	30 Summer	2	+20%	5/15 Summer				21.915	-0.115	0.000	0.76		288.6	OK	
7.001	CP27208	30 Summer	2	+20%	2/30 Summer				21.750	0.010	0.000	1.51		291.4	SURCHARGED	
6.001	CP137	30 Summer	2	+20%	2/15 Summer				21.689	0.054	0.000	1.09		295.2	SURCHARGED	
27.000	CP153	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.192	-0.143	0.000	0.52		44.0	OK	7
27.001	CP154	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.015	-0.106	0.000	0.73		60.3	OK	7
27.002	CP49	15 Summer	2	+20%	100/15 Summer				32.789	-0.111	0.000	0.72		70.0	OK	
28.000	KO-12	15 Summer	2	+20%	100/15 Summer				33.620	-0.089	0.000	0.34		9.8	OK	
29.000	KO-10	15 Summer	2	+20%	5/15 Summer	100/15 Summer			34.265	-0.041	0.000	0.87		21.2	OK	5
29.001	CP47	15 Summer	2	+20%	100/15 Summer				34.072	-0.084	0.000	0.39		21.2	OK	
30.000	KO-11	15 Summer	2	+20%	100/30 Summer				34.495	-0.112	0.000	0.14		4.0	OK	
31.000	KO363	15 Summer	2	+20%	100/15 Summer	100/15 Summer			35.484	-0.121	0.000	0.42		22.0	OK	7
31.001	CP358A	15 Summer	2	+20%	5/15 Summer	100/15 Summer			34.596	-0.104	0.000	0.54		32.2	OK	7
31.002	EXCP07	15 Summer	2	+20%	2/15 Summer	100/15 Summer			34.135	0.280	0.000	0.82		28.4	SURCHARGED	7
31.003	EXCP07-1	15 Summer	2	+20%	2/15 Summer				33.912	0.117	0.000	0.83		34.0	SURCHARGED	
31.004	EXCP07-2	15 Summer	2	+20%	2/15 Summer	100/15 Summer			33.728	0.118	0.000	0.50		39.1	SURCHARGED	10
32.000	EXCP08	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.094	-0.131	0.000	0.35		18.9	OK	1
31.005	EXCP07-3	15 Summer	2	+20%	2/15 Summer				33.619	0.119	0.000	0.83		50.7	SURCHARGED	
33.000	CPDN7	15 Summer	2	+20%	100/15 Summer				35.326	-0.119	0.000	0.07		1.0	OK	
33.001	CP6203	15 Summer	2	+20%	100/15 Summer	100/15 Summer			35.322	-0.093	0.000	0.55		16.8	OK	5
34.000	CP6203	15 Summer	2	+20%	100/15 Summer				35.673	-0.097	0.000	0.27		2.1	OK	
33.002	CP6202	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.922	-0.168	0.000	0.39		31.1	OK	2
35.000	CP6202	15 Summer	2	+20%	100/15 Summer				35.319	-0.121	0.000	0.08		1.2	OK	
33.003	CP6201	15 Summer	2	+20%	2/15 Summer	100/15 Summer			34.387	0.282	0.000	1.21		52.4	SURCHARGED	7
31.006	EXCP07-4	15 Summer	2	+20%	2/15 Summer				33.533	0.073	0.000	1.30		103.1	SURCHARGED	
31.007	CP146A	15 Summer	2	+20%	5/15 Summer				33.220	-0.118	0.000	0.81		103.6	OK	
30.001	CP46	15 Summer	2	+20%	5/15 Summer				33.127	-0.103	0.000	0.87		104.8	OK	
30.002	CP49	30 Summer	2	+20%	5/15 Summer				33.074	-0.015	0.000	0.93		99.8	OK	
29.002	CP48	30 Summer	2	+20%	2/15 Summer				33.001	0.062	0.000	2.30		77.6	SURCHARGED	
36.000	CP41	15 Summer	2	+20%	100/15 Summer				42.210	-0.140	0.000	0.30		37.6	OK	
36.001	CP42	15 Summer	2	+20%	100/15 Summer	100/15 Summer			40.475	-0.127	0.000	0.39		53.1	OK	3
36.002	CP43	15 Summer	2	+20%	100/15 Summer				36.485	-0.193	0.000	0.27		62.7	OK	
36.003	CP44	15 Summer	2	+20%	5/15 Summer	100/15 Summer			34.878	-0.066	0.000	0.95		62.6	OK	3
36.004	CP45	15 Summer	2	+20%	5/15 Summer				34.730	-0.089	0.000	0.83		61.6	OK	
36.005	EXCP04	15 Summer	2	+20%	100/15 Summer				34.595	-0.105	0.000	0.75		61.7	OK	
37.000	EXCP05	15 Summer	2	+20%	100/15 Summer	100/360 Summer			34.588	-0.137	0.000	0.32		16.1	OK	10
36.006	EXCP06	15 Summer	2	+20%	100/15 Summer				34.347	-0.193	0.000	0.28		77.5	OK	
36.007	CP54	600 Winter	2	+20%	2/15 Summer				33.499	0.219	0.000	0.25		10.6	SURCHARGED	
36.008	CP55	600 Winter	2	+20%	2/30 Summer				33.499	0.324	0.000	0.02		1.3	SURCHARGED	
29.003	EXCP07-6	30 Summer	2	+20%	5/15 Summer				32.828	-0.087	0.000	0.84		78.2	OK	

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Section 1
Proposed Network S1-OU1&7



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Network 2019.1

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
38.000	KO-12	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.583	-0.072	0.000	0.53		22.6	OK	2
38.001	CP300	15 Summer	2	+20%	100/15 Summer				34.107	-0.085	0.000	0.38		22.4	OK	
29.004	CP301	120 Summer	2	+20%	5/120 Summer				32.290	-0.123	0.000	0.79		84.5	OK	
28.001	CP302	120 Summer	2	+20%	100/15 Summer				32.202	-0.138	0.000	0.72		87.3	OK	
27.003	CP52	120 Summer	2	+20%	2/60 Summer				31.891	0.088	0.000	0.59		90.6	SURCHARGED	
39.000	CPDN10	15 Summer	2	+20%	100/15 Summer				33.303	-0.200	0.000	0.03		2.2	OK	
27.004	CP53	120 Summer	2	+20%	2/15 Summer				31.702	0.415	0.000	0.79		91.1	SURCHARGED	
27.005	CP80	120 Summer	2	+20%	100/15 Summer				30.744	-0.143	0.000	0.54		95.7	OK	
27.006	CP344	120 Summer	2	+20%	2/15 Summer	100/15 Summer			28.981	0.101	0.000	2.45		95.7	SURCHARGED	11
40.000	EXCP15	15 Summer	2	+20%					31.844	-0.116	0.000	0.12		3.2	OK	
27.007	CP344.1	30 Summer	2	+20%	5/30 Summer	100/15 Summer			28.656	-0.144	0.000	0.53		110.6	OK	5
27.008	CP344.2	120 Summer	2	+20%	2/15 Summer	100/15 Summer			27.236	1.246	0.000	1.30		103.3	SURCHARGED	3
27.009	CP345	120 Summer	2	+20%	2/15 Summer				27.066	1.236	0.000	0.94		103.4	SURCHARGED	
27.010	CP346	120 Summer	2	+20%	2/15 Summer				26.723	1.343	0.000	3.29		104.4	SURCHARGED	
27.011	CP347	120 Summer	2	+20%	2/15 Summer				26.551	1.136	0.000	3.05		105.5	SURCHARGED	
41.000	CP355A	15 Summer	2	+20%					28.233	-0.167	0.000	0.15		8.2	OK	
41.001	CP355	15 Summer	2	+20%	5/15 Summer				26.956	-0.169	0.000	0.14		8.1	OK	
41.002	CP355.1	15 Summer	2	+20%	5/15 Summer	100/15 Summer			26.533	-0.122	0.000	0.43		29.0	OK	7
27.012	CP348	120 Summer	2	+20%	2/15 Summer				26.478	0.998	0.000	0.45		114.5	SURCHARGED	
27.013	MH87	120 Summer	2	+20%	2/15 Summer	100/15 Summer			26.323	1.279	0.000	1.58		114.7	SURCHARGED	16
42.000	GY308	15 Summer	2	+20%	100/15 Summer	100/15 Summer			29.600	-0.110	0.000	0.16		5.8	OK	2
42.001	CP352	15 Summer	2	+20%	100/15 Summer				28.976	-0.139	0.000	0.30		20.1	OK	
42.002	CP351	15 Summer	2	+20%	100/15 Summer	100/15 Summer			27.188	-0.127	0.000	0.38		19.0	OK	3
42.003	CP350	15 Summer	2	+20%	5/15 Summer	100/15 Summer			26.203	-0.102	0.000	0.56		35.9	OK	7
42.004	CP349	120 Summer	2	+20%	2/15 Summer	100/15 Summer			26.140	0.765	0.000	0.33		21.0	SURCHARGED	4
27.014	MH65	120 Summer	2	+20%	2/15 Summer	100/15 Summer			26.115	1.225	0.000	2.37		130.3	SURCHARGED	13
27.015	MH64	120 Summer	2	+20%	2/15 Summer	100/15 Summer			25.834	0.994	0.000	1.43		131.7	SURCHARGED	7
27.016	MH63	120 Summer	2	+20%	2/15 Summer	100/15 Summer			25.406	0.796	0.000	1.60		134.6	SURCHARGED	5
27.017	MH62	120 Summer	2	+20%	2/15 Summer				24.766	0.436	0.000	1.23		137.5	SURCHARGED	
43.000	CP6119A	15 Summer	2	+20%			2/15 Summer	72	24.751	-0.119	0.000	0.09	1.6	1.5	OK	
44.000	CP6119B	15 Summer	2	+20%	2/15 Summer	100/15 Summer			24.031	0.281	0.000	1.33		12.4	SURCHARGED	5
27.018	CP6119	120 Summer	2	+20%	100/15 Summer		2/15 Summer	57	23.417	-0.153	0.000	0.77	5.9	137.0	OK	
45.000	CP149C	15 Summer	2	+20%					24.434	-0.106	0.000	0.18		2.9	OK	
27.019	CP149B	120 Summer	2	+20%	100/30 Summer				23.207	-0.263	0.000	0.36		137.8	OK	
46.000	CPDN9	15 Summer	2	+20%	2/15 Summer	5/15 Summer			24.350	0.750	0.000	1.62		21.1	SURCHARGED	10
27.020	CP149A	120 Summer	2	+20%	100/15 Summer				22.241	-0.205	0.000	0.58		144.0	OK	
47.000	CPDN10	15 Summer	2	+20%					23.352	-0.128	0.000	0.05		0.7	OK	
6.002	CP149	30 Summer	2	+20%	5/30 Summer				21.042	-0.173	0.000	0.88		419.4	OK	
48.000	CPDN11	15 Summer	2	+20%	2/15 Summer	100/15 Summer			23.080	0.060	0.000	1.04		61.1	SURCHARGED	5
6.003	CP148	30 Summer	2	+20%	100/15 Summer				20.258	-0.317	0.000	0.55		429.4	OK	
6.004	EXCP147	120 Summer	2	+20%	2/15 Summer				20.023	0.018	0.000	2.48		430.7	SURCHARGED	
1.006	CP20	120 Summer	2	+20%	100/15 Summer				19.663	-0.317	0.000	0.55		481.2	OK	

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Network 2019.1

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	CP147	120	Summer	2	+20%	100/15	Summer		19.284	-0.221	0.000	0.79		480.1	OK	
1.008	CP148	120	Summer	2	+20%	5/120	Summer		18.805	-0.200	0.000	0.84		478.6	OK	
1.009	CP6114A	120	Summer	2	+20%	5/30	Winter		18.366	-0.201	0.000	0.83		476.7	OK	
1.010	CP6114B	120	Summer	2	+20%	5/30	Summer		18.057	-0.068	0.000	0.82		466.1	OK	
49.000	CP146.1	15	Summer	2	+20%	100/15	Summer	100/15 Summer	22.706	-0.159	0.000	0.39		38.6	OK	3
49.001	CP146	15	Summer	2	+20%	5/15	Summer	5/15 Summer	13 21.545	-0.085	0.000	0.77	0.0	49.5	OK	
49.002	CP145	15	Summer	2	+20%	5/15	Summer		21.205	-0.065	0.000	0.97		62.0	OK	
49.003	CP144	15	Summer	2	+20%				20.433	-0.461	0.000	0.12		61.8	OK	
50.000	CPDN	15	Summer	2	+20%	100/15	Summer		21.809	-0.141	0.000	0.29		9.6	OK	
50.001	CP22	15	Summer	2	+20%	100/15	Summer		21.443	-0.147	0.000	0.25		9.4	OK	
50.002	CP23	15	Summer	2	+20%	100/15	Summer		21.126	-0.157	0.000	0.43		22.4	OK	
50.003	CP24	15	Summer	2	+20%	100/15	Summer		21.031	-0.124	0.000	0.65		34.7	OK	
50.004	CP25	15	Summer	2	+20%	100/15	Summer		20.736	-0.281	0.000	0.29		44.2	OK	
50.005	CP26	15	Summer	2	+20%	100/15	Summer		20.610	-0.268	0.000	0.34		53.1	OK	
50.006	CP27	15	Summer	2	+20%	100/15	Summer		20.471	-0.253	0.000	0.39		61.2	OK	
50.007	CP28	15	Summer	2	+20%				20.255	-0.315	0.000	0.20		68.7	OK	
49.004	CP201	15	Summer	2	+20%				19.278	-0.528	0.000	0.11		137.1	OK	
1.011	CP200	120	Summer	2	+20%	5/15	Winter		17.763	0.000	0.000	0.89		503.4	OK	
1.012	Pond Inlet	120	Summer	2	+20%	5/30	Summer		17.680	0.000	0.000	1.05		501.9	OK	
51.000	CP30	15	Summer	2	+20%				20.296	-0.226	0.000	0.14		14.2	OK	
51.001	CP31	15	Summer	2	+20%				19.770	-0.268	0.000	0.18		28.3	OK	
52.000	CPDN12	15	Summer	2	+20%	100/15	Summer		20.633	-0.133	0.000	0.47		25.0	OK	
52.001	CP56	15	Summer	2	+20%				20.186	-0.309	0.000	0.07		24.8	OK	
51.002	CP57	15	Summer	2	+20%				19.440	-0.275	0.000	0.16		51.9	OK	
1.013	Pond Outlet	180	Summer	2	+20%	100/120	Summer		17.223	-0.347	0.000	0.56		333.6	OK	
53.000	CP143	15	Summer	2	+20%	100/15	Summer		20.282	-0.138	0.000	0.45		30.7	OK	
53.001	CP6112A	15	Summer	2	+20%				19.620	-0.210	0.000	0.20		30.6	OK	
54.000	CP6113	15	Summer	2	+20%	100/15	Summer		19.462	-0.253	0.000	0.20		32.3	OK	
53.002	CP6112	15	Summer	2	+20%				19.296	-0.284	0.000	0.13		67.8	OK	
1.014	CP6112B	180	Summer	2	+20%	100/60	Summer		16.670	-0.303	0.000	0.66		338.2	OK	
55.000	CP359	15	Summer	2	+20%				35.109	-0.221	0.000	0.15		13.5	OK	
56.000	CP6204A	30	Summer	2	+20%	2/15	Summer	100/15 Summer	35.739	0.216	0.000	1.46		35.5	SURCHARGED	8
56.001	CP6204	30	Summer	2	+20%			0	35.069	-0.181	0.000	0.33	0.0	40.5	OK	
57.000	CP361	30	Winter	2	+20%	100/15	Summer		35.261	-0.339	0.000	0.50		283.1	OK	
55.001	CP360	30	Winter	2	+20%				34.680	-0.405	0.000	0.34		327.8	OK	
58.000	CPDN18	120	Summer	2	+20%	100/15	Summer		23.372	-0.153	0.000	0.22		5.7	OK	
58.001	CP6118	120	Summer	2	+20%				22.996	-0.159	0.000	0.19		6.1	OK	
58.002	CP6117	120	Summer	2	+20%	100/60	Summer		22.775	-0.150	0.000	0.24		6.4	OK	
59.000	CPDN19	15	Summer	2	+20%				24.623	-0.120	0.000	0.09		1.5	OK	
59.001	CP6116	15	Summer	2	+20%				23.821	-0.119	0.000	0.09		2.3	OK	
58.003	CP6116A	120	Summer	2	+20%				22.477	-0.163	0.000	0.17		7.3	OK	
60.000	EXCP09	15	Summer	2	+20%				34.089	-0.156	0.000	0.20		12.2	OK	

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
60.001	EXCP10	15 Summer	2	+20%	100/15 Summer				33.274	-0.166	0.000	0.15		16.2	OK	
60.002	EXCP11	15 Summer	2	+20%	100/15 Summer				32.383	-0.142	0.000	0.29		27.7	OK	
60.003	EXCP12	15 Summer	2	+20%	100/15 Summer	100/15 Summer			30.580	-0.145	0.000	0.27		27.8	OK	3
60.004	CP340	15 Summer	2	+20%	100/15 Summer				30.063	-0.132	0.000	0.35		37.5	OK	
60.005	CP338	15 Summer	2	+20%	2/15 Summer	100/15 Summer			27.837	0.472	0.000	0.97		42.8	SURCHARGED	6
61.000	CP339	15 Summer	2	+20%					28.796	-0.199	0.000	0.03		2.0	OK	
60.006	CP337	15 Summer	2	+20%	2/15 Summer	5/15 Summer			27.600	0.515	0.000	1.29		56.4	SURCHARGED	14
60.007	CP SW MH31A	15 Summer	2	+20%	2/15 Summer				26.595	0.110	0.000	1.88		56.2	SURCHARGED	
60.008	MH334	15 Summer	2	+20%	5/15 Summer				26.158	-0.107	0.000	0.82		106.8	OK	
60.009	CP355.3	15 Summer	2	+20%					25.571	-0.484	0.000	0.17		247.3	OK	
62.000	MH230	120 Winter	2	+20%					24.130	-0.525	0.000	0.00		0.0	OK	
62.001	MH228	15 Summer	2	+20%					24.026	-0.589	0.000	0.02		9.5	OK	
62.002	MH229	15 Summer	2	+20%					23.984	-0.453	0.000	0.08		34.6	OK	
60.010	MH231	15 Summer	2	+20%					23.964	-0.495	0.000	0.33		257.6	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 4 Number of Offline Controls 5 Number of Storage Structures 5 Number of Time/Area Diagrams 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Pipe Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CPDN07	15 Summer	5	+20%	100/15 Summer	100/15 Summer			23.417	-0.140	0.000	0.49	28.8	28.8	OK	2
1.001	CP15	15 Summer	5	+20%	100/15 Summer	100/15 Summer			23.185	-0.064	0.000	0.96	56.5	56.5	OK	1
1.002	CP16	15 Summer	5	+20%	100/15 Summer				22.226	-0.196	0.000	0.44	53.7	53.7	OK	
2.000	CPDN09	15 Summer	5	+20%	5/15 Summer	100/15 Summer			23.002	0.039	0.000	1.08	60.9	60.9	SURCHARGED	3
1.003	CP17	15 Summer	5	+20%	100/15 Summer				21.965	-0.081	0.000	0.90	102.4	102.4	OK	
3.000	CPDN10	15 Summer	5	+20%	100/15 Summer				22.477	-0.104	0.000	0.75	36.0	36.0	OK	
1.004	CP18	15 Summer	5	+20%	100/15 Summer				21.796	-0.033	0.000	0.99	118.0	118.0	OK	
4.000	CPDN11	15 Summer	5	+20%	100/15 Summer				22.260	-0.111	0.000	0.70	37.2	37.2	OK	
1.005	CP19	15 Summer	5	+20%	100/15 Summer				21.422	-0.137	0.000	0.83	138.9	138.9	OK	
5.000	CPDN15	15 Summer	5	+20%					21.944	-0.160	0.000	0.45	25.3	25.3	OK	
6.000	CP137.1	15 Summer	5	+20%	2/15 Summer	100/15 Summer			24.907	1.717	0.000	2.11	24.8	24.8	SURCHARGED	5
7.000	CPDN6	15 Summer	5	+20%	2/15 Summer	5/15 Summer			24.511	1.201	1.146	1.72	23.2	23.2	FLOOD	12
8.000	CPDN1	15 Summer	5	+20%	2/15 Summer	5/15 Summer			26.120	1.615	0.017	1.11	29.4	29.4	FLOOD	8
8.001	CP139	15 Summer	5	+20%	2/15 Summer	5/15 Summer			25.551	1.436	0.948	1.64	49.9	49.9	FLOOD	12
9.000	CP2001B	15 Summer	5	+20%	100/15 Summer				25.302	-0.153	0.000	0.15	5.2	5.2	OK	
9.001	CP2001A	15 Summer	5	+20%	100/15 Summer	100/15 Summer			25.281	-0.034	0.000	0.83	31.1	31.1	OK	5
9.002	CP2001	15 Summer	5	+20%	5/15 Summer	100/15 Summer			24.828	0.303	0.000	1.22	35.8	35.8	SURCHARGED	5
9.003	CP2000.1	15 Summer	5	+20%	100/15 Summer				23.652	-0.128	0.000	0.62	35.8	35.8	OK	
8.002	CP138	15 Summer	5	+20%	100/15 Summer				23.296	-0.179	0.000	0.54	84.4	84.4	OK	
10.000	CP3108	15 Summer	5	+20%	5/15 Summer	100/15 Summer			24.542	0.192	0.000	1.17	26.9	26.9	SURCHARGED	3

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Section 1
Proposed Network S1-OU1&7



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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
11.000	CP152	15 Summer	5	+20%	5/15 Summer				31.954	0.069	0.000	0.12		4.8	SURCHARGED	
11.001	CP151	15 Summer	5	+20%	5/15 Summer	100/15 Summer			31.947	0.372	0.000	0.91		41.9	SURCHARGED	7
11.002	CP150	15 Summer	5	+20%	5/15 Summer	100/15 Summer			30.733	0.748	0.000	0.96		72.3	SURCHARGED	8
11.003	CP142	15 Summer	5	+20%	2/15 Summer	100/15 Summer			28.324	1.089	0.000	1.21		87.6	SURCHARGED	10
12.000	CP01	15 Summer	5	+20%					32.212	-0.138	0.000	0.31		11.4	OK	
12.001	CP02	15 Summer	5	+20%					31.910	-0.142	0.000	0.29		13.0	OK	
12.002	CP03	15 Summer	5	+20%					31.447	-0.160	0.000	0.18		13.2	OK	
12.003	CP04	15 Summer	5	+20%					30.862	-0.174	0.000	0.12		13.5	OK	
13.000	CP07	15 Summer	5	+20%					31.664	-0.175	0.000	0.35		20.3	OK	
13.001	CP08	15 Summer	5	+20%					31.564	-0.171	0.000	0.38		48.7	OK	
12.004	CP05	15 Summer	5	+20%	100/15 Summer				29.983	-0.242	0.000	0.27		61.0	OK	
14.000	CPDN05	15 Summer	5	+20%	100/30 Summer				30.585	-0.131	0.000	0.36		18.6	OK	
15.000	CPDN06	15 Summer	5	+20%					31.502	-0.195	0.000	0.04		2.8	OK	
15.001	CP14	15 Summer	5	+20%	100/30 Summer				30.406	-0.172	0.000	0.13		5.1	OK	
12.005	CP06	15 Summer	5	+20%	100/15 Summer				29.448	-0.184	0.000	0.50		83.4	OK	
16.000	CP09	15 Summer	5	+20%					31.562	-0.212	0.000	0.18		21.9	OK	
16.001	CP010	15 Summer	5	+20%					30.913	-0.297	0.000	0.10		21.9	OK	
17.000	CPDN01	15 Summer	5	+20%	100/15 Summer				31.417	-0.081	0.000	0.73		32.8	OK	
16.002	CP11	15 Summer	5	+20%	100/15 Summer				30.144	-0.245	0.000	0.26		54.1	OK	
18.000	CPDN02	15 Summer	5	+20%	100/15 Summer				30.785	-0.156	0.000	0.46		47.2	OK	
16.003	CP12	15 Summer	5	+20%	100/15 Summer				29.462	-0.183	0.000	0.52		99.7	OK	
19.000	CPDN03	15 Summer	5	+20%	100/15 Winter				30.029	-0.173	0.000	0.37		34.5	OK	
20.000	CPDN04	15 Summer	5	+20%	100/15 Summer	100/30 Summer			30.028	-0.072	0.000	0.80		29.3	OK	
12.006	CP13	120 Summer	5	+20%	5/30 Summer	100/30 Summer			29.150	0.062	0.000	0.44		67.4	SURCHARGED	5
12.007	CP3116A	30 Summer	5	+20%	100/15 Summer				28.723	-0.210	0.000	0.38		84.6	OK	
12.008	CP3106	30 Summer	5	+20%	100/15 Summer				26.626	-0.209	0.000	0.40		114.1	OK	
12.009	CP3107	30 Summer	5	+20%	5/15 Summer	100/30 Summer			24.612	0.237	0.000	0.88		109.1	SURCHARGED	8
21.000	CP2011B	15 Summer	5	+20%	5/15 Summer	100/15 Summer			33.738	0.548	0.000	0.40		5.4	SURCHARGED	10
21.001	CP2011A	15 Summer	5	+20%	2/15 Summer	100/15 Summer			33.701	0.809	0.000	1.27		17.3	SURCHARGED	3
21.002	CP2011	30 Summer	5	+20%	2/15 Summer	100/15 Summer			32.441	1.111	0.000	0.85		15.7	SURCHARGED	9
21.003	CP2009	30 Summer	5	+20%	2/15 Summer	100/15 Summer			31.435	1.935	0.000	1.14		21.7	SURCHARGED	11
21.004	CP2007	30 Summer	5	+20%	2/15 Summer	100/15 Summer			29.192	1.532	0.000	1.27		31.6	FLOOD RISK	11
21.005	CP2005	30 Summer	5	+20%	100/15 Summer				25.187	-0.108	0.000	0.53		31.6	OK	
11.004	CP141	30 Summer	5	+20%	5/15 Summer				24.503	0.248	0.000	1.14		227.1	SURCHARGED	
22.000	CPDN2	15 Summer	5	+20%	5/15 Summer	100/15 Summer			25.433	0.133	0.000	1.08		19.4	SURCHARGED	3
11.005	CP140	30 Summer	5	+20%	2/15 Summer		100/30 Summer	9	23.641	0.091	0.000	1.39	0.0	235.4	SURCHARGED	
10.001	CP202	30 Summer	5	+20%	2/15 Summer				23.464	0.264	0.000	1.43		243.5	SURCHARGED	
23.000	CPDN3	15 Summer	5	+20%	2/15 Summer	2/15 Summer			25.696	1.506	5.571	2.21		23.5	FLOOD	20
10.002	CP3109A	30 Summer	5	+20%	100/15 Summer				22.885	-0.207	0.000	0.75		266.2	OK	
24.000	CPDN4	15 Summer	5	+20%	2/15 Summer	5/15 Summer			25.301	1.501	1.458	2.02		24.1	FLOOD	12
10.003	CP3109	30 Summer	5	+20%	100/15 Summer	100/30 Summer			22.555	-0.285	0.000	0.54		281.0	OK	5
25.000	CPDN5	15 Summer	5	+20%	2/15 Summer	100/15 Summer			24.038	0.728	0.000	2.33		20.1	SURCHARGED	9

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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
10.004	CP3110A	30 Summer	5	+20%	100/15 Summer				22.408	-0.061	0.000	0.54		270.4	OK	
26.000	CP3110B	15 Summer	5	+20%	2/15 Summer	100/15 Summer			23.431	0.281	0.000	1.58		16.4	SURCHARGED	5
8.003	CP3110	30 Summer	5	+20%	5/15 Summer	100/30 Summer			22.287	0.127	0.000	1.00		346.9	SURCHARGED	6
8.004	CP3111	30 Summer	5	+20%	5/15 Summer				22.226	0.196	0.000	0.91		344.5	SURCHARGED	
7.001	CP27208	30 Summer	5	+20%	2/30 Summer				21.998	0.258	0.000	1.80		347.1	SURCHARGED	
6.001	CP137	30 Summer	5	+20%	2/15 Summer				21.889	0.254	0.000	1.31		354.9	SURCHARGED	
27.000	CP153	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.232	-0.103	0.000	0.74		62.2	OK	7
27.001	CP154	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.098	-0.023	0.000	1.00		82.1	OK	7
27.002	CP49	15 Summer	5	+20%	100/15 Summer				32.837	-0.063	0.000	0.98		95.6	OK	
28.000	KO-12	15 Summer	5	+20%	100/15 Summer				33.633	-0.076	0.000	0.49		13.8	OK	
29.000	KO-10	15 Summer	5	+20%	5/15 Summer	100/15 Summer			34.383	0.077	0.000	1.23		29.8	SURCHARGED	5
29.001	CP47	15 Summer	5	+20%	100/15 Summer				34.087	-0.069	0.000	0.56		30.0	OK	
30.000	KO-11	15 Summer	5	+20%	100/30 Summer				34.503	-0.104	0.000	0.20		5.7	OK	
31.000	KO363	15 Summer	5	+20%	100/15 Summer	100/15 Summer			35.508	-0.097	0.000	0.59		31.2	OK	7
31.001	CP358A	15 Summer	5	+20%	5/15 Summer	100/15 Summer			34.807	0.107	0.000	0.70		41.7	SURCHARGED	7
31.002	EXCP07	15 Summer	5	+20%	2/15 Summer	100/15 Summer			34.519	0.664	0.000	1.02		35.1	SURCHARGED	7
31.003	EXCP07-1	15 Summer	5	+20%	2/15 Summer				34.169	0.374	0.000	1.05		42.8	SURCHARGED	
31.004	EXCP07-2	15 Summer	5	+20%	2/15 Summer	100/15 Summer			33.884	0.274	0.000	0.63		49.1	SURCHARGED	10
32.000	EXCP08	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.115	-0.110	0.000	0.50		26.7	OK	1
31.005	EXCP07-3	15 Summer	5	+20%	2/15 Summer				33.778	0.278	0.000	1.13		69.2	SURCHARGED	
33.000	CPDN7	15 Summer	5	+20%	100/15 Summer				35.363	-0.082	0.000	0.10		1.4	OK	
33.001	CP6203	15 Summer	5	+20%	100/15 Summer	100/15 Summer			35.359	-0.056	0.000	0.78		23.7	OK	5
34.000	CP6203	15 Summer	5	+20%	100/15 Summer				35.684	-0.086	0.000	0.38		3.0	OK	
33.002	CP6202	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.952	-0.138	0.000	0.54		43.0	OK	2
35.000	CP6202	15 Summer	5	+20%	100/15 Summer				35.324	-0.116	0.000	0.12		1.6	OK	
33.003	CP6201	15 Summer	5	+20%	2/15 Summer	100/15 Summer			34.823	0.718	0.000	1.48		64.3	SURCHARGED	7
31.006	EXCP07-4	15 Summer	5	+20%	2/15 Summer				33.695	0.235	0.000	1.64		129.9	SURCHARGED	
31.007	CP146A	30 Summer	5	+20%	5/15 Summer				33.414	0.076	0.000	0.96		123.3	SURCHARGED	
30.001	CP46	30 Summer	5	+20%	5/15 Summer				33.305	0.075	0.000	1.05		126.3	SURCHARGED	
30.002	CP49	30 Summer	5	+20%	5/15 Summer				33.194	0.105	0.000	1.20		128.5	SURCHARGED	
29.002	CP48	30 Summer	5	+20%	2/15 Summer				33.107	0.168	0.000	2.84		95.7	SURCHARGED	
36.000	CP41	15 Summer	5	+20%	100/15 Summer				42.228	-0.122	0.000	0.43		53.2	OK	
36.001	CP42	15 Summer	5	+20%	100/15 Summer	100/15 Summer			40.498	-0.104	0.000	0.56		75.1	OK	3
36.002	CP43	15 Summer	5	+20%	100/15 Summer				36.508	-0.170	0.000	0.39		88.7	OK	
36.003	CP44	15 Summer	5	+20%	5/15 Summer	100/15 Summer			35.060	0.116	0.000	1.32		87.3	SURCHARGED	3
36.004	CP45	15 Summer	5	+20%	5/15 Summer				34.848	0.029	0.000	1.16		86.4	SURCHARGED	
36.005	EXCP04	15 Summer	5	+20%	100/15 Summer				34.683	-0.017	0.000	1.00		82.6	OK	
37.000	EXCP05	15 Summer	5	+20%	100/15 Summer	100/360 Summer			34.606	-0.119	0.000	0.45		22.8	OK	10
36.006	EXCP06	15 Summer	5	+20%	100/15 Summer				34.367	-0.173	0.000	0.37		104.0	OK	
36.007	CP54	600 Winter	5	+20%	2/15 Summer				33.663	0.383	0.000	0.31		13.2	SURCHARGED	
36.008	CP55	600 Winter	5	+20%	2/30 Summer				33.662	0.487	0.000	0.02		1.3	SURCHARGED	
29.003	EXCP07-6	30 Summer	5	+20%	5/15 Summer				32.960	0.045	0.000	1.04		97.3	SURCHARGED	

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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
38.000	KO-12	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.603	-0.052	0.000	0.75		32.0	OK	2
38.001	CP300	15 Summer	5	+20%	100/15 Summer				34.122	-0.070	0.000	0.54		31.7	OK	
29.004	CP301	120 Summer	5	+20%	5/120 Summer				32.425	0.012	0.000	0.96		102.8	SURCHARGED	
28.001	CP302	120 Summer	5	+20%	100/15 Summer				32.335	-0.005	0.000	0.89		106.9	OK	
27.003	CP52	120 Summer	5	+20%	2/60 Summer				32.245	0.442	0.000	0.72		109.8	SURCHARGED	
39.000	CPDN10	15 Summer	5	+20%	100/15 Summer				33.307	-0.196	0.000	0.04		3.2	OK	
27.004	CP53	120 Summer	5	+20%	2/15 Summer				31.977	0.690	0.000	0.96		110.4	SURCHARGED	
27.005	CP80	120 Summer	5	+20%	100/15 Summer				30.764	-0.123	0.000	0.65		115.2	OK	
27.006	CP344	120 Summer	5	+20%	2/15 Summer	100/15 Summer			29.556	0.676	0.000	2.95		115.1	SURCHARGED	11
40.000	EXCP15	15 Summer	5	+20%					31.851	-0.109	0.000	0.16		4.5	OK	
27.007	CP344.1	120 Summer	5	+20%	5/30 Summer	100/15 Summer			29.347	0.547	0.000	0.57		120.4	SURCHARGED	5
27.008	CP344.2	120 Summer	5	+20%	2/15 Summer	100/15 Summer			28.436	2.446	0.000	1.55		122.4	SURCHARGED	3
27.009	CP345	120 Summer	5	+20%	2/15 Summer				28.208	2.378	0.000	1.12		122.7	SURCHARGED	
27.010	CP346	120 Summer	5	+20%	2/15 Summer				27.750	2.370	0.000	3.90		123.7	SURCHARGED	
27.011	CP347	120 Summer	5	+20%	2/15 Summer				27.524	2.109	0.000	3.60		124.6	SURCHARGED	
41.000	CP355A	15 Summer	5	+20%					28.245	-0.155	0.000	0.21		11.6	OK	
41.001	CP355	120 Summer	5	+20%	5/15 Summer				27.468	0.343	0.000	0.09		5.6	SURCHARGED	
41.002	CP355.1	120 Summer	5	+20%	5/15 Summer	100/15 Summer			27.463	0.808	0.000	0.32		22.1	SURCHARGED	7
27.012	CP348	120 Summer	5	+20%	2/15 Summer				27.429	1.949	0.000	0.52		134.0	SURCHARGED	
27.013	MH87	120 Summer	5	+20%	2/15 Summer	100/15 Summer			27.274	2.230	0.000	1.85		134.4	FLOOD RISK	16
42.000	GY308	15 Summer	5	+20%	100/15 Summer	100/15 Summer			29.608	-0.102	0.000	0.23		8.3	OK	2
42.001	CP352	15 Summer	5	+20%	100/15 Summer				28.994	-0.121	0.000	0.42		28.4	OK	
42.002	CP351	15 Summer	5	+20%	100/15 Summer	100/15 Summer			27.211	-0.104	0.000	0.53		26.8	OK	3
42.003	CP350	30 Summer	5	+20%	5/15 Summer	100/15 Summer			27.145	0.840	0.000	0.72		46.6	SURCHARGED	7
42.004	CP349	120 Summer	5	+20%	2/15 Summer	100/15 Summer			27.037	1.662	0.000	0.33		21.3	SURCHARGED	4
27.014	MH65	120 Summer	5	+20%	2/15 Summer	100/15 Summer			27.004	2.114	0.000	2.73		150.0	FLOOD RISK	13
27.015	MH64	120 Summer	5	+20%	2/15 Summer	100/15 Summer			26.633	1.793	0.000	1.64		151.5	SURCHARGED	7
27.016	MH63	120 Summer	5	+20%	2/15 Summer	100/15 Summer			26.068	1.458	0.000	1.84		155.0	SURCHARGED	5
27.017	MH62	120 Summer	5	+20%	2/15 Summer				25.219	0.889	0.000	1.42		158.6	SURCHARGED	
43.000	CP6119A	15 Summer	5	+20%			2/15 Summer	72	24.757	-0.113	0.000	0.12	2.2	2.0	OK	
44.000	CP6119B	15 Summer	5	+20%	2/15 Summer	100/15 Summer			24.521	0.771	0.000	1.76		16.5	SURCHARGED	5
27.018	CP6119	30 Summer	5	+20%	100/15 Summer		2/15 Summer	57	23.450	-0.120	0.000	0.89	10.3	158.4	OK	
45.000	CP149C	15 Summer	5	+20%					24.442	-0.098	0.000	0.26		4.1	OK	
27.019	CP149B	30 Summer	5	+20%	100/30 Summer				23.223	-0.247	0.000	0.42		159.7	OK	
46.000	CPDN9	15 Summer	5	+20%	2/15 Summer	5/15 Summer			24.951	1.351	0.535	2.00		26.0	FLOOD	10
27.020	CP149A	30 Summer	5	+20%	100/15 Summer				22.273	-0.173	0.000	0.70		173.5	OK	
47.000	CPDN10	15 Summer	5	+20%					23.357	-0.123	0.000	0.08		0.9	OK	
6.002	CP149	30 Summer	5	+20%	5/30 Summer				21.246	0.031	0.000	1.06		503.1	SURCHARGED	
48.000	CPDN11	15 Summer	5	+20%	2/15 Summer	100/15 Summer			23.737	0.717	0.000	1.47		86.4	SURCHARGED	5
6.003	CP148	30 Winter	5	+20%	100/15 Summer				20.344	-0.231	0.000	0.66		512.0	OK	
6.004	EXCP147	60 Summer	5	+20%	2/15 Summer				20.110	0.105	0.000	2.95		512.6	SURCHARGED	
1.006	CP20	30 Summer	5	+20%	100/15 Summer				19.714	-0.266	0.000	0.68		592.4	OK	

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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	CP147	120 Summer	5	+20%	100/15 Summer				19.442	-0.063	0.000	0.95		580.1	OK	
1.008	CP148	120 Summer	5	+20%	5/120 Summer				19.030	0.025	0.000	0.97		555.3	SURCHARGED	
1.009	CP6114A	120 Summer	5	+20%	5/30 Winter				18.621	0.054	0.000	0.97		552.1	SURCHARGED	
1.010	CP6114B	120 Summer	5	+20%	5/30 Summer				18.208	0.083	0.000	0.97		552.9	SURCHARGED	
49.000	CP146.1	15 Summer	5	+20%	100/15 Summer	100/15 Summer			22.739	-0.126	0.000	0.55		54.7	OK	3
49.001	CP146	15 Summer	5	+20%	5/15 Summer		5/15 Summer	13	21.646	0.016	0.000	0.94	12.1	60.1	SURCHARGED	
49.002	CP145	30 Summer	5	+20%	5/15 Summer				21.352	0.082	0.000	1.12		71.9	SURCHARGED	
49.003	CP144	15 Summer	5	+20%					20.443	-0.451	0.000	0.14		71.9	OK	
50.000	CPDN	15 Summer	5	+20%	100/15 Summer				21.827	-0.123	0.000	0.42		13.5	OK	
50.001	CP22	15 Summer	5	+20%	100/15 Summer				21.460	-0.130	0.000	0.35		13.3	OK	
50.002	CP23	15 Summer	5	+20%	100/15 Summer				21.160	-0.123	0.000	0.61		31.7	OK	
50.003	CP24	15 Summer	5	+20%	100/15 Summer				21.079	-0.076	0.000	0.88		47.3	OK	
50.004	CP25	15 Summer	5	+20%	100/15 Summer				20.790	-0.227	0.000	0.47		71.6	OK	
50.005	CP26	15 Summer	5	+20%	100/15 Summer				20.664	-0.214	0.000	0.53		82.5	OK	
50.006	CP27	15 Summer	5	+20%	100/15 Summer				20.526	-0.198	0.000	0.59		92.0	OK	
50.007	CP28	15 Summer	5	+20%					20.286	-0.284	0.000	0.29		101.9	OK	
49.004	CP201	15 Summer	5	+20%					19.300	-0.506	0.000	0.14		180.2	OK	
1.011	CP200	120 Summer	5	+20%	5/15 Winter				17.804	0.041	0.000	1.07		605.1	SURCHARGED	
1.012	Pond Inlet	120 Summer	5	+20%	5/30 Summer				17.710	0.030	0.000	1.27		604.9	SURCHARGED	
51.000	CP30	15 Summer	5	+20%					20.312	-0.210	0.000	0.19		20.0	OK	
51.001	CP31	15 Summer	5	+20%					19.791	-0.247	0.000	0.25		39.8	OK	
52.000	CPDN12	15 Summer	5	+20%	100/15 Summer				20.678	-0.088	0.000	0.65		34.8	OK	
52.001	CP56	15 Summer	5	+20%					20.199	-0.296	0.000	0.10		34.7	OK	
51.002	CP57	15 Summer	5	+20%					19.460	-0.255	0.000	0.22		72.8	OK	
1.013	Pond Outlet	180 Summer	5	+20%	100/120 Summer				17.300	-0.270	0.000	0.73		434.7	OK	
53.000	CP143	15 Summer	5	+20%	100/15 Summer				20.324	-0.096	0.000	0.64		43.4	OK	
53.001	CP6112A	15 Summer	5	+20%					19.637	-0.193	0.000	0.28		43.3	OK	
54.000	CP6113	15 Summer	5	+20%	100/15 Summer				19.489	-0.226	0.000	0.29		45.8	OK	
53.002	CP6112	15 Summer	5	+20%					19.311	-0.269	0.000	0.18		96.4	OK	
1.014	CP6112B	180 Summer	5	+20%	100/60 Summer				16.761	-0.212	0.000	0.86		439.9	OK	
55.000	CP359	15 Summer	5	+20%					35.125	-0.205	0.000	0.22		19.1	OK	
56.000	CP6204A	30 Summer	5	+20%	2/15 Summer	100/15 Summer			36.163	0.640	0.000	2.07		50.2	SURCHARGED	8
56.001	CP6204	30 Summer	5	+20%				0	35.094	-0.156	0.000	0.46	0.0	56.6	OK	
57.000	CP361	30 Winter	5	+20%	100/15 Summer				35.343	-0.257	0.000	0.70		400.5	OK	
55.001	CP360	30 Winter	5	+20%					34.739	-0.346	0.000	0.48		463.2	OK	
58.000	CPDN18	30 Summer	5	+20%	100/15 Summer				23.398	-0.127	0.000	0.36		9.3	OK	
58.001	CP6118	120 Summer	5	+20%					23.016	-0.139	0.000	0.31		10.2	OK	
58.002	CP6117	120 Summer	5	+20%	100/60 Summer				22.799	-0.126	0.000	0.40		10.7	OK	
59.000	CPDN19	15 Summer	5	+20%					24.628	-0.115	0.000	0.12		2.1	OK	
59.001	CP6116	15 Summer	5	+20%					23.826	-0.114	0.000	0.13		3.2	OK	
58.003	CP6116A	120 Summer	5	+20%					22.496	-0.144	0.000	0.28		12.0	OK	
60.000	EXCP09	15 Summer	5	+20%					34.103	-0.142	0.000	0.28		17.2	OK	

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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
60.001	EXCP10	15 Summer	5	+20%	100/15 Summer				33.286	-0.154	0.000	0.21		23.0	OK	
60.002	EXCP11	15 Summer	5	+20%	100/15 Summer				32.401	-0.124	0.000	0.41		39.1	OK	
60.003	EXCP12	15 Summer	5	+20%	100/15 Summer	100/15 Summer			30.597	-0.128	0.000	0.38		39.3	OK	3
60.004	CP340	15 Summer	5	+20%	100/15 Summer				30.083	-0.112	0.000	0.50		53.2	OK	
60.005	CP338	15 Summer	5	+20%	2/15 Summer	100/15 Summer			28.563	-1.198	0.000	1.44		64.0	SURCHARGED	6
61.000	CP339	15 Summer	5	+20%					28.800	-0.195	0.000	0.04		2.8	OK	
60.006	CP337	15 Summer	5	+20%	2/15 Summer	5/15 Summer			27.944	-0.859	4.429	1.48		64.8	FLOOD	14
60.007	CP SW MH31A	15 Summer	5	+20%	2/15 Summer				26.645	-0.160	0.000	2.17		64.8	SURCHARGED	
60.008	MH334	15 Summer	5	+20%	5/15 Summer				26.319	-0.054	0.000	1.13		146.2	SURCHARGED	
60.009	CP355.3	15 Summer	5	+20%					25.608	-0.447	0.000	0.24		344.6	OK	
62.000	MH230	120 Winter	5	+20%					24.130	-0.525	0.000	0.00		0.0	OK	
62.001	MH228	15 Summer	5	+20%					24.075	-0.540	0.000	0.03		13.0	OK	
62.002	MH229	15 Summer	5	+20%					24.059	-0.378	0.000	0.11		48.8	OK	
60.010	MH231	15 Summer	5	+20%					24.030	-0.429	0.000	0.45		353.7	OK	

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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 4 Number of Offline Controls 5 Number of Storage Structures 5 Number of Time/Area Diagrams 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Pipe Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CPDN07	15 Summer	100	+20%	100/15 Summer	100/15 Summer			24.504	0.947	0.843	1.04	61.2		FLOOD	2
1.001	CP15	15 Summer	100	+20%	100/15 Summer	100/15 Summer			24.174	0.925	0.412	2.22	130.7		FLOOD	1
1.002	CP16	15 Summer	100	+20%	100/15 Summer				23.156	0.734	0.000	0.80	98.9		SURCHARGED	
2.000	CPDN09	15 Summer	100	+20%	5/15 Summer	100/15 Summer			23.858	0.895	3.051	1.97	111.1		FLOOD	3
1.003	CP17	15 Summer	100	+20%	100/15 Summer				22.945	0.899	0.000	1.50	171.6		SURCHARGED	
3.000	CPDN10	15 Summer	100	+20%	100/15 Summer				22.827	0.246	0.000	1.62	78.0		SURCHARGED	
1.004	CP18	30 Summer	100	+20%	100/15 Summer				22.465	0.636	0.000	1.67	198.5		SURCHARGED	
4.000	CPDN11	15 Summer	100	+20%	100/15 Summer				22.660	0.289	0.000	1.53	81.1		SURCHARGED	
1.005	CP19	60 Summer	100	+20%	100/15 Summer				22.130	0.571	0.000	1.30	218.1		SURCHARGED	
5.000	CPDN15	60 Summer	100	+20%					22.046	-0.058	0.000	0.65	37.0		OK	
6.000	CP137.1	15 Summer	100	+20%	2/15 Summer	100/15 Summer			25.767	2.577	7.274	2.52	29.7		FLOOD	5
7.000	CPDN6	15 Summer	100	+20%	2/15 Summer	5/15 Summer			24.522	1.212	11.773	1.72	23.3		FLOOD	12
8.000	CPDN1	15 Summer	100	+20%	2/15 Summer	5/15 Summer			26.132	1.627	12.064	1.23	32.6		FLOOD	8
8.001	CP139	60 Summer	100	+20%	2/15 Summer	5/15 Summer			25.579	1.464	28.985	1.74	53.1		FLOOD	12
9.000	CP2001B	30 Summer	100	+20%	100/15 Summer				26.930	1.475	0.000	0.30	10.2		FLOOD RISK	
9.001	CP2001A	15 Summer	100	+20%	100/15 Summer	100/15 Summer			26.899	1.584	8.928	1.20	45.1		FLOOD	5
9.002	CP2001	30 Summer	100	+20%	5/15 Summer	100/15 Summer			26.152	1.627	2.257	1.90	55.6		FLOOD	5
9.003	CP2000.1	30 Summer	100	+20%	100/15 Summer				24.853	1.073	0.000	0.96	55.5		SURCHARGED	
8.002	CP138	30 Winter	100	+20%	100/15 Summer				24.685	1.210	0.000	0.68	106.1		FLOOD RISK	
10.000	CP3108	15 Summer	100	+20%	5/15 Summer	100/15 Summer			26.052	1.702	1.623	2.07	47.4		FLOOD	3

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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
11.000	CP152	15 Summer	100	+20%	5/15 Summer				33.241	1.356	0.000	0.28		10.9	FLOOD RISK	
11.001	CP151	30 Summer	100	+20%	5/15 Summer	100/15 Summer			33.214	1.639	23.809	1.00		46.4	FLOOD	7
11.002	CP150	30 Summer	100	+20%	5/15 Summer	100/15 Summer			31.635	1.650	25.426	1.04		78.7	FLOOD	8
11.003	CP142	60 Summer	100	+20%	2/15 Summer	100/15 Summer			28.813	1.578	33.449	1.26		91.2	FLOOD	10
12.000	CP01	15 Summer	100	+20%					32.262	-0.088	0.000	0.66		24.8	OK	
12.001	CP02	15 Summer	100	+20%					31.961	-0.091	0.000	0.64		29.3	OK	
12.002	CP03	15 Summer	100	+20%					31.483	-0.124	0.000	0.41		29.3	OK	
12.003	CP04	30 Summer	100	+20%					30.983	-0.053	0.000	0.24		27.6	OK	
13.000	CP07	15 Summer	100	+20%					31.741	-0.098	0.000	0.77		44.1	OK	
13.001	CP08	15 Summer	100	+20%					31.674	-0.061	0.000	0.97		123.4	OK	
12.004	CP05	30 Summer	100	+20%	100/15 Summer				30.951	0.726	0.000	0.60		135.4	SURCHARGED	
14.000	CPDN05	30 Summer	100	+20%	100/30 Summer				30.888	0.172	0.000	0.71		37.2	SURCHARGED	
15.000	CPDN06	15 Summer	100	+20%					31.518	-0.179	0.000	0.09		6.0	OK	
15.001	CP14	30 Summer	100	+20%	100/30 Summer				30.767	0.189	0.000	0.28		11.1	SURCHARGED	
12.005	CP06	30 Summer	100	+20%	100/15 Summer				30.793	1.161	0.000	0.99		164.3	FLOOD RISK	
16.000	CP09	15 Summer	100	+20%					31.607	-0.167	0.000	0.40		47.6	OK	
16.001	CP010	30 Summer	100	+20%					30.954	-0.256	0.000	0.19		43.1	OK	
17.000	CPDN01	15 Summer	100	+20%	100/15 Summer				32.284	0.786	0.000	1.59		71.3	FLOOD RISK	
16.002	CP11	30 Summer	100	+20%	100/15 Summer				30.938	0.549	0.000	0.51		107.1	SURCHARGED	
18.000	CPDN02	15 Summer	100	+20%	100/15 Summer				30.944	0.003	0.000	1.00		102.9	SURCHARGED	
16.003	CP12	30 Summer	100	+20%	100/15 Summer				30.777	1.132	0.000	0.92		178.1	SURCHARGED	
19.000	CPDN03	30 Summer	100	+20%	100/15 Winter				30.879	0.677	0.000	0.73		68.5	FLOOD RISK	
20.000	CPDN04	30 Summer	100	+20%	100/15 Summer	100/30 Summer			30.999	0.899	0.006	1.56		57.4	FLOOD	
12.006	CP13	60 Summer	100	+20%	5/30 Summer	100/30 Summer			30.607	1.519	19.017	1.01		155.2	FLOOD	5
12.007	CP3116A	60 Summer	100	+20%	100/15 Summer				29.524	0.591	0.000	0.85		188.1	SURCHARGED	
12.008	CP3106	60 Summer	100	+20%	100/15 Summer				28.021	1.186	0.000	0.78		223.0	FLOOD RISK	
12.009	CP3107	120 Summer	100	+20%	5/15 Summer	100/30 Summer			26.573	2.198	72.983	1.86		229.9	FLOOD	8
21.000	CP2011B	30 Summer	100	+20%	5/15 Summer	100/15 Summer			34.401	1.211	11.252	1.08		14.3	FLOOD	10
21.001	CP2011A	15 Summer	100	+20%	2/15 Summer	100/15 Summer			35.272	2.380	1.536	1.39		19.0	FLOOD	3
21.002	CP2011	30 Summer	100	+20%	2/15 Summer	100/15 Summer			33.533	2.203	3.070	0.91		17.0	FLOOD	9
21.003	CP2009	30 Winter	100	+20%	2/15 Summer	100/15 Summer			32.041	2.541	10.838	1.22		23.1	FLOOD	11
21.004	CP2007	60 Summer	100	+20%	2/15 Summer	100/15 Summer			29.340	1.680	20.161	1.30		32.3	FLOOD	11
21.005	CP2005	120 Summer	100	+20%	100/15 Summer				26.531	1.236	0.000	0.67		39.7	SURCHARGED	
11.004	CP141	120 Summer	100	+20%	5/15 Summer				26.464	2.209	0.000	1.47		291.1	SURCHARGED	
22.000	CPDN2	15 Summer	100	+20%	5/15 Summer	100/15 Summer			26.882	1.582	1.971	1.73		31.2	FLOOD	3
11.005	CP140	60 Winter	100	+20%	2/15 Summer		100/30 Summer	9	25.687	2.137	0.000	1.74	28.2	294.0	SURCHARGED	
10.001	CP202	60 Winter	100	+20%	2/15 Summer				25.527	2.327	0.000	1.82		309.4	FLOOD RISK	
23.000	CPDN3	30 Summer	100	+20%	2/15 Summer	2/15 Summer			25.716	1.526	26.107	2.22		23.6	FLOOD	20
10.002	CP3109A	60 Winter	100	+20%	100/15 Summer				24.981	1.889	0.000	0.91		321.0	SURCHARGED	
24.000	CPDN4	15 Summer	100	+20%	2/15 Summer	5/15 Summer			25.313	1.513	12.998	2.03		24.2	FLOOD	12
10.003	CP3109	60 Summer	100	+20%	100/15 Summer	100/30 Summer			24.816	1.976	5.889	0.67		351.9	FLOOD	5
25.000	CPDN5	15 Summer	100	+20%	2/15 Summer	100/15 Summer			24.813	1.503	3.439	3.23		27.8	FLOOD	9

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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
10.004	CP3110A	60 Summer	100	+20%	100/15 Summer				24.649	2.180	0.000	0.73		366.4	FLOOD RISK	
26.000	CP3110B	15 Summer	100	+20%	2/15 Summer	100/15 Summer			24.651	1.501	0.613	2.99		30.9	FLOOD	5
8.003	CP3110	60 Summer	100	+20%	5/15 Summer	100/30 Summer			24.477	2.317	17.357	1.29		446.3	FLOOD	6
8.004	CP3111	60 Summer	100	+20%	5/15 Summer				24.417	2.387	0.000	1.13		428.3	FLOOD RISK	
7.001	CP27208	60 Summer	100	+20%	2/30 Summer				24.196	2.456	0.000	2.24		432.0	FLOOD RISK	
6.001	CP137	60 Summer	100	+20%	2/15 Summer				24.062	2.427	0.000	1.67		453.4	SURCHARGED	
27.000	CP153	30 Summer	100	+20%	100/15 Summer	100/15 Summer			34.547	1.212	12.300	1.20		100.2	FLOOD	7
27.001	CP154	30 Summer	100	+20%	100/15 Summer	100/15 Summer			34.504	1.383	2.643	1.87		153.3	FLOOD	7
27.002	CP49	30 Summer	100	+20%	100/15 Summer				34.580	1.680	0.000	1.91		186.0	FLOOD RISK	
28.000	KO-12	30 Summer	100	+20%	100/15 Summer				34.553	0.844	0.000	0.95		27.1	SURCHARGED	
29.000	KO-10	15 Summer	100	+20%	5/15 Summer	100/15 Summer			34.858	0.552	1.342	2.17		52.6	FLOOD	5
29.001	CP47	60 Summer	100	+20%	100/15 Summer				34.862	0.706	0.000	0.82		44.1	SURCHARGED	
30.000	KO-11	60 Winter	100	+20%	100/30 Summer				34.992	0.385	0.000	0.22		6.1	FLOOD RISK	
31.000	KO363	15 Summer	100	+20%	100/15 Summer	100/15 Summer			36.138	0.533	8.401	0.88		46.5	FLOOD	7
31.001	CP358A	15 Summer	100	+20%	5/15 Summer	100/15 Summer			35.924	1.224	4.261	0.80		47.3	FLOOD	7
31.002	EXCP07	30 Summer	100	+20%	2/15 Summer	100/15 Summer			35.477	1.622	7.048	1.09		37.6	FLOOD	7
31.003	EXCP07-1	30 Summer	100	+20%	2/15 Summer				35.302	1.507	0.000	1.37		56.1	FLOOD RISK	
31.004	EXCP07-2	120 Summer	100	+20%	2/15 Summer	100/15 Summer			34.903	1.293	61.016	0.75		58.0	FLOOD	10
32.000	EXCP08	15 Summer	100	+20%	100/15 Summer	100/15 Summer			35.558	1.333	0.046	0.94		50.4	FLOOD	1
31.005	EXCP07-3	60 Summer	100	+20%	2/15 Summer				34.978	1.478	0.000	1.57		96.1	FLOOD RISK	
33.000	CPDN7	15 Summer	100	+20%	100/15 Summer				36.577	1.132	0.000	0.21		3.0	FLOOD RISK	
33.001	CP6203	15 Summer	100	+20%	100/15 Summer	100/15 Summer			36.568	1.153	8.365	1.24		37.7	FLOOD	5
34.000	CP6203	15 Summer	100	+20%	100/15 Summer				36.459	0.689	0.000	0.72		5.6	FLOOD RISK	
33.002	CP6202	15 Summer	100	+20%	100/15 Summer	100/15 Summer			36.281	1.191	0.645	1.06		83.8	FLOOD	2
35.000	CP6202	15 Summer	100	+20%	100/15 Summer				35.906	0.466	0.000	0.24		3.3	SURCHARGED	
33.003	CP6201	30 Summer	100	+20%	2/15 Summer	100/15 Summer			35.880	1.775	22.728	1.80		78.2	FLOOD	7
31.006	EXCP07-4	60 Winter	100	+20%	2/15 Summer				35.008	1.548	0.000	1.91		151.8	FLOOD RISK	
31.007	CP146A	60 Winter	100	+20%	5/15 Summer				34.994	1.656	0.000	1.15		148.5	FLOOD RISK	
30.001	CP46	60 Winter	100	+20%	5/15 Summer				34.985	1.755	0.000	1.28		154.4	SURCHARGED	
30.002	CP49	60 Winter	100	+20%	5/15 Summer				34.910	1.821	0.000	1.50		160.8	SURCHARGED	
29.002	CP48	60 Summer	100	+20%	2/15 Summer				34.818	1.879	0.000	3.13		105.5	SURCHARGED	
36.000	CP41	15 Summer	100	+20%	100/15 Summer				42.940	0.590	0.000	0.90		111.6	SURCHARGED	
36.001	CP42	15 Summer	100	+20%	100/15 Summer	100/15 Summer			41.505	0.903	2.915	1.07		145.0	FLOOD	3
36.002	CP43	15 Summer	100	+20%	100/15 Summer				37.254	0.576	0.000	0.78		179.1	SURCHARGED	
36.003	CP44	15 Summer	100	+20%	5/15 Summer	100/15 Summer			36.149	1.205	5.248	2.27		150.2	FLOOD	3
36.004	CP45	720 Winter	100	+20%	5/15 Summer				35.711	0.892	0.000	0.22		16.4	SURCHARGED	
36.005	EXCP04	600 Winter	100	+20%	100/15 Summer				35.716	1.016	0.000	0.23		19.2	FLOOD RISK	
37.000	EXCP05	600 Winter	100	+20%	100/15 Summer	100/360 Summer			35.677	0.952	15.249	0.15		7.4	FLOOD	10
36.006	EXCP06	600 Winter	100	+20%	100/15 Summer				35.721	1.181	0.000	0.09		24.4	FLOOD RISK	
36.007	CP54	600 Winter	100	+20%	2/15 Summer				35.733	2.453	0.000	0.60		26.0	SURCHARGED	
36.008	CP55	600 Winter	100	+20%	2/30 Summer				35.735	2.560	0.000	0.03		2.3	SURCHARGED	
29.003	EXCP07-6	60 Winter	100	+20%	5/15 Summer				34.742	1.827	0.000	1.14		106.3	SURCHARGED	

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File PROPOSED CASE DRAINAGE MODEL_S1_OU1_7 DF3.MDX

A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
38.000	KO-12	15 Summer	100	+20%	100/15 Summer	100/15 Summer			35.206	0.551	0.245	1.43		60.7	FLOOD	2
38.001	CP300	30 Summer	100	+20%	100/15 Summer				34.856	0.664	0.000	1.02		59.7	FLOOD RISK	
29.004	CP301	120 Summer	100	+20%	5/120 Summer				34.489	2.076	0.000	1.06		114.1	SURCHARGED	
28.001	CP302	60 Winter	100	+20%	100/15 Summer				34.394	2.054	0.000	1.03		123.9	SURCHARGED	
27.003	CP52	30 Summer	100	+20%	2/60 Summer				34.348	2.545	0.000	1.01		154.6	SURCHARGED	
39.000	CPDN10	30 Winter	100	+20%	100/15 Summer				33.934	0.431	0.000	0.08		6.4	SURCHARGED	
27.004	CP53	30 Summer	100	+20%	2/15 Summer				33.989	2.702	0.000	1.12		129.0	SURCHARGED	
27.005	CP80	60 Summer	100	+20%	100/15 Summer				32.413	1.526	0.000	0.91		161.7	SURCHARGED	
27.006	CP344	120 Summer	100	+20%	2/15 Summer	100/15 Summer			30.770	1.890	29.591	3.52		137.5	FLOOD	11
40.000	EXCP15	15 Summer	100	+20%					31.872	-0.088	0.000	0.34		9.3	OK	
27.007	CP344.1	30 Summer	100	+20%	5/30 Summer	100/15 Summer			30.603	1.803	3.187	0.72		151.5	FLOOD	5
27.008	CP344.2	30 Summer	100	+20%	2/15 Summer	100/15 Summer			29.380	3.390	0.192	1.93		152.8	FLOOD	3
27.009	CP345	15 Summer	100	+20%	2/15 Summer				29.021	3.191	0.000	1.39		152.4	SURCHARGED	
27.010	CP346	30 Summer	100	+20%	2/15 Summer				28.288	2.908	0.000	5.03		159.5	SURCHARGED	
27.011	CP347	120 Summer	100	+20%	2/15 Summer				27.880	2.465	0.000	4.61		159.5	SURCHARGED	
41.000	CP355A	15 Summer	100	+20%					28.310	-0.090	0.000	0.44		23.8	OK	
41.001	CP355	15 Summer	100	+20%	5/15 Summer				28.104	0.979	0.000	0.46		27.3	FLOOD RISK	
41.002	CP355.1	30 Summer	100	+20%	5/15 Summer	100/15 Summer			27.981	1.326	10.671	0.67		45.6	FLOOD	7
27.012	CP348	120 Summer	100	+20%	2/15 Summer				27.744	2.264	0.000	0.80		203.2	SURCHARGED	
27.013	MH87	120 Summer	100	+20%	2/15 Summer	100/15 Summer			27.589	2.545	129.466	2.18		158.1	FLOOD	16
42.000	GY308	15 Summer	100	+20%	100/15 Summer	100/15 Summer			30.310	0.600	0.553	0.48		17.4	FLOOD	2
42.001	CP352	30 Summer	100	+20%	100/15 Summer				30.313	1.198	0.000	0.82		55.1	FLOOD RISK	
42.002	CP351	15 Summer	100	+20%	100/15 Summer	100/15 Summer			29.160	1.845	0.463	0.95		48.2	FLOOD	3
42.003	CP350	30 Summer	100	+20%	5/15 Summer	100/15 Summer			28.240	1.935	10.383	0.88		56.7	FLOOD	7
42.004	CP349	15 Summer	100	+20%	2/15 Summer	100/15 Summer			27.550	2.175	0.118	0.93		59.1	FLOOD	4
27.014	MH65	60 Summer	100	+20%	2/15 Summer	100/15 Summer			27.300	2.410	49.548	2.94		161.7	FLOOD	13
27.015	MH64	30 Summer	100	+20%	2/15 Summer	100/15 Summer			26.975	2.135	5.313	1.76		162.0	FLOOD	7
27.016	MH63	30 Summer	100	+20%	2/15 Summer	100/15 Summer			26.563	1.953	2.824	1.92		161.9	FLOOD	5
27.017	MH62	15 Summer	100	+20%	2/15 Summer				25.906	1.576	0.000	1.59		177.4	FLOOD RISK	
43.000	CP6119A	15 Summer	100	+20%			2/15 Summer	72	24.776	-0.094	0.000	0.25	4.8	4.1	OK	
44.000	CP6119B	15 Summer	100	+20%	2/15 Summer	100/15 Summer			24.955	1.205	4.791	2.24		21.0	FLOOD	5
27.018	CP6119	60 Summer	100	+20%	100/15 Summer		2/15 Summer	57	23.725	0.155	0.000	1.03	30.0	183.4	SURCHARGED	
45.000	CP149C	15 Summer	100	+20%					24.471	-0.069	0.000	0.56		9.0	OK	
27.019	CP149B	60 Summer	100	+20%	100/30 Summer				23.676	0.206	0.000	0.50		189.7	SURCHARGED	
46.000	CPDN9	15 Summer	100	+20%	2/15 Summer	5/15 Summer			24.960	1.360	10.462	2.01		26.1	FLOOD	10
27.020	CP149A	60 Summer	100	+20%	100/15 Summer				23.446	1.000	0.000	0.86		215.5	SURCHARGED	
47.000	CPDN10	15 Summer	100	+20%					23.371	-0.109	0.000	0.16		2.0	OK	
6.002	CP149	60 Summer	100	+20%	5/30 Summer				23.294	2.079	0.000	1.27		603.6	SURCHARGED	
48.000	CPDN11	15 Summer	100	+20%	2/15 Summer	100/15 Summer			24.272	1.252	20.004	1.77		104.4	FLOOD	5
6.003	CP148	60 Summer	100	+20%	100/15 Summer				22.638	2.063	0.000	0.87		679.3	SURCHARGED	
6.004	EXCP147	60 Summer	100	+20%	2/15 Summer				22.284	2.279	0.000	3.87		672.3	SURCHARGED	
1.006	CP20	60 Summer	100	+20%	100/15 Summer				22.034	2.054	0.000	0.94		817.3	SURCHARGED	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU1&7



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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	CP147	60 Summer	100	+20%	100/15 Summer				21.662	2.157	0.000	1.30		795.8	SURCHARGED	
1.008	CP148	60 Summer	100	+20%	5/120 Summer				20.857	1.852	0.000	1.37		782.3	SURCHARGED	
1.009	CP6114A	60 Summer	100	+20%	5/30 Winter				20.044	1.477	0.000	1.36		778.9	SURCHARGED	
1.010	CP6114B	60 Summer	100	+20%	5/30 Summer				19.219	1.094	0.000	1.37		779.2	SURCHARGED	
49.000	CP146.1	15 Summer	100	+20%	100/15 Summer	100/15 Summer			23.150	0.285	5.251	1.04		102.6	FLOOD	3
49.001	CP146	15 Summer	100	+20%	5/15 Summer		5/15 Summer	13	21.916	0.286	0.000	0.88	177.5	56.2	SURCHARGED	
49.002	CP145	15 Summer	100	+20%	5/15 Summer				21.815	0.545	0.000	1.69		108.6	SURCHARGED	
49.003	CP144	15 Summer	100	+20%					20.473	-0.421	0.000	0.21		106.8	OK	
50.000	CPDN	15 Summer	100	+20%	100/15 Summer				22.803	0.853	0.000	0.87		28.4	FLOOD RISK	
50.001	CP22	15 Summer	100	+20%	100/15 Summer				22.693	1.103	0.000	0.74		27.8	FLOOD RISK	
50.002	CP23	15 Summer	100	+20%	100/15 Summer				22.576	1.293	0.000	1.14		59.0	FLOOD RISK	
50.003	CP24	15 Summer	100	+20%	100/15 Summer				22.381	1.226	0.000	1.78		95.6	FLOOD RISK	
50.004	CP25	15 Summer	100	+20%	100/15 Summer				21.889	0.872	0.000	1.65		250.4	SURCHARGED	
50.005	CP26	15 Summer	100	+20%	100/15 Summer				21.617	0.739	0.000	1.65		259.1	SURCHARGED	
50.006	CP27	15 Summer	100	+20%	100/15 Summer				21.090	0.366	0.000	1.72		270.5	SURCHARGED	
50.007	CP28	30 Summer	100	+20%					20.438	-0.132	0.000	0.84		295.2	OK	
49.004	CP201	30 Summer	100	+20%					19.390	-0.416	0.000	0.31		401.2	OK	
1.011	CP200	60 Summer	100	+20%	5/15 Winter				18.413	0.650	0.000	1.75		990.7	SURCHARGED	
1.012	Pond Inlet	60 Summer	100	+20%	5/30 Summer				18.010	0.330	0.000	2.07		986.1	SURCHARGED	
51.000	CP30	15 Summer	100	+20%					20.359	-0.163	0.000	0.42		43.4	OK	
51.001	CP31	15 Summer	100	+20%					19.881	-0.157	0.000	0.61		98.0	OK	
52.000	CPDN12	15 Summer	100	+20%	100/15 Summer				21.572	0.806	0.000	1.40		75.0	SURCHARGED	
52.001	CP56	15 Summer	100	+20%					20.238	-0.257	0.000	0.21		74.2	OK	
51.002	CP57	15 Summer	100	+20%					19.529	-0.186	0.000	0.50		161.4	OK	
1.013	Pond Outlet	180 Summer	100	+20%	100/120 Summer				17.605	0.035	0.000	0.99		588.7	SURCHARGED	
53.000	CP143	15 Summer	100	+20%	100/15 Summer				21.543	1.123	0.000	1.38		93.3	FLOOD RISK	
53.001	CP6112A	15 Summer	100	+20%					19.699	-0.131	0.000	0.60		93.8	OK	
54.000	CP6113	15 Summer	100	+20%	100/15 Summer				19.859	0.144	0.000	0.63		99.9	SURCHARGED	
53.002	CP6112	15 Summer	100	+20%					19.366	-0.214	0.000	0.38		204.9	OK	
1.014	CP6112B	180 Summer	100	+20%	100/60 Summer				17.029	0.056	0.000	1.17		597.9	SURCHARGED	
55.000	CP359	15 Summer	100	+20%					35.176	-0.154	0.000	0.47		40.7	OK	
56.000	CP6204A	30 Summer	100	+20%	2/15 Summer	100/15 Summer			37.198	1.675	28.393	3.09		74.8	FLOOD	8
56.001	CP6204	30 Summer	100	+20%				0	35.164	-0.086	0.000	0.83	0.0	102.0	OK	
57.000	CP361	30 Winter	100	+20%	100/15 Summer				36.131	0.531	0.000	1.56		888.6	SURCHARGED	
55.001	CP360	30 Winter	100	+20%					35.020	-0.065	0.000	1.00		968.2	OK	
58.000	CPDN18	60 Summer	100	+20%	100/15 Summer				24.326	0.801	0.000	1.08		28.0	SURCHARGED	
58.001	CP6118	60 Summer	100	+20%					23.093	-0.062	0.000	0.87		28.4	OK	
58.002	CP6117	60 Summer	100	+20%	100/60 Summer				22.941	0.016	0.000	1.03		27.3	SURCHARGED	
59.000	CPDN19	15 Summer	100	+20%					24.646	-0.097	0.000	0.26		4.6	OK	
59.001	CP6116	15 Summer	100	+20%					23.848	-0.092	0.000	0.30		7.5	OK	
58.003	CP6116A	60 Summer	100	+20%					22.553	-0.087	0.000	0.69		29.6	OK	
60.000	EXCP09	15 Summer	100	+20%					34.150	-0.095	0.000	0.61		37.3	OK	

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A12 Chelmsford to A120widening
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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU1&7

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
60.001	EXCP10	15 Summer	100	+20%	100/15 Summer				33.450	0.010	0.000	0.48		51.8	SURCHARGED	
60.002	EXCP11	15 Summer	100	+20%	100/15 Summer				33.269	0.744	0.000	0.90		86.8	SURCHARGED	
60.003	EXCP12	15 Summer	100	+20%	100/15 Summer	100/15 Summer			31.733	1.008	2.163	0.83		84.8	FLOOD	3
60.004	CP340	15 Summer	100	+20%	100/15 Summer				31.574	1.379	0.000	0.95		101.7	SURCHARGED	
60.005	CP338	15 Summer	100	+20%	2/15 Summer	100/15 Summer			29.027	1.662	16.671	1.94		86.2	FLOOD	6
61.000	CP339	15 Summer	100	+20%					28.816	-0.179	0.000	0.09		6.0	OK	
60.006	CP337	30 Summer	100	+20%	2/15 Summer	5/15 Summer			27.991	0.906	50.682	1.51		65.8	FLOOD	14
60.007	CP SW MH31A	15 Summer	100	+20%	2/15 Summer				27.159	0.674	0.000	2.41		72.1	FLOOD RISK	
60.008	MH334	15 Summer	100	+20%	5/15 Summer				27.004	0.739	0.000	2.15		278.9	FLOOD RISK	
60.009	CP355.3	15 Summer	100	+20%					25.723	-0.332	0.000	0.50		709.9	OK	
62.000	MH230	15 Summer	100	+20%					24.420	-0.235	0.000	0.01		2.4	OK	
62.001	MH228	15 Summer	100	+20%					24.420	-0.195	0.000	0.06		30.1	OK	
62.002	MH229	15 Summer	100	+20%					24.359	-0.078	0.000	0.22		97.0	OK	
60.010	MH231	15 Summer	100	+20%					24.283	-0.176	0.000	0.95		739.3	OK	

Project Name	A12 Chelmsford to A120 widening scheme
Project Number	HE551497

File Number	HE551497-JAC-HDG-S1_J19-CA-D-0002				
Document Description	MICRODRAINAGE MODELLING RESULTS FOR PROPOSED CATCHMENT S1-OU7A				
Purpose of Issue	S2 - SUITABLE FOR INFORMATION	Status Code	S2		
Current Revision	P01				
Calculation Number	0002	Index Page	1 of 16	Sheet Nos (incl. cover sheet)	16

P01	FIRST ISSUE	DG	AM	AM	DT	07/06/22
Rev	Comments	Originated	Checked	Reviewed	Approved	Date

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Summary

This calculation sheet documents the Microdrainage modelling results (1D analysis) for the proposed highway drainage catchment "Section 1 - Outfall 7A (S1-OU7A) for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events.

It should be noted that the Microdrainage modelling results have been summarised by "the maximum water level for critical storm duration" for all design events meaning that the discharge rates presented from the Microdrainage modelling results may vary slightly from the proposed discharge rates documented within Appendix C - Table C.1 of the surface water drainage design report (Document Ref. HE551497-JAC-HDG-S1_J19-RP-D-0001).

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



Date 15/12/2021
File Proposed Case Drainage Model_S1_OU7A DF3 FEH199...

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Network 2020.1.3

Free Flowing Outfall Details for Proposed Network S1-OU7A

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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3.012	OU7A	22.700	22.100	0.000	0	0
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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



Date 15/12/2021
File Proposed Case Drainage Model_S1_OU7A DF3 FEH199...

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Network 2020.1.3

Online Controls for Proposed Network S1-OU7A

Hydro-Brake® Optimum Manhole: EXCP17, DS/PN: 3.003, Volume (m³): 3.1

Unit Reference	MD-SHE-0150-1150-1350-1150	Objective	Minimise upstream storage	Invert Level (m)	31.170
Design Head (m)	1.350	Application	Surface	Minimum Outlet Pipe Diameter (mm)	225
Design Flow (l/s)	11.5	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	150		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	11.5	Flush-Flo™	0.398	11.4	Kick-Flo®	0.859	9.3	Mean Flow over Head Range	-	9.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.4	0.500	11.3	1.200	10.9	2.000	13.8	3.000	16.8	5.000	21.4	7.000	25.2	9.000	28.4
0.200	10.6	0.600	11.1	1.400	11.7	2.200	14.5	3.500	18.1	5.500	22.4	7.500	26.0	9.500	29.2
0.300	11.3	0.800	10.0	1.600	12.5	2.400	15.1	4.000	19.3	6.000	23.4	8.000	26.9		
0.400	11.4	1.000	10.0	1.800	13.2	2.600	15.7	4.500	20.4	6.500	24.3	8.500	27.7		

Hydro-Brake® Optimum Manhole: Pond - OU7A, DS/PN: 3.011, Volume (m³): 14.9

Unit Reference	MD-SHE-0107-5000-0900-5000	Objective	Minimise upstream storage	Invert Level (m)	22.240
Design Head (m)	0.900	Application	Surface	Minimum Outlet Pipe Diameter (mm)	150
Design Flow (l/s)	5.0	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	107		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Flush-Flo™	0.271	5.0	Kick-Flo®	0.590	4.1	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	0.500	4.6	1.200	5.7	2.000	7.2	3.000	8.8	5.000	11.2	7.000	13.1	9.000	14.8
0.200	4.9	0.600	4.1	1.400	6.1	2.200	7.6	3.500	9.4	5.500	11.7	7.500	13.6	9.500	15.2
0.300	5.0	0.800	4.7	1.600	6.5	2.400	7.9	4.000	10.1	6.000	12.2	8.000	14.0		
0.400	4.9	1.000	5.2	1.800	6.9	2.600	8.2	4.500	10.6	6.500	12.7	8.500	14.4		

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



Date 15/12/2021
File Proposed Case Drainage Model_S1_OU7A DF3 FEH199...

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Network 2020.1.3

Storage Structures for Proposed Network S1-OU7A

Tank or Pond Manhole: Tank, DS/PN: 5.000

Invert Level (m) 31.230

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	120.0	0.100	120.0	0.200	120.0	0.300	120.0	0.400	120.0	0.500	120.0	0.600	120.0	0.601	0.0

Tank or Pond Manhole: Pond - OU7A, DS/PN: 3.011

Invert Level (m) 22.240

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	600.0	0.900	953.3	1.200	1089.2	1.760	1367.0

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



Date 15/12/2021
File Proposed Case Drainage Model_S1_OU7A DF3 FEH199...

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 0 Number of Storage Structures 2 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.284 F (1km) 2.568
FEH Rainfall Version 1999 D2 (1km) 0.251 Cv (Summer) 1.000
Site Location GB 574100 207900 TL 74100 07900 D3 (1km) 0.209 Cv (Winter) 1.000
C (1km) -0.023 E (1km) 0.314

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	KO-04	15 Summer	1	+20%					31.921	-0.071	0.000	0.54			7.3	OK	
3.001	CP03	15 Summer	1	+20%					31.858	-0.086	0.000	0.37			7.3	OK	
4.000	KO-02	15 Summer	1	+20%					31.943	-0.065	0.000	0.61			19.7	OK	
3.002	CP04	15 Summer	1	+20%					31.614	-0.128	0.000	0.38			26.8	OK	
5.000	Tank	15 Summer	1	+20%					31.306	-0.149	0.000	0.16			5.0	OK	
6.000	CP19	15 Summer	1	+20%					31.958	-0.127	0.000	0.39			7.1	OK	
6.001	CP20	15 Summer	1	+20%					31.876	-0.179	0.000	0.09			7.2	OK	
6.002	CP02	15 Summer	1	+20%					31.554	-0.098	0.000	0.32			13.9	OK	
3.003	EXCP17	15 Summer	1	+20%	1/15 Summer				31.525	0.055	0.000	0.13			11.4	SURCHARGED	
7.000	KO-03	15 Summer	1	+20%					31.872	-0.099	0.000	0.25			9.2	OK	
7.001	CP21	15 Summer	1	+20%					31.464	-0.162	0.000	0.17			9.1	OK	
7.002	CP22	15 Summer	1	+20%					31.294	-0.138	0.000	0.31			9.2	OK	
3.004	CP12	15 Summer	1	+20%					31.093	-0.273	0.000	0.17			29.0	OK	
3.005	CP13	15 Summer	1	+20%					30.793	-0.297	0.000	0.10			36.1	OK	
8.000	BDU2	15 Summer	1	+20%					34.145	-0.241	0.000	0.09			21.2	FLOOD RISK*	
8.001	KO-05	15 Summer	1	+20%					33.240	-0.165	0.000	0.16			21.2	FLOOD RISK	
8.002	CP06	15 Summer	1	+20%					32.335	-0.158	0.000	0.19			21.3	OK	
8.003	CP24	15 Summer	1	+20%					31.745	-0.124	0.000	0.42			24.9	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
9.000	BDU1	15	Summer	1	+20%				34.155	-0.240	0.000	0.09		21.3	FLOOD RISK*	
9.001	KO-01	15	Summer	1	+20%				33.238	-0.161	0.000	0.18		21.4	FLOOD RISK	
9.002	CP01	15	Summer	1	+20%				32.507	-0.147	0.000	0.26		21.5	OK	
9.003	CP16	15	Summer	1	+20%				32.139	-0.100	0.000	0.59		30.5	OK	
9.004	EXCP16	15	Summer	1	+20%				31.925	-0.020	0.000	1.00		36.4	OK	
9.005	24	15	Summer	1	+20%				31.725	-0.073	0.000	0.79		36.4	OK	
8.004	EXCP SW IC10	15	Summer	1	+20%				31.268	-0.131	0.000	0.60		69.0	OK	
8.005	CP07	15	Summer	1	+20%				31.043	-0.144	0.000	0.68		71.5	OK	
8.006	CP08	15	Summer	1	+20%				30.902	-0.234	0.000	0.30		72.0	OK	
10.000	CPDN04	15	Summer	1	+20%				31.635	-0.219	0.000	0.01		0.4	OK	
8.007	CP09	15	Summer	1	+20%				30.444	-0.249	0.000	0.25		72.5	OK	
11.000	CPDN05	15	Summer	1	+20%				31.038	-0.220	0.000	0.00		0.3	OK	
8.008	CP10	15	Summer	1	+20%				29.843	-0.252	0.000	0.24		72.6	OK	
12.000	CPDN06	15	Summer	1	+20%				30.369	-0.221	0.000	0.00		0.3	OK	
8.009	CP11	15	Summer	1	+20%				29.262	-0.231	0.000	0.31		72.3	OK	
13.000	CPDN01	15	Summer	1	+20%				31.184	-0.172	0.000	0.13		10.6	OK	
3.006	CP12	15	Summer	1	+20%				28.904	-0.239	0.000	0.28		115.9	OK	
14.000	CPDN02	15	Summer	1	+20%				29.453	-0.176	0.000	0.11		10.5	OK	
15.000	CPDN08	15	Summer	1	+20%				28.183	-0.199	0.000	0.03		2.6	OK	
3.007	CP13	15	Summer	1	+20%				26.390	-0.222	0.000	0.35		126.6	OK	
16.000	CPDN03	15	Summer	1	+20%				26.957	-0.152	0.000	0.23		19.6	OK	
3.008	CP14	15	Summer	1	+20%				23.867	-0.257	0.000	0.38		141.9	OK	
17.000	CPDN03	15	Summer	1	+20%				24.503	-0.128	0.000	0.38		20.9	OK	
3.009	CP15	15	Summer	1	+20%				22.963	-0.165	0.000	0.72		143.1	OK	
3.010	CP18	15	Summer	1	+20%				22.681	-0.243	0.000	0.56		136.1	OK	
3.011	Pond - OU7A	720	Summer	1	+20%				22.525	-0.090	0.000	0.08		5.0	OK	
3.012	CP23	720	Summer	1	+20%				22.248	-0.252	0.000	0.06		5.0	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

Free Flowing Outfall Details for Proposed Network S1-OU7A

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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3.012	OU7A	22.700	22.100	0.000	0	0
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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

Online Controls for Proposed Network S1-OU7A

Hydro-Brake® Optimum Manhole: EXCP17, DS/PN: 3.003, Volume (m³): 3.1

Unit Reference	MD-SHE-0150-1150-1350-1150	Objective	Minimise upstream storage	Invert Level (m)	31.170
Design Head (m)	1.350	Application	Surface	Minimum Outlet Pipe Diameter (mm)	225
Design Flow (l/s)	11.5	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	150		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	11.5	Flush-Flo™	0.398	11.4	Kick-Flo®	0.859	9.3	Mean Flow over Head Range	-	9.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.4	0.500	11.3	1.200	10.9	2.000	13.8	3.000	16.8	5.000	21.4	7.000	25.2	9.000	28.4
0.200	10.6	0.600	11.1	1.400	11.7	2.200	14.5	3.500	18.1	5.500	22.4	7.500	26.0	9.500	29.2
0.300	11.3	0.800	10.0	1.600	12.5	2.400	15.1	4.000	19.3	6.000	23.4	8.000	26.9		
0.400	11.4	1.000	10.0	1.800	13.2	2.600	15.7	4.500	20.4	6.500	24.3	8.500	27.7		

Hydro-Brake® Optimum Manhole: Pond - OU7A, DS/PN: 3.011, Volume (m³): 14.9

Unit Reference	MD-SHE-0107-5000-0900-5000	Objective	Minimise upstream storage	Invert Level (m)	22.240
Design Head (m)	0.900	Application	Surface	Minimum Outlet Pipe Diameter (mm)	150
Design Flow (l/s)	5.0	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	107		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Flush-Flo™	0.271	5.0	Kick-Flo®	0.590	4.1	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	0.500	4.6	1.200	5.7	2.000	7.2	3.000	8.8	5.000	11.2	7.000	13.1	9.000	14.8
0.200	4.9	0.600	4.1	1.400	6.1	2.200	7.6	3.500	9.4	5.500	11.7	7.500	13.6	9.500	15.2
0.300	5.0	0.800	4.7	1.600	6.5	2.400	7.9	4.000	10.1	6.000	12.2	8.000	14.0		
0.400	4.9	1.000	5.2	1.800	6.9	2.600	8.2	4.500	10.6	6.500	12.7	8.500	14.4		

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

Storage Structures for Proposed Network S1-OU7A

Tank or Pond Manhole: Tank, DS/PN: 5.000

Invert Level (m) 31.230

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	120.0	0.100	120.0	0.200	120.0	0.300	120.0	0.400	120.0	0.500	120.0	0.600	120.0	0.601	0.0

Tank or Pond Manhole: Pond - OU7A, DS/PN: 3.011

Invert Level (m) 22.240

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	600.0	0.900	953.3	1.200	1089.2	1.760	1367.0

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 0 Number of Storage Structures 2 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574100 207900 TL 74100 07900 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	KO-04	15 Summer	2	+20%	100/15 Summer				31.919	-0.073	0.000	0.52		7.1	OK	
3.001	CP03	15 Summer	2	+20%	100/15 Summer				31.857	-0.087	0.000	0.36		7.1	OK	
4.000	KO-02	15 Summer	2	+20%	100/15 Summer	100/15 Summer			31.942	-0.066	0.000	0.59		19.2	OK	3
3.002	CP04	15 Summer	2	+20%	100/15 Summer				31.612	-0.130	0.000	0.37		26.0	OK	
5.000	Tank	30 Summer	2	+20%	100/15 Summer				31.303	-0.152	0.000	0.13		4.1	OK	
6.000	CP19	15 Summer	2	+20%	100/15 Summer				31.957	-0.128	0.000	0.38		6.9	OK	
6.001	CP20	15 Summer	2	+20%	100/15 Summer				31.876	-0.179	0.000	0.09		7.0	OK	
6.002	CP02	15 Summer	2	+20%	100/15 Summer				31.552	-0.100	0.000	0.31		13.6	OK	
3.003	EXCP17	15 Summer	2	+20%	2/15 Summer				31.522	0.052	0.000	0.13		11.4	SURCHARGED	
7.000	KO-03	15 Summer	2	+20%					31.871	-0.100	0.000	0.24		8.9	OK	
7.001	CP21	15 Summer	2	+20%					31.463	-0.163	0.000	0.17		8.9	OK	
7.002	CP22	15 Summer	2	+20%					31.292	-0.140	0.000	0.30		8.9	OK	
3.004	CP12	15 Summer	2	+20%					31.092	-0.274	0.000	0.16		28.5	OK	
3.005	CP13	15 Summer	2	+20%					30.793	-0.297	0.000	0.09		35.4	OK	
8.000	BDU2	15 Summer	2	+20%					34.144	-0.242	0.000	0.09		20.6	FLOOD RISK*	
8.001	KO-05	15 Summer	2	+20%					33.239	-0.166	0.000	0.15		20.6	FLOOD RISK	
8.002	CP06	15 Summer	2	+20%	100/15 Summer				32.334	-0.159	0.000	0.19		20.7	OK	
8.003	CP24	15 Summer	2	+20%	100/15 Summer				31.744	-0.125	0.000	0.40		24.2	OK	
9.000	BDU1	15 Summer	2	+20%					34.154	-0.241	0.000	0.09		20.7	FLOOD RISK*	
9.001	KO-01	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.237	-0.162	0.000	0.17		20.8	FLOOD RISK	3

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
9.002	CP01	15 Summer	2	+20%	100/15 Summer				32.505	-0.149	0.000	0.25		20.9	OK	
9.003	CP16	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.137	-0.102	0.000	0.57		29.7	OK	2
9.004	EXCP16	15 Summer	2	+20%	5/15 Summer				31.900	-0.045	0.000	0.98		35.9	OK	
9.005	24	15 Summer	2	+20%	100/15 Summer				31.724	-0.074	0.000	0.78		36.0	OK	
8.004	EXCP SW IC10	15 Summer	2	+20%	100/15 Summer				31.266	-0.133	0.000	0.58		67.3	OK	
8.005	CP07	15 Summer	2	+20%	100/15 Summer				31.040	-0.147	0.000	0.67		70.2	OK	
8.006	CP08	15 Summer	2	+20%					30.900	-0.236	0.000	0.29		70.6	OK	
10.000	CPDN04	15 Summer	2	+20%					31.635	-0.219	0.000	0.01		0.4	OK	
8.007	CP09	15 Summer	2	+20%					30.443	-0.250	0.000	0.24		70.9	OK	
11.000	CPDN05	15 Summer	2	+20%					31.038	-0.220	0.000	0.00		0.3	OK	
8.008	CP10	15 Summer	2	+20%					29.842	-0.253	0.000	0.23		70.9	OK	
12.000	CPDN06	15 Summer	2	+20%					30.368	-0.222	0.000	0.00		0.3	OK	
8.009	CP11	15 Summer	2	+20%					29.261	-0.232	0.000	0.30		70.5	OK	
13.000	CPDN01	15 Summer	2	+20%					31.184	-0.172	0.000	0.12		10.3	OK	
3.006	CP12	15 Summer	2	+20%					28.902	-0.241	0.000	0.28		113.1	OK	
14.000	CPDN02	15 Summer	2	+20%					29.453	-0.176	0.000	0.11		10.2	OK	
15.000	CPDN08	15 Summer	2	+20%					28.183	-0.199	0.000	0.03		2.5	OK	
3.007	CP13	15 Summer	2	+20%	100/15 Summer				26.388	-0.224	0.000	0.34		123.4	OK	
16.000	CPDN03	15 Summer	2	+20%					26.956	-0.153	0.000	0.22		19.0	OK	
3.008	CP14	15 Summer	2	+20%	100/15 Summer				23.865	-0.259	0.000	0.37		138.2	OK	
17.000	CPDN03	15 Summer	2	+20%	100/15 Summer				24.501	-0.130	0.000	0.37		20.3	OK	
3.009	CP15	15 Summer	2	+20%	100/15 Summer				22.956	-0.172	0.000	0.70		139.6	OK	
3.010	CP18	15 Summer	2	+20%	100/15 Summer				22.677	-0.247	0.000	0.55		132.7	OK	
3.011	Pond - OU7A	360 Winter	2	+20%	5/120 Summer				22.605	-0.010	0.000	0.08		5.0	OK	
3.012	CP23	360 Winter	2	+20%					22.249	-0.251	0.000	0.06		5.0	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 0 Number of Storage Structures 2 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574100 207900 TL 74100 07900 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	KO-04	15 Summer	5	+20%	100/15 Summer				31.937	-0.055	0.000	0.72		9.9	OK	
3.001	CP03	15 Summer	5	+20%	100/15 Summer				31.870	-0.074	0.000	0.50		9.8	OK	
4.000	KO-02	15 Summer	5	+20%	100/15 Summer	100/15 Summer			31.963	-0.045	0.000	0.82		26.6	OK	3
3.002	CP04	15 Summer	5	+20%	100/15 Summer				31.648	-0.094	0.000	0.51		36.2	OK	
5.000	Tank	30 Summer	5	+20%	100/15 Summer				31.358	-0.097	0.000	0.27		8.4	OK	
6.000	CP19	15 Summer	5	+20%	100/15 Summer				31.977	-0.108	0.000	0.53		9.6	OK	
6.001	CP20	15 Summer	5	+20%	100/15 Summer				31.883	-0.172	0.000	0.13		9.7	OK	
6.002	CP02	15 Summer	5	+20%	100/15 Summer				31.603	-0.049	0.000	0.42		18.7	OK	
3.003	EXCP17	15 Summer	5	+20%	2/15 Summer				31.568	0.098	0.000	0.13		11.4	SURCHARGED	
7.000	KO-03	15 Summer	5	+20%					31.881	-0.090	0.000	0.34		12.4	OK	
7.001	CP21	15 Summer	5	+20%					31.475	-0.151	0.000	0.23		12.3	OK	
7.002	CP22	15 Summer	5	+20%					31.309	-0.123	0.000	0.42		12.4	OK	
3.004	CP12	15 Summer	5	+20%					31.105	-0.261	0.000	0.20		35.2	OK	
3.005	CP13	15 Summer	5	+20%					30.801	-0.289	0.000	0.12		44.7	OK	
8.000	BDU2	15 Summer	5	+20%					34.158	-0.228	0.000	0.13		28.6	FLOOD RISK*	
8.001	KO-05	15 Summer	5	+20%					33.251	-0.154	0.000	0.21		28.6	FLOOD RISK	
8.002	CP06	15 Summer	5	+20%	100/15 Summer				32.346	-0.147	0.000	0.26		28.7	OK	
8.003	CP24	15 Summer	5	+20%	100/15 Summer				31.765	-0.104	0.000	0.56		33.5	OK	
9.000	BDU1	15 Summer	5	+20%					34.167	-0.228	0.000	0.13		28.8	FLOOD RISK*	
9.001	KO-01	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.249	-0.150	0.000	0.24		28.8	FLOOD RISK	3

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
9.002	CP01	15 Summer	5	+20%	100/15 Summer				32.521	-0.133	0.000	0.35		28.9	OK	
9.003	CP16	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.227	-0.012	0.000	0.77		40.0	OK	2
9.004	EXCP16	15 Summer	5	+20%	5/15 Summer				32.052	0.107	0.000	1.33		48.4	SURCHARGED	
9.005	24	15 Summer	5	+20%	100/15 Summer				31.794	-0.004	0.000	1.00		46.1	OK	
8.004	EXCP SW IC10	15 Summer	5	+20%	100/15 Summer				31.301	-0.098	0.000	0.78		89.6	OK	
8.005	CP07	15 Summer	5	+20%	100/15 Summer				31.093	-0.094	0.000	0.89		93.4	OK	
8.006	CP08	15 Summer	5	+20%					30.924	-0.212	0.000	0.39		94.0	OK	
10.000	CPDN04	15 Summer	5	+20%					31.638	-0.216	0.000	0.01		0.6	OK	
8.007	CP09	15 Summer	5	+20%					30.464	-0.229	0.000	0.32		94.5	OK	
11.000	CPDN05	15 Summer	5	+20%					31.039	-0.219	0.000	0.01		0.5	OK	
8.008	CP10	15 Summer	5	+20%					29.862	-0.233	0.000	0.31		94.5	OK	
12.000	CPDN06	15 Summer	5	+20%					30.370	-0.220	0.000	0.00		0.4	OK	
8.009	CP11	15 Summer	5	+20%					29.285	-0.208	0.000	0.41		94.1	OK	
13.000	CPDN01	15 Summer	5	+20%					31.194	-0.162	0.000	0.17		14.3	OK	
3.006	CP12	15 Summer	5	+20%					28.924	-0.219	0.000	0.36		148.9	OK	
14.000	CPDN02	15 Summer	5	+20%					29.461	-0.168	0.000	0.15		14.2	OK	
15.000	CPDN08	15 Summer	5	+20%					28.187	-0.195	0.000	0.04		3.5	OK	
3.007	CP13	15 Summer	5	+20%	100/15 Summer				26.413	-0.199	0.000	0.45		163.4	OK	
16.000	CPDN03	15 Summer	5	+20%					26.970	-0.139	0.000	0.31		26.4	OK	
3.008	CP14	15 Summer	5	+20%	100/15 Summer				23.900	-0.224	0.000	0.50		184.5	OK	
17.000	CPDN03	15 Summer	5	+20%	100/15 Summer				24.521	-0.110	0.000	0.52		28.2	OK	
3.009	CP15	15 Summer	5	+20%	100/15 Summer				23.107	-0.021	0.000	0.93		185.3	OK	
3.010	CP18	15 Summer	5	+20%	100/15 Summer				22.736	-0.188	0.000	0.73		176.8	OK	
3.011	Pond - OU7A	480 Winter	5	+20%	5/120 Summer				22.705	0.090	0.000	0.08		5.0	SURCHARGED	
3.012	CP23	600 Summer	5	+20%					22.249	-0.251	0.000	0.06		5.0	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 0 Number of Storage Structures 2 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574100 207900 TL 74100 07900 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	KO-04	15 Summer	100	+20%	100/15 Summer				32.488	0.496	0.000	1.52		20.8	FLOOD RISK	
3.001	CP03	15 Summer	100	+20%	100/15 Summer				32.377	0.433	0.000	1.05		20.3	SURCHARGED	
4.000	KO-02	15 Summer	100	+20%	100/15 Summer	100/15 Summer			32.561	0.553	2.202	1.43		46.2	FLOOD	3
3.002	CP04	15 Summer	100	+20%	100/15 Summer				32.146	0.404	0.000	0.87		61.9	SURCHARGED	
5.000	Tank	120 Summer	100	+20%	100/15 Summer				31.653	0.198	0.000	0.35		10.8	SURCHARGED	
6.000	CP19	15 Summer	100	+20%	100/15 Summer				32.131	0.046	0.000	1.12		20.6	SURCHARGED	
6.001	CP20	15 Summer	100	+20%	100/15 Summer				32.098	0.043	0.000	0.29		22.4	SURCHARGED	
6.002	CP02	15 Summer	100	+20%	100/15 Summer				32.067	0.415	0.000	0.95		41.9	SURCHARGED	
3.003	EXCP17	15 Summer	100	+20%	2/15 Summer				31.932	0.462	0.000	0.13		11.4	SURCHARGED	
7.000	KO-03	15 Summer	100	+20%					31.918	-0.053	0.000	0.74		27.1	OK	
7.001	CP21	15 Summer	100	+20%					31.516	-0.110	0.000	0.51		26.9	OK	
7.002	CP22	15 Summer	100	+20%					31.377	-0.055	0.000	0.92		27.1	OK	
3.004	CP12	15 Summer	100	+20%					31.157	-0.209	0.000	0.40		69.3	OK	
3.005	CP13	15 Summer	100	+20%					30.846	-0.244	0.000	0.26		97.2	OK	
8.000	BDU2	15 Summer	100	+20%					34.207	-0.179	0.000	0.27		62.4	FLOOD RISK*	
8.001	KO-05	15 Summer	100	+20%					33.289	-0.116	0.000	0.46		62.4	FLOOD RISK	
8.002	CP06	15 Summer	100	+20%	100/15 Summer				32.705	0.212	0.000	0.55		61.5	SURCHARGED	
8.003	CP24	15 Summer	100	+20%	100/15 Summer				32.520	0.651	0.000	1.21		72.2	SURCHARGED	
9.000	BDU1	15 Summer	100	+20%					34.217	-0.178	0.000	0.28		62.9	FLOOD RISK*	
9.001	KO-01	15 Summer	100	+20%	100/15 Summer	100/15 Summer			33.479	0.080	5.508	0.50		60.3	FLOOD	3

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU7A



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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU7A

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
9.002	CP01	15 Winter	100	+20%	100/15 Summer				33.467	0.813	0.000	0.71		59.0	FLOOD RISK	
9.003	CP16	15 Summer	100	+20%	100/15 Summer	100/15 Summer			33.439	1.200	0.194	1.28		66.5	FLOOD	2
9.004	EXCP16	15 Summer	100	+20%	5/15 Summer				33.159	1.214	0.000	2.24		81.7	FLOOD RISK	
9.005	24	15 Summer	100	+20%	100/15 Summer				32.419	0.621	0.000	1.77		81.4	SURCHARGED	
8.004	EXCP SW IC10	15 Summer	100	+20%	100/15 Summer				31.898	0.499	0.000	1.57		180.6	SURCHARGED	
8.005	CP07	15 Summer	100	+20%	100/15 Summer				31.365	0.178	0.000	1.81		188.8	SURCHARGED	
8.006	CP08	15 Summer	100	+20%					31.015	-0.121	0.000	0.78		187.9	OK	
10.000	CPDN04	15 Summer	100	+20%					31.648	-0.206	0.000	0.02		1.2	OK	
8.007	CP09	15 Summer	100	+20%					30.540	-0.153	0.000	0.65		190.7	OK	
11.000	CPDN05	15 Summer	100	+20%					31.047	-0.211	0.000	0.01		1.0	OK	
8.008	CP10	15 Summer	100	+20%					29.938	-0.157	0.000	0.63		192.3	OK	
12.000	CPDN06	15 Summer	100	+20%					30.376	-0.214	0.000	0.01		0.9	OK	
8.009	CP11	15 Summer	100	+20%					29.382	-0.111	0.000	0.83		192.7	OK	
13.000	CPDN01	15 Summer	100	+20%					31.227	-0.129	0.000	0.37		31.3	OK	
3.006	CP12	15 Summer	100	+20%					29.013	-0.130	0.000	0.73		301.0	OK	
14.000	CPDN02	15 Summer	100	+20%					29.492	-0.137	0.000	0.32		31.0	OK	
15.000	CPDN08	15 Summer	100	+20%					28.203	-0.179	0.000	0.09		7.6	OK	
3.007	CP13	15 Summer	100	+20%	100/15 Summer				26.701	0.089	0.000	0.89		325.8	SURCHARGED	
16.000	CPDN03	15 Summer	100	+20%					27.021	-0.088	0.000	0.67		57.6	OK	
3.008	CP14	15 Summer	100	+20%	100/15 Summer				24.729	0.605	0.000	0.99		365.5	SURCHARGED	
17.000	CPDN03	15 Summer	100	+20%	100/15 Summer				24.903	0.272	0.000	1.11		60.9	SURCHARGED	
3.009	CP15	15 Summer	100	+20%	100/15 Summer				23.779	0.651	0.000	1.83		364.8	SURCHARGED	
3.010	CP18	480 Winter	100	+20%	100/15 Summer				23.171	0.247	0.000	0.26		62.6	SURCHARGED	
3.011	Pond - OU7A	600 Winter	100	+20%	5/120 Summer				23.167	0.552	0.000	0.08		5.0	SURCHARGED	
3.012	CP23	600 Winter	100	+20%					22.249	-0.251	0.000	0.06		5.0	OK	

Project Name	A12 Chelmsford to A120 widening scheme
Project Number	HE551497

File Number	HE551497-JAC-HDG-S1_J19-CA-D-0003				
Document Description	MICRODRAINAGE MODELLING RESULTS FOR PROPOSED CATCHMENT S1-OU10				
Purpose of Issue	S2 - SUITABLE FOR INFORMATION	Status Code	S2		
Current Revision	P01				
Calculation Number	0003	Index Page	1 of 16	Sheet Nos (incl. cover sheet)	16

P01	FIRST ISSUE	LM	AM	AM	DT	07/06/22
Rev	Comments	Originated	Checked	Reviewed	Approved	Date

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Summary

This calculation sheet documents the Microdrainage modelling results (1D analysis) for the proposed highway drainage catchment "Section 1 - Outfall 10 (S1-OU10)" for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events.

It should be noted that the Microdrainage modelling results have been summarised by "the maximum water level for critical storm duration" for all design events meaning that the discharge rates presented from the Microdrainage modelling results may vary slightly from the proposed discharge rates documented within Appendix C - Table C.1 of the surface water drainage design report (Document Ref. HE551497-JAC-HDG-S1_J19-RP-D-0001).

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA...

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Network 2020.1.3

Free Flowing Outfall Details for Proposed network S1-OU10

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.007	IC6 (R)	30.410	28.249	28.249	300	0
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Simulation Criteria for Proposed network S1-OU10

Volumetric Runoff Coeff	1.000	Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000
Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	0.000	Run Time (mins)	120
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coefficient	0.800	Output Interval (mins)	2

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment	Cv (Winter)	0.840
Return Period (years)	100	Summer Storms	Yes	Storm Duration (mins)	60
FEH Rainfall Version	2013	Winter Storms	No		
Site Location	GB 574850 208550 TL 74850 08550	Cv (Summer)	1.000		

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. Section 1
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Date 15/12/2021 Designed by LM

File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA... Checked by AM

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Online Controls for Proposed network S1-OU10

Orifice Manhole: CP23, DS/PN: 1.007, Volume (m³): 7.8

Diameter (m) 0.240 Discharge Coefficient 0.600 Invert Level (m) 28.295

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Section 1
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Date 15/12/2021
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Network 2020.1.3

Storage Structures for Proposed network S1-OU10

Cellular Storage Manhole: TANK, DS/PN: 15.000

Invert Level (m) 28.469 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	110.0	76.0	0.600	110.0	96.9	1.200	110.0	117.8	1.800	0.0	125.2	2.400	0.0	125.2
0.100	110.0	79.5	0.700	110.0	100.4	1.300	110.0	121.3	1.900	0.0	125.2	2.500	0.0	125.2
0.200	110.0	83.0	0.800	110.0	103.9	1.320	110.0	122.0	2.000	0.0	125.2	2.600	0.0	125.2
0.300	110.0	86.5	0.900	110.0	107.4	1.321	0.0	125.2	2.100	0.0	125.2	2.700	0.0	125.2
0.400	110.0	89.9	1.000	110.0	110.9	1.600	0.0	125.2	2.200	0.0	125.2	2.800	0.0	125.2
0.500	110.0	93.4	1.100	110.0	114.4	1.700	0.0	125.2	2.300	0.0	125.2	2.831	0.0	125.2

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Date 15/12/2021
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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.282 F (1km) 2.556
FEH Rainfall Version 1999 D2 (1km) 0.257 Cv (Summer) 1.000
Site Location GB 574850 208550 TL 74850 08550 D3 (1km) 0.212 Cv (Winter) 1.000
C (1km) -0.023 E (1km) 0.314

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP6027	15 Summer	1	+20%					30.903	-0.212	0.000	0.01			1.4	OK	
1.001	CP6032	15 Summer	1	+20%					30.043	-0.277	0.000	0.02			1.4	OK	
2.000	CP01	15 Summer	1	+20%					31.588	-0.112	0.000	0.14			2.2	OK	
2.001	CP02	15 Summer	1	+20%					31.283	-0.117	0.000	0.11			3.2	OK	
1.002	CP SW IC7B (R)	15 Summer	1	+20%					29.684	-0.266	0.000	0.03			4.5	OK	
3.000	CP03	15 Summer	1	+20%					30.499	-0.149	0.000	0.00			0.0	OK	
4.000	CP05	15 Summer	1	+20%					29.934	-0.122	0.000	0.08			1.3	OK	
3.001	CP06	15 Summer	1	+20%					29.705	-0.207	0.000	0.02			1.3	OK	
1.003	CP07	15 Summer	1	+20%					29.361	-0.239	0.000	0.09			5.8	OK	
1.004	CP08	15 Summer	1	+20%					29.272	-0.236	0.000	0.10			5.6	OK	
5.000	CKD01	15 Summer	1	+20%					31.319	-0.236	0.000	0.07			6.7	FLOOD RISK*	
5.001	KO01	15 Summer	1	+20%					30.635	-0.087	0.000	0.36			6.7	OK	
6.000	CP10	15 Summer	1	+20%					29.959	-0.119	0.000	0.09			1.3	OK	
6.001	CP11	15 Summer	1	+20%					29.838	-0.118	0.000	0.10			1.5	OK	
6.002	CP12	15 Summer	1	+20%					29.446	-0.202	0.000	0.02			1.5	OK	
1.005	CP13	15 Summer	1	+20%					29.186	-0.230	0.000	0.12			13.2	OK	
7.000	CKD02	15 Summer	1	+20%					31.017	-0.253	0.000	0.03			2.4	FLOOD RISK*	
7.001	KO02	15 Summer	1	+20%					30.396	-0.104	0.000	0.20			2.3	OK	

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Section 1
Proposed Network S1-OU10



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA...

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.006	CP14	15 Summer	1	+20%					28.924	-0.225	0.000	0.13			15.2	OK	
8.000	CP6029	15 Summer	1	+20%					30.828	-0.187	0.000	0.07			3.2	OK	
9.000	CKD03	15 Summer	1	+20%					32.672	-0.202	0.000	0.18			27.6	FLOOD RISK*	
9.001	KO03	15 Summer	1	+20%					31.403	-0.088	0.000	0.68			27.4	OK	
8.001	CP6030	15 Summer	1	+20%					30.533	-0.185	0.000	0.51			73.3	OK	
8.002	CP15	15 Summer	1	+20%					30.410	-0.171	0.000	0.57			72.9	OK	
10.000	CKD04	15 Summer	1	+20%					31.767	-0.228	0.000	0.10			10.2	FLOOD RISK*	
10.001	KO04	15 Summer	1	+20%					31.132	-0.067	0.000	0.58			10.1	OK	
8.003	CP16	15 Summer	1	+20%					30.309	-0.164	0.000	0.59			82.3	OK	
8.004	CP17	15 Summer	1	+20%					30.193	-0.155	0.000	0.64			82.6	OK	
11.000	CKD05	15 Summer	1	+20%					31.560	-0.182	0.000	0.28			22.0	FLOOD RISK*	
11.001	KO05	15 Summer	1	+20%					30.837	-0.100	0.000	0.58			22.1	OK	
8.005	CP18	15 Summer	1	+20%					30.037	-0.150	0.000	0.66			102.8	OK	
12.000	CKD06	15 Summer	1	+20%					31.228	-0.219	0.000	0.12			9.7	FLOOD RISK*	
12.001	KO06	15 Summer	1	+20%					30.574	-0.067	0.000	0.58			9.7	OK	
8.006	CP19	15 Summer	1	+20%					29.694	-0.204	0.000	0.42			111.7	OK	
13.000	CKD07	15 Summer	1	+20%					30.970	-0.218	0.000	0.13			12.7	FLOOD RISK*	
13.001	KO07	15 Summer	1	+20%					29.978	-0.062	0.000	0.64			12.8	OK	
14.000	CKD08	15 Summer	1	+20%					30.358	-0.227	0.000	0.10			13.3	FLOOD RISK*	
14.001	KO08	15 Summer	1	+20%					29.333	-0.046	0.000	0.81			13.2	OK	
14.002	CP20	15 Summer	1	+20%					28.927	-0.119	0.000	0.34			13.1	OK	
15.000	TANK	15 Summer	1	+20%					28.701	-0.143	0.000	0.45			29.5	OK	
8.007	CP21	15 Summer	1	+20%	1/15 Summer				28.898	0.078	0.000	0.65			69.4	SURCHARGED	
16.000	CKD09	15 Summer	1	+20%					30.796	-0.248	0.000	0.04			4.1	FLOOD RISK*	
16.001	KO09	15 Summer	1	+20%					30.008	-0.101	0.000	0.23			4.1	OK	
17.000	CKD10	15 Summer	1	+20%					30.406	-0.247	0.000	0.04			5.6	FLOOD RISK*	
17.001	KO10	15 Summer	1	+20%					29.236	-0.090	0.000	0.33			5.6	OK	
17.002	CP22	15 Summer	1	+20%					28.895	-0.067	0.000	0.41			5.5	OK	
1.007	CP23	15 Summer	1	+20%	1/15 Summer				28.875	0.130	0.000	0.55			81.0	SURCHARGED	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10



Date 15/12/2021
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Network 2020.1.3

Free Flowing Outfall Details for Proposed network S1-OU10

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	IC6 (R)	30.410	28.249	28.249	300	0

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Network 2020.1.3



Online Controls for Proposed network S1-OU10

Orifice Manhole: CP23, DS/PN: 1.007, Volume (m³): 7.8

Diameter (m) 0.240 Discharge Coefficient 0.600 Invert Level (m) 28.295

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Network 2020.1.3

Storage Structures for Proposed network S1-OU10

Cellular Storage Manhole: TANK, DS/PN: 15.000

Invert Level (m) 28.469 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	110.0	76.0	0.600	110.0	96.9	1.200	110.0	117.8	1.800	0.0	125.2	2.400	0.0	125.2
0.100	110.0	79.5	0.700	110.0	100.4	1.300	110.0	121.3	1.900	0.0	125.2	2.500	0.0	125.2
0.200	110.0	83.0	0.800	110.0	103.9	1.320	110.0	122.0	2.000	0.0	125.2	2.600	0.0	125.2
0.300	110.0	86.5	0.900	110.0	107.4	1.321	0.0	125.2	2.100	0.0	125.2	2.700	0.0	125.2
0.400	110.0	89.9	1.000	110.0	110.9	1.600	0.0	125.2	2.200	0.0	125.2	2.800	0.0	125.2
0.500	110.0	93.4	1.100	110.0	114.4	1.700	0.0	125.2	2.300	0.0	125.2	2.831	0.0	125.2

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Section 1
Proposed Network S1-OU10



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File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA...

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Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP6027	15 Summer	2	+20%					30.903	-0.212	0.000	0.01			1.3	OK	
1.001	CP6032	15 Summer	2	+20%					30.042	-0.278	0.000	0.02			1.3	OK	
2.000	CP01	15 Summer	2	+20%					31.587	-0.113	0.000	0.14			2.1	OK	
2.001	CP02	15 Summer	2	+20%					31.283	-0.117	0.000	0.11			3.1	OK	
1.002	CP SW IC7B (R)	15 Summer	2	+20%					29.684	-0.266	0.000	0.03			4.4	OK	
3.000	CP03	15 Summer	2	+20%					30.499	-0.149	0.000	0.00			0.0	OK	
4.000	CP05	15 Summer	2	+20%					29.934	-0.122	0.000	0.08			1.2	OK	
3.001	CP06	15 Summer	2	+20%					29.704	-0.208	0.000	0.02			1.3	OK	
1.003	CP07	15 Summer	2	+20%					29.360	-0.240	0.000	0.09			5.6	OK	
1.004	CP08	15 Summer	2	+20%					29.271	-0.237	0.000	0.10			5.4	OK	
5.000	CKD01	15 Summer	2	+20%					31.318	-0.237	0.000	0.07			6.5	FLOOD RISK*	
5.001	KO01	15 Summer	2	+20%	100/15 Summer				30.634	-0.088	0.000	0.35			6.4	OK	
6.000	CP10	15 Summer	2	+20%					29.958	-0.120	0.000	0.09			1.3	OK	
6.001	CP11	15 Summer	2	+20%					29.837	-0.119	0.000	0.10			1.4	OK	
6.002	CP12	15 Summer	2	+20%					29.446	-0.202	0.000	0.02			1.4	OK	
1.005	CP13	15 Summer	2	+20%	100/30 Summer				29.185	-0.231	0.000	0.12			12.7	OK	
7.000	CKD02	15 Summer	2	+20%					31.017	-0.253	0.000	0.03			2.3	FLOOD RISK*	
7.001	KO02	15 Summer	2	+20%					30.395	-0.105	0.000	0.19			2.3	OK	
1.006	CP14	15 Summer	2	+20%	100/15 Summer				28.920	-0.229	0.000	0.13			14.6	OK	
8.000	CP6029	15 Summer	2	+20%	100/15 Summer				30.827	-0.188	0.000	0.06			3.1	OK	

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Section 1
Proposed Network S1-OU10



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Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
9.000	CKD03	15 Summer	2	+20%					32.670	-0.204	0.000	0.18			26.5	FLOOD RISK*	
9.001	KO03	15 Summer	2	+20%	100/15 Summer				31.400	-0.091	0.000	0.65			26.3	OK	
8.001	CP6030	15 Summer	2	+20%	100/15 Summer				30.529	-0.189	0.000	0.49			70.4	OK	
8.002	CP15	15 Summer	2	+20%	100/15 Summer				30.405	-0.176	0.000	0.54			70.0	OK	
10.000	CKD04	15 Summer	2	+20%					31.766	-0.229	0.000	0.09			9.8	FLOOD RISK*	
10.001	KO04	15 Summer	2	+20%	100/15 Summer				31.129	-0.070	0.000	0.55			9.7	OK	
8.003	CP16	15 Summer	2	+20%	100/15 Summer				30.304	-0.169	0.000	0.57			79.0	OK	
8.004	CP17	15 Summer	2	+20%	100/15 Summer				30.187	-0.161	0.000	0.62			79.4	OK	
11.000	CKD05	15 Summer	2	+20%					31.558	-0.184	0.000	0.27			21.1	FLOOD RISK*	
11.001	KO05	15 Summer	2	+20%	100/15 Summer				30.834	-0.103	0.000	0.56			21.2	OK	
8.005	CP18	15 Summer	2	+20%	100/15 Summer				30.031	-0.156	0.000	0.63			98.8	OK	
12.000	CKD06	15 Summer	2	+20%					31.226	-0.221	0.000	0.12			9.3	FLOOD RISK*	
12.001	KO06	15 Summer	2	+20%	100/15 Summer				30.572	-0.069	0.000	0.56			9.4	OK	
8.006	CP19	15 Summer	2	+20%	100/15 Summer				29.690	-0.208	0.000	0.41			107.3	OK	
13.000	CKD07	15 Summer	2	+20%					30.968	-0.220	0.000	0.12			12.2	FLOOD RISK*	
13.001	KO07	15 Summer	2	+20%	100/15 Summer				29.976	-0.064	0.000	0.61			12.3	OK	
14.000	CKD08	15 Summer	2	+20%					30.357	-0.228	0.000	0.10			12.8	FLOOD RISK*	
14.001	KO08	15 Summer	2	+20%	5/15 Summer				29.330	-0.049	0.000	0.78			12.7	OK	
14.002	CP20	15 Summer	2	+20%	100/15 Summer				28.920	-0.126	0.000	0.33			12.6	OK	
15.000	TANK	15 Summer	2	+20%	100/15 Summer				28.682	-0.162	0.000	0.43			28.2	OK	
8.007	CP21	15 Summer	2	+20%	2/15 Summer				28.892	0.072	0.000	0.64			68.1	SURCHARGED	
16.000	CKD09	15 Summer	2	+20%					30.795	-0.249	0.000	0.04			4.0	FLOOD RISK*	
16.001	KO09	15 Summer	2	+20%					30.007	-0.102	0.000	0.22			3.9	OK	
17.000	CKD10	15 Summer	2	+20%					30.406	-0.247	0.000	0.04			5.4	FLOOD RISK*	
17.001	KO10	15 Summer	2	+20%	100/15 Summer				29.235	-0.091	0.000	0.32			5.4	OK	
17.002	CP22	15 Summer	2	+20%	5/15 Summer				28.887	-0.075	0.000	0.39			5.3	OK	
1.007	CP23	15 Summer	2	+20%	2/15 Summer				28.854	0.109	0.000	0.55			80.2	SURCHARGED	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA...

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Checked by AM

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Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP6027	15 Summer	5	+20%					30.908	-0.207	0.000	0.02			1.9	OK	
1.001	CP6032	15 Summer	5	+20%					30.051	-0.269	0.000	0.02			1.8	OK	
2.000	CP01	15 Summer	5	+20%					31.595	-0.105	0.000	0.19			3.0	OK	
2.001	CP02	15 Summer	5	+20%					31.289	-0.111	0.000	0.15			4.3	OK	
1.002	CP SW IC7B (R)	15 Summer	5	+20%					29.689	-0.261	0.000	0.04			6.2	OK	
3.000	CP03	15 Summer	5	+20%					30.500	-0.148	0.000	0.00			0.1	OK	
4.000	CP05	15 Summer	5	+20%					29.939	-0.117	0.000	0.11			1.7	OK	
3.001	CP06	15 Summer	5	+20%					29.710	-0.202	0.000	0.02			1.8	OK	
1.003	CP07	15 Summer	5	+20%					29.370	-0.230	0.000	0.13			7.8	OK	
1.004	CP08	15 Summer	5	+20%					29.283	-0.225	0.000	0.14			7.6	OK	
5.000	CKD01	15 Summer	5	+20%					31.327	-0.228	0.000	0.10			9.1	FLOOD RISK*	
5.001	KO01	15 Summer	5	+20%	100/15 Summer				30.648	-0.074	0.000	0.50			9.1	OK	
6.000	CP10	15 Summer	5	+20%					29.964	-0.114	0.000	0.13			1.8	OK	
6.001	CP11	15 Summer	5	+20%					29.843	-0.113	0.000	0.14			2.0	OK	
6.002	CP12	15 Summer	5	+20%					29.448	-0.200	0.000	0.03			2.0	OK	
1.005	CP13	15 Summer	5	+20%	100/30 Summer				29.199	-0.217	0.000	0.17			18.1	OK	
7.000	CKD02	15 Summer	5	+20%					31.021	-0.249	0.000	0.04			3.2	FLOOD RISK*	
7.001	KO02	15 Summer	5	+20%					30.404	-0.096	0.000	0.27			3.2	OK	
1.006	CP14	15 Summer	5	+20%	100/15 Summer				28.946	-0.203	0.000	0.19			21.5	OK	
8.000	CP6029	15 Summer	5	+20%	100/15 Summer				30.836	-0.179	0.000	0.09			4.4	OK	

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Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA...

A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10



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Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
9.000	CKD03	15 Summer	5	+20%					32.686	-0.188	0.000	0.25			37.5	FLOOD RISK*	
9.001	KO03	15 Summer	5	+20%	100/15 Summer				31.437	-0.054	0.000	0.92			37.3	OK	
8.001	CP6030	15 Summer	5	+20%	100/15 Summer				30.574	-0.144	0.000	0.69			99.6	OK	
8.002	CP15	15 Summer	5	+20%	100/15 Summer				30.457	-0.124	0.000	0.77			99.0	OK	
10.000	CKD04	15 Summer	5	+20%					31.778	-0.217	0.000	0.13			13.9	FLOOD RISK*	
10.001	KO04	15 Summer	5	+20%	100/15 Summer				31.150	-0.049	0.000	0.78			13.8	OK	
8.003	CP16	15 Summer	5	+20%	100/15 Summer				30.358	-0.115	0.000	0.81			112.3	OK	
8.004	CP17	15 Summer	5	+20%	100/15 Summer				30.246	-0.102	0.000	0.87			112.2	OK	
11.000	CKD05	15 Summer	5	+20%					31.579	-0.163	0.000	0.38			29.8	FLOOD RISK*	
11.001	KO05	15 Summer	5	+20%	100/15 Summer				30.866	-0.071	0.000	0.79			30.0	OK	
8.005	CP18	15 Summer	5	+20%	100/15 Summer				30.092	-0.095	0.000	0.89			140.0	OK	
12.000	CKD06	15 Summer	5	+20%					31.241	-0.206	0.000	0.17			13.2	FLOOD RISK*	
12.001	KO06	15 Summer	5	+20%	100/15 Summer				30.593	-0.048	0.000	0.79			13.2	OK	
8.006	CP19	15 Summer	5	+20%	100/15 Summer				29.728	-0.170	0.000	0.58			151.3	OK	
13.000	CKD07	15 Summer	5	+20%					30.983	-0.205	0.000	0.18			17.3	FLOOD RISK*	
13.001	KO07	15 Summer	5	+20%	100/15 Summer				29.999	-0.041	0.000	0.86			17.4	OK	
14.000	CKD08	15 Summer	5	+20%					30.369	-0.216	0.000	0.14			18.1	FLOOD RISK*	
14.001	KO08	15 Summer	5	+20%	5/15 Summer				29.389	-0.010	0.000	1.10			18.0	SURCHARGED	
14.002	CP20	15 Summer	5	+20%	100/15 Summer				28.998	-0.048	0.000	0.44			17.0	OK	
15.000	TANK	15 Summer	5	+20%	100/15 Summer				28.843	-0.001	0.000	0.68			44.4	OK	
8.007	CP21	15 Summer	5	+20%	2/15 Summer				28.957	0.137	0.000	0.67			72.2	SURCHARGED	
16.000	CKD09	15 Summer	5	+20%					30.801	-0.243	0.000	0.05			5.6	FLOOD RISK*	
16.001	KO09	15 Summer	5	+20%					30.017	-0.092	0.000	0.32			5.6	OK	
17.000	CKD10	15 Summer	5	+20%					30.412	-0.241	0.000	0.06			7.6	FLOOD RISK*	
17.001	KO10	15 Summer	5	+20%	100/15 Summer				29.248	-0.078	0.000	0.45			7.6	OK	
17.002	CP22	15 Summer	5	+20%	5/15 Summer				28.981	0.019	0.000	0.56			7.5	SURCHARGED	
1.007	CP23	15 Summer	5	+20%	2/15 Summer				28.905	0.160	0.000	0.58			84.3	SURCHARGED	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA...

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Checked by AM

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Network 2020.1.3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP6027	15 Summer	100	+20%					30.918	-0.197	0.000	0.04			4.1	OK	
1.001	CP6032	15 Summer	100	+20%					30.062	-0.258	0.000	0.05			4.0	OK	
2.000	CP01	15 Summer	100	+20%					31.618	-0.082	0.000	0.41			6.5	OK	
2.001	CP02	15 Summer	100	+20%					31.313	-0.087	0.000	0.36			10.1	OK	
1.002	CP SW IC7B (R)	15 Summer	100	+20%					29.712	-0.238	0.000	0.10			14.2	OK	
3.000	CP03	15 Summer	100	+20%					30.502	-0.146	0.000	0.01			0.1	OK	
4.000	CP05	15 Summer	100	+20%					29.955	-0.101	0.000	0.24			3.8	OK	
3.001	CP06	15 Summer	100	+20%					29.719	-0.193	0.000	0.05			3.8	OK	
1.003	CP07	30 Winter	100	+20%					29.475	-0.125	0.000	0.21			13.1	OK	
1.004	CP08	30 Winter	100	+20%					29.471	-0.037	0.000	0.23			12.8	OK	
5.000	CKD01	15 Summer	100	+20%					31.358	-0.197	0.000	0.21			19.9	FLOOD RISK*	
5.001	KO01	15 Summer	100	+20%	100/15 Summer				30.732	0.010	0.000	1.07			19.7	SURCHARGED	
6.000	CP10	15 Summer	100	+20%					29.982	-0.096	0.000	0.28			4.0	OK	
6.001	CP11	15 Summer	100	+20%					29.863	-0.093	0.000	0.30			4.5	OK	
6.002	CP12	30 Winter	100	+20%					29.468	-0.180	0.000	0.05			3.3	OK	
1.005	CP13	30 Winter	100	+20%	100/30 Summer				29.468	0.052	0.000	0.28			29.2	SURCHARGED	
7.000	CKD02	15 Summer	100	+20%					31.036	-0.234	0.000	0.08			7.0	FLOOD RISK*	
7.001	KO02	15 Summer	100	+20%					30.434	-0.066	0.000	0.59			6.9	OK	
1.006	CP14	30 Winter	100	+20%	100/15 Summer				29.459	0.310	0.000	0.24			28.3	SURCHARGED	
8.000	CP6029	15 Summer	100	+20%	100/15 Summer				31.839	0.824	0.000	0.18			8.9	SURCHARGED	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10_FREE OUTFA...

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Network 2020.1.3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed network S1-OU10

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
9.000	CKD03	15 Summer	100	+20%					32.741	-0.133	0.000	0.55			81.4	FLOOD RISK*	
9.001	KO03	15 Summer	100	+20%	100/15 Summer				31.999	0.508	0.000	1.89			76.7	FLOOD RISK	
8.001	CP6030	15 Summer	100	+20%	100/15 Summer				31.821	1.103	0.000	1.31			189.6	FLOOD RISK	
8.002	CP15	15 Summer	100	+20%	100/15 Summer				31.636	1.055	0.000	1.39			178.5	FLOOD RISK	
10.000	CKD04	15 Summer	100	+20%					31.814	-0.181	0.000	0.29			30.1	FLOOD RISK*	
10.001	KO04	15 Summer	100	+20%	100/15 Summer				31.658	0.459	0.000	1.68			29.6	FLOOD RISK	
8.003	CP16	15 Summer	100	+20%	100/15 Summer				31.501	1.028	0.000	1.45			201.2	FLOOD RISK	
8.004	CP17	15 Summer	100	+20%	100/15 Summer				31.326	0.978	0.000	1.49			191.5	FLOOD RISK	
11.000	CKD05	15 Summer	100	+20%					31.667	-0.075	0.000	0.82			64.8	FLOOD RISK*	
11.001	KO05	15 Summer	100	+20%	100/15 Summer				31.222	0.285	0.000	1.72			65.2	FLOOD RISK	
8.005	CP18	15 Summer	100	+20%	100/15 Summer				31.059	0.872	0.000	1.55			242.2	SURCHARGED	
12.000	CKD06	15 Summer	100	+20%					31.281	-0.166	0.000	0.36			28.5	FLOOD RISK*	
12.001	KO06	15 Summer	100	+20%	100/15 Summer				30.782	0.141	0.000	1.72			28.8	SURCHARGED	
8.006	CP19	15 Summer	100	+20%	100/15 Summer				30.433	0.535	0.000	0.98			257.3	SURCHARGED	
13.000	CKD07	15 Summer	100	+20%					31.025	-0.163	0.000	0.38			37.4	FLOOD RISK*	
13.001	KO07	15 Summer	100	+20%	100/15 Summer				30.306	0.266	0.000	1.88			37.8	FLOOD RISK	
14.000	CKD08	15 Summer	100	+20%					30.406	-0.179	0.000	0.29			39.3	FLOOD RISK*	
14.001	KO08	15 Summer	100	+20%	5/15 Summer				29.762	0.383	0.000	2.36			38.5	FLOOD RISK	
14.002	CP20	30 Winter	100	+20%	100/15 Summer				29.562	0.516	0.000	0.70			27.0	SURCHARGED	
15.000	TANK	30 Summer	100	+20%	100/15 Summer				29.524	0.680	0.000	0.89			57.6	SURCHARGED	
8.007	CP21	30 Winter	100	+20%	2/15 Summer				29.541	0.721	0.000	1.00			107.4	SURCHARGED	
16.000	CKD09	15 Summer	100	+20%					30.820	-0.224	0.000	0.11			12.2	FLOOD RISK*	
16.001	KO09	15 Summer	100	+20%					30.052	-0.057	0.000	0.69			12.1	OK	
17.000	CKD10	15 Summer	100	+20%					30.432	-0.221	0.000	0.12			16.6	FLOOD RISK*	
17.001	KO10	15 Summer	100	+20%	100/15 Summer				29.531	0.205	0.000	0.97			16.2	SURCHARGED	
17.002	CP22	15 Summer	100	+20%	5/15 Summer				29.487	0.525	0.000	1.05			14.2	SURCHARGED	
1.007	CP23	30 Winter	100	+20%	2/15 Summer				29.449	0.704	0.000	0.83			121.8	SURCHARGED	

Project Name	A12 Chelmsford to A120 widening scheme
Project Number	HE551497

File Number	HE551497-JAC-HDG-S1_J19-CA-D-0004			
Document Description	MICRODRAINAGE MODELLING RESULTS FOR PROPOSED CATCHMENT S1-OU10A			
Purpose of Issue	S2 - SUITABLE FOR INFORMATION	Status Code	S2	
Current Revision	P01			
Calculation Number	0004	Index Page	1 of 12	Sheet Nos (incl. cover sheet) 12

P01	FIRST ISSUE	LM	AM	AM	DT	07/06/22
Rev	Comments	Originated	Checked	Reviewed	Approved	Date

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Summary

This calculation sheet documents the Microdrainage modelling results (1D analysis) for the proposed highway drainage catchment "Section 1 - Outfall 10A (S1-OU10A) for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events.

It should be noted that the Microdrainage modelling results have been summarised by "the maximum water level for critical storm duration" for all design events meaning that the discharge rates presented from the Microdrainage modelling results may vary slightly from the proposed discharge rates documented within Appendix C - Table C.1 of the surface water drainage design report (Document Ref. HE551497-JAC-HDG-S1_J19-RP-D-0001).

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10A.MDX

Designed by LM
Checked by AM

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Network 2020.1.3

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.005	OU10A	28.380	26.955	26.219	0	0
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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10A.MDX

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Network 2020.1.3

Online Controls for Storm

Hydro-Brake® Optimum Manhole: CP05, DS/PN: 1.004, Volume (m³): 3.6

Unit Reference	MD-SHE-0107-5000-0900-5000	Objective	Minimise upstream storage	Invert Level (m)	27.537
Design Head (m)	0.900	Application	Surface	Minimum Outlet Pipe Diameter (mm)	150
Design Flow (l/s)	5.0	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	107		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Flush-Flo™	0.271	5.0	Kick-Flo®	0.590	4.1	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	0.500	4.6	1.200	5.7	2.000	7.2	3.000	8.8	5.000	11.2	7.000	13.1	9.000	14.8
0.200	4.9	0.600	4.1	1.400	6.1	2.200	7.6	3.500	9.4	5.500	11.7	7.500	13.6	9.500	15.2
0.300	5.0	0.800	4.7	1.600	6.5	2.400	7.9	4.000	10.1	6.000	12.2	8.000	14.0		
0.400	4.9	1.000	5.2	1.800	6.9	2.600	8.2	4.500	10.6	6.500	12.7	8.500	14.4		

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10A.MDX

Designed by LM
Checked by AM

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Network 2020.1.3

Storage Structures for Storm

Cellular Storage Manhole: TANK, DS/PN: 2.000

Invert Level (m) 27.549 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	45.0	45.0	0.400	45.0	55.7	0.800	45.0	66.5	1.200	45.0	77.2	2.326	0.0	80.4
0.100	45.0	47.7	0.500	45.0	58.4	0.900	45.0	69.1	1.300	45.0	79.9			
0.200	45.0	50.4	0.600	45.0	61.1	1.000	45.0	71.8	1.320	45.0	80.4			
0.300	45.0	53.0	0.700	45.0	63.8	1.100	45.0	74.5	1.321	0.0	80.4			

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU10A.MDX

Designed by LM
Checked by AM

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.282 F (1km) 2.556
FEH Rainfall Version 1999 D2 (1km) 0.257 Cv (Summer) 1.000
Site Location GB 574850 208550 TL 74850 08550 D3 (1km) 0.212 Cv (Winter) 1.000
C (1km) -0.023 E (1km) 0.314

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Surcharged Flooded			Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
									Level (m)	Depth (m)	Volume (m ³)						
1.000	CP01	15 Summer	1	+20%					29.497	-0.178	0.000	0.09			5.0		OK
1.001	CP02	15 Summer	1	+20%					29.050	-0.150	0.000	0.24			11.7		OK
1.002	CP03	15 Summer	1	+20%					28.660	-0.146	0.000	0.26			13.0		OK
1.003	CP04	15 Summer	1	+20%					28.231	-0.150	0.000	0.24			14.5		OK
2.000	TANK	30 Summer	1	+20%					27.711	-0.063	0.000	0.17			4.1		OK
1.004	CP05	15 Summer	1	+20%	1/15	Summer			27.798	0.036	0.000	0.11			5.0	SURCHARGED	
1.005	CP06	30 Summer	1	+20%					27.463	-0.187	0.000	0.07			5.0		OK

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A12 Chelmsford to A120widening
 Section 1
 Proposed Network S1-OU10A



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Network 2019.1

Free Flowing Outfall Details for Proposed Network S1-OU10A

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005	OU10A	28.380	26.955	26.219	0	0

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



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Network 2019.1

Online Controls for Proposed Network S1-OU10A

Hydro-Brake® Optimum Manhole: CP05, DS/PN: 1.004, Volume (m³): 3.6

Unit Reference	MD-SHE-0107-5000-0900-5000	Objective	Minimise upstream storage	Invert Level (m)	27.537
Design Head (m)	0.900	Application	Surface	Minimum Outlet Pipe Diameter (mm)	150
Design Flow (l/s)	5.0	Sump Available	Yes	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	107		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	5.0	Flush-Flo™	0.271	5.0	Kick-Flo®	0.590	4.1	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	0.500	4.6	1.200	5.7	2.000	7.2	3.000	8.8	5.000	11.2	7.000	13.1	9.000	14.8
0.200	4.9	0.600	4.1	1.400	6.1	2.200	7.6	3.500	9.4	5.500	11.7	7.500	13.6	9.500	15.2
0.300	5.0	0.800	4.7	1.600	6.5	2.400	7.9	4.000	10.1	6.000	12.2	8.000	14.0		
0.400	4.9	1.000	5.2	1.800	6.9	2.600	8.2	4.500	10.6	6.500	12.7	8.500	14.4		

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



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Network 2019.1

Storage Structures for Proposed Network S1-OU10A

Cellular Storage Manhole: TANK, DS/PN: 2.000

Invert Level (m) 27.549 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	45.0	45.0	0.400	45.0	55.7	0.800	45.0	66.5	1.200	45.0	77.2	2.326	0.0	80.4
0.100	45.0	47.7	0.500	45.0	58.4	0.900	45.0	69.1	1.300	45.0	79.9			
0.200	45.0	50.4	0.600	45.0	61.1	1.000	45.0	71.8	1.320	45.0	80.4			
0.300	45.0	53.0	0.700	45.0	63.8	1.100	45.0	74.5	1.321	0.0	80.4			

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



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Network 2019.1

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU10A

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP01	15 Summer	2	+20%					29.496	-0.179	0.000	0.09		4.8	OK	
1.001	CP02	15 Summer	2	+20%					29.048	-0.152	0.000	0.23		11.2	OK	
1.002	CP03	15 Summer	2	+20%					28.658	-0.148	0.000	0.25		12.5	OK	
1.003	CP04	15 Summer	2	+20%	100/15 Summer				28.230	-0.151	0.000	0.23		13.9	OK	
2.000	TANK	120 Summer	2	+20%	5/15 Summer				27.731	-0.043	0.000	0.11		2.7	OK	
1.004	CP05	15 Summer	2	+20%	2/15 Summer				27.796	0.034	0.000	0.11		5.0	SURCHARGED	
1.005	CP06	30 Summer	2	+20%					27.463	-0.187	0.000	0.07		5.0	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



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Network 2019.1

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU10A

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP01	15 Summer	5	+20%					29.504	-0.171	0.000	0.13		6.8	OK	
1.001	CP02	15 Summer	5	+20%					29.064	-0.136	0.000	0.32		15.9	OK	
1.002	CP03	15 Summer	5	+20%					28.675	-0.131	0.000	0.36		17.8	OK	
1.003	CP04	15 Summer	5	+20%	100/15 Summer				28.245	-0.136	0.000	0.33		19.7	OK	
2.000	TANK	120 Summer	5	+20%	5/15 Summer				27.845	0.071	0.000	0.17		4.2	SURCHARGED	
1.004	CP05	120 Summer	5	+20%	2/15 Summer				27.846	0.084	0.000	0.11		5.0	SURCHARGED	
1.005	CP06	30 Winter	5	+20%					27.463	-0.187	0.000	0.07		5.0	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU10A



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Network 2019.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU10A

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP01	15 Summer	100	+20%					29.532	-0.143	0.000	0.28		14.7	OK	
1.001	CP02	15 Summer	100	+20%					29.135	-0.065	0.000	0.81		39.7	OK	
1.002	CP03	15 Summer	100	+20%					28.763	-0.043	0.000	0.91		45.2	OK	
1.003	CP04	120 Summer	100	+20%	100/15 Summer				28.456	0.075	0.000	0.39		23.6	SURCHARGED	
2.000	TANK	120 Summer	100	+20%	5/15 Summer				28.446	0.672	0.000	0.19		4.6	SURCHARGED	
1.004	CP05	120 Summer	100	+20%	2/15 Summer				28.447	0.685	0.000	0.11		5.0	SURCHARGED	
1.005	CP06	120 Summer	100	+20%					27.463	-0.187	0.000	0.07		5.0	OK	

Project Name	A12 Chelmsford to A120 widening scheme
Project Number	HE551497

File Number	HE551497-JAC-HDG-S1_J19-CA-D-0005			
Document Description	MICRODRAINAGE MODELLING RESULTS FOR PROPOSED CATCHMENT S1-OU11 & 12			
Purpose of Issue	S2 - SUITABLE FOR INFORMATION	Status Code	S2	
Current Revision	P01			
Calculation Number	0005	Index Page	1 of 32	Sheet Nos (incl. cover sheet) 32

P01	FIRST ISSUE	LM	AM	AM	DT	07/06/22
Rev	Comments	Originated	Checked	Reviewed	Approved	Date

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Summary

This calculation sheet documents the Microdrainage modelling results (1D analysis) for the proposed highway drainage catchments "Section 1 - Outfalls 11 & 12 (S1-OU11 & S1-OU12) for the 1 in 1, 1 in 2, 1 in 5 and 1 in 100 year return period design events.

It should be noted that the Microdrainage modelling results have been summarised by "the maximum water level for critical storm duration" for all design events meaning that the discharge rates presented from the Microdrainage modelling results may vary slightly from the proposed discharge rates documented within Appendix C - Table C.1 of the surface water drainage design report (Document Ref. HE551497-JAC-HDG-S1_J19-RP-D-0001).

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Date 15/12/2021
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Network 2020.1.3

Free Flowing Outfall Details for Proposed Network S1-OU11&12

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.006	OU11	24.482	23.262	22.600	675	0
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Free Flowing Outfall Details for Proposed Network S1-OU11&12

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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39.009	Proposed OU12	25.000	24.016	24.016	600	0
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Simulation Criteria for Proposed Network S1-OU11&12

Volumetric Runoff Coeff	1.000	Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000
Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	0.000	Run Time (mins)	60
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coefficient	0.800	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 7 Number of Storage Structures 4 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment	Cv (Winter)	0.840
Return Period (years)	100	Summer Storms	Yes	Storm Duration (mins)	30
FEH Rainfall Version	2013	Winter Storms	No		
Site Location	GB 574850 208550 TL 74850 08550	Cv (Summer)	1.000		

. A12 Chelmsford to A120widening
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Network 2020.1.3



Online Controls for Proposed Network S1-OU11&12

Orifice Manhole: Pond Outlet 1, DS/PN: 1.006, Volume (m³): 50.8

Diameter (m) 0.224 Discharge Coefficient 0.600 Invert Level (m) 25.900

Orifice Manhole: Pond Outlet 2, DS/PN: 39.009, Volume (m³): 5.4

Diameter (m) 0.595 Discharge Coefficient 0.600 Invert Level (m) 25.700

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Section 1
Proposed Network S1-OU11 & 12



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Network 2020.1.3

Storage Structures for Proposed Network S1-OU11&12

Infiltration Trench Manhole: CP179, DS/PN: 19.000

Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.20 Trench Length (m) 46.0 Cap Infiltration Depth (m) 0.000
 Infiltration Coefficient Side (m/hr) 0.00000 Invert Level (m) 33.789 Slope (1:X) 200.0
 Safety Factor 2.0 Trench Width (m) 1.0 Cap Volume Depth (m) 0.000

Infiltration Trench Manhole: CP180, DS/PN: 19.001

Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.20 Trench Length (m) 52.6 Cap Infiltration Depth (m) 0.000
 Infiltration Coefficient Side (m/hr) 0.00000 Invert Level (m) 33.614 Slope (1:X) 300.6
 Safety Factor 2.0 Trench Width (m) 1.0 Cap Volume Depth (m) 0.000

Tank or Pond Manhole: Pond Outlet 1, DS/PN: 1.006

Invert Level (m) 25.900

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1200.0	0.900	1682.8	1.200	1861.8

Tank or Pond Manhole: Pond Outlet 2, DS/PN: 39.009

Invert Level (m) 25.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	500.0	0.900	826.1	1.200	952.9

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Date 15/12/2021
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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
 Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
 Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 7 Number of Storage Structures 4 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.282 F (1km) 2.556
 FEH Rainfall Version 1999 D2 (1km) 0.257 Cv (Summer) 1.000
 Site Location GB 574850 208550 TL 74850 08550 D3 (1km) 0.212 Cv (Winter) 1.000
 C (1km) -0.023 E (1km) 0.314

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
 Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
 DTS Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
 Return Period(s) (years) 1
 Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP153	15 Summer	1	+20%					31.603	-0.182	0.000	0.08		2.9		OK	
1.001	CP154	15 Summer	1	+20%					31.422	-0.133	0.000	0.35		14.6		OK	
2.000	CP2015	15 Summer	1	+20%					32.096	-0.294	0.000	0.00		0.3		OK	
3.000	CP175	15 Summer	1	+20%					32.303	-0.287	0.000	0.01		0.8		OK	
2.001	CP2013	15 Summer	1	+20%					30.025	-0.365	0.000	0.02		1.4		OK	
1.002	CP155	15 Summer	1	+20%					30.022	-0.328	0.000	0.16		29.0		OK	
4.000	CP1	15 Summer	1	+20%					33.819	-0.289	0.000	0.01		0.8		OK	
4.001	CP2	15 Summer	1	+20%					33.500	-0.255	0.000	0.05		5.5		OK	
4.002	CP3	15 Summer	1	+20%					33.131	-0.234	0.000	0.11		10.8		OK	
4.003	CP4	15 Summer	1	+20%					32.833	-0.217	0.000	0.17		17.6		OK	
4.004	CP5	15 Summer	1	+20%					32.418	-0.200	0.000	0.24		24.9		OK	
5.000	DN18	15 Summer	1	+20%					34.851	-0.228	0.000	0.13		21.0		OK	
5.001	CP77	15 Summer	1	+20%					34.381	-0.200	0.000	0.24		35.1		OK	
5.002	CP78	15 Summer	1	+20%					33.864	-0.204	0.000	0.22		34.8		OK	
5.003	CP6	15 Summer	1	+20%					33.454	-0.186	0.000	0.30		43.0		OK	
5.004	CP7	15 Summer	1	+20%					32.874	-0.216	0.000	0.37		51.4		OK	
5.005	CP8	15 Summer	1	+20%					32.650	-0.173	0.000	0.44		53.1		OK	
6.000	DIT03	15 Summer	1	+20%					37.336	-0.487	0.000	0.00		3.6		OK	

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Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU11 & OU12.MDX

A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.001	DIT04	15 Summer	1	+20%					35.770	-0.460	0.000	0.01			10.0	OK	
6.002	DIT05	15 Summer	1	+20%					34.969	-0.431	0.000	0.03			13.0	OK	
7.000	DIT01	15 Summer	1	+20%					35.888	-0.462	0.000	0.01			9.1	OK	
7.001	DIT02	15 Summer	1	+20%					35.254	-0.446	0.000	0.02			13.7	OK	
6.003	DN02	15 Summer	1	+20%					34.715	-0.147	0.000	0.26			26.3	OK	
8.000	DN30	15 Summer	1	+20%					33.904	-0.219	0.000	0.01			0.4	OK	
6.004	CP10	15 Summer	1	+20%					33.629	-0.184	0.000	0.31			29.0	OK	
6.005	CP11	15 Summer	1	+20%					33.123	-0.181	0.000	0.33			30.5	OK	
6.006	CP173	15 Summer	1	+20%					32.794	-0.285	0.000	0.13			30.6	OK	
5.006	CP174	15 Summer	1	+20%					32.623	-0.106	0.000	0.86			79.2	OK	
5.007	CP9	15 Summer	1	+20%					32.560	-0.119	0.000	0.79			81.1	OK	
9.000	CP12	15 Summer	1	+20%					33.003	-0.261	0.000	0.04			2.1	OK	
9.001	CP13	15 Summer	1	+20%					32.909	-0.254	0.000	0.06			2.9	OK	
5.008	CP14	15 Summer	1	+20%					32.450	-0.126	0.000	0.76			81.1	OK	
10.000	DN20	15 Summer	1	+20%					33.535	-0.157	0.000	0.20			7.1	OK	
5.009	CP15	15 Summer	1	+20%					32.291	-0.116	0.000	0.81			81.8	OK	
11.000	DN21	15 Summer	1	+20%					33.396	-0.189	0.000	0.06			2.5	OK	
5.010	CP16	15 Summer	1	+20%					32.188	-0.126	0.000	0.76			80.7	OK	
12.000	DN22	15 Summer	1	+20%					33.307	-0.196	0.000	0.04			1.6	OK	
5.011	CP17	15 Summer	1	+20%					32.054	-0.099	0.000	0.89			79.8	OK	
4.005	CP18	15 Summer	1	+20%					31.995	-0.116	0.000	0.81			85.8	OK	
13.000	DN23	15 Summer	1	+20%					32.793	-0.124	0.000	0.42			13.0	OK	
4.006	CP19	15 Summer	1	+20%					31.774	-0.188	0.000	0.58			86.8	OK	
14.000	DN03	15 Summer	1	+20%					32.662	-0.109	0.000	0.52			15.1	OK	
15.000	CP20	15 Summer	1	+20%					33.005	-0.215	0.000	0.01			0.6	OK	
16.000	CP3182A	15 Summer	1	+20%					33.584	-0.155	0.000	0.21			8.8	OK	
16.001	CP21	15 Summer	1	+20%					33.224	-0.155	0.000	0.21			10.4	OK	
17.000	DN04	15 Summer	1	+20%					32.959	-0.188	0.000	0.06			1.8	OK	
18.000	DN05	15 Summer	1	+20%					33.314	-0.200	0.000	0.03			1.9	OK	
17.001	CP22	15 Summer	1	+20%					32.827	-0.147	0.000	0.13			3.5	OK	
16.002	CP23	15 Summer	1	+20%					32.817	-0.121	0.000	0.41			12.8	OK	
15.001	CP24	15 Summer	1	+20%					32.526	-0.168	0.000	0.14			13.4	OK	
19.000	CP179	15 Summer	1	+20%					34.140	-0.179	0.000	0.32			21.3	OK	
19.001	CP180	15 Summer	1	+20%					33.955	-0.134	0.000	0.55			29.7	OK	
19.002	CP181	15 Summer	1	+20%					33.788	-0.126	0.000	0.62			32.2	OK	
20.000	DN31	15 Summer	1	+20%					35.395	-0.193	0.000	0.05			2.9	OK	
20.001	CP177	15 Summer	1	+20%					33.895	-0.194	0.000	0.05			2.9	OK	
19.003	CP182	15 Summer	1	+20%					33.700	-0.129	0.000	0.60			39.4	OK	
19.004	CP183	15 Summer	1	+20%					33.478	-0.108	0.000	0.70			47.0	OK	
19.005	CP184	30 Summer	1	+20%					32.977	-0.161	0.000	0.43			46.3	OK	
21.000	CPDN15	15 Summer	1	+20%					33.318	-0.191	0.000	0.28			22.0	OK	
22.000	CP47	15 Summer	1	+20%					34.326	-0.204	0.000	0.02			0.8	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Date 15/12/2021
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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
22.001	CP48	15 Summer	1	+20%					33.979	-0.179	0.000	0.03			1.1	OK	
22.002	CP33	15 Summer	1	+20%					33.977	-0.117	0.000	0.61			37.7	OK	
22.003	CP34	15 Summer	1	+20%					33.598	-0.124	0.000	0.62			38.2	OK	
22.004	CP35	15 Summer	1	+20%					33.350	-0.123	0.000	0.63			38.5	OK	
22.005	CP36	15 Summer	1	+20%					33.097	-0.124	0.000	0.62			38.5	OK	
22.006	CP37	15 Summer	1	+20%					32.794	-0.124	0.000	0.63			38.2	OK	
22.007	CP80	15 Summer	1	+20%					32.507	-0.203	0.000	0.23			38.4	OK	
19.006	CP185	15 Summer	1	+20%					32.082	-0.164	0.000	0.61			87.8	OK	
15.002	CP25	30 Summer	1	+20%					31.918	-0.191	0.000	0.49			94.2	OK	
4.007	CP26	15 Summer	1	+20%					31.695	-0.169	0.000	0.80			178.1	OK	
23.000	DN06	15 Summer	1	+20%					32.547	-0.155	0.000	0.21			9.2	OK	
4.008	CP27	30 Summer	1	+20%					31.618	-0.187	0.000	0.74			179.8	OK	
24.000	DN07	15 Summer	1	+20%					32.575	-0.151	0.000	0.23			11.0	OK	
4.009	CP28	30 Summer	1	+20%					31.518	-0.200	0.000	0.70			180.8	OK	
25.000	DN08	15 Summer	1	+20%					32.570	-0.138	0.000	0.31			14.0	OK	
4.010	CP29	30 Summer	1	+20%					31.411	-0.178	0.000	0.77			182.8	OK	
26.000	DN09	15 Summer	1	+20%					32.461	-0.162	0.000	0.17			8.3	OK	
4.011	CP30	30 Summer	1	+20%					31.305	-0.206	0.000	0.68			183.5	OK	
27.000	DN10	15 Summer	1	+20%					32.428	-0.128	0.000	0.38			16.7	OK	
28.000	CP2011	15 Summer	1	+20%					31.905	-0.160	0.000	0.16			6.2	OK	
28.001	CP3178A	15 Summer	1	+20%					31.130	-0.175	0.000	0.11			6.3	OK	
4.012	CP31	30 Summer	1	+20%					31.069	-0.265	0.000	0.49			186.5	OK	
29.000	DN11	15 Summer	1	+20%					32.252	-0.140	0.000	0.30			13.3	OK	
4.013	CP32	30 Summer	1	+20%					30.756	-0.265	0.000	0.49			188.2	OK	
30.000	CP38	15 Summer	1	+20%					33.129	-0.251	0.000	0.06			4.3	OK	
30.001	CP39	15 Summer	1	+20%					32.721	-0.245	0.000	0.07			5.4	OK	
30.002	CP40	15 Summer	1	+20%					32.578	-0.240	0.000	0.09			6.6	OK	
31.000	Ditch 1	15 Summer	1	+20%					33.421	-0.479	0.000	0.00			1.5	OK	
32.000	Ditch 3	15 Summer	1	+20%					33.124	-0.476	0.000	0.00			1.4	OK	
31.001	Ditch 2	15 Summer	1	+20%					32.772	-0.268	0.000	0.03			2.9	OK	
30.003	CP41	15 Summer	1	+20%					32.258	-0.230	0.000	0.12			9.1	OK	
33.000	Ditch 4	15 Summer	1	+20%					32.916	-0.484	0.000	0.00			0.6	OK	
34.000	Ditch 6	15 Summer	1	+20%					32.924	-0.476	0.000	0.00			0.9	OK	
33.001	Ditch 5	15 Summer	1	+20%					32.810	-0.290	0.000	0.01			1.5	OK	
30.004	CP42	15 Summer	1	+20%					31.972	-0.223	0.000	0.15			11.1	OK	
30.005	CP43	15 Summer	1	+20%					31.673	-0.219	0.000	0.17			11.0	OK	
35.000	DN12	15 Summer	1	+20%					32.174	-0.137	0.000	0.32			12.3	OK	
4.014	CP44	30 Summer	1	+20%					30.459	-0.215	0.000	0.65			192.3	OK	
36.000	DN13	15 Summer	1	+20%					32.252	-0.159	0.000	0.19			7.0	OK	
4.015	CP45	30 Summer	1	+20%					30.297	-0.216	0.000	0.65			193.0	OK	
37.000	DN14	15 Summer	1	+20%					32.318	-0.170	0.000	0.13			7.2	OK	
4.016	CP46	30 Summer	1	+20%					30.073	-0.273	0.000	0.58			193.8	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	CP156	30 Winter	1	+20%					29.339	-0.273	0.000	0.58			200.0	OK	
38.000	CP190	15 Summer	1	+20%					31.129	-0.148	0.000	0.25			10.9	OK	
38.001	CP191	15 Summer	1	+20%					30.949	-0.116	0.000	0.44			18.8	OK	
38.002	CP192	15 Summer	1	+20%					30.360	-0.175	0.000	0.36			42.2	OK	
1.004	CP200	30 Summer	1	+20%					28.409	-0.441	0.000	0.16			216.5	OK	
1.005	Pond Inlet 1	30 Summer	1	+20%					26.697	-0.378	0.000	0.40			214.6	OK	
1.006	Pond Outlet 1	360 Summer	1	+20%					26.182	-0.393	0.000	0.03			40.0	OK	
39.000	CP2018A	15 Summer	1	+20%					32.485	-0.065	0.000	0.61			2.9	OK	
39.001	CP2018	15 Summer	1	+20%	1/15 Summer				32.301	0.006	0.000	1.82			17.9	SURCHARGED	
39.002	CP2017	15 Summer	1	+20%					31.893	-0.082	0.000	0.71			22.7	OK	
39.003	CP6010	15 Summer	1	+20%					30.929	-0.211	0.000	0.19			22.5	OK	
40.000	CPDN10	15 Summer	1	+20%					32.329	-0.110	0.000	0.15			2.4	OK	
40.001	CP162	15 Summer	1	+20%					31.578	-0.137	0.000	0.32			17.9	OK	
39.004	CP161	15 Summer	1	+20%					30.616	-0.144	0.000	0.51			60.7	OK	
39.005	CP160	15 Summer	1	+20%					29.536	-0.254	0.000	0.22			91.1	OK	
41.000	Ditch 7	15 Summer	1	+20%					30.381	-0.233	0.000	0.04			3.8	FLOOD RISK	
41.001	Ditch 8	15 Summer	1	+20%					30.178	-0.212	0.000	0.07			6.5	FLOOD RISK	
42.000	Ditch 10	15 Summer	1	+20%					30.630	-0.284	0.000	0.00			1.2	FLOOD RISK	
41.002	Ditch 9	15 Summer	1	+20%					29.916	-0.244	0.000	0.08			7.1	OK	
41.003	CP157	15 Summer	1	+20%					29.567	-0.343	0.000	0.12			23.1	OK	
41.004	CP159A	15 Summer	1	+20%					29.316	-0.284	0.000	0.29			48.4	OK	
41.005	CP159	15 Summer	1	+20%				0	29.135	-0.374	0.000	0.07	0.0		62.4	OK	
43.000	CP193	15 Summer	1	+20%					30.396	-0.244	0.000	0.26			26.4	OK	
43.001	CP194	15 Summer	1	+20%					30.295	-0.216	0.000	0.36			36.2	OK	
43.002	CP195	15 Summer	1	+20%					30.219	-0.203	0.000	0.43			43.8	OK	
41.006	EXCP4050D	15 Winter	1	+20%	1/15 Summer				26.755	0.060	0.000	0.61			115.2	SURCHARGED	
39.006	CP091002	15 Winter	1	+20%	1/15 Summer				26.629	0.047	0.000	0.58			190.7	SURCHARGED	
44.000	CP167	15 Summer	1	+20%					35.067	-0.103	0.000	0.21			2.9	OK	
45.000	CP2111	15 Summer	1	+20%					34.420	-0.155	0.000	0.19			7.8	OK	
46.000	CP2109	15 Summer	1	+20%					34.991	-0.184	0.000	0.08			4.8	OK	
47.000	CP2027	15 Summer	1	+20%					34.745	-0.190	0.000	0.05			1.9	OK	
48.000	CP2026	15 Summer	1	+20%					34.695	-0.130	0.000	0.34			9.7	OK	
48.001	CP2025	15 Summer	1	+20%					34.522	-0.093	0.000	0.64			27.2	OK	
47.001	CP2025.1	15 Summer	1	+20%				0	34.231	-0.199	0.000	0.25	0.0		29.1	OK	
45.001	CP2110	15 Summer	1	+20%	1/15 Summer				33.982	0.052	0.000	2.28			69.8	SURCHARGED	
44.001	CP168	15 Summer	1	+20%					33.780	-0.100	0.000	0.77			72.0	OK	
44.002	CP169	15 Summer	1	+20%	1/15 Summer				33.506	0.006	0.000	0.93			78.6	SURCHARGED	
44.003	CP170	15 Summer	1	+20%	1/15 Summer				33.377	0.017	0.000	1.09			83.6	SURCHARGED	
49.000	CP2024	15 Summer	1	+20%					34.136	-0.099	0.000	0.57			13.8	OK	
49.001	CP2023	15 Summer	1	+20%					34.066	-0.059	0.000	0.88			25.4	OK	
50.000	CPDN11	15 Summer	1	+20%					34.441	-0.189	0.000	0.06			2.2	OK	
51.000	CP2023.1A	120 Winter	1	+20%					33.950	-0.225	0.000	0.00			0.0	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
49.002	CP2023.1	15 Summer	1	+20%					33.830	-0.190	0.000	0.28			29.2	OK	
49.003	CP2108	15 Summer	1	+20%				0	33.277	-0.203	0.000	0.23	0.0		29.3	OK	
44.004	CP171	15 Summer	1	+20%					33.085	-0.130	0.000	0.75			116.4	OK	
44.005	CP172	15 Summer	1	+20%					32.758	-0.222	0.000	0.51			126.6	OK	
44.006	CP3136	15 Summer	1	+20%					32.448	-0.162	0.000	0.63			136.0	OK	
44.007	CP3137	15 Summer	1	+20%	1/15 Summer				32.344	0.024	0.000	1.26			142.8	SURCHARGED	
52.000	CP2022	15 Summer	1	+20%					33.504	-0.081	0.000	0.69			19.1	OK	
52.001	CP2021	15 Summer	1	+20%					33.323	-0.092	0.000	0.63			34.0	OK	
53.000	CP2020	15 Summer	1	+20%					32.778	-0.127	0.000	0.39			14.7	OK	
52.002	CP2019	15 Summer	1	+20%	1/15 Summer				32.509	0.244	0.000	5.49			56.8	SURCHARGED	
54.000	CP2107	120 Winter	1	+20%					33.090	-0.225	0.000	0.00			0.0	OK	
52.003	CP162.1	15 Summer	1	+20%	1/15 Summer			0	32.238	0.028	0.000	2.79	0.0		56.6	SURCHARGED	
44.008	CP3138	15 Summer	1	+20%					32.062	-0.188	0.000	0.63			210.2	OK	
44.009	CP3139	15 Summer	1	+20%					31.454	-0.136	0.000	0.82			217.6	OK	
44.010	CP3140	15 Summer	1	+20%	1/15 Summer				31.090	0.050	0.000	1.26			222.8	SURCHARGED	
55.000	CP3141A	15 Summer	1	+20%					30.781	-0.119	0.000	0.09			0.9	OK	
56.000	CP3138C	15 Summer	1	+20%					34.096	-0.104	0.000	0.21			3.6	OK	
57.000	CP3138G	15 Summer	1	+20%					35.128	-0.122	0.000	0.08			0.6	OK	
57.001	CP3138F	15 Summer	1	+20%		1/15 Summer		24	34.958	-0.142	0.000	0.01	1.1		0.2	OK	
57.002	CP3138E	15 Summer	1	+20%					34.451	-0.199	0.000	0.03			0.7	OK	
57.003	CP3138D	15 Summer	1	+20%		1/15 Summer		24	34.301	-0.139	0.000	0.02	1.4		0.2	OK	
56.001	CP3138B	15 Summer	1	+20%					33.325	-0.125	0.000	0.06			3.8	OK	
58.000	CPDN1	15 Summer	1	+20%					34.241	-0.109	0.000	0.16			1.7	OK	
58.001	CPDN2	15 Summer	1	+20%					34.055	-0.065	0.000	0.61			2.2	OK	
58.002	CPDN3	15 Summer	1	+20%					34.000	-0.100	0.000	0.24			2.9	OK	
58.003	CPDN4	15 Summer	1	+20%					33.837	-0.093	0.000	0.30			3.9	OK	
58.004	CPDN5	15 Summer	1	+20%					33.430	-0.080	0.000	0.44			5.3	OK	
58.005	CPDN6	15 Summer	1	+20%					32.805	-0.075	0.000	0.48			6.8	OK	
58.006	CPDN7	15 Summer	1	+20%					32.415	-0.045	0.000	0.81			8.4	OK	
56.002	CP3138A	60 Winter	1	+20%		1/15 Summer		24	32.190	0.000	0.000	0.99	5.6		4.7	OK	
56.003	CPDN8	15 Winter	1	+20%					32.088	-0.092	0.000	0.31			5.7	OK	
56.004	CPDN9	15 Summer	1	+20%					31.412	-0.098	0.000	0.26			6.1	OK	
44.011	CP3141	15 Summer	1	+20%					30.747	-0.175	0.000	0.69			228.2	OK	
59.000	CP3142	15 Summer	1	+20%					31.079	-0.166	0.000	0.15			17.1	OK	
44.012	CP091001	15 Summer	1	+20%	1/15 Summer				30.306	0.115	0.000	2.31			230.3	SURCHARGED	
60.000	GY3068	15 Summer	1	+20%					31.265	-0.180	0.000	0.09			7.9	OK	
60.001	CP4050C	15 Summer	1	+20%					29.807	-0.172	0.000	0.12			17.0	OK	
44.013	CP4050B	15 Summer	1	+20%					28.532	-0.118	0.000	0.89			234.7	OK	
61.000	DN40	15 Summer	1	+20%					28.863	-0.132	0.000	0.03			1.2	OK	
61.001	CP100	15 Summer	1	+20%					27.461	-0.118	0.000	0.10			1.2	OK	
39.007	CP4050A	15 Summer	1	+20%	1/15 Summer				26.593	0.066	0.000	0.96			391.8	SURCHARGED	
62.000	CP4051B	15 Summer	1	+20%					32.655	-0.045	0.000	0.83			19.5	OK	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU11 & OU12.MDX

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Network 2020.1.3

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
62.001	CP4051A	15 Summer	1	+20%					28.940	-0.160	0.000	0.18			19.4	OK	
39.008	Pond Inlet 2	15 Winter	1	+20%	1/15 Summer				26.434	0.073	0.000	1.18			399.3	SURCHARGED	
39.009	Pond Outlet 2	60 Summer	1	+20%					26.114	-0.186	0.000	0.20			183.2	OK	

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Free Flowing Outfall Details for Proposed Network S1-OU11&12

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.006	OU11	24.482	23.262	22.600	675	0
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Free Flowing Outfall Details for Proposed Network S1-OU11&12

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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39.009	Proposed OU12	25.000	24.016	24.016	600	0
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Online Controls for Proposed Network S1-OU11&12

Orifice Manhole: Pond Outlet 1, DS/PN: 1.006, Volume (m³): 50.8

Diameter (m) 0.224 Discharge Coefficient 0.600 Invert Level (m) 25.900

Orifice Manhole: Pond Outlet 2, DS/PN: 39.009, Volume (m³): 5.4

Diameter (m) 0.595 Discharge Coefficient 0.600 Invert Level (m) 25.700

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Network 2020.1.3

Storage Structures for Proposed Network S1-OU11&12

Infiltration Trench Manhole: CP179, DS/PN: 19.000

Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.20 Trench Length (m) 46.0 Cap Infiltration Depth (m) 0.000
 Infiltration Coefficient Side (m/hr) 0.00000 Invert Level (m) 33.789 Slope (1:X) 200.0
 Safety Factor 2.0 Trench Width (m) 1.0 Cap Volume Depth (m) 0.000

Infiltration Trench Manhole: CP180, DS/PN: 19.001

Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.20 Trench Length (m) 52.6 Cap Infiltration Depth (m) 0.000
 Infiltration Coefficient Side (m/hr) 0.00000 Invert Level (m) 33.614 Slope (1:X) 300.6
 Safety Factor 2.0 Trench Width (m) 1.0 Cap Volume Depth (m) 0.000

Tank or Pond Manhole: Pond Outlet 1, DS/PN: 1.006

Invert Level (m) 25.900

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1200.0	0.900	1682.8	1.200	1861.8

Tank or Pond Manhole: Pond Outlet 2, DS/PN: 39.009

Invert Level (m) 25.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	500.0	0.900	826.1	1.200	952.9

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Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 7 Number of Storage Structures 4 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP153	15 Summer	2	+20%					31.602	-0.183	0.000	0.08			2.8	OK	
1.001	CP154	15 Summer	2	+20%	100/15 Summer				31.420	-0.135	0.000	0.33			14.0	OK	
2.000	CP2015	15 Summer	2	+20%					32.095	-0.295	0.000	0.00			0.2	OK	
3.000	CP175	15 Summer	2	+20%					32.303	-0.287	0.000	0.01			0.8	OK	
2.001	CP2013	15 Summer	2	+20%					30.022	-0.368	0.000	0.02			1.3	OK	
1.002	CP155	15 Summer	2	+20%					30.020	-0.330	0.000	0.16			27.8	OK	
4.000	CP1	15 Summer	2	+20%					33.818	-0.290	0.000	0.01			0.7	OK	
4.001	CP2	15 Summer	2	+20%					33.499	-0.256	0.000	0.05			5.3	OK	
4.002	CP3	15 Summer	2	+20%					33.130	-0.235	0.000	0.10			10.4	OK	
4.003	CP4	15 Summer	2	+20%	100/15 Summer				32.831	-0.219	0.000	0.16			16.9	OK	
4.004	CP5	15 Summer	2	+20%	100/15 Summer				32.416	-0.202	0.000	0.23			23.9	OK	
5.000	DN18	15 Summer	2	+20%					34.849	-0.230	0.000	0.12			20.2	OK	
5.001	CP77	15 Summer	2	+20%	100/15 Summer				34.379	-0.202	0.000	0.23			33.7	OK	
5.002	CP78	15 Summer	2	+20%	100/15 Summer				33.862	-0.206	0.000	0.21			33.4	OK	
5.003	CP6	15 Summer	2	+20%	100/15 Summer				33.452	-0.188	0.000	0.29			41.3	OK	
5.004	CP7	15 Summer	2	+20%	100/15 Summer				32.871	-0.219	0.000	0.35			49.4	OK	
5.005	CP8	15 Summer	2	+20%	5/15 Summer				32.643	-0.180	0.000	0.43			51.2	OK	
6.000	DIT03	15 Summer	2	+20%					37.336	-0.487	0.000	0.00			3.5	OK	
6.001	DIT04	15 Summer	2	+20%					35.769	-0.461	0.000	0.01			9.7	OK	
6.002	DIT05	15 Summer	2	+20%					34.968	-0.432	0.000	0.02			12.5	OK	

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Section 1
Proposed Network S1-OU11 & 12



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Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	DIT01	15 Summer	2	+20%					35.887	-0.463	0.000	0.01			8.8	OK	
7.001	DIT02	15 Summer	2	+20%					35.253	-0.447	0.000	0.02			13.2	OK	
6.003	DN02	15 Summer	2	+20%					34.714	-0.148	0.000	0.25			25.4	OK	
8.000	DN30	15 Summer	2	+20%	100/15 Summer				33.904	-0.219	0.000	0.01			0.3	OK	
6.004	CP10	15 Summer	2	+20%	100/15 Summer				33.627	-0.186	0.000	0.30			27.9	OK	
6.005	CP11	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.121	-0.183	0.000	0.32			29.4	OK	5
6.006	CP173	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.793	-0.286	0.000	0.13			29.4	OK	3
5.006	CP174	15 Summer	2	+20%	5/15 Summer				32.615	-0.114	0.000	0.83			76.1	OK	
5.007	CP9	15 Summer	2	+20%	100/15 Summer				32.553	-0.126	0.000	0.76			77.9	OK	
9.000	CP12	15 Summer	2	+20%	100/15 Summer				33.003	-0.261	0.000	0.04			2.1	OK	
9.001	CP13	15 Summer	2	+20%	100/15 Summer				32.908	-0.255	0.000	0.05			2.8	OK	
5.008	CP14	15 Summer	2	+20%	100/15 Summer				32.443	-0.133	0.000	0.73			77.9	OK	
10.000	DN20	15 Summer	2	+20%	100/30 Summer				33.533	-0.159	0.000	0.19			6.8	OK	
5.009	CP15	15 Summer	2	+20%	100/15 Summer				32.284	-0.123	0.000	0.78			78.6	OK	
11.000	DN21	15 Summer	2	+20%	100/30 Summer				33.395	-0.190	0.000	0.06			2.4	OK	
5.010	CP16	15 Summer	2	+20%	100/15 Summer				32.181	-0.133	0.000	0.73			77.6	OK	
12.000	DN22	15 Summer	2	+20%					33.307	-0.196	0.000	0.04			1.5	OK	
5.011	CP17	15 Summer	2	+20%	5/15 Winter				32.046	-0.107	0.000	0.86			76.7	OK	
4.005	CP18	30 Summer	2	+20%	100/15 Summer				31.991	-0.120	0.000	0.80			84.1	OK	
13.000	DN23	15 Summer	2	+20%	100/15 Summer				32.791	-0.126	0.000	0.40			12.5	OK	
4.006	CP19	30 Summer	2	+20%	100/15 Summer				31.775	-0.187	0.000	0.57			86.2	OK	
14.000	DN03	15 Summer	2	+20%	100/15 Summer				32.659	-0.112	0.000	0.50			14.5	OK	
15.000	CP20	15 Summer	2	+20%					33.005	-0.215	0.000	0.01			0.6	OK	
16.000	CP3182A	15 Summer	2	+20%					33.583	-0.156	0.000	0.20			8.5	OK	
16.001	CP21	15 Summer	2	+20%					33.223	-0.156	0.000	0.20			10.0	OK	
17.000	DN04	15 Summer	2	+20%	100/30 Summer				32.958	-0.189	0.000	0.06			1.7	OK	
18.000	DN05	15 Summer	2	+20%					33.314	-0.200	0.000	0.03			1.8	OK	
17.001	CP22	15 Summer	2	+20%	100/15 Summer				32.824	-0.150	0.000	0.13			3.3	OK	
16.002	CP23	15 Summer	2	+20%	100/15 Summer				32.815	-0.123	0.000	0.39			12.3	OK	
15.001	CP24	15 Summer	2	+20%	100/15 Summer				32.525	-0.169	0.000	0.14			12.8	OK	
19.000	CP179	15 Summer	2	+20%	100/15 Summer				34.137	-0.182	0.000	0.31			20.4	OK	
19.001	CP180	15 Summer	2	+20%	100/15 Summer				33.951	-0.138	0.000	0.53			28.4	OK	
19.002	CP181	15 Summer	2	+20%	100/15 Summer				33.783	-0.131	0.000	0.59			30.7	OK	
20.000	DN31	15 Summer	2	+20%					35.394	-0.194	0.000	0.05			2.7	OK	
20.001	CP177	15 Summer	2	+20%	100/15 Summer				33.894	-0.195	0.000	0.04			2.7	OK	
19.003	CP182	30 Summer	2	+20%	100/15 Summer				33.697	-0.132	0.000	0.59			38.8	OK	
19.004	CP183	30 Summer	2	+20%	100/15 Summer				33.479	-0.107	0.000	0.71			47.7	OK	
19.005	CP184	30 Summer	2	+20%	100/15 Summer				32.978	-0.160	0.000	0.44			46.9	OK	
21.000	CPDN15	15 Summer	2	+20%					33.316	-0.193	0.000	0.27			21.2	OK	
22.000	CP47	15 Summer	2	+20%	100/15 Summer				34.325	-0.205	0.000	0.02			0.8	OK	
22.001	CP48	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.975	-0.183	0.000	0.03			1.0	OK	3
22.002	CP33	15 Summer	2	+20%	100/15 Summer				33.972	-0.122	0.000	0.58			36.2	OK	

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Date 15/12/2021
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Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
22.003	CP34	15 Summer	2	+20%	100/15 Summer				33.594	-0.128	0.000	0.60			36.7	OK	
22.004	CP35	15 Summer	2	+20%	100/15 Summer				33.346	-0.127	0.000	0.60			37.0	OK	
22.005	CP36	15 Summer	2	+20%	100/15 Summer				33.093	-0.128	0.000	0.60			37.0	OK	
22.006	CP37	15 Summer	2	+20%	100/15 Summer				32.789	-0.129	0.000	0.61			36.7	OK	
22.007	CP80	15 Summer	2	+20%	100/15 Summer				32.505	-0.205	0.000	0.22			36.9	OK	
19.006	CP185	30 Summer	2	+20%	100/15 Summer				32.083	-0.163	0.000	0.61			88.2	OK	
15.002	CP25	30 Summer	2	+20%	100/15 Summer				31.919	-0.190	0.000	0.49			95.5	OK	
4.007	CP26	30 Summer	2	+20%	5/30 Summer				31.698	-0.166	0.000	0.81			180.5	OK	
23.000	DN06	15 Summer	2	+20%	100/30 Summer				32.546	-0.156	0.000	0.20			8.9	OK	
4.008	CP27	30 Summer	2	+20%	100/15 Summer				31.621	-0.184	0.000	0.75			182.0	OK	
24.000	DN07	15 Summer	2	+20%					32.573	-0.153	0.000	0.22			10.6	OK	
4.009	CP28	30 Summer	2	+20%	100/15 Summer				31.521	-0.197	0.000	0.71			183.1	OK	
25.000	DN08	15 Summer	2	+20%					32.568	-0.140	0.000	0.30			13.4	OK	
4.010	CP29	30 Summer	2	+20%	100/15 Summer				31.414	-0.175	0.000	0.78			185.1	OK	
26.000	DN09	15 Summer	2	+20%					32.459	-0.164	0.000	0.17			8.0	OK	
4.011	CP30	30 Summer	2	+20%	100/15 Summer				31.308	-0.203	0.000	0.69			185.8	OK	
27.000	DN10	15 Summer	2	+20%	100/15 Summer				32.426	-0.130	0.000	0.37			16.0	OK	
28.000	CP2011	15 Summer	2	+20%					31.903	-0.162	0.000	0.15			6.0	OK	
28.001	CP3178A	15 Summer	2	+20%	100/15 Summer				31.129	-0.176	0.000	0.11			6.0	OK	
4.012	CP31	30 Summer	2	+20%	100/15 Summer				31.071	-0.263	0.000	0.50			188.9	OK	
29.000	DN11	15 Summer	2	+20%					32.251	-0.141	0.000	0.29			12.8	OK	
4.013	CP32	30 Summer	2	+20%	100/15 Summer				30.758	-0.263	0.000	0.50			190.6	OK	
30.000	CP38	15 Summer	2	+20%					33.128	-0.252	0.000	0.06			4.2	OK	
30.001	CP39	15 Summer	2	+20%					32.719	-0.247	0.000	0.07			5.2	OK	
30.002	CP40	15 Summer	2	+20%					32.577	-0.241	0.000	0.08			6.3	OK	
31.000	Ditch 1	15 Summer	2	+20%					33.420	-0.480	0.000	0.00			1.4	OK	
32.000	Ditch 3	15 Summer	2	+20%					33.123	-0.477	0.000	0.00			1.4	OK	
31.001	Ditch 2	15 Summer	2	+20%					32.772	-0.268	0.000	0.02			2.8	OK	
30.003	CP41	15 Summer	2	+20%					32.257	-0.231	0.000	0.12			8.8	OK	
33.000	Ditch 4	15 Summer	2	+20%					32.915	-0.485	0.000	0.00			0.6	OK	
34.000	Ditch 6	15 Summer	2	+20%					32.923	-0.477	0.000	0.00			0.9	OK	
33.001	Ditch 5	15 Summer	2	+20%					32.810	-0.290	0.000	0.01			1.5	OK	
30.004	CP42	15 Summer	2	+20%					31.970	-0.225	0.000	0.14			10.6	OK	
30.005	CP43	15 Summer	2	+20%					31.672	-0.220	0.000	0.16			10.6	OK	
35.000	DN12	15 Summer	2	+20%					32.172	-0.139	0.000	0.31			11.8	OK	
4.014	CP44	30 Summer	2	+20%	100/15 Summer				30.461	-0.213	0.000	0.66			194.8	OK	
36.000	DN13	15 Summer	2	+20%					32.251	-0.160	0.000	0.18			6.7	OK	
4.015	CP45	30 Summer	2	+20%	100/15 Summer				30.300	-0.213	0.000	0.66			195.5	OK	
37.000	DN14	15 Summer	2	+20%					32.317	-0.171	0.000	0.13			6.9	OK	
4.016	CP46	30 Summer	2	+20%	100/15 Summer				30.076	-0.270	0.000	0.59			196.3	OK	
1.003	CP156	30 Winter	2	+20%	100/15 Summer				29.341	-0.271	0.000	0.58			202.4	OK	
38.000	CP190	15 Summer	2	+20%	100/15 Summer				31.127	-0.150	0.000	0.24			10.5	OK	

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Section 1
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Innovyze

Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
38.001	CP191	15 Summer	2	+20%	100/15 Summer				30.947	-0.118	0.000	0.42			18.1	OK	
38.002	CP192	15 Summer	2	+20%	100/15 Summer				30.358	-0.177	0.000	0.35			40.6	OK	
1.004	CP200	30 Summer	2	+20%					28.410	-0.440	0.000	0.16			219.3	OK	
1.005	Pond Inlet 1	30 Summer	2	+20%	100/30 Summer				26.699	-0.376	0.000	0.41			217.2	OK	
1.006	Pond Outlet 1	240 Summer	2	+20%	100/60 Summer				26.256	-0.319	0.000	0.04			51.7	OK	
39.000	CP2018A	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.483	-0.067	0.000	0.58			2.8	OK	1
39.001	CP2018	15 Summer	2	+20%	2/15 Summer				32.299	0.004	0.000	1.75			17.2	SURCHARGED	
39.002	CP2017	15 Summer	2	+20%	100/15 Summer	100/15 Summer			31.889	-0.086	0.000	0.69			21.8	OK	3
39.003	CP6010	15 Summer	2	+20%	100/15 Summer				30.927	-0.213	0.000	0.18			21.6	OK	
40.000	CPDN10	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.328	-0.111	0.000	0.14			2.3	OK	7
40.001	CP162	15 Summer	2	+20%	100/15 Summer				31.576	-0.139	0.000	0.31			17.3	OK	
39.004	CP161	15 Summer	2	+20%	100/15 Summer				30.612	-0.148	0.000	0.49			58.5	OK	
39.005	CP160	15 Summer	2	+20%					29.533	-0.257	0.000	0.21			87.9	OK	
41.000	Ditch 7	15 Summer	2	+20%					30.379	-0.235	0.000	0.04			3.6	FLOOD RISK	
41.001	Ditch 8	15 Summer	2	+20%					30.176	-0.214	0.000	0.07			6.3	FLOOD RISK	
42.000	Ditch 10	15 Summer	2	+20%					30.630	-0.284	0.000	0.00			1.1	FLOOD RISK	
41.002	Ditch 9	15 Summer	2	+20%					29.914	-0.246	0.000	0.08			6.9	OK	
41.003	CP157	15 Summer	2	+20%					29.565	-0.345	0.000	0.11			22.1	OK	
41.004	CP159A	15 Summer	2	+20%					29.312	-0.288	0.000	0.27			46.4	OK	
41.005	CP159	15 Summer	2	+20%				0	29.133	-0.376	0.000	0.06	0.0		59.8	OK	
43.000	CP193	15 Summer	2	+20%	100/15 Summer				30.393	-0.247	0.000	0.25			25.3	OK	
43.001	CP194	15 Summer	2	+20%	100/15 Summer				30.291	-0.220	0.000	0.35			34.7	OK	
43.002	CP195	15 Summer	2	+20%	100/15 Summer				30.215	-0.207	0.000	0.41			42.1	OK	
41.006	EXCP4050D	15 Summer	2	+20%	2/15 Summer				26.743	0.048	0.000	0.61			114.7	SURCHARGED	
39.006	CP091002	15 Summer	2	+20%	2/15 Summer				26.620	0.038	0.000	0.59			193.3	SURCHARGED	
44.000	CP167	15 Summer	2	+20%	100/15 Summer				35.066	-0.104	0.000	0.20			2.8	OK	
45.000	CP2111	15 Summer	2	+20%	100/15 Summer				34.419	-0.156	0.000	0.18			7.5	OK	
46.000	CP2109	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.990	-0.185	0.000	0.07			4.6	OK	2
47.000	CP2027	15 Summer	2	+20%	100/15 Summer				34.745	-0.190	0.000	0.05			1.9	OK	
48.000	CP2026	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.693	-0.132	0.000	0.33			9.4	OK	3
48.001	CP2025	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.519	-0.096	0.000	0.62			26.1	OK	3
47.001	CP2025.1	15 Summer	2	+20%	100/15 Summer	100/15 Summer	100/15 Summer	7	34.229	-0.201	0.000	0.24	0.0		27.9	OK	5
45.001	CP2110	15 Summer	2	+20%	2/15 Summer	100/15 Summer			33.974	0.044	0.000	2.20			67.2	SURCHARGED	2
44.001	CP168	15 Summer	2	+20%	5/15 Summer				33.775	-0.105	0.000	0.74			69.2	OK	
44.002	CP169	15 Summer	2	+20%	5/15 Summer	100/15 Summer			33.481	-0.019	0.000	0.89			74.9	OK	4
44.003	CP170	15 Summer	2	+20%	2/15 Summer	100/15 Summer			33.361	0.001	0.000	1.04			79.5	SURCHARGED	3
49.000	CP2024	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.133	-0.102	0.000	0.55			13.3	OK	1
49.001	CP2023	15 Summer	2	+20%	5/15 Summer	100/15 Summer			34.061	-0.064	0.000	0.84			24.4	OK	4
50.000	CPDN11	15 Summer	2	+20%	100/15 Summer	100/15 Summer			34.440	-0.190	0.000	0.06			2.1	OK	6
51.000	CP2023.1A	120 Winter	2	+20%	100/15 Summer	100/15 Summer			33.950	-0.225	0.000	0.00			0.0	OK	5
49.002	CP2023.1	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.827	-0.193	0.000	0.27			28.0	OK	1
49.003	CP2108	15 Summer	2	+20%	100/15 Summer		100/15 Summer	6	33.275	-0.205	0.000	0.22	0.0		28.2	OK	

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Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU11 & OU12.MDX

A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Designed by LM
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Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
44.004	CP171	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.078	-0.137	0.000	0.72			112.3	OK	2
44.005	CP172	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.753	-0.227	0.000	0.49			122.1	OK	
44.006	CP3136	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.433	-0.177	0.000	0.61			131.2	OK	1
44.007	CP3137	15 Summer	2	+20%	2/15 Summer	100/15 Summer			32.337	0.017	0.000	1.21			137.6	SURCHARGED	3
52.000	CP2022	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.500	-0.085	0.000	0.66			18.4	OK	3
52.001	CP2021	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.320	-0.095	0.000	0.60			32.7	OK	6
53.000	CP2020	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.776	-0.129	0.000	0.37			14.1	OK	1
52.002	CP2019	15 Summer	2	+20%	2/15 Summer	100/15 Summer			32.490	0.225	0.000	5.30			54.9	SURCHARGED	6
54.000	CP2107	120 Winter	2	+20%	100/15 Summer				33.090	-0.225	0.000	0.00			0.0	OK	
52.003	CP162.1	15 Summer	2	+20%	2/15 Summer		100/15 Summer	8	32.234	0.024	0.000	2.68	0.0		54.5	SURCHARGED	
44.008	CP3138	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.050	-0.200	0.000	0.59			198.3	OK	5
44.009	CP3139	15 Summer	2	+20%	5/15 Summer				31.441	-0.149	0.000	0.78			205.2	OK	
44.010	CP3140	15 Summer	2	+20%	2/15 Summer				31.069	0.029	0.000	1.19			210.8	SURCHARGED	
55.000	CP3141A	15 Summer	2	+20%	100/15 Summer				30.781	-0.119	0.000	0.09			0.9	OK	
56.000	CP3138C	15 Summer	2	+20%					34.095	-0.105	0.000	0.20			3.4	OK	
57.000	CP3138G	15 Summer	2	+20%					35.127	-0.123	0.000	0.07			0.5	OK	
57.001	CP3138F	15 Summer	2	+20%			2/15 Summer	72	34.958	-0.142	0.000	0.01	1.0		0.2	OK	
57.002	CP3138E	15 Summer	2	+20%					34.450	-0.200	0.000	0.03			0.7	OK	
57.003	CP3138D	15 Summer	2	+20%			2/15 Summer	72	34.300	-0.140	0.000	0.01	1.3		0.2	OK	
56.001	CP3138B	15 Summer	2	+20%					33.324	-0.126	0.000	0.06			3.6	OK	
58.000	CPDN1	15 Summer	2	+20%	100/15 Summer				34.240	-0.110	0.000	0.15			1.6	OK	
58.001	CPDN2	15 Summer	2	+20%	100/15 Summer				34.053	-0.067	0.000	0.58			2.1	OK	
58.002	CPDN3	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.999	-0.101	0.000	0.23			2.8	OK	
58.003	CPDN4	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.835	-0.095	0.000	0.29			3.8	OK	
58.004	CPDN5	15 Summer	2	+20%	100/15 Summer	100/15 Summer			33.429	-0.081	0.000	0.43			5.1	OK	1
58.005	CPDN6	15 Summer	2	+20%	100/15 Summer	100/15 Summer			32.803	-0.077	0.000	0.46			6.6	OK	3
58.006	CPDN7	15 Summer	2	+20%	5/15 Summer	100/15 Summer			32.412	-0.048	0.000	0.78			8.0	OK	5
56.002	CP3138A	15 Summer	2	+20%	2/15 Summer		2/15 Summer	72	32.190	0.000	0.000	0.95	16.3		4.5	SURCHARGED	
56.003	CPDN8	30 Summer	2	+20%	100/15 Summer	100/15 Summer			32.088	-0.092	0.000	0.31			5.7	OK	4
56.004	CPDN9	30 Summer	2	+20%	100/15 Summer				31.412	-0.098	0.000	0.26			6.1	OK	
44.011	CP3141	15 Summer	2	+20%	100/15 Summer				30.739	-0.183	0.000	0.66			217.8	OK	
59.000	CP3142	15 Summer	2	+20%					31.077	-0.168	0.000	0.15			16.4	OK	
44.012	CP091001	15 Summer	2	+20%	2/15 Summer				30.291	0.100	0.000	2.20			219.5	SURCHARGED	
60.000	GY3068	15 Summer	2	+20%					31.264	-0.181	0.000	0.08			7.6	OK	
60.001	CP4050C	15 Summer	2	+20%					29.806	-0.173	0.000	0.12			16.3	OK	
44.013	CP4050B	15 Summer	2	+20%	5/15 Summer				28.521	-0.129	0.000	0.85			224.3	OK	
61.000	DN40	15 Summer	2	+20%					28.862	-0.133	0.000	0.03			1.2	OK	
61.001	CP100	15 Summer	2	+20%	100/15 Summer				27.460	-0.119	0.000	0.09			1.1	OK	
39.007	CP4050A	30 Summer	2	+20%	2/15 Summer				26.578	0.051	0.000	0.93			381.1	SURCHARGED	
62.000	CP4051B	15 Summer	2	+20%	5/15 Summer	100/15 Summer			32.652	-0.048	0.000	0.79			18.7	OK	6
62.001	CP4051A	15 Summer	2	+20%					28.938	-0.162	0.000	0.18			18.7	OK	
39.008	Pond Inlet 2	15 Summer	2	+20%	2/15 Summer				26.430	0.069	0.000	1.15			388.4	SURCHARGED	

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A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Date 15/12/2021
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Network 2020.1.3

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
39.009	Pond Outlet 2	120 Summer	2	+20%	100/15 Summer				26.153	-0.147	0.000	0.22		207.1	OK	

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Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU11 & OU12.MDX

A12 Chelmsford to A120widening
Section 1
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Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 7 Number of Storage Structures 4 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP153	15 Summer	5	+20%					31.610	-0.175	0.000	0.11			4.0	OK	
1.001	CP154	15 Summer	5	+20%	100/15 Summer				31.439	-0.116	0.000	0.47			19.8	OK	
2.000	CP2015	15 Summer	5	+20%					32.098	-0.292	0.000	0.01			0.3	OK	
3.000	CP175	15 Summer	5	+20%					32.308	-0.282	0.000	0.01			1.1	OK	
2.001	CP2013	15 Summer	5	+20%					30.046	-0.344	0.000	0.02			1.9	OK	
1.002	CP155	15 Summer	5	+20%					30.044	-0.306	0.000	0.22			39.3	OK	
4.000	CP1	15 Summer	5	+20%					33.823	-0.285	0.000	0.01			1.0	OK	
4.001	CP2	15 Summer	5	+20%					33.509	-0.246	0.000	0.07			7.4	OK	
4.002	CP3	15 Summer	5	+20%					33.142	-0.223	0.000	0.14			14.7	OK	
4.003	CP4	15 Summer	5	+20%	100/15 Summer				32.848	-0.202	0.000	0.23			23.8	OK	
4.004	CP5	15 Summer	5	+20%	100/15 Summer				32.436	-0.182	0.000	0.32			33.8	OK	
5.000	DN18	15 Summer	5	+20%					34.864	-0.215	0.000	0.18			28.6	OK	
5.001	CP77	15 Summer	5	+20%	100/15 Summer				34.399	-0.182	0.000	0.32			47.6	OK	
5.002	CP78	15 Summer	5	+20%	100/15 Summer				33.881	-0.187	0.000	0.30			47.3	OK	
5.003	CP6	15 Summer	5	+20%	100/15 Summer				33.476	-0.164	0.000	0.41			58.5	OK	
5.004	CP7	15 Summer	5	+20%	100/15 Summer				32.905	-0.185	0.000	0.50			69.9	OK	
5.005	CP8	15 Summer	5	+20%	5/15 Summer				32.830	0.007	0.000	0.56			66.7	SURCHARGED	
6.000	DIT03	15 Summer	5	+20%					37.339	-0.484	0.000	0.00			4.9	OK	
6.001	DIT04	15 Summer	5	+20%					35.778	-0.452	0.000	0.01			13.6	OK	
6.002	DIT05	15 Summer	5	+20%					34.983	-0.417	0.000	0.03			17.1	OK	

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5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	DIT01	15 Summer	5	+20%					35.896	-0.454	0.000	0.01			12.2	OK	
7.001	DIT02	15 Summer	5	+20%					35.263	-0.437	0.000	0.02			18.3	OK	
6.003	DN02	15 Summer	5	+20%					34.729	-0.133	0.000	0.35			35.1	OK	
8.000	DN30	15 Summer	5	+20%	100/15 Summer				33.906	-0.217	0.000	0.01			0.5	OK	
6.004	CP10	15 Summer	5	+20%	100/15 Summer				33.649	-0.164	0.000	0.42			39.0	OK	
6.005	CP11	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.145	-0.159	0.000	0.44			40.7	OK	5
6.006	CP173	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.810	-0.269	0.000	0.18			40.9	OK	3
5.006	CP174	15 Summer	5	+20%	5/15 Summer				32.741	0.012	0.000	1.00			92.4	SURCHARGED	
5.007	CP9	15 Summer	5	+20%	100/15 Summer				32.592	-0.087	0.000	0.94			96.3	OK	
9.000	CP12	15 Summer	5	+20%	100/15 Summer				33.010	-0.254	0.000	0.06			2.9	OK	
9.001	CP13	15 Summer	5	+20%	100/15 Summer				32.918	-0.245	0.000	0.08			3.9	OK	
5.008	CP14	15 Summer	5	+20%	100/15 Summer				32.485	-0.091	0.000	0.92			97.9	OK	
10.000	DN20	15 Summer	5	+20%	100/30 Summer				33.546	-0.146	0.000	0.27			9.7	OK	
5.009	CP15	30 Summer	5	+20%	100/15 Summer				32.363	-0.044	0.000	1.00			100.5	OK	
11.000	DN21	15 Summer	5	+20%	100/30 Summer				33.403	-0.182	0.000	0.08			3.3	OK	
5.010	CP16	30 Summer	5	+20%	100/15 Summer				32.290	-0.024	0.000	0.91			96.6	OK	
12.000	DN22	15 Summer	5	+20%					33.312	-0.191	0.000	0.06			2.1	OK	
5.011	CP17	30 Summer	5	+20%	5/15 Winter				32.176	0.023	0.000	1.01			90.5	SURCHARGED	
4.005	CP18	30 Summer	5	+20%	100/15 Summer				32.093	-0.018	0.000	0.98			103.6	OK	
13.000	DN23	15 Summer	5	+20%	100/15 Summer				32.814	-0.103	0.000	0.57			17.6	OK	
4.006	CP19	30 Summer	5	+20%	100/15 Summer				31.956	-0.006	0.000	0.75			113.1	OK	
14.000	DN03	15 Summer	5	+20%	100/15 Summer				32.687	-0.084	0.000	0.71			20.5	OK	
15.000	CP20	15 Summer	5	+20%					33.009	-0.211	0.000	0.01			0.8	OK	
16.000	CP3182A	15 Summer	5	+20%					33.596	-0.143	0.000	0.28			12.0	OK	
16.001	CP21	15 Summer	5	+20%					33.237	-0.142	0.000	0.29			14.1	OK	
17.000	DN04	15 Summer	5	+20%	100/30 Summer				32.966	-0.181	0.000	0.08			2.4	OK	
18.000	DN05	15 Summer	5	+20%					33.317	-0.197	0.000	0.04			2.6	OK	
17.001	CP22	15 Summer	5	+20%	100/15 Summer				32.846	-0.128	0.000	0.18			4.7	OK	
16.002	CP23	15 Summer	5	+20%	100/15 Summer				32.838	-0.100	0.000	0.55			17.4	OK	
15.001	CP24	15 Summer	5	+20%	100/15 Summer				32.537	-0.157	0.000	0.20			18.1	OK	
19.000	CP179	15 Summer	5	+20%	100/15 Summer				34.164	-0.155	0.000	0.45			29.5	OK	
19.001	CP180	15 Summer	5	+20%	100/15 Summer				33.995	-0.094	0.000	0.77			41.6	OK	
19.002	CP181	15 Summer	5	+20%	100/15 Summer				33.832	-0.082	0.000	0.87			44.9	OK	
20.000	DN31	15 Summer	5	+20%					35.401	-0.187	0.000	0.06			3.9	OK	
20.001	CP177	15 Summer	5	+20%	100/15 Summer				33.900	-0.189	0.000	0.06			3.9	OK	
19.003	CP182	15 Summer	5	+20%	100/15 Summer				33.743	-0.086	0.000	0.84			55.1	OK	
19.004	CP183	30 Summer	5	+20%	100/15 Summer				33.564	-0.022	0.000	0.99			66.8	OK	
19.005	CP184	30 Summer	5	+20%	100/15 Summer				33.010	-0.128	0.000	0.62			66.3	OK	
21.000	CPDN15	15 Summer	5	+20%					33.339	-0.170	0.000	0.38			29.9	OK	
22.000	CP47	15 Summer	5	+20%	100/15 Summer				34.329	-0.201	0.000	0.03			1.1	OK	
22.001	CP48	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.024	-0.134	0.000	0.05			1.7	OK	3
22.002	CP33	15 Summer	5	+20%	100/15 Summer				34.022	-0.072	0.000	0.83			51.3	OK	

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Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU11 & OU12.MDX

A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Designed by LM
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Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
22.003	CP34	15	Summer	5	+20%	100/15	Summer		33.640	-0.082	0.000	0.84			51.6		OK
22.004	CP35	15	Summer	5	+20%	100/15	Summer		33.390	-0.083	0.000	0.85			52.3		OK
22.005	CP36	15	Summer	5	+20%	100/15	Summer		33.139	-0.082	0.000	0.84			52.1		OK
22.006	CP37	15	Summer	5	+20%	100/15	Summer		32.834	-0.084	0.000	0.85			51.7		OK
22.007	CP80	15	Summer	5	+20%	100/15	Summer		32.523	-0.187	0.000	0.31			51.6		OK
19.006	CP185	30	Summer	5	+20%	100/15	Summer		32.138	-0.108	0.000	0.85			123.7		OK
15.002	CP25	30	Summer	5	+20%	100/15	Summer		31.982	-0.127	0.000	0.69			132.8		OK
4.007	CP26	30	Summer	5	+20%	5/30	Summer		31.866	-0.002	0.000	1.07			238.7	SURCHARGED	
23.000	DN06	15	Summer	5	+20%	100/30	Summer		32.560	-0.142	0.000	0.29			12.5		OK
4.008	CP27	30	Summer	5	+20%	100/15	Summer		31.700	-0.105	0.000	1.00			241.2		OK
24.000	DN07	15	Summer	5	+20%				32.588	-0.138	0.000	0.32			14.9		OK
4.009	CP28	30	Summer	5	+20%	100/15	Summer		31.621	-0.097	0.000	0.92			239.1		OK
25.000	DN08	15	Summer	5	+20%				32.586	-0.122	0.000	0.42			19.0		OK
4.010	CP29	30	Summer	5	+20%	100/15	Summer		31.515	-0.074	0.000	1.00			237.6		OK
26.000	DN09	15	Summer	5	+20%				32.472	-0.151	0.000	0.24			11.3		OK
4.011	CP30	30	Winter	5	+20%	100/15	Summer		31.373	-0.138	0.000	0.89			239.8		OK
27.000	DN10	15	Summer	5	+20%	100/15	Summer		32.447	-0.109	0.000	0.52			22.7		OK
28.000	CP2011	15	Summer	5	+20%				31.916	-0.149	0.000	0.22			8.4		OK
28.001	CP3178A	15	Summer	5	+20%	100/15	Summer		31.138	-0.167	0.000	0.15			8.5		OK
4.012	CP31	30	Winter	5	+20%	100/15	Summer		31.119	-0.215	0.000	0.65			248.2		OK
29.000	DN11	15	Summer	5	+20%				32.269	-0.123	0.000	0.41			18.0		OK
4.013	CP32	30	Winter	5	+20%	100/15	Summer		30.807	-0.214	0.000	0.66			252.4		OK
30.000	CP38	15	Summer	5	+20%				33.139	-0.241	0.000	0.08			5.9		OK
30.001	CP39	15	Summer	5	+20%				32.730	-0.236	0.000	0.10			7.3		OK
30.002	CP40	15	Summer	5	+20%				32.587	-0.231	0.000	0.12			9.0		OK
31.000	Ditch 1	15	Summer	5	+20%				33.425	-0.475	0.000	0.00			2.0		OK
32.000	Ditch 3	15	Summer	5	+20%				33.129	-0.471	0.000	0.00			1.9		OK
31.001	Ditch 2	15	Summer	5	+20%				32.776	-0.264	0.000	0.03			3.9		OK
30.003	CP41	15	Summer	5	+20%				32.271	-0.217	0.000	0.17			12.5		OK
33.000	Ditch 4	15	Summer	5	+20%				32.919	-0.481	0.000	0.00			0.8		OK
34.000	Ditch 6	15	Summer	5	+20%				32.929	-0.471	0.000	0.00			1.2		OK
33.001	Ditch 5	15	Summer	5	+20%				32.814	-0.286	0.000	0.01			2.1		OK
30.004	CP42	15	Summer	5	+20%				31.987	-0.208	0.000	0.20			15.2		OK
30.005	CP43	15	Summer	5	+20%				31.688	-0.204	0.000	0.23			15.1		OK
35.000	DN12	15	Summer	5	+20%				32.190	-0.121	0.000	0.43			16.7		OK
4.014	CP44	30	Winter	5	+20%	100/15	Summer		30.536	-0.138	0.000	0.89			263.2		OK
36.000	DN13	15	Summer	5	+20%				32.264	-0.147	0.000	0.26			9.5		OK
4.015	CP45	30	Winter	5	+20%	100/15	Summer		30.375	-0.138	0.000	0.89			264.7		OK
37.000	DN14	15	Summer	5	+20%				32.328	-0.160	0.000	0.18			9.7		OK
4.016	CP46	30	Winter	5	+20%	100/15	Summer		30.151	-0.195	0.000	0.79			266.2		OK
1.003	CP156	30	Winter	5	+20%	100/15	Summer		29.422	-0.190	0.000	0.81			280.3		OK
38.000	CP190	15	Summer	5	+20%	100/15	Summer		31.143	-0.134	0.000	0.34			14.8		OK

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A12 Chelmsford to A120widening
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Innovyze

Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
38.001	CP191	15 Summer	5	+20%	100/15 Summer				30.972	-0.093	0.000	0.60			25.5	OK	
38.002	CP192	15 Summer	5	+20%	100/15 Summer				30.384	-0.151	0.000	0.49			57.1	OK	
1.004	CP200	30 Summer	5	+20%					28.441	-0.409	0.000	0.22			303.9	OK	
1.005	Pond Inlet 1	30 Summer	5	+20%	100/30 Summer				26.765	-0.310	0.000	0.56			300.7	OK	
1.006	Pond Outlet 1	240 Summer	5	+20%	100/60 Summer				26.348	-0.227	0.000	0.04			60.7	OK	
39.000	CP2018A	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.505	-0.045	0.000	0.83			3.9	OK	1
39.001	CP2018	15 Summer	5	+20%	2/15 Summer				32.319	0.024	0.000	2.46			24.2	SURCHARGED	
39.002	CP2017	15 Summer	5	+20%	100/15 Summer	100/15 Summer			31.929	-0.046	0.000	0.97			30.8	OK	3
39.003	CP6010	15 Summer	5	+20%	100/15 Summer				30.944	-0.196	0.000	0.26			30.5	OK	
40.000	CPDN10	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.337	-0.102	0.000	0.20			3.3	OK	7
40.001	CP162	15 Summer	5	+20%	100/15 Summer				31.594	-0.121	0.000	0.43			23.9	OK	
39.004	CP161	15 Summer	5	+20%	100/15 Summer				30.650	-0.110	0.000	0.69			82.3	OK	
39.005	CP160	15 Summer	5	+20%					29.556	-0.234	0.000	0.29			123.0	OK	
41.000	Ditch 7	15 Summer	5	+20%					30.392	-0.222	0.000	0.06			5.1	FLOOD RISK	
41.001	Ditch 8	15 Summer	5	+20%					30.192	-0.198	0.000	0.10			8.9	FLOOD RISK	
42.000	Ditch 10	15 Summer	5	+20%					30.633	-0.281	0.000	0.01			1.6	FLOOD RISK	
41.002	Ditch 9	15 Summer	5	+20%					29.925	-0.235	0.000	0.11			9.8	OK	
41.003	CP157	15 Summer	5	+20%					29.587	-0.323	0.000	0.17			31.8	OK	
41.004	CP159A	15 Summer	5	+20%					29.348	-0.252	0.000	0.39			66.5	OK	
41.005	CP159	15 Summer	5	+20%				0	29.151	-0.358	0.000	0.09	0.0		87.1	OK	
43.000	CP193	15 Summer	5	+20%	100/15 Summer				30.420	-0.220	0.000	0.35			35.8	OK	
43.001	CP194	15 Summer	5	+20%	100/15 Summer				30.327	-0.184	0.000	0.49			49.1	OK	
43.002	CP195	15 Summer	5	+20%	100/15 Summer				30.254	-0.168	0.000	0.59			59.5	OK	
41.006	EXCP4050D	15 Summer	5	+20%	2/15 Summer				26.997	0.302	0.000	0.87			165.1	SURCHARGED	
39.006	CP091002	30 Summer	5	+20%	2/15 Summer				26.873	0.291	0.000	0.83			271.9	SURCHARGED	
44.000	CP167	15 Summer	5	+20%	100/15 Summer				35.075	-0.095	0.000	0.29			4.0	OK	
45.000	CP2111	15 Summer	5	+20%	100/15 Summer				34.432	-0.143	0.000	0.26			10.6	OK	
46.000	CP2109	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.998	-0.177	0.000	0.10			6.6	OK	2
47.000	CP2027	15 Summer	5	+20%	100/15 Summer				34.753	-0.182	0.000	0.07			2.6	OK	
48.000	CP2026	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.714	-0.111	0.000	0.46			13.2	OK	3
48.001	CP2025	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.554	-0.061	0.000	0.87			37.0	OK	3
47.001	CP2025.1	15 Summer	5	+20%	100/15 Summer	100/15 Summer	100/15 Summer	7	34.250	-0.180	0.000	0.33	0.0		39.3	OK	5
45.001	CP2110	15 Summer	5	+20%	2/15 Summer	100/15 Summer			34.132	0.202	0.000	2.92			89.3	SURCHARGED	2
44.001	CP168	15 Summer	5	+20%	5/15 Summer				33.999	0.119	0.000	0.92			86.7	SURCHARGED	
44.002	CP169	15 Summer	5	+20%	5/15 Summer	100/15 Summer			33.682	0.182	0.000	1.16			97.8	SURCHARGED	4
44.003	CP170	15 Summer	5	+20%	2/15 Summer	100/15 Summer			33.478	0.118	0.000	1.37			104.6	SURCHARGED	3
49.000	CP2024	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.223	-0.012	0.000	0.75			18.3	OK	1
49.001	CP2023	15 Summer	5	+20%	5/15 Summer	100/15 Summer			34.157	0.032	0.000	1.16			33.8	SURCHARGED	4
50.000	CPDN11	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.449	-0.181	0.000	0.08			2.9	OK	6
51.000	CP2023.1A	120 Winter	5	+20%	100/15 Summer	100/15 Summer			33.950	-0.225	0.000	0.00			0.0	OK	5
49.002	CP2023.1	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.849	-0.171	0.000	0.38			38.9	OK	1
49.003	CP2108	15 Summer	5	+20%	100/15 Summer		100/15 Summer	6	33.291	-0.189	0.000	0.30	0.0		38.8	OK	

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Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
44.004	CP171	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.133	-0.082	0.000	0.96			149.0	OK	2
44.005	CP172	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.796	-0.184	0.000	0.65			162.5	OK	
44.006	CP3136	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.579	-0.031	0.000	0.80			172.5	OK	1
44.007	CP3137	15 Summer	5	+20%	2/15 Summer	100/15 Summer			32.414	0.094	0.000	1.60			181.6	SURCHARGED	3
52.000	CP2022	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.540	-0.045	0.000	0.94			26.0	OK	3
52.001	CP2021	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.364	-0.051	0.000	0.84			45.4	OK	6
53.000	CP2020	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.797	-0.108	0.000	0.52			19.8	OK	1
52.002	CP2019	15 Summer	5	+20%	2/15 Summer	100/15 Summer			32.698	0.433	0.000	6.97			72.1	SURCHARGED	6
54.000	CP2107	120 Winter	5	+20%	100/15 Summer				33.090	-0.225	0.000	0.00			0.0	OK	
52.003	CP162.1	15 Summer	5	+20%	2/15 Summer		100/15 Summer	8	32.275	0.065	0.000	3.53	0.0		71.8	SURCHARGED	
44.008	CP3138	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.108	-0.142	0.000	0.81			269.9	OK	5
44.009	CP3139	15 Summer	5	+20%	5/15 Summer				31.611	0.021	0.000	1.04			275.1	SURCHARGED	
44.010	CP3140	15 Summer	5	+20%	2/15 Summer				31.196	0.156	0.000	1.58			279.4	SURCHARGED	
55.000	CP3141A	30 Summer	5	+20%	100/15 Summer				30.822	-0.078	0.000	0.11			1.1	OK	
56.000	CP3138C	15 Summer	5	+20%					34.104	-0.096	0.000	0.28			4.8	OK	
57.000	CP3138G	15 Summer	5	+20%					35.133	-0.117	0.000	0.11			0.8	OK	
57.001	CP3138F	15 Summer	5	+20%			2/15 Summer	72	34.961	-0.139	0.000	0.02	1.5		0.2	OK	
57.002	CP3138E	15 Summer	5	+20%					34.454	-0.196	0.000	0.04			1.0	OK	
57.003	CP3138D	15 Summer	5	+20%			2/15 Summer	72	34.305	-0.135	0.000	0.02	1.8		0.3	OK	
56.001	CP3138B	15 Summer	5	+20%					33.330	-0.120	0.000	0.09			5.1	OK	
58.000	CPDN1	15 Summer	5	+20%	100/15 Summer				34.248	-0.102	0.000	0.21			2.2	OK	
58.001	CPDN2	15 Summer	5	+20%	100/15 Summer				34.075	-0.045	0.000	0.82			3.0	OK	
58.002	CPDN3	15 Summer	5	+20%	100/15 Summer	100/15 Summer			34.009	-0.091	0.000	0.32			3.9	OK	
58.003	CPDN4	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.847	-0.083	0.000	0.41			5.3	OK	
58.004	CPDN5	15 Summer	5	+20%	100/15 Summer	100/15 Summer			33.445	-0.065	0.000	0.60			7.1	OK	1
58.005	CPDN6	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.821	-0.059	0.000	0.66			9.4	OK	3
58.006	CPDN7	15 Summer	5	+20%	5/15 Summer	100/15 Summer			32.494	0.034	0.000	1.08			11.2	SURCHARGED	5
56.002	CP3138A	15 Summer	5	+20%	2/15 Summer		2/15 Summer	72	32.195	0.005	0.000	0.91	17.2		4.3	SURCHARGED	
56.003	CPDN8	15 Summer	5	+20%	100/15 Summer	100/15 Summer			32.091	-0.089	0.000	0.33			6.2	OK	4
56.004	CPDN9	15 Summer	5	+20%	100/15 Summer				31.415	-0.095	0.000	0.29			6.7	OK	
44.011	CP3141	30 Summer	5	+20%	100/15 Summer				30.820	-0.102	0.000	0.85			283.6	OK	
59.000	CP3142	15 Summer	5	+20%					31.090	-0.155	0.000	0.21			23.3	OK	
44.012	CP091001	30 Summer	5	+20%	2/15 Summer				30.398	0.207	0.000	2.88			287.3	SURCHARGED	
60.000	GY3068	15 Summer	5	+20%					31.272	-0.173	0.000	0.12			10.8	OK	
60.001	CP4050C	15 Summer	5	+20%					29.816	-0.163	0.000	0.17			23.1	OK	
44.013	CP4050B	30 Summer	5	+20%	5/15 Summer				28.737	0.087	0.000	1.11			292.8	SURCHARGED	
61.000	DN40	15 Summer	5	+20%					28.865	-0.130	0.000	0.05			1.6	OK	
61.001	CP100	15 Summer	5	+20%	100/15 Summer				27.466	-0.113	0.000	0.13			1.6	OK	
39.007	CP4050A	30 Summer	5	+20%	2/15 Summer				26.838	0.311	0.000	1.28			521.9	SURCHARGED	
62.000	CP4051B	15 Summer	5	+20%	5/15 Summer	100/15 Summer			33.240	0.540	0.000	1.07			25.2	SURCHARGED	6
62.001	CP4051A	15 Summer	5	+20%					28.949	-0.151	0.000	0.24			25.2	OK	
39.008	Pond Inlet 2	15 Summer	5	+20%	2/15 Summer				26.565	0.204	0.000	1.61			542.6	SURCHARGED	

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Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
39.009	Pond Outlet 2	120 Summer	5	+20%	100/15 Summer				26.250	-0.050	0.000	0.30		284.8	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coefficient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 2 Number of Offline Controls 7 Number of Storage Structures 4 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 574850 208550 TL 74850 08550 Cv (Summer) 1.000
FEH Rainfall Version 2013 Data Type Catchment Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status ON
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 5, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP153	15 Summer	100	+20%					31.689	-0.096	0.000	0.23			8.3	OK	
1.001	CP154	15 Summer	100	+20%	100/15 Summer				31.667	0.112	0.000	1.13			47.8	SURCHARGED	
2.000	CP2015	15 Summer	100	+20%					32.107	-0.283	0.000	0.01			0.8	OK	
3.000	CP175	15 Summer	100	+20%					32.323	-0.267	0.000	0.03			2.4	OK	
2.001	CP2013	15 Summer	100	+20%					30.149	-0.241	0.000	0.05			4.4	OK	
1.002	CP155	15 Summer	100	+20%					30.148	-0.202	0.000	0.57			101.0	OK	
4.000	CP1	15 Summer	100	+20%					33.839	-0.269	0.000	0.02			2.2	OK	
4.001	CP2	15 Summer	100	+20%					33.547	-0.208	0.000	0.20			20.9	OK	
4.002	CP3	30 Summer	100	+20%					33.308	-0.057	0.000	0.35			36.0	OK	
4.003	CP4	30 Summer	100	+20%	100/15 Summer				33.301	0.251	0.000	0.57			58.8	SURCHARGED	
4.004	CP5	30 Summer	100	+20%	100/15 Summer				33.287	0.669	0.000	0.73			77.0	SURCHARGED	
5.000	DN18	15 Summer	100	+20%					34.908	-0.171	0.000	0.38			62.0	OK	
5.001	CP77	30 Summer	100	+20%	100/15 Summer				34.743	0.162	0.000	0.70			102.5	SURCHARGED	
5.002	CP78	30 Summer	100	+20%	100/15 Summer				34.601	0.533	0.000	0.64			100.6	SURCHARGED	
5.003	CP6	30 Summer	100	+20%	100/15 Summer				34.474	0.834	0.000	0.82			115.9	SURCHARGED	
5.004	CP7	30 Summer	100	+20%	100/15 Summer				34.306	1.216	0.000	0.89			124.3	SURCHARGED	
5.005	CP8	30 Summer	100	+20%	5/15 Summer				34.189	1.366	0.000	1.06			127.7	SURCHARGED	
6.000	DIT03	15 Summer	100	+20%					37.348	-0.475	0.000	0.00			10.6	OK	
6.001	DIT04	15 Summer	100	+20%					35.814	-0.416	0.000	0.04			34.8	OK	
6.002	DIT05	15 Summer	100	+20%					35.046	-0.354	0.000	0.08			42.9	OK	

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File PROPOSED CASE DRAINAGE MODEL_S1_OU11 & OU12.MDX

A12 Chelmsford to A120widening
Section 1
Proposed Network S1-OU11 & 12



Designed by LM
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Network 2020.1.3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	DIT01	15 Summer	100	+20%					35.921	-0.429	0.000	0.03			26.3	OK	
7.001	DIT02	15 Summer	100	+20%					35.306	-0.394	0.000	0.05			41.5	OK	
6.003	DN02	15 Summer	100	+20%					34.786	-0.076	0.000	0.71			71.8	OK	
8.000	DN30	30 Summer	100	+20%	100/15 Summer				34.553	0.430	0.000	0.02			1.0	SURCHARGED	
6.004	CP10	30 Summer	100	+20%	100/15 Summer				34.552	0.739	0.000	0.80			74.7	FLOOD RISK	
6.005	CP11	30 Summer	100	+20%	100/15 Summer	100/15 Summer			34.215	0.911	10.665	0.65			59.5	FLOOD	5
6.006	CP173	30 Summer	100	+20%	100/15 Summer	100/15 Summer			34.158	1.079	2.215	0.26			60.0	FLOOD	3
5.006	CP174	30 Summer	100	+20%	5/15 Summer				34.096	1.367	0.000	1.66			152.7	SURCHARGED	
5.007	CP9	30 Summer	100	+20%	100/15 Summer				34.017	1.338	0.000	1.50			153.0	SURCHARGED	
9.000	CP12	30 Summer	100	+20%	100/15 Summer				33.905	0.641	0.000	0.11			5.7	FLOOD RISK	
9.001	CP13	30 Summer	100	+20%	100/15 Summer				33.901	0.738	0.000	0.33			16.6	SURCHARGED	
5.008	CP14	30 Summer	100	+20%	100/15 Summer				33.898	1.322	0.000	1.25			133.2	SURCHARGED	
10.000	DN20	30 Summer	100	+20%	100/30 Summer				33.741	0.049	0.000	0.53			18.9	SURCHARGED	
5.009	CP15	30 Summer	100	+20%	100/15 Summer				33.721	1.314	0.000	1.32			132.6	SURCHARGED	
11.000	DN21	30 Summer	100	+20%	100/30 Summer				33.588	0.003	0.000	0.16			6.6	SURCHARGED	
5.010	CP16	30 Summer	100	+20%	100/15 Summer				33.583	1.269	0.000	1.21			128.7	SURCHARGED	
12.000	DN22	30 Summer	100	+20%					33.373	-0.130	0.000	0.11			4.2	OK	
5.011	CP17	30 Summer	100	+20%	5/15 Winter				33.369	1.216	0.000	1.42			126.3	SURCHARGED	
4.005	CP18	30 Summer	100	+20%	100/15 Summer				33.265	1.154	0.000	1.34			141.8	SURCHARGED	
13.000	DN23	30 Summer	100	+20%	100/15 Summer				33.024	0.107	0.000	1.11			34.4	SURCHARGED	
4.006	CP19	30 Summer	100	+20%	100/15 Summer				33.003	1.041	0.000	1.01			152.6	SURCHARGED	
14.000	DN03	15 Summer	100	+20%	100/15 Summer				32.969	0.198	0.000	1.53			44.6	SURCHARGED	
15.000	CP20	30 Summer	100	+20%					33.150	-0.070	0.000	0.03			1.6	OK	
16.000	CP3182A	15 Summer	100	+20%					33.644	-0.095	0.000	0.61			26.0	OK	
16.001	CP21	15 Summer	100	+20%					33.288	-0.091	0.000	0.64			31.8	OK	
17.000	DN04	30 Summer	100	+20%	100/30 Summer				33.181	0.034	0.000	0.16			4.7	SURCHARGED	
18.000	DN05	15 Summer	100	+20%					33.332	-0.182	0.000	0.08			5.6	OK	
17.001	CP22	30 Summer	100	+20%	100/15 Summer				33.178	0.204	0.000	0.33			8.4	SURCHARGED	
16.002	CP23	30 Summer	100	+20%	100/15 Summer				33.176	0.238	0.000	0.99			31.4	SURCHARGED	
15.001	CP24	30 Summer	100	+20%	100/15 Summer				33.149	0.455	0.000	0.31			28.5	SURCHARGED	
19.000	CP179	30 Summer	100	+20%	100/15 Summer				34.962	0.643	0.000	0.62			40.8	FLOOD RISK	
19.001	CP180	30 Summer	100	+20%	100/15 Summer				34.876	0.787	0.000	0.92			49.8	FLOOD RISK	
19.002	CP181	30 Summer	100	+20%	100/15 Summer				34.774	0.860	0.000	1.05			54.6	SURCHARGED	
20.000	DN31	15 Summer	100	+20%					35.420	-0.168	0.000	0.14			8.4	OK	
20.001	CP177	30 Summer	100	+20%	100/15 Summer				34.681	0.592	0.000	0.11			7.1	SURCHARGED	
19.003	CP182	30 Summer	100	+20%	100/15 Summer				34.690	0.861	0.000	1.09			71.7	SURCHARGED	
19.004	CP183	30 Summer	100	+20%	100/15 Summer				34.501	0.915	0.000	1.56			104.9	FLOOD RISK	
19.005	CP184	30 Summer	100	+20%	100/15 Summer				33.859	0.721	0.000	0.81			86.2	SURCHARGED	
21.000	CPDN15	15 Summer	100	+20%					33.421	-0.088	0.000	0.83			65.0	OK	
22.000	CP47	15 Summer	100	+20%	100/15 Summer				35.370	0.840	0.000	0.06			2.5	FLOOD RISK	
22.001	CP48	15 Summer	100	+20%	100/15 Summer	100/15 Summer			35.362	1.204	4.346	1.04			36.2	FLOOD	3
22.002	CP33	15 Summer	100	+20%	100/15 Summer				35.514	1.420	0.000	1.82			113.0	FLOOD RISK	

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A12 Chelmsford to A120widening
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Network 2020.1.3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
22.003	CP34	30	Summer	100	+20%	100/15	Summer		35.097	1.375	0.000	1.63			100.0	FLOOD RISK	
22.004	CP35	30	Summer	100	+20%	100/15	Summer		34.836	1.363	0.000	1.48			90.6	FLOOD RISK	
22.005	CP36	30	Summer	100	+20%	100/15	Summer		34.457	1.236	0.000	1.34			82.6	SURCHARGED	
22.006	CP37	30	Summer	100	+20%	100/15	Summer		33.961	1.043	0.000	1.34			81.1	SURCHARGED	
22.007	CP80	30	Summer	100	+20%	100/15	Summer		33.575	0.865	0.000	0.55			92.8	SURCHARGED	
19.006	CP185	30	Summer	100	+20%	100/15	Summer		33.344	1.098	0.000	1.24			179.4	SURCHARGED	
15.002	CP25	30	Summer	100	+20%	100/15	Summer		33.135	1.026	0.000	0.96			186.7	SURCHARGED	
4.007	CP26	30	Summer	100	+20%	5/30	Summer		32.908	1.044	0.000	1.54			343.7	SURCHARGED	
23.000	DN06	30	Summer	100	+20%	100/30	Summer		32.716	0.014	0.000	0.57			24.6	SURCHARGED	
4.008	CP27	30	Summer	100	+20%	100/15	Summer		32.706	0.901	0.000	1.44			348.8	SURCHARGED	
24.000	DN07	15	Summer	100	+20%				32.639	-0.087	0.000	0.69			32.4	OK	
4.009	CP28	30	Summer	100	+20%	100/15	Summer		32.498	0.780	0.000	1.37			354.1	SURCHARGED	
25.000	DN08	15	Summer	100	+20%				32.654	-0.054	0.000	0.91			41.3	OK	
4.010	CP29	30	Summer	100	+20%	100/15	Summer		32.271	0.682	0.000	1.52			361.8	SURCHARGED	
26.000	DN09	15	Summer	100	+20%				32.512	-0.111	0.000	0.51			24.5	OK	
4.011	CP30	30	Summer	100	+20%	100/15	Summer		32.077	0.566	0.000	1.36			365.3	SURCHARGED	
27.000	DN10	15	Summer	100	+20%	100/15	Summer		32.676	0.120	0.000	1.13			49.5	SURCHARGED	
28.000	CP2011	15	Summer	100	+20%				31.958	-0.107	0.000	0.47			18.3	OK	
28.001	CP3178A	30	Summer	100	+20%	100/15	Summer		31.841	0.536	0.000	0.25			14.2	SURCHARGED	
4.012	CP31	30	Summer	100	+20%	100/15	Summer		31.796	0.462	0.000	1.00			378.9	SURCHARGED	
29.000	DN11	15	Summer	100	+20%				32.335	-0.057	0.000	0.90			39.1	OK	
4.013	CP32	30	Summer	100	+20%	100/15	Summer		31.497	0.476	0.000	1.01			385.8	SURCHARGED	
30.000	CP38	15	Summer	100	+20%				33.167	-0.213	0.000	0.18			12.8	OK	
30.001	CP39	15	Summer	100	+20%				32.765	-0.201	0.000	0.23			16.7	OK	
30.002	CP40	15	Summer	100	+20%				32.628	-0.190	0.000	0.27			20.8	OK	
31.000	Ditch 1	15	Summer	100	+20%				33.439	-0.461	0.000	0.01			4.3	OK	
32.000	Ditch 3	15	Summer	100	+20%				33.144	-0.456	0.000	0.01			4.2	OK	
31.001	Ditch 2	15	Summer	100	+20%				32.794	-0.246	0.000	0.07			8.5	OK	
30.003	CP41	15	Summer	100	+20%				32.319	-0.169	0.000	0.39			29.1	OK	
33.000	Ditch 4	15	Summer	100	+20%				32.930	-0.470	0.000	0.00			1.8	OK	
34.000	Ditch 6	15	Summer	100	+20%				32.945	-0.455	0.000	0.01			2.7	OK	
33.001	Ditch 5	15	Summer	100	+20%				32.830	-0.270	0.000	0.02			4.5	OK	
30.004	CP42	15	Summer	100	+20%				32.038	-0.157	0.000	0.45			34.2	OK	
30.005	CP43	15	Summer	100	+20%				31.745	-0.147	0.000	0.52			34.4	OK	
35.000	DN12	15	Summer	100	+20%				32.260	-0.051	0.000	0.94			36.3	OK	
4.014	CP44	30	Summer	100	+20%	100/15	Summer		31.148	0.474	0.000	1.46			429.2	SURCHARGED	
36.000	DN13	15	Summer	100	+20%				32.307	-0.104	0.000	0.55			20.5	OK	
4.015	CP45	30	Summer	100	+20%	100/15	Summer		30.811	0.298	0.000	1.47			436.3	SURCHARGED	
37.000	DN14	15	Summer	100	+20%				32.361	-0.127	0.000	0.39			21.1	OK	
4.016	CP46	30	Summer	100	+20%	100/15	Summer		30.446	0.100	0.000	1.33			444.3	SURCHARGED	
1.003	CP156	30	Summer	100	+20%	100/15	Summer		29.743	0.131	0.000	1.42			491.3	SURCHARGED	
38.000	CP190	15	Summer	100	+20%	100/15	Summer		31.797	0.520	0.000	0.74			32.1	SURCHARGED	

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PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
38.001	CP191	15 Summer	100	+20%	100/15 Summer				31.692	0.627	0.000	1.32			56.5	SURCHARGED	
38.002	CP192	15 Summer	100	+20%	100/15 Summer				30.682	0.147	0.000	1.18			137.0	SURCHARGED	
1.004	CP200	30 Summer	100	+20%					28.520	-0.330	0.000	0.42			565.9	OK	
1.005	Pond Inlet 1	30 Summer	100	+20%	100/30 Summer				27.098	0.023	0.000	1.03			553.3	SURCHARGED	
1.006	Pond Outlet 1	240 Summer	100	+20%	100/60 Summer				26.764	0.189	0.000	0.07			90.8	SURCHARGED	
39.000	CP2018A	15 Summer	100	+20%	100/15 Summer	100/15 Summer			33.556	1.006	0.069	1.69			8.0	FLOOD	1
39.001	CP2018	15 Summer	100	+20%	2/15 Summer				33.447	1.152	0.000	6.32			62.1	FLOOD RISK	
39.002	CP2017	15 Summer	100	+20%	100/15 Summer	100/15 Summer			33.043	1.068	3.165	1.70			54.1	FLOOD	3
39.003	CP6010	15 Summer	100	+20%	100/15 Summer				31.729	0.589	0.000	0.61			71.6	SURCHARGED	
40.000	CPDN10	30 Summer	100	+20%	100/15 Summer	100/15 Summer			33.800	1.361	0.352	1.18			19.2	FLOOD	7
40.001	CP162	15 Summer	100	+20%	100/15 Summer				32.574	0.859	0.000	0.98			55.2	SURCHARGED	
39.004	CP161	15 Summer	100	+20%	100/15 Summer				31.624	0.864	0.000	1.34			160.6	SURCHARGED	
39.005	CP160	15 Summer	100	+20%					29.636	-0.154	0.000	0.62			262.1	OK	
41.000	Ditch 7	15 Summer	100	+20%					30.432	-0.182	0.000	0.13			11.1	FLOOD RISK	
41.001	Ditch 8	15 Summer	100	+20%					30.243	-0.147	0.000	0.21			19.0	FLOOD RISK	
42.000	Ditch 10	15 Summer	100	+20%					30.644	-0.270	0.000	0.01			3.5	FLOOD RISK	
41.002	Ditch 9	15 Summer	100	+20%					29.958	-0.202	0.000	0.23			21.3	OK	
41.003	CP157	15 Summer	100	+20%					29.681	-0.229	0.000	0.44			84.9	OK	
41.004	CP159A	15 Summer	100	+20%					29.571	-0.029	0.000	1.00			169.0	OK	
41.005	CP159	15 Summer	100	+20%				0	29.482	-0.027	0.000	0.25	0.0		238.3	OK	
43.000	CP193	15 Summer	100	+20%	100/15 Summer				30.688	0.048	0.000	0.73			75.3	SURCHARGED	
43.001	CP194	15 Summer	100	+20%	100/15 Summer				30.599	0.088	0.000	1.08			108.3	SURCHARGED	
43.002	CP195	15 Summer	100	+20%	100/15 Summer				30.487	0.065	0.000	1.31			133.6	SURCHARGED	
41.006	EXCP4050D	15 Summer	100	+20%	2/15 Summer				29.115	2.420	0.000	2.11			399.2	SURCHARGED	
39.006	CP091002	30 Summer	100	+20%	2/15 Summer				28.716	2.134	0.000	1.87			612.3	SURCHARGED	
44.000	CP167	15 Summer	100	+20%	100/15 Summer				35.665	0.495	0.000	0.49			6.8	SURCHARGED	
45.000	CP2111	15 Summer	100	+20%	100/15 Summer				35.790	1.215	0.000	0.54			22.0	FLOOD RISK	
46.000	CP2109	15 Summer	100	+20%	100/15 Summer	100/15 Summer			35.580	0.405	0.301	0.28			17.7	FLOOD	2
47.000	CP2027	15 Summer	100	+20%	100/15 Summer				35.328	0.393	0.000	0.13			4.9	SURCHARGED	
48.000	CP2026	15 Summer	100	+20%	100/15 Summer	100/15 Summer			35.700	0.875	0.401	0.89			25.6	FLOOD	3
48.001	CP2025	15 Summer	100	+20%	100/15 Summer	100/15 Summer			35.512	0.897	2.392	1.59			67.3	FLOOD	3
47.001	CP2025.1	15 Summer	100	+20%	100/15 Summer	100/15 Summer	100/15 Summer	7	35.305	0.875	15.205	0.49	55.2		57.6	FLOOD	5
45.001	CP2110	15 Summer	100	+20%	2/15 Summer	100/15 Summer			35.561	1.631	0.658	3.43			105.0	FLOOD	2
44.001	CP168	15 Winter	100	+20%	5/15 Summer				35.523	1.643	0.000	0.97			91.4	FLOOD RISK	
44.002	CP169	30 Summer	100	+20%	5/15 Summer	100/15 Summer			35.172	1.672	1.746	1.38			116.0	FLOOD	4
44.003	CP170	15 Summer	100	+20%	2/15 Summer	100/15 Summer			35.021	1.661	0.820	1.83			139.9	FLOOD	3
49.000	CP2024	15 Summer	100	+20%	100/15 Summer	100/15 Summer			35.260	1.025	0.049	1.49			36.0	FLOOD	1
49.001	CP2023	15 Summer	100	+20%	5/15 Summer	100/15 Summer			34.984	0.859	3.749	2.86			83.0	FLOOD	4
50.000	CPDN11	30 Summer	100	+20%	100/15 Summer	100/15 Summer			35.157	0.527	12.059	1.29			45.6	FLOOD	6
51.000	CP2023.1A	30 Summer	100	+20%	100/15 Summer	100/15 Summer			34.558	0.383	8.212	1.97			29.2	FLOOD	5
49.002	CP2023.1	30 Summer	100	+20%	100/15 Summer	100/15 Summer			35.000	0.980	0.054	0.93			96.0	FLOOD	1
49.003	CP2108	30 Summer	100	+20%	100/15 Summer		100/15 Summer	6	34.946	1.466	0.000	0.75	18.5		97.1	SURCHARGED	

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Section 1
Proposed Network S1-OU11 & 12



Date 15/12/2021
File PROPOSED CASE DRAINAGE MODEL_S1_OU11 & OU12.MDX

Designed by LM
Checked by AM

Innovyze

Network 2020.1.3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
44.004	CP171	15 Summer	100	+20%	100/15 Summer	100/15 Summer			34.780	1.565	0.439	1.36			210.9	FLOOD	2
44.005	CP172	15 Summer	100	+20%	100/15 Summer				34.397	1.417	0.000	0.91			226.9	FLOOD RISK	
44.006	CP3136	15 Summer	100	+20%	100/15 Summer	100/15 Summer			34.140	1.530	0.079	1.22			265.0	FLOOD	1
44.007	CP3137	15 Summer	100	+20%	2/15 Summer	100/15 Summer			33.722	1.402	2.109	2.46			278.6	FLOOD	3
52.000	CP2022	15 Summer	100	+20%	100/15 Summer	100/15 Summer			34.553	0.968	2.514	1.57			43.4	FLOOD	3
52.001	CP2021	30 Summer	100	+20%	100/15 Summer	100/15 Summer			34.184	0.769	14.351	1.00			54.1	FLOOD	6
53.000	CP2020	15 Summer	100	+20%	100/15 Summer	100/15 Summer			33.890	0.985	0.007	1.03			39.4	FLOOD	1
52.002	CP2019	30 Summer	100	+20%	2/15 Summer	100/15 Summer			33.595	1.330	14.946	9.57			99.0	FLOOD	6
54.000	CP2107	30 Summer	100	+20%	100/15 Summer				33.569	0.254	0.000	0.39			17.4	SURCHARGED	
52.003	CP162.1	30 Summer	100	+20%	2/15 Summer		100/15 Summer	8	33.490	1.280	0.000	4.55	20.5		92.4	SURCHARGED	
44.008	CP3138	30 Summer	100	+20%	100/15 Summer	100/15 Summer			33.301	1.051	11.302	1.04			347.0	FLOOD	5
44.009	CP3139	15 Summer	100	+20%	5/15 Summer				32.830	1.240	0.000	1.34			354.4	FLOOD RISK	
44.010	CP3140	30 Summer	100	+20%	2/15 Summer				32.215	1.175	0.000	2.15			381.3	FLOOD RISK	
55.000	CP3141A	30 Summer	100	+20%	100/15 Summer				31.705	0.805	0.000	0.24			2.4	FLOOD RISK	
56.000	CP3138C	15 Summer	100	+20%					34.135	-0.065	0.000	0.60			10.5	OK	
57.000	CP3138G	15 Summer	100	+20%					35.149	-0.101	0.000	0.21			1.5	OK	
57.001	CP3138F	15 Summer	100	+20%			2/15 Summer	72	34.974	-0.126	0.000	0.06	3.4		0.8	OK	
57.002	CP3138E	15 Summer	100	+20%					34.479	-0.171	0.000	0.12			2.9	OK	
57.003	CP3138D	15 Summer	100	+20%			2/15 Summer	72	34.318	-0.122	0.000	0.08	5.0		1.1	OK	
56.001	CP3138B	30 Summer	100	+20%					33.391	-0.059	0.000	0.18			10.4	OK	
58.000	CPDN1	15 Summer	100	+20%	100/15 Summer				34.622	0.272	0.000	0.46			4.8	SURCHARGED	
58.001	CPDN2	15 Summer	100	+20%	100/15 Summer				34.574	0.454	0.000	1.66			6.1	SURCHARGED	
58.002	CPDN3	30 Summer	100	+20%	100/15 Summer	100/15 Summer			34.533	0.433	0.013	0.53			6.5	FLOOD	
58.003	CPDN4	15 Summer	100	+20%	100/15 Summer	100/15 Summer			34.488	0.558	0.028	0.78			10.1	FLOOD	
58.004	CPDN5	15 Summer	100	+20%	100/15 Summer	100/15 Summer			34.430	0.920	0.061	1.04			12.4	FLOOD	1
58.005	CPDN6	15 Summer	100	+20%	100/15 Summer	100/15 Summer			34.140	1.260	0.165	0.99			14.1	FLOOD	3
58.006	CPDN7	30 Summer	100	+20%	5/15 Summer	100/15 Summer			33.721	1.261	0.921	1.68			17.3	FLOOD	5
56.002	CP3138A	30 Summer	100	+20%	2/15 Summer		2/15 Summer	72	33.356	1.166	0.000	3.67	18.0		17.4	FLOOD RISK	
56.003	CPDN8	30 Summer	100	+20%	100/15 Summer	100/15 Summer			32.880	0.700	0.039	1.07			19.9	FLOOD	4
56.004	CPDN9	30 Summer	100	+20%	100/15 Summer				32.114	0.604	0.000	0.89			20.7	SURCHARGED	
44.011	CP3141	30 Summer	100	+20%	100/15 Summer				31.688	0.766	0.000	1.23			408.5	SURCHARGED	
59.000	CP3142	15 Summer	100	+20%					31.126	-0.119	0.000	0.45			50.5	OK	
44.012	CP091001	30 Summer	100	+20%	2/15 Summer				30.785	0.594	0.000	4.49			447.9	SURCHARGED	
60.000	GY3068	15 Summer	100	+20%					31.298	-0.147	0.000	0.26			23.4	OK	
60.001	CP4050C	30 Summer	100	+20%					29.933	-0.046	0.000	0.37			51.2	OK	
44.013	CP4050B	30 Summer	100	+20%	5/15 Summer				29.874	1.224	0.000	1.79			470.9	SURCHARGED	
61.000	DN40	15 Summer	100	+20%					28.877	-0.118	0.000	0.10			3.6	OK	
61.001	CP100	30 Summer	100	+20%	100/15 Summer				28.422	0.843	0.000	0.61			7.5	SURCHARGED	
39.007	CP4050A	30 Summer	100	+20%	2/15 Summer				28.419	1.892	0.000	2.47			1010.0	SURCHARGED	
62.000	CP4051B	15 Summer	100	+20%	5/15 Summer	100/15 Summer			33.757	1.057	7.325	1.14			26.8	FLOOD	6
62.001	CP4051A	15 Winter	100	+20%					28.952	-0.148	0.000	0.25			26.8	OK	
39.008	Pond Inlet 2	30 Summer	100	+20%	2/15 Summer				27.411	1.050	0.000	3.07			1037.3	SURCHARGED	

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Date 15/12/2021
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Designed by LM
Checked by AM

Innovyze

Network 2020.1.3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Proposed Network S1-OU11&12

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
39.009	Pond Outlet 2	60 Summer	100	+20%	100/15 Summer				26.595	0.295	0.000	0.61			571.2	SURCHARGED	

Appendix C - Discharge Rate and Attenuation Storage Volume Summary Tables

Table C.1 Junction 19 Proposed Site Condition Outfall Discharge Rates and Attenuation Storage Volumes

Proposed Catchment	Receiving Watercourse ¹	Modelled Peak Discharge Rates (l/s) ²					Flow Control Type	Attenuation Storage Type	Modelled Attenuation Storage Volume ⁵ (m ³)	Catchment Specific Comments
		Allowable Discharge Rates (A) ^{3, 6}								
		Proposed Discharge Rates (P) ⁴								
A/P	1yr	2yr	5yr	100yr						
S1-OU1	River Chelmer	A	510.4	533.3	605.0	925.9	Orifice Plate	Underground Geocellular Attenuation Storage No.1	151	<p>Brownfield discharge rates applicable due to the online highway widening works at A12 mainline, slip roads and adjoining Junction 19 improvement works. Catchment S1-OU1 attenuation pond will require a new outfall to the River Chelmer.</p> <p>The existing underground geocellular attenuation storage is installed in the Junction 19 Generals Lane roundabout as part of the Junction 19 upgrade for the Beaulieu Park development which precedes the proposed A12 scheme. This attenuation storage is to be retained. Additional new underground geocellular attenuation storage is required to meet the requirements for proposed A12 scheme.</p>
							Geocellular System Outlet Pipe	Underground Geocellular Attenuation Storage No. 2	176	
		P	254.5	338.2	439.9	597.9	Existing Hydrobrake	Existing Underground Attenuation Storage	289	
							Orifice Plate	Underground Geocellular Attenuation Storage No. 3	63	
							Pond Outlet Pipe	Attenuation Pond	2069	

Proposed Catchment	Receiving Watercourse ¹	Modelled Peak Discharge Rates (l/s) ²					Flow Control Type	Attenuation Storage Type	Modelled Attenuation Storage Volume ⁵ (m ³)	Catchment Specific Comments
		Allowable Discharge Rates (A) ^{3, 6}								
		Proposed Discharge Rates (P) ⁴								
A/P	1yr	2yr	5yr	100yr						
S1-OU7A	Ordinary Watercourse 2	A	(See Comments)				Existing Hydrobrake	Existing Underground Attenuation Storage	72	<p>The proposed S1-OU7A drainage catchment was part of existing S1-OU1 drainage catchment. However, it is now separated out due to potential spatial constraints in providing attenuation storage for the proposed S1-OU7A catchment and other site-specific constraints (i.e. potential clash with existing culvert crossing). A new outfall for the proposed S1-OU7A catchment to Ordinary Watercourse 2 will be required.</p> <p>The existing underground geocellular attenuation storage is installed in the Junction 19 Generals Farm roundabout as part of the Junction 19 upgrade for the Beaulieu Park development which precedes the proposed A12 scheme. This attenuation storage is to be retained.</p>
		P	5.0	5.0	5.0	5.0	Vortex Flow Control Device	Attenuation Pond	693	

Proposed Catchment	Receiving Watercourse ¹	Modelled Peak Discharge Rates (l/s) ²					Flow Control Type	Attenuation Storage Type	Modelled Attenuation Storage Volume ⁵ (m ³)	Catchment Specific Comments
		Allowable Discharge Rates (A) ^{3, 6}								
		Proposed Discharge Rates (P) ⁴								
A/P	1yr	2yr	5yr	100yr						
S1-OU10	Existing Highway Drainage System serving the B1137 road	A	84.8	81.6	105.4	179.4	Orifice Plate	Underground Geocellular Attenuation Storage System	138	Brownfield discharge rates applicable due to online highway widening works. An underground geocellular attenuation storage has been used due to spatial constraints on site in addition to the proposed highway drainage system being relatively deep at its downstream end (i.e. avoids a deep attenuation pond). Outfalls into an existing un-surveyed manhole. Further drainage survey is required.
		P	81.0	80.2	84.3	122.1				
S1-OU10A	Existing Highway Drainage System serving the B1137 road	A	6.5	6.3	8.9	16.7	Vortex Flow Control Device	Underground Geocellular Attenuation Storage System	56	Brownfield discharge rates applicable given that the existing Payne's Lane site is currently paved and the proposed S1-OU10A highway drainage is discharging to the B1137 local road highway drainage system. An underground geocellular attenuation storage has been used. Outfalls into an existing un-surveyed manhole. Further drainage survey is required.
		P	5.0	5.0	5.0	5.0				

Proposed Catchment	Receiving Watercourse ¹	Modelled Peak Discharge Rates (l/s) ²					Flow Control Type	Attenuation Storage Type	Modelled Attenuation Storage Volume ⁵ (m ³)	Catchment Specific Comments
		Allowable Discharge Rates (A) ^{3, 6}								
		Proposed Discharge Rates (P) ⁴								
A/P	1yr	2yr	5yr	100yr						
S1-OU11	Boreham Brook	A	(See Comments)				Orifice Plate	Attenuation Pond	1291	Brownfield discharge rates applicable due to online highway widening works. The existing case S1-OU12 catchment has been divided up in the proposed case due to the proposed highway geometry. The existing S1-OU12 catchment allowable discharge rates are apportioned between the proposed case S1-OU11 and S1-OU12 catchments. A new outfall for S1-OU11 to Boreham Brook will be required.
		P	40.0	51.7	60.7	90.8				
S1-OU12	Boreham Brook	A	402.8	390.5	536.4	909.0	Orifice Plate	Attenuation Pond	590	Brownfield discharge rates applicable due to online highway widening works. The catchment specific comments for the proposed S1-OU11 catchment are applicable to the proposed S1-OU12 catchment. The existing outfall needs to be re-positioned on Boreham Brook. The combined proposed discharge rates from the proposed S1-OU11 and S1-OU12 catchments are less than the existing case S1-OU12 allowable discharge rates.
		P	183.2	207.1	284.8	571.2				

Proposed Catchment	Receiving Watercourse ¹	Modelled Peak Discharge Rates (l/s) ²					Flow Control Type	Attenuation Storage Type	Modelled Attenuation Storage Volume ⁵ (m ³)	Catchment Specific Comments
		Allowable Discharge Rates (A) ^{3, 6}								
		Proposed Discharge Rates (P) ⁴								
A/P	1yr	2yr	5yr	100yr						
Combined S1-OU11 & S1-OU12	Boreham Brook	A	402.8	390.5	536.4	909.0	N/A	N/A	N/A	A check has been undertaken to ensure the combined proposed discharge rates from the S1-OU11 and S1-OU12 catchments are less than existing case S1-OU12 allowable discharge rates.
		P	223.2	258.8	345.5	662.0				

Notes:

- Where there is no nearby receiving watercourse locally (i.e. Main River, Ordinary Watercourse, exiting drainage ditch or proposed drainage ditch), the proposed catchments in such situations discharge to the nearest available existing highway drainage system which will ultimately discharge to a watercourse further downstream.
- FEH2013 rainfall data has been used in the hydraulic modelling of the proposed highway drainage systems for the proposed scheme. FEH2013 rainfall cannot be used for the assessment of the 1 in 1 year return period storm event. Therefore, FEH1999 rainfall data has been used for the assessment of the 1 in 1 year return period storm event.
- The existing case allowable discharge rates do not include a climate change allowance given that current climatic conditions are required inform the discharge rates for the proposed highway drainage systems. Where applicable the brownfield allowable discharge rates have been determined based on the information available from the drainage surveys undertaken at the preliminary design stage. It is noted that the drainage surveys were found to have gaps in the information and/or were found to be incomplete and as such appropriate design assumptions have been made where necessary. These assumptions including the potential impact to the current brownfield discharge rate estimates presented in this summary table would need to be reviewed at detailed design stage.
- The proposed case discharge rates include a climate change allowance as described in Section 4.4 (Climate Change Allowance) of this report. At an individual outfall the proposed discharge rates may be less than the allowable discharge rates, such that the cumulative impacts of all discharges to a receiving watercourse generally provide a reduction in the downstream flood risk and to allow for a margin of uncertainty in estimating the existing highway drainage system discharge rates.
- The modelled proposed case attenuation storage volumes are determined for the 1 in 100 year return period storm event plus a 20% climate change allowance.
- For the proposed drainage catchments subject to online highway widening works, the modelled allowable discharge rates are modelled brownfield discharge rates for the existing paved area footprint.