OxSRFI
OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

DCO Submission

Environmental Statement

Chapter 9: Water Environment
Appendix 9.4: Sustainable Drainage Statement - Offsite and Highways Works

Document 6.9D
Rev P03

On behalf of
Oxfordshire Railfreight Limited

Prepared by BWB Consulting Ltd
May 2026

PINS REF:	TR050008
Document Reference	6.9D
APFP Regulation	5(2)(a)
Author	BWB Consulting Ltd
Date	May 2026
Revision	P03

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Oxfordshire Railfreight Limited

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Sustainable Drainage Statement

Offsite Highway Works

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May 2026

DOCUMENT ISSUE RECORD

Document Number:	OXSRFI-BWB-ZZ-XX-T-W-1051_SDS
BWB Reference:	NTH2479-1051-SDS

Revision	Date of Issue	Status	Author:	Checked:	Approved:
P01	20/02/2026	S2	Toby Bass MCIWEM BEng	Matthew Bailey BSc (Hons)	Rowan Jobling BEng (Hons)
P02	20/03/2026	S2	Toby Bass MCIWEM BEng	Matthew Bailey BSc (Hons)	Rowan Jobling BEng (Hons)
P03*	15/05/2026	S2	Toby Bass MCIWEM BEng	Matthew Bailey BSc (Hons)	Rowan Jobling BEng (Hons)

* Updates to reflect latest Order Limits

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1. INTRODUCTION

1.1 A Sustainable Drainage Statement (SDS) sets out the principles of drainage design for a development and summarises the reasoning behind the chosen design. This includes justification of specific flow rates, volumes of attenuated storage, as well as the appropriate level of treatment to be provided to surface water runoff.

1.2 This SDS has been produced by BWB Consulting on behalf of Oxfordshire Railfreight Limited in respect of a Development Consent Order (DCO) for Oxfordshire Strategic Rail Freight Interchange (OxSRFI).

1.3 A series of other Flood Risk Assessments (FRAs) and SDS reports have been prepared to support the DCO submission:

- OxSRFI Main Site FRA - "OXSRFI-ZZ-XX-T-W-1006_FRA (Main Development Site)";
- OxSRFI Main Site SDS - "OXSRFI-BWB-ZZ-XX-T-W-1050_SDS (Main Development Site)"
- OxSRFI Offsite and Highway Works Flood Risk Screening - "OXSRFI-BWB-ZZ-XX-T-W-1007_Offsite and Highway Works Flood Risk Screening"; and

1.4 This SDS has been produced in relation to the Offsite Highways Works. Drainage strategies for the SRFI Main Site Works are covered in the Main Site SDS report, with the exception of Heyford Park Link Road which is covered in both the Main Site SDS report and this report.

1.5 Some of the proposed works across the scheme do not require drainage, or do not include changes to impermeable areas or introduce features that would be detrimental to flood risk; these areas have been 'Screened Out' of this SDS. The justification for any this is provided in **Table 1.1**.

1.6 The proposed development is to be submitted for a DCO, and as such the details have been developed in consultation with the relevant statutory bodies relating to flood risk and drainage for the site.

1.7 The Lead Local Flood Authority (LLFA) for the site are Oxfordshire County Council (OCC). The LLFA are not the prescribed consultee under the DCO process; however, Cherwell District Council, the Local Planning Authority (LPA), are. As the LPA is not the LLFA for the site, the Environment Agency (EA) have been deferred to as the relevant body to comment on the surface water drainage strategy. Despite this, as the LLFA is the body responsible for surface water flood risk in relation to planning, OCC have been consulted through the DCO consultation stage and will comment of the surface water drainage proposals, via the EA.

1.8 Drainage assets within the strategic road network are the responsibility of National Highways. Drainage assets in other adopted highways are the responsibility of Oxfordshire County Council Highway Authority.

Situational Context

1.9 The proposed development comprises a number of interrelated component parts as follows, split into two groups based on the areas assessed within the technical SDS reports prepared by BWB, and collectively they are the Oxfordshire SRFI:

- **SRFI Main Site**
    - Works No. 1 to 10. SRFI Main Site.
    - Works No. 11 Principal access to the main site.
    - Works No. 12 Heyford Park Link Road.
    - Works No. 30 Biodiversity and landscaping enhancement area (South).
    - Works No. 35 Foul drainage outfall to Bicester.
    - Works No. 36 Foul drainage outfall to Ardley.
- **Offsite/Highway Works**
    - Works No. 12 Heyford Park Link Road.
    - Works No. 13 Camp Road/Chilgrove Drive Junction and Bridleway.
    - Works No. 14 to 18 Junction 10 Highways Improvements.
    - Works No. 19 Ardley Road.
    - Works No. 20 Ardley Bypass.
    - Works No. 21 Ardley Bypass Public Right of Way (PROW).
    - Works No. 22 Junction 9 Highways Improvements.
    - Works No. 23 Middleton Stoney Relief Road (MSRR) pedestrian and cyclist connectivity.
    - Works No. 24 MSRR pedestrian and cyclist connectivity.
    - Works No. 25 B430 minor works.
    - Works No. 26 Quarry Cottages.
    - Works No. 27 Middleton Stoney Crossroads.
    - Works No. 28 Aves Ditch (North).
    - Works No. 29 Ecological Mitigation Area.
    - Works No. 31 Biodiversity and landscaping enhancement areas (Including Woodland Planting).
    - Works No. 32 Ecological Mitigation Area.
    - Works No. 33 Cycle link to Middleton Road (for pedestrian and cyclist connectivity).
    - Works No. 34 Landfill work.
    - Works No. 37. Ecological Mitigation Area.
    - Works No. 38 Ardley Tunnel works.
    - Works No. 39 A4095 / B4030 Roundabout.

1.10 It should be noted that Works 12 (Heyford Park Link Road) is covered within both the Main site SDS and this report, due to these works falling across two drainage catchments that are split between the main development site drainage system and the wider offsite highway works.

1.11 A site location plan is provided as **Figure 1.1**, for ease of reference and for the purpose of the SDSs, the individual components have been grouped together based upon the geographical location. Although Works No. 29 and 34 are located within areas that could be considered with in the 'OxSRFI Main Site', these works have been included within the 'Offsite' category for the purpose of the drainage strategy presented within this report.

1.12 Works that are included in this SDS report and works that have been 'screened out' of the assessment, are described in **Table 1.1**.

1.13 This SDS report includes specific sections for 'major works' that require the development of a drainage strategy. Within these sections, details are provided to outline each individual works drainage philosophy and present the accompanying drawings and calculations. For 'minor works', which require will require generic drainage mitigation but not a developed drainage strategy at this stage (for example, a new pedestrian / cycle route), these works have been grouped together to avoid duplication of the same drainage principles across the wider scheme. The 'major works' have been identified in **Table 1.1** in **bold**, with the minor works identified in *italics*.

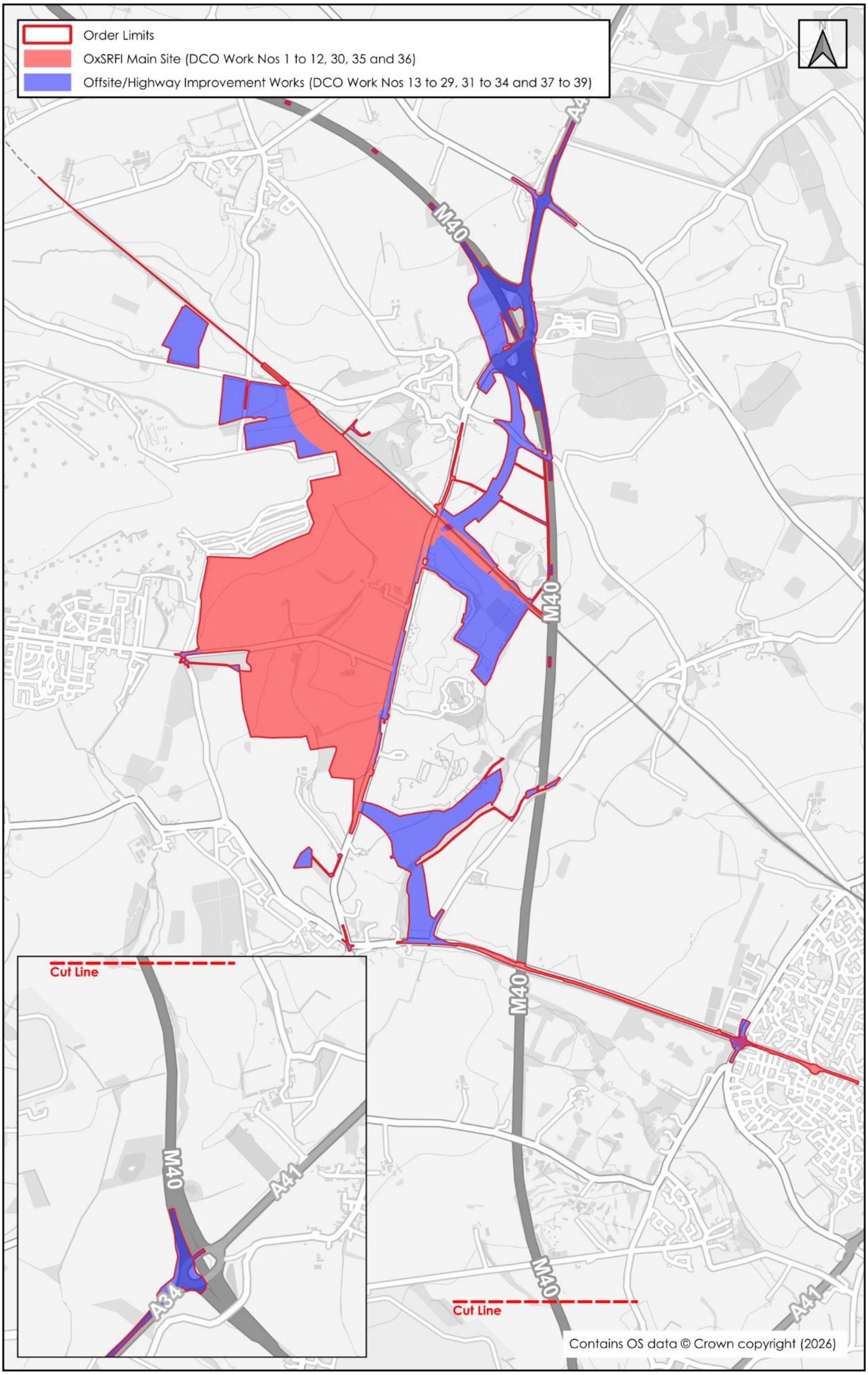

Figure 1.1: Site Location

Table 1.1: Summary of Offsite/Highway Works

Works No.	Name/Location	Description of Proposed Works	Screened In/Out
12	**Heyford Park Link Road**	**Heyford Park Link Road connecting at the west end to the Camp Road and Chilgrove Drive junction.**	Screened In.
13	*Camp Road*	*Camp Road/Chilgrove Drive Junction and Bridleway works.*	
14 to 18	**M40 Junction 10**	**M40 Junction 10 to A43 and B430 highway improvement works.**	
19	**Ardley Road**	**Ardley Road works to link to Ardley Bypass.**	
20	**Ardley Bypass**	**Ardley Bypass works.**	
21	*Ardley Bypass PROW*	*Amendments to existing PROW*	
22	**M40 Junction 9**	**Junction 9 Highway Improvement Works.**	
23	**Middleton Stoney Relief Road (MSRR)**	**MSRR works connecting B430 and B4030 with shared use cycle track.**	
24	*Middleton Road*	*MSRR pedestrian and cyclist connectivity.*	
25	*B430*	*Shared use cycle track on the western side of the B4030 connecting to that provided at the principal site access.*	
26	*Quarry Cottages*	*Quarry cottages turning head and public rights of way.*	

Works No.	Name/Location	Description of Proposed Works	Screened In/Out
27	Middleton Stoney	Middleton Stoney Crossroad Works.	Screened Out – Proposed works result in a negligible increase in impermeable surfacing (i.e., less than 90m[2]), which will be drained via either the existing drainage system present.
28	Aves Ditch (North)	Improvements to field access through connection of the existing bridleway to provide access into the biodiversity and landscaping enhancement area.	Screened Out - No drainage is required, or proposed, to facilitate these works.
29	Main Site – North West	Ecological Mitigation Area	Screened Out – No drainage is required, or proposed, to facilitate these works.
31	Between B4030 and B430	Biodiversity and landscaping enhancement areas, including woodland planting.	
32	Between Middleton Road and B430	Ecological Mitigation Area	
33	*Between proposed MSRR and Middleton Road*	*Cycle lane to Middleton Road (for pedestrian and cyclist connectivity)*	Screened In.
34	Landfill Works	Works to the waste management site to remove material for the construction of the railway works to the Chiltern Main Line private railway and the principal main site access.	Screened Out – Any drainage works to be covered under separate technical works prepared by third party geotechnical designers.
37	Ardley Road	Ecological Mitigation Area	Screened Out – No drainage is required, or proposed, to facilitate these works.
38	Ardley Tunnel	Works to Ardley Tunnel to provide W8 loading gauge clearance through tunnel	Screened Out – Proposed works do not require any new drainage systems or amendments to the existing drainage system already in place.

Works No.	Name/Location	Description of Proposed Works	Screened In/Out
39	A4095 / B4030 Roundabout	Amendments to existing A4095 / B4030 roundabout	Screened Out – Proposed works will result in negligible change to existing impermeable area and existing drainage system will be amended as necessary (i.e., gully locations) to facilitate the works

1.14 Refer to DCO Document 2.5 for the parameters plan Document 2.2 for the Proposed Works Plans, Document 2.13 for the Components Plan and Document 2.7 for the Highways General Arrangement Plans. Contextual information for the site is provided within **Table 1.2**.

Table 1.2: Site Details

Site Name	Oxfordshire SRFI Offsite Highway Works (DCO Works No. **12 to 26 and 33**)
Location	Oxfordshire
NGR (approx.)	Various, Main Site at SP533261
Development Type	Rail Freight Interchange
Anticipated Development Lifetime	75-years*
Lead Local Flood Authority	Oxfordshire County Council
Local Planning Authority	Cherwell District Council
EA Area	Thames
Sewerage Undertaker	Thames Water (Anglian Water to the north)

* In accordance with Paragraph 006 of the Flood Risk and Coastal Change Planning Practice Guidance

Sustainable Drainage Guidance

<u>Guidance Documents</u>

1.15 This SDS and associated drainage strategy has been written with reference to the following guidance documents:

- OCC's Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire[1];
- The DEFRA Non-Statutory Technical Standards for SuDS (2015)[2];
- The National Policy Statement for National Networks[3] (NPSNN); and
- The CIRIA C753 SuDS Manual[4].
- The Standards for Highways Design Manual for Roads and Bridges (DMRB)[5]

[1] Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire, V1.2 (Oxfordshire County Council, December 2021)
[2] 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems
[3] National Policy Statement for National Networks, Department for Transport, March 2024
[4] The SuDS Manual Version 6 (CIRIA, 2019)
[5] The Design Manual for Roads and Bridges, Standards for Highways. Available from: https://www.standardsforhighways.co.uk/dmrb

Climate Change and Urban Creep Allowances

1.16 The proposed works are spread across two DEFRA management catchments. Northern areas comprising Junction 10 of the M40, and the top of the proposed Ardley Bypass are in the Upper and Bedford Ouse Management Catchment. The main site and other works are located within the Cherwell and Ray Management Catchment within the Thames River Basin District. Both Catchments are shown to have the same recommended climate change Allowances. Table 2 from the EA's 'Flood risk assessments: climate change allowances', included as **Table 1.3**, shows the anticipated changes in peak rainfall intensity for the site.

Table 1.3: Peak Rainfall Allowances

Cherwell and Ray Management Catchment & Upper and Bedford Ouse Management Catchment Allowances*	Total Potential Change Anticipated for the '2050s' (Lifetime up to 2060)	Total Potential Change Anticipated for the '2070s' (2061 to 2125)
1 in 30-Year Rainfall Event		
Upper End	35%	35%
Central	20%	25%
1 in 100-Year Rainfall Event		
Upper End	40%	40%
Central	20%	25%

* Both management catchments have identical climate change allowances

1.17 The proposed works are anticipated to have a lifespan of up to 75 years, therefore the 2070's epoch central allowance will be used to assess the impacts of Climate Change (CC) for the proposed surface water drainage strategy. Sensitivity testing has been undertaken using the 2070's epoch upper end allowance to ensure that there is no increase in flood risk elsewhere and the built development will be safe from surface water flooding over the anticipated lifetime of the proposed development. This meets the requirements of CG501- Design of Highway Drainage Systems.

1.18 Based on the above guidance, an allowance of 25% will be applied to the 1 in 100-year return period within the drainage design calculations, with sensitivity testing using a 40% allowance to the 1 in 100-year return period. During the detailed design stage a 25% climate change allowance, with a 35% sensitivity test, should be applied to the 1 in 30-year return period within the drainage design calculations. As the development is built out, the latest EA climate change allowance should be reviewed and used for the detailed design calculations for each phase of the development.

1.19 Based on the proposed development use, no urban creep allowance has been applied to the drainage design calculations.

2. EXISTING CONDITIONS

2.1 The proposed works are spread across the Heyford, Ardley and Middleton Stoney in Oxfordshire as described in **Table 1.1.** The works comprise both new highways on greenfield land and modifications of existing highways. Further information is included in the drainage strategy for each part of the works in Section 3 below.

Existing Watercourses

2.2 There are a number of watercourses located in the vicinity, as illustrated in **Figure 2.1.**

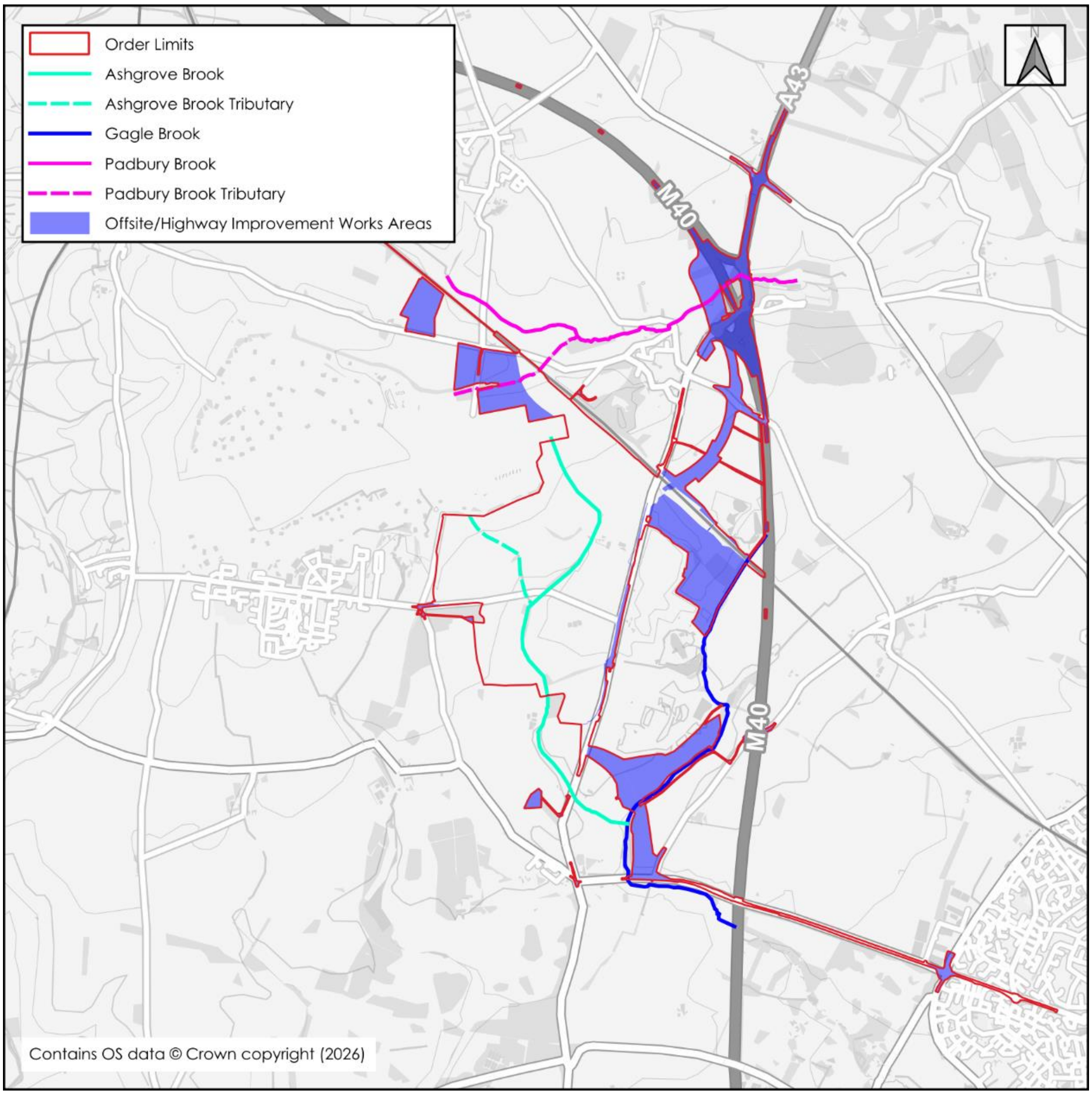

Figure 2.1: Site Location and Watercourse Network

2.3 The Ashgrove Brook, an ordinary watercourse, initially flows from Upper Heyford Airfield through the main development site in a south easterly direction. The watercourse then flows in a south-westerly and southerly direction where it is culverted beneath Camp Road and the B430 where it continues east to its confluence with the Gagle Brook, approximately 1.4km downstream of the site.

2.4 A tributary of the Ashgrove Brook also flows from Upper Heyford Airfield, through the main development site, in a south-easterly direction. The tributary is culverted beneath Camp Road where it then outfalls to the Ashgrove Brook.

2.5 The Gagle Brook flows in a south westerly and southerly direction to the east of Middleton Stoney. The watercourse is culverted beneath the B4030 where it then flows in an easterly direction towards and beneath the M40.

2.6 A tributary of the Padbury Brook rises to the north of Upper Heyford Airfield and flows in a north-easterly direction to its confluence with the Padbury Brook approximately 390m downstream of the main site.

2.7 The Padbury Brook rises to the north of the site within agricultural fields, east of Somerton. The watercourse generally flows in an easterly direction where it is culverted beneath the Chiltern Main Line Railway, M40 and A43. The watercourse then continues to flow in an easterly to north-easterly direction to its ultimate confluence with the Great River Ouse, approximately 30km downstream of the main site.

2.8 Beyond the key watercourses described above and illustrated in **Figure 2.1**, there are numerous minor watercourses and drainage ditches in the area which will be described in further detail, where relevant within **Sections 4 – 10** of this report.

<u>Hydraulic Flood Modelling</u>

2.9 Baseline hydraulic modelling of the following watercourses has been undertaken by BWB Consulting Ltd (BWB) to support the FRAs for the proposed DCO:

- Ashgrove Brook;
- Ashgrove Brook Tributary;
- Gagle Brook;
- Padbury Brook; and
- Padbury Brook Tributary.

2.10 The BWB hydraulic modelling has identified that there are existing fluvial flood extents affecting both the main site and offsite works, although the risk to the site and offsite works is considered to be low, providing the recommended mitigation measures are adhered to. More information on the existing flood risk constraints and proposed mitigation measures are presented within the highway works flood risk screening report. This report concludes that each of the separate works has a low risk of surface water flooding.

2.11 Due to the spatial distribution of the proposed works, the topography of each part will be briefly discussed in the relevant part of **Sections 4 - 10**. A full topographical survey (reference: 36646_T) included as **Appendix 1**.

2.12 British Geological Survey (BGS) Mapping indicates the area to be underlain predominantly by White Limestone Formation (Principal Aquifer). There are also small pockets of Rutland Formation Mudstone (Secondary B Aquifer), Forest Marble Formation – Limestone (Principal Aquifer) And Bladon Member - Mudstone and Limestone, Interbedded (Principal Aquifer) across the development area. Junction 9 of the M40 is underlain by Peterborough Member – Mudstone (No Aquifer). The bedrock geology for the site, as informed by BGS, is illustrated as **Figure 2.2**.

2.13 Superficial deposits of Alluvium - Clay, Silt, Sand and Gravel (Secondary A Aquifer) and Head - Clay, Silt, Sand and Gravel (Secondary Undifferentiated Aquifer) are shown along the alignment of the local watercourse network. The superficial geology for the site, as informed by BGS, is illustrated as **Figure 2.3**.

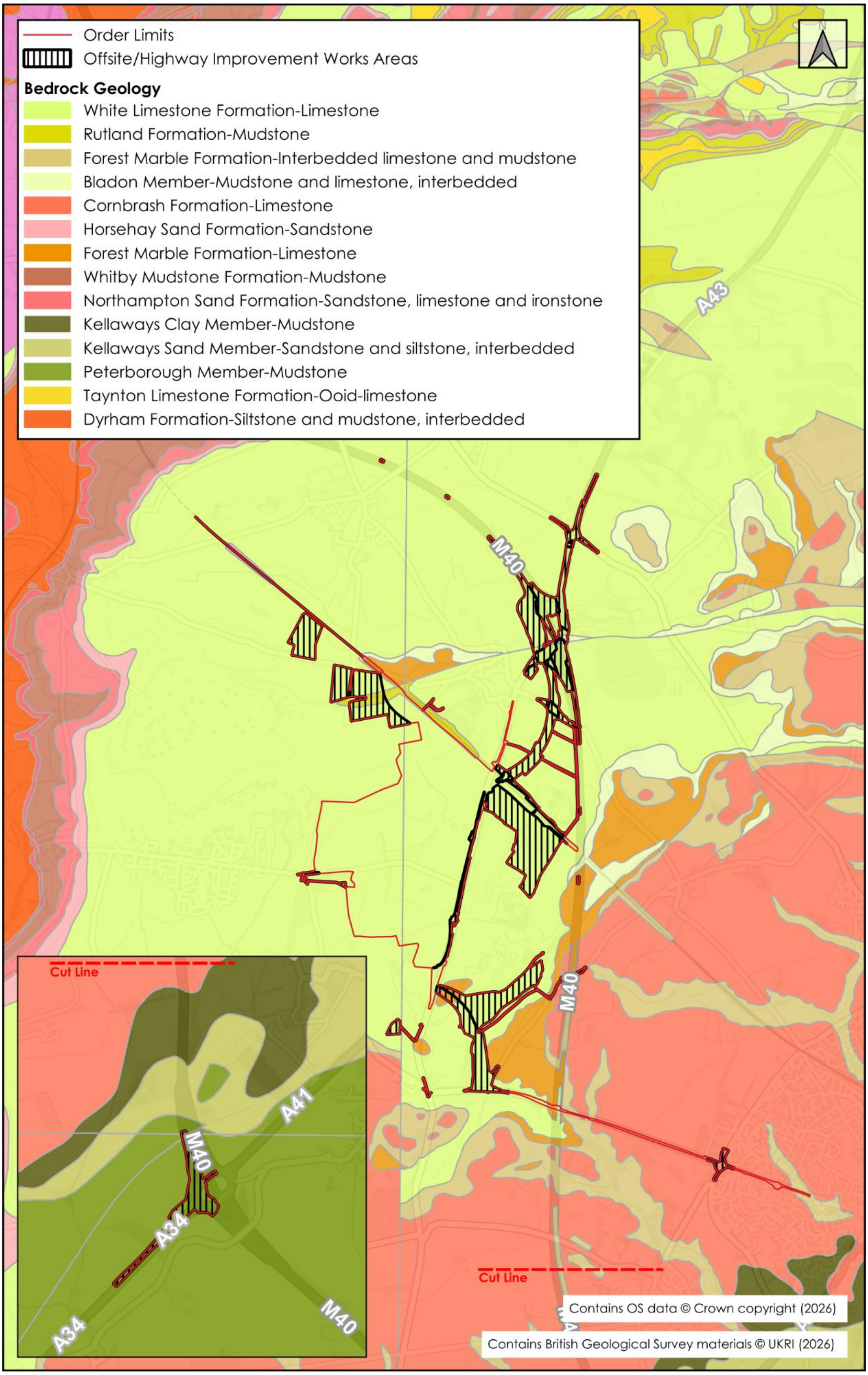

Figure 2.2: BGS Bedrock Geology for Site

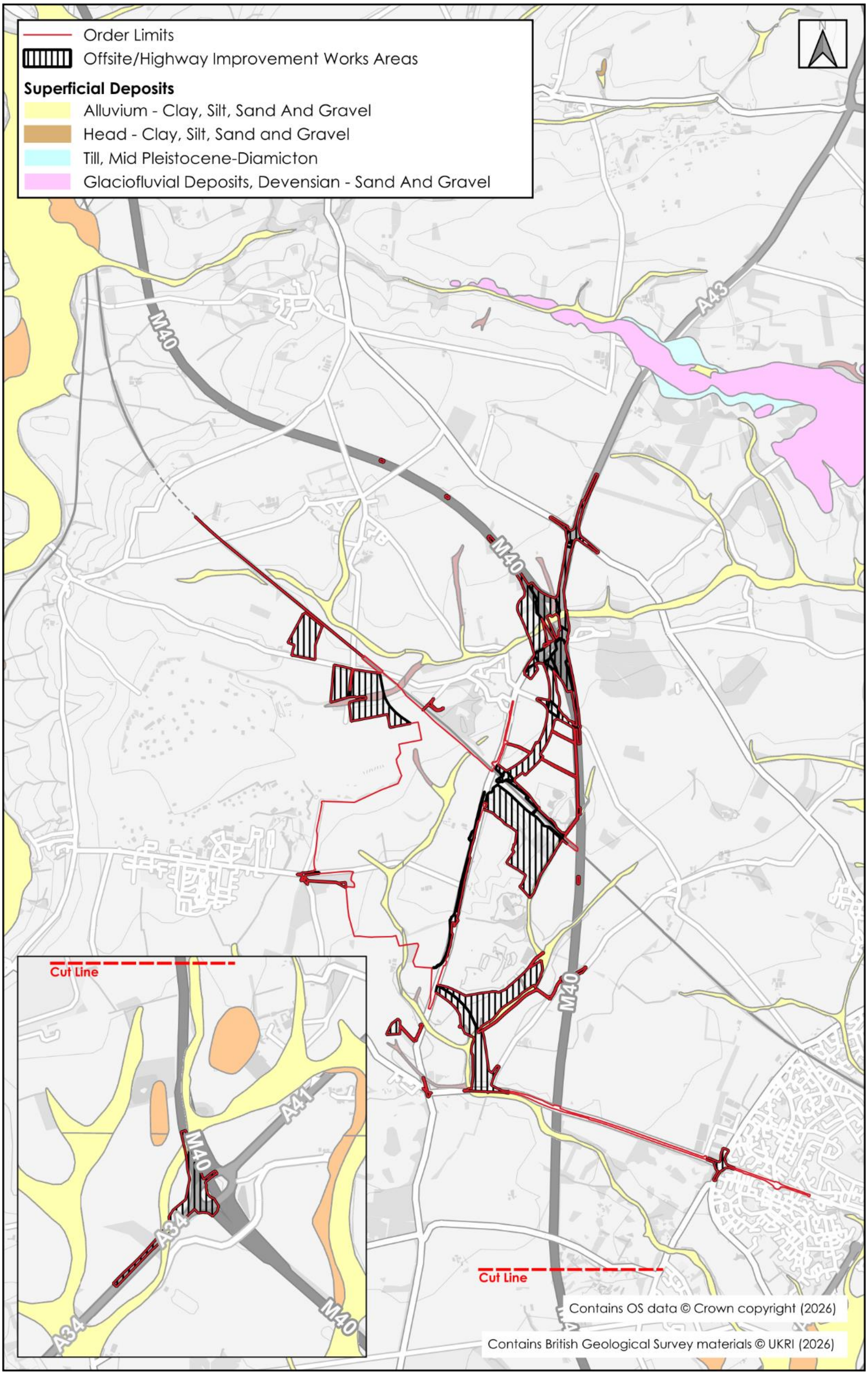

Figure 2.3: BGS Superficial Deposits for Site

2.14 Aquifer definitions, as outlined by the EA, are summarised in **Table 2.1**.

Table 2.1: Aquifer Definitions

Aquifer	Definition
Principal	Layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Secondary B	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
Secondary Undifferentiated	Assigned in cases where it has not been possible to attribute either category A or B to a rock type.

2.15 Intrusive geotechnical testing has not been carried out at the offsite work locations. However, given that BGS mapping indicates relatively homogeneous strata in the area, it is reasonable to infer that infiltration test results would be broadly consistent with those obtained during the Phase 2 Geo-Environmental assessment on the main site.

2.16 The main site's Phase 2 Geo-Environmental Assessment undertaken by BWB (reference: OFRI-BWB-ZZ-XX-RP-YE-0001_Ph1) included soakaway testing in line with BRE365 guidance in eleven locations. Results varied between $4.3x10^{-06}$ and 1.66^{-04}m/s, indicating good infiltration potential. The report also recorded groundwater depths of less than 2.0mBGL in five of fourteen test locations. Further information can be found in the full report.

2.17 Geotechnical testing will be undertaken at each of the proposed works' locations, where practical, prior to detailed design.

2.18 Based on the above information, the existing drainage regime of the greenfield portions of the site is considered to consist of infiltration followed by surface water runoff into watercourses. Parts of the wider site which are served by existing drainage systems (i.e., existing highways) will drain via the existing network to either soakaways, or drainage ditches or the surrounding watercourses. Some minor roads in the area appear to have no formal drainage system in place and are anticipated to drain via overland runoff to surrounding verges and ultimately infiltration or drain to surrounding drainage ditches in the vicinity.

Existing Runoff Rates

2.19 An assessment of the existing surface water runoff rates has been undertaken on a litres per second per hectare basis and is summarised within **Table 2.2**, with the supporting calculations included within **Appendix 2**.

2.20 The runoff rates have been estimated using the IH124 method, with appropriate prorated adjustments for a site of less than 50ha, as recommended in Interim Code of Practice for Sustainable Drainage[6]. This was undertaken using the UKSUDS Greenfield Runoff Rate Estimation Tool[7], which makes the necessary adjustments for small sites automatically. A single point has been considered within the main site. This is considered representative of the wider works because of the relatively homogeneous underlying strata.

Table 2.2: Existing Runoff Rate per hectare from the Site

Return Period (Yrs.)	Runoff Rate (l/s/ha)
1	0.1
Mean Annual Flow Rate (QBAR)	0.2
30	0.4
100	0.5

[6] The National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage
[7] UKSUDS Greenfield Runoff Rate Estimation Tool, HR Wallingford, last accessed 09/12/2025. Available From: https://www.uksuds.com/tools/greenfield-runoff-rate-estimation

2.21 The above existing greenfield runoff rates are representative of a site which has permeable soil characteristics and suggests that infiltration may be occurring across the site.

Existing Runoff Volume

2.22 An assessment of the existing surface water runoff rates from the site has been made for a 1 in 100-year, 6 hour storm, on a per hectare basis. The middle of the main site has been used as an indicative central location. This is considered representative of the wider works because of the relatively homogeneous underlying strata.

2.23 As most of the pre-development works areas are permeable, the runoff volume has been calculated using the 'pre-development discharge' calculator in Causeway Flow to be **48m^3/ha**. The supporting calculations are provided within **Appendix 2**.

3. SURFACE WATER DRAINAGE PRINCIPLES

3.1 Individual drainage strategies have been devised for each part of the offsite works. The following principles have been applied across all locations.

- Cv values of 0.9 have been used in accordance with Oxfordshire's guidance for highways.
- It is assumed that 100% of carriageway areas, and pedestrian / cycle routes, will be drained. Where earthworks and landscaped areas are drained, it is assumed that 50% of the contributing area will be drained.
- Existing drainage infrastructure will be retained and used where possible, subject to surveys to confirm their condition and connectivity.
- The proposed contributing impermeable areas have been measured from the Highways General Arrangement Plans (DCO Document 2.7).

Drainage Hierarchy

3.2 The SuDS Manual[8] identifies that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:

i. into the ground (infiltration);
ii. to a surface water body;
iii. to a surface water sewer, highway drain, or another drainage system;
iv. to a combined sewer.

3.3 The aim of this is approach is to manage surface water runoff close to where it falls and mimic natural drainage as closely as possible.

Infiltration

3.4 Based on the ground investigation information discussed in **Section 2**, it is considered likely that the use of infiltration drainage techniques would be viable for most of the proposed works

3.5 There is a significant degree of earthworks required to deliver some areas of the proposed works, which will result in the finished levels changing.

3.6 The BRE365 soakaway testing was undertaken at depths approximately 2m below the existing ground level on the main site only. Further testing will be undertaken during the detailed design stage to determine correct rates for each works location at realistic levels.

[8] The SuDS Manual (C753). CIRIA 2015.

3.7 It should be noted that the use of soakaway drainage should be avoided in areas of significant fill, where finished levels are to be raised, as soakaways should not be sited in made ground unless there is a specific earthworks specification to facilitate this.

3.8 Furthermore, the base of any infiltration features should be a minimum of 1m above the maximum recorded groundwater level at the location of each soakaway. It is noted that there are pockets of shallow ground water across the main site and this should be considered in the future detailed drainage design works.

3.9 Based on the above, it is considered that infiltration drainage is potentially viable as a means of discharge surface water from the proposed development; however, at this stage, a drainage strategy with an outfall has been provided, to demonstrate that a deliverable drainage strategy is viable, should future ground investigative works deem soakaway drainage unviable following the completion of the enabling earthworks.

3.10 If future infiltration testing and groundwater monitoring confirms soakaways to be viable for the proposed development, the use of infiltration will be prioritised within the detailed drainage design of the development.

Surface waterbodies

3.11 It is proposed that surface water from the development will discharge to the existing waterbodies within the area. Existing waterbodies are present within the order limits and these receptors can be drained to via gravity.

3.12 The proposed surface water outfall locations across the site are as follows:

- Ashgrove Brook;
- Padbury Brook;
- Gagle Brook; and
- Other local minor watercourses, drainage ditches and soakaways where existing drainage infrastructure is to be retained.

3.13 Ordinary watercourse consent will be required with the LLFA prior to the construction of any new outfalls to these watercourses being made.

Peak Flow and Volume Control

3.14 In order to comply with the Non-Statutory Technical Standards for Sustainable Drainage Systems S2-S3[9], runoff from greenfield developments should not exceed the equivalent greenfield rates for the 1 and 100-year return period events.

3.15 The Non-Statutory Technical Standards for Sustainable Drainage Systems S4-S6[10] states that where reasonably practical the runoff volume from a development for the 1 in 100-year 6 hour rainfall event should not exceed the runoff volume prior to development or redevelopment. Where it is not reasonably practicable to constrain the volume of runoff from a development at or below the existing volume, then the runoff must be discharged in a manner that does not adversely affect flood risk, i.e.:

i. The additional runoff volume resulting from the development (the 'long term storage volume') should be discharged separately from the site at a rate of 2l/s/ha or less. Or,
ii. All the runoff volume from the development should be discharged at a rate equivalent to the mean annual flow rate (QBAR) rate under greenfield conditions or less. Or,
iii. All the runoff volume from the development should be discharged at a rate of 2l/s/ha or less.

3.16 The LLFA's local SuDS guidance states that there are two options for providing storage in order to limit peak discharge rates and volumes from a developed site. It is proposed to utilise the 'Simple approach' outlined within the local guidance, at 2l/s/ha for all events up to the 1 in 100-year plus climate change critical storm.

3.17 Therefore, to comply with the peak flow and volume control criterion, it is proposed to restrict the discharge rate of surface water from the development to 2l/s/ha for all events up to and including the 1 in 100-year + 25% critical storm, with sensitivity testing using a 40% allowance. This is summarised within **Table 3.1**.

Table 3.1: Existing & Proposed Runoff Rates

Return Period (Yr.)	Existing Runoff Rate (l/s/ha)	Proposed Discharge Rate (l/s/ha)
1	0.1	2.0
QBAR	0.2	
30	0.4	
100	0.5	
100 + CC%	-	

3.18 This approach fulfils the necessary peak runoff and volume control criteria. This will be applied to each section of the proposed works, where practical.

[9] 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems
[10] 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems

3.19 It should be noted that in instances across the proposed development area, where existing highways are to be amended and it is not practical to construct a separate drainage system for the modified highways area, or these areas cannot achieve a gravity connection into proposed new drainage systems, the peak flow control will be managed based on an existing rate calculated using the modified rational method, as described in **Figure 3.1**. In these instances, where impermeable areas increase as part of the proposed works, a flow control will be added onto the existing drainage system to retain the calculated existing peak flows rate in the 1 in 100-year 30-minute storm.

$$Q = 2.78 \times Ap \times C \times i$$

Where:
Q = runoff rate (l/s)
Ap = impermeable area (ha)
C = Runoff Coefficient
i = rainfall intensity (mm/hr)

Figure 3.1: Modified Rational Method

3.20 Where the existing brownfield rate is proposed to be retained, details will be provided within the relevant works section; however, based on a 63mm/hr average rainfall intensity during the 1 in 100-year 30-minute storm, and a runoff coefficient of 90% (based in the LLFAs local guidance), it is anticipated that the peak discharge design rate will be 157.63l/s/ha. The rainfall intensity calculation for the site is provided within **Appendix 2**.

Sustainable Drainage Systems

3.21 Generally, the proposed works are to be drain via a combination or gullys, kerb drainage, filter drains and swales. The following SuDS are proposed across the scheme, the details of which for each works will be confirmed in the relevant sections of this report:

- Filter Strips
- Filter Drains
- Swales
- Detention Basins
- Attenuation Ponds

3.22 The details of the proposed SuDS, including locations and design criteria, will be confirmed through detailed design. however, some overarching principles are outlined below.

3.23 Filter drains will be used to drain the proposed pedestrian / cycle routes, embankments, and areas of new highways, where practical. Where space allows, a short filter strip should be provided between the runoff surface and the filter drain, to provide pre-treatment to runoff.

3.24 Swales will have minimum slopes of 1:3, with slacker slopes where space allows.

3.25 At this stage it is proposed that any new detention basins / attenuation ponds will have 1:4 internal slide slopes, with a minimum 300mm freeboard above the design maximum water storage level.

Water Quality

3.26 The proposed drainage systems will provide embedded mitigation in the form of SuDS to suitably manage water quality of storm water flows that drain to surrounding receptors.

3.27 Different areas of the proposed works will be adopted by different highways authorities, with some areas being adopted by NH, and others by the Local Highways Authority (LHA).

3.28 Where new highways are proposed to be adopted by NH, and assessment of water quality will be undertaken using the 'Highways England Water Risk Assessment Tool' (HEWRAT). Where existing NH assets are being modified, no HEWRAT will be undertaken, as it assumed that the existing drainage system provides sufficient water quality mitigation.

3.29 Other parts of the scheme, which are to be adopted by the LHA, will be assessed using the CIRIA SuDS Manual 'Simple Index Approach'.

3.30 The relevant water quality assessments for each proposed works will be confirmed at detailed design, once the drainage strategies are finalised. However, an example HEWRAT assessment for the A43 works has been undertaken at this stage and is included as **Appendix 3**. Furthermore, details of the Simple Index Approach methodology that will be used at detailed design, along with the proposed future land uses and mitigating SuDS is provided below.

Simple Index Approach Methodology

3.31 In accordance with the SuDS Manual a simple index approach to water quality risk management should be undertaken for the proposed development, unless another methodology for assessing water quality management is preferred (i.e., HEWRAT assessment for future NH assets). The simple index approach will be completed at detailed design to provide a comprehensive account of the water quality treatment provided by the proposed surface water drainage systems.

3.32 The SuDS Manual Mitigation Index will be used to assess the treatment levels proposed in relation to the pollution hazard posed from the proposed land use(s). This methodology is adopted to ensure that surface water flows receive adequate treatment through all areas of the site prior to final outfall.

3.33 **Table 3.2** shows the pollution hazard indices for the land use classification(s) that are relevant to the proposed development, as described within table 26.2 in the SuDS Manual.

Table 3.2: Pollution Hazard Indices for Different Land Use Classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Pedestrian / Cycle paths and bridleways	Low	0.3	0.2	0.05
Low traffic roads	Low	0.5	0.4	0.4
All roads except motorways and trunk roads.	Medium	0.7	0.6	0.7
Trunk roads and motorways	High	0.8	0.8	0.9

3.34 The SuDS Mitigation Indices that are relevant to the proposed development, as described within table 26.3 of the SuDS Manual, are outlined in **Table 3.3.**

Table 3.3: SuDS Mitigation Indices

Type of SuDS Component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Detention Basin	0.5	0.5	0.6
Attenuation Pond	0.7	0.7	0.5

3.35 During the detailed design stage, the pollution hazard rating and proposed SuDS Mitigation Index for each drainage Catchment will need to be compared to demonstrate that a suitable level of water quality treatment is provided. Where more than one SuDS component is proposed, a factor of 0.5 has been applied to the downstream (i.e., secondary and/or tertiary) treatment stages to account for the reduced performance due to reduced inflow concentrations.

Maintenance

3.36 Ultimately, future maintenance works will be undertaken by the adopting authority, which will be either NH or the LHA. NH and the LHA will have their own maintenance schedules; however, general maintenance requirements and schedules for the proposed SuDS are provided below, as informed by the CIRIA SuDS Manual. At detailed design, specific Operation and Maintenance (O&M) manuals will be prepared for each works area.

3.37 Highways that form part of the strategic road network are adopted by NH. This includes the M40 and its junctions, the A43 and the A34. NH will be responsible for the ongoing maintenance of any upgrades or modifications to these roads.

3.38 Minor roads including the B430, B4030, B4100 and Camp Road are adopted by Oxfordshire County Council Highways, the LHA. Maintenance of upgrades or modifications made to these roads will be the responsibility of the LHA.

3.39 The proposed Heyford Park Link Road, Ardley Bypass and Middleton Stoney Relief Road will be adopted by the LHA. They will be responsible for ongoing maintenance of the roads.

Filter Strips

Table 3.4: The SuDS Manual Typical Maintenance Schedule for Filter Strips

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly (during growing season), or as required	• Remove litter and debris. • Cut the grass - to retain grass height within specified design range.
	Monthly (during the first year, then half yearly)	• Manage other vegetation and remove nuisance plants; • Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (e.g. oils); • Check flow spreader and filter strip surface for even gradients; • Inspect gravel flow spreader upstream of filter strip for clogging; and • Inspect silt accumulation rates and establish appropriate removal frequencies.
Occasional Maintenance	As required or if bare soil is exposed over > 10% of the filter strip area	• Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required.
Remedial Action	As required	• Repair erosion or other damage by re-turfing or reseeding; • Relevel uneven surfaces and reinstate design levels; • Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface; • Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip; and • Remove and dispose of oils or petrol residues using safe standard practices.

Filter Drains

Table 3.5: The SuDS Manual Typical Maintenance Schedule for Filter Drains

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly (or as required)	• Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices; and • Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage.
	Six monthly (or as required)	• Remove sediment from pre-treatment devices; and • Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies.
Occasional Maintenance	Five yearly, or as required	• At locations with high pollution loads, remove surface geotextiles and replace, and wash or replace overlying filter medium. • Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010); and • Clear perforated pipework of blockages.

Swales

Table 3.6: The SuDS Manual Typical Maintenance Schedule for Swales

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly (or as required)	• Inspect inlets, outlets and overflows for blockages, and clear if required; • Remove litter and debris; and • Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours.
	Monthly (during growing season), or as required	• Cut grass – to retain grass height within specified design range.
	Monthly for first year, then as required	• Manage other vegetation and remove nuisance plants.
	Monthly for 6 months, quarterly for 2 years, then half yearly	• Inspect vegetation coverage.
	Half yearly	• Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.
Occasional Maintenance	As required or if bare soil is exposed over > 10% of the swale treatment area	• Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.
Remedial Action	As required	• Repair erosion or other damage by re-turfing or reseeding; • Relevel uneven surfaces and reinstate design levels; • Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface; • Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip; and • Remove and dispose of oils or petrol residues using safe standard practices.

Detention Basins

Table 3.7: The SuDS Manual Typical Maintenance Schedule for Detention Basins

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly	• Remove litter and debris; • Inspect inlets, outlets and overflows for blockages, and clear if required; and • Inspect banksides, structures, pipework etc for evidence of physical damage.
	Monthly (during growing season, or as required	• Cut grass – for spillways and access routes.
	Monthly for first year, then annually or as required	• Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.
	Monthly at start, then as required	• Manage other vegetation and remove nuisance plants.
	Half yearly (spring – before nesting season, and autumn	• Cut grass – meadow grass in and around basin.
	Annually or as required	• Check any penstocks and other mechanical devices; • Tidy all dead growth before start of growing season; • Manage wetland plants in outlet pool – where provided; and • Remove sediment from inlets, outlet and forebay.
Occasional Maintenance	As required	• Reseed areas of poor vegetation growth.
	Every 2 years, or as required	• Prune and trim any trees and remove cuttings.
	Every 5 years, or as required	• Remove sediment from inlets, outlets, forebay and main basin when required.
Remedial Action	As required	• Repair/rehabilitation of inlets, outlets and overflows; • Repair erosion and other damage by reseeding or returfing; • Realignment of rip-rap; and • Relevel uneven surfaces and reinstate design levels.

Attenuation Ponds

Table 3.8: The SuDS Manual Typical Maintenance Schedule for Attenuation Ponds

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly	• Inspect inlets, outlets, banksides, structures, pipework etc. for evidence of blockage and/or physical damage.
	Monthly (or as required)	• Remove litter and debris.
	Monthly (during growing season, or as required)	• Cut grass – public areas.
	Monthly for first three years, then as required	• Inspect marginal and bankside vegetation and remove nuisance plants.
	Monthly (May to October)	• Inspect water body for signs of poor water quality.
	Half yearly; spring (before nesting season) and autumn	• Cut grass – meadow grass.
	Half yearly	• Check any penstocks and other mechanical devices; and • Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options.
	Annually	• Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface); • Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level; and • Tidy all dead growth (scrub clearance) before start of growing season. Note: tree maintenance is usually part of overall landscape management contract).
	Every 1-5 years (or as required)	• Remove sediment from any forebay.
	Every 5 years (or as required)	• Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.

Maintenance Schedule	Typical Frequency	Required Action
Occasional Maintenance	With effective pre-treatment, this will only be required rarely, e.g. every 25–50 years	• Remove sediment from the main body of big ponds when pool volume is reduced by 20%.
Remedial Action	As required	• Repair erosion or other damage; • Replant, where necessary; • Aerate pond when signs of eutrophication are detected; • Realign rip-rap or repair other damage; and • Repair/rehabilitate inlets, outlets and overflows.

Flow Controls

Table 3.9: Typical Maintenance Schedule for Flow Control Structures

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly	• Inspect and identify any areas that are not operating correctly (for three months following installation).
	Every 6 months	• Inspect and identify any areas that are not operating correctly. Take remedial action if required. • Remove sediment from pre-treatment structures.
Remedial Actions	Following all significant storm events	• Inspect and carry out any essential recovery works to return the feature to full working order.

Residual Risks and Designing for Exceedance

3.40 For new drainage systems, each network has been designed to have a minimum of 300mm of freeboard in the critical 1 in 100 year + 25% climate change event. Sensitivity testing has been undertaken for the 1 in 100 year + 40% event, which shows a reduced freeboard and no flooding.

3.41 In the event of a blockage or exceedance storm event, surface water will be directed to landscaped areas where possible. Exceedance flows will flow toward surrounding watercourse receptors in the vicinity of each works location.

4. WORKS NO.12: HEYFORD PARK LINK ROAD DRAINAGE STRATEGY

Proposals

4.1 The proposals include construction of the Heyford Park Link Road connecting at the west end to the Camp Road and Chilgrove Drive junction. The proposed works are illustrated in **Figure 4.1**.

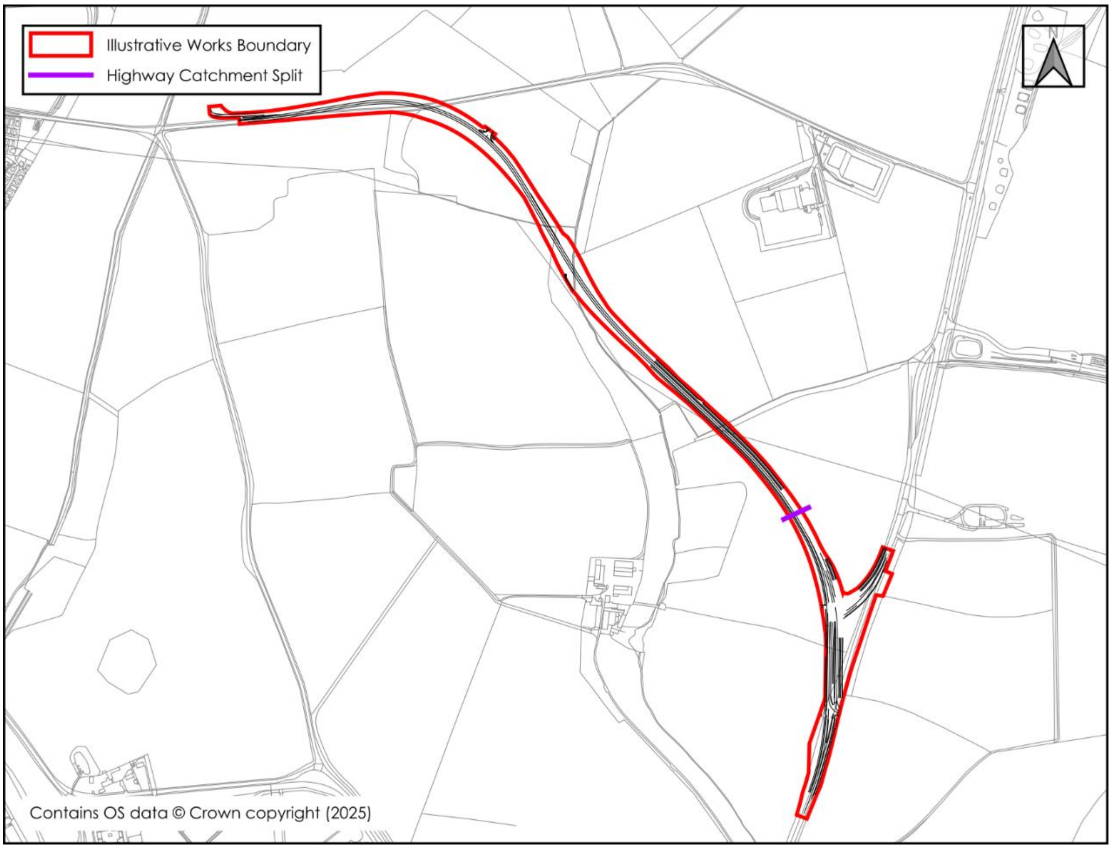

Figure 4.1: Illustrative Works Boundary - Works No. 12

4.2 Drainage from the Heyford Park link road will be split into 2 catchments. The southeasternmost 400m (approximately) will drain to the Gagle Brook as part of the Middleton Stoney Relief Road drainage system as described below in **Section 8.** The majority of the Link Road will drain into Ashgrove Brook, as per mast of the Main Development Site drainage system. The drainage strategy for this section of road is included within the Main Development Site drainage strategy (OXSRFI-BWB-ZZ-XX-T-W-1050_SDS (Main Development Site).

5. WORKS NO.14 TO 18: M40 JUNCTION 10 TO A43 AND B430 HIGHWAY IMPROVEMENT WORKS DRAINAGE STRATEGY

Proposals

5.1 In this location the proposed works comprise a series of upgrades/improvements to junction 10 of the M40 at its link with the A43 and B430, the extent of the works are shown in **Figure 5.1**.

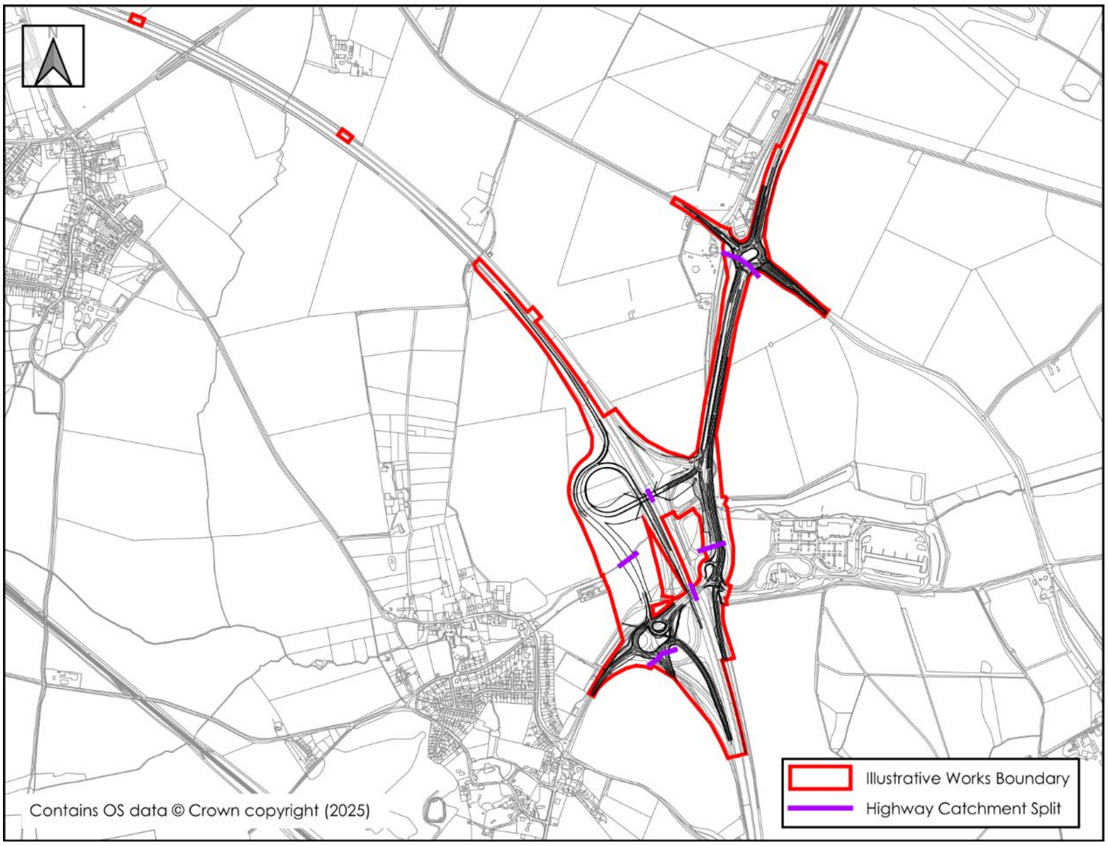

Figure 5.1: Illustrative Works – Works No. 14 to 18

Point of Discharge

5.2 There are two existing detention basins located within the centre of Junction 10, located between the M40 and A43 eastern slip roads. These basins are understood to serve the M40 and A43 and potentially drain via infiltration with overflow weirs to Padbury Brook.

5.3 It is anticipated that Barnards Green Roundabout and its east and west arms, with a portion of the A43 to the north is served by existing highway drainage that outfalls to an existing drainage ditch along the B4100 at an unrestricted rate, ultimately draining to Padbury Brook to the south east.

5.4 The existing drainage arrangements described above are based on a review of National Highway's (NH) Geotechnical & Drainage Management Service (GDMS) and the existing drainage arrangements and catchment areas are to be confirmed as part of the detailed design works.

5.5 As discussed in **Section 3**, the drainage strategy will assume that infiltration is not viable for new drainage systems, however this should be confirmed at the detailed design stage.

5.6 Surface water runoff from the upgrades and improvements to Junction 10 will drain into Padbury Brook which flows beneath the junction. The drainage strategy will include:

- Two new attenuation basins on the western side of the M40.
- Modifications to the existing drainage pond/basin on the eastern side of the M40, north of Padbury Brook.
- The existing pond located east of the M40 and south of Padbury Brook will be retained in its current form as far as practicable.
- A filter drain located at the toe of embankment for the eastern A43 southbound slip road.
- Drainage around the Baynard's Green Roundabout which forms the intersection between the A43 and B4100 will continue to drain along the B4100 as per the existing situation. This also leads toward Padbury Brook.

5.7 These discharge locations have been selected to align with the existing topography and mimic the existing drainage catchment as much as possible.

Proposed Drainage Strategy

5.8 As stated in **Section 3**, surface water runoff from any new drained areas will be restricted to 2.0l/s/ha, with the exception of the highway amendment works to Baynard's Green Roundabout, which will continue to drain at the existing peak brownfield rate for the 1 in 100-year 30-minute storm.

5.9 The proposed drainage strategy will be split into 6 separate networks as described below:

- Baynard's Green Roundabout;
- Northwest Pond;
- Southwest Pond;
- Northeast Pond;
- Southeast Pond; and
- A43 Southbound Eastern Embankments.

5.10 The proposed drainage strategy drawings and calculations are included in **Appendix 4** and **Appendix 5** respectively.

Baynard's Green Roundabout

5.11 Based on the NH GDMS data, topographical survey, and online mapping, it is assumed that the roundabout and a part of the A43 drain to the ditches alongside the roundabout that follow the B4100 to the east.

5.12 Adequate data is not available to confirm the size of the existing catchment, but GDMS indicates the A43 catchment extends 850m north of the roundabout. No existing attenuation features have been identified.

5.13 The drainage catchment for the existing drainage system will be confirmed through the detailed design works; however, at this stage it is assumed that that the total catchment draining through Baynard's Green Roundabout to the existing ditches to the east alongside the B4100 is 2.505ha, which equates to a peak flow of 394.9l/s during the 1 in 100-year 30-minute storm, as calculated using the Modified Rational Method described in **Figure 3.1**.

5.14 The proposed works will introduce the following additional drained areas:

- Total new impermeable carriageway and pedestrian / cycle paths: 0.65ha
- Total verges: 0.09ha (50% of 0.18ha)
- Total new drained area = 0.74ha
- Total drainage area following completion of highway modification works = 3.245ha

5.15 It is proposed that this will drain as per the existing scenario toward Padbury Brook via the ditches alongside the B4100. Given the local geology, it is assumed that a significant proportion of surface water runoff infiltrates into the ground before joining the watercourse.

5.16 The new drained areas will tie into the existing drainage system in place and an orifice plate will be placed system outfall, limiting flows to 394.9l/s (or 157.63l/s/ha of a future calculated existing drained catchment area) to the outfall ditch, to ensure the calculated peak flow does not increase as a result highway modification works.

5.17 Storage will be provided in the form of oversized pipes and filter drains to provide attenuation of peak flows for the new drained areas.

5.18 At this stage, there is insufficient data to recreate the existing drainage model to hydraulically assess the performance of network and to assess the proposed upgrades. However, a volumetric calculation has been undertaken to assess the assumed current attenuation required (which is assumed to currently be provided by the existing drainage system) for the assumed catchment area of 2.505ha, limited to 394.9l/s in the existing scenario, which has then been compared with the required attenuation for the new total drained area of 3.245ha, the results of which is provided below:

- Assumed pre-development storage requirement = 685m^3
- Assumed post-development storage requirement = 999m^3
- Difference between assumed pre- and post-development storage requirements = 314m^3

5.19 Based on the above volumetric calculation, it is anticipated that approximately 314m^3 of new storage, in the form of filter drains and oversized pipes, will be required to attenuate the flows from the highway modifications and new pedestrian / cycle paths proposed at Baynard's Green Roundabout.

Northwest Pond

5.20 A new attenuation pond will be constructed on the western side of the M40 to the north of Padbury Brook. This pond will attenuate surface water runoff from the proposed new slip roads on the northbound M40.

5.21 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

5.22 The drainage catchment for the new pond will comprise:

- Total new impermeable carriageway: 1.49ha
- Total embankments and verges: 0.96ha (50% of 1.92ha)
- Total SuDS pond footprint: 0.28ha
- Total design drained area = 2.74ha

5.23 This equates to a proposed discharge rate of 5.5l/s.

5.24 Runoff will be discharged to Padbury Brook at an attenuated rate of 5.5l/s. Storage will be provided in the pond. In the critical 1 in 100 year +25% climate change event, 2,244m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 2,550m³ is stored in the critical event and over 300mm of freeboard is available for both design scenarios.

Southwest Pond

5.25 A new attenuation pond will be constructed on the western side of the M40 to the south of Padbury Brook. This pond will attenuate surface water runoff from the new slip roads on the northbound M40, and the new roundabout replacing Ardley Roundabout, which currently drains to the southeast pond.

5.26 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

5.27 The drainage catchment for the new pond will comprise:

- Total new impermeable carriageway and pedestrian / cycle paths: 1.41ha
- Total embankments and verges: 0.72ha (50% of 1.44ha)
- Total SuDS pond footprint: 0.26ha
- Total design drained area = 2.39ha

5.28 This equates to a proposed discharge rate of 4.8l/s.

5.29 Runoff will be discharged to Padbury Brook at an attenuated rate of 4.8l/s. Storage will be provided in the pond. In the critical 1 in 100 year +25% climate change event, 1,960m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 2,227m³ is stored in the critical event and over 300mm of freeboard is available for both design scenarios.

Northeast Pond

5.30 The existing northeast pond will be modified by the proposed works as a result of the new bridge over the M40 which will reduce the pond's footprint area.

5.31 The catchment will be modified to include the length of the A43 to the south of Baynard's Green Roundabout, and carriageway areas around Junction 10. Part of the existing catchment will be transferred to the southeast basin because of the northeast pond's reduced capacity.

5.32 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

5.33 The drainage catchment for the modified pond will comprise:

- Total impermeable carriageway and pedestrian / cycle paths: 3.17ha
- Total embankments and verges: 0.90ha (50% of 1.80ha)
- Total SuDS pond footprint: 0.33ha
- Total design drained area = 4.41ha

5.34 This equates to a proposed discharge rate of 8.8l/s.

5.35 Runoff will be discharged to Padbury Brook at an attenuated rate of 8.8l/s. Storage will be provided in the pond. In the critical 1 in 100 year +25% climate change event, 3,594m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 4,086m³ is stored in the critical event and over 300mm of freeboard is available for both design scenarios.

Southeast Pond

5.36 The southeastern pond is an existing drainage feature to the south of Padbury Brook on the eastern side of the M40. The drainage information for the main M40 carriageway is not confirmed, but it is assumed to drain a significant part of the M40. GDMS shows that the pond currently drains Ardley roundabout on the western side of the M40. The pond has a weir overflow into Padbury Brook, however the design of this is unclear. It is assumed that routine rainfall events are drained primarily via infiltration.

5.37 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

5.38 It is proposed that the new roundabout replacing Ardley roundabout on the western side of the M40 will drain to the southwestern pond. This catchment area removed from the existing pond has been measured as approximately 1.13ha.

5.39 It is proposed that the pond will drain new and modified carriageway on the western side of the M40. These additional areas comprise:

- Total of impermeable carriageway and pedestrian / cycle paths: 0.83ha
- Total embankments and verges: 0.15ha (50% of 0.30ha)
- Total drained area: 0.98ha

5.40 The above transfer of catchment areas is illustrated on the BWB Existing Basin Catchment Transfer Plan, presented within **Appendix 4.**

5.41 As the additional area drained to the pond is less than the catchment area which will be removed, it is proposed that the pond is left in its current design apart from a new headwall connecting the drainage from the new contributing catchment.

A43 Southbound Eastern Embankments

5.42 Due to level constraints, and to avoid excessively deep pipework being installed below the A43 southbound slip road, it is proposed that the eastern embankments will be drained by filter drains located at the toe of embankment.

5.43 The filter drains for these embankments will either drain surface water via infiltration, or to Padbury Brook at 2l/s/ha.

Sustainable Drainage Systems

5.44 The proposed drainage strategy incorporates a combination of detention ponds and filter drains, delivering multiple benefits aligned with the four pillars of Sustainable Drainage Systems (SuDS).

5.45 From a water quantity perspective, detention ponds and filter drains provide attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. Vortex flow control devices will be used to control surface water discharge.

5.46 In terms of water quality, filter drains promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

5.47 The strategy also supports amenity by integrating ponds into the landscape, creating visually appealing features that can enhance the character of the surrounding environment.

5.48 Finally, the inclusion of vegetated components contributes to biodiversity, offering habitats for flora and fauna and supporting ecological connectivity within the scheme.

5.49 Collectively, these measures ensure compliance with SuDS principles while delivering a resilient and environmentally sensitive drainage solution.

6. WORKS NO.19 TO 20: ARDLEY BYPASS DRAINAGE STRATEGY

Proposals

6.1 The proposals include for construction of the B430 Ardley Bypass and associated works, this is shown in **Figure 6.1**.

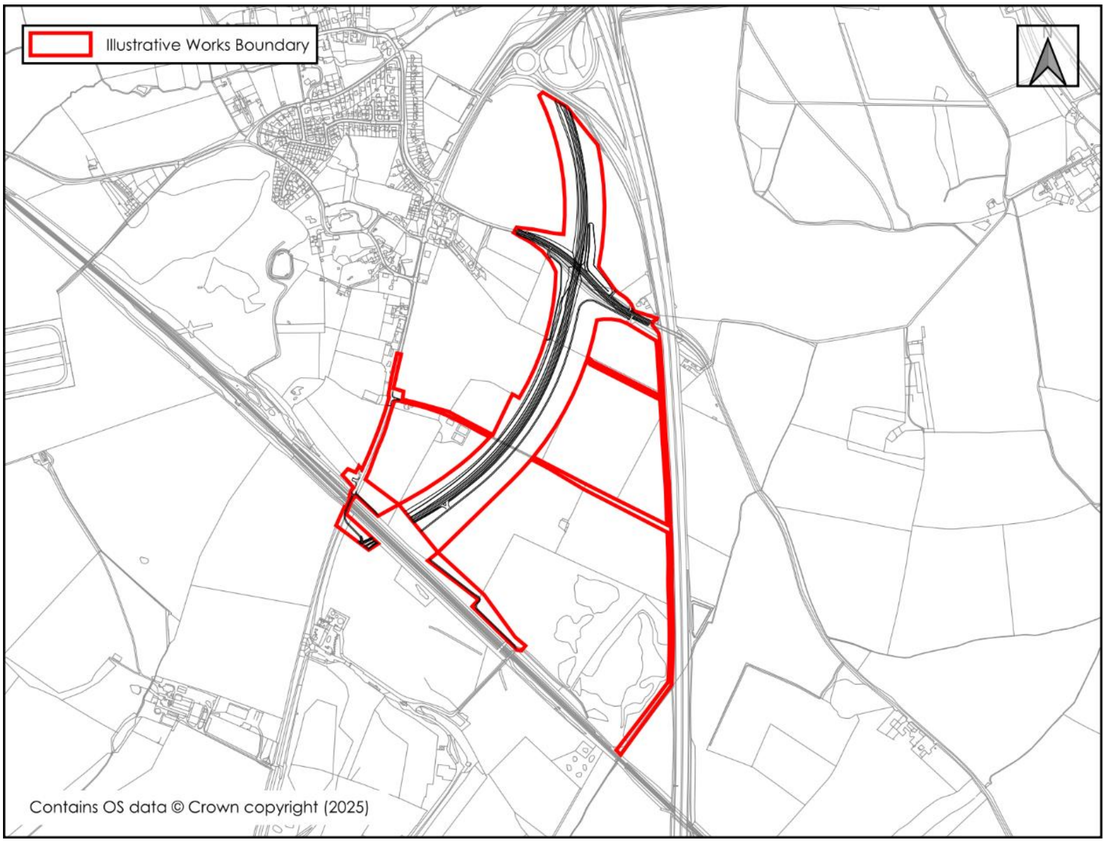

Figure 6.1: Illustrative Works Boundary - Works No. 19 to 20

Point of Discharge

6.2 As discussed in **Section 3**, the drainage strategy will assume that infiltration is not viable, however this should be confirmed at the detailed design stage.

6.3 Surface water runoff from the proposed Ardley Bypass will discharge into Gagle Brook at a single location to the southeast. Based on online mapping, the proposed connection point, located immediately adjacent to the M40, coincides with the origin of the watercourse. From the proposed outfall point, the watercourse flows to the south, under the railway line and onwards Middleton Stoney.

6.4 This discharge location has been selected to align with the existing topography and mimic the existing drainage catchment as much as possible.

Drained Areas

6.5 The proposed link road will introduce drained areas in the form of impermeable carriageway, surface level SuDS features, and embankments that will be drained with toe drains.

6.6 As outlined in **Section 3**, 100% of impermeable carriageway and SuDS pond footprints is assumed to drain to the system, while 50% of drained embankments and verges away from the main carriageway are assumed to drain into the system.

6.7 For the Ardley Bypass, the proposed drained areas are as follows:

- Total impermeable carriageway: 2.48ha
- Total embankments and verges: 1.92ha (50% of total)
- Total SuDS Pond footprint: 0.56ha
- Total design drainage area: 4.96ha

Proposed Drainage Strategy

6.8 As stated in **Section 3**, surface water runoff from any new drained areas will be restricted to 2.0l/s/ha.

6.9 The proposed carriageway will be drained into either gullys, filter drains, or adjacent swales, where levels allow. Embankments will be drained into filter drains. Swales, filter drains and pipework will be used to convey surface water runoff toward the attenuation pond situated adjacent to the roads low point.

6.10 The proposed drained area of 4.96ha equates to a discharge rate of 9.9l/s.

6.11 Runoff will be discharged to Gagle Brook at an attenuated rate of 9.9l/s. Storage will be provided in the pond. In the critical 1 in 100 year +25% climate change event, 4,038m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 4,597m³ is stored in the critical event and over 300mm of freeboard is available for both design scenarios.

6.12 The proposed drainage strategy drawings and calculations are included in **Appendix 6** and **Appendix 7** respectively.

Sustainable Drainage Systems

6.13 The proposed drainage strategy incorporates a combination of swales, detention ponds, and filter drains, delivering multiple benefits aligned with the four pillars of SuDS.

6.14 From a water quantity perspective, detention ponds and swales provide attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. A vortex flow control device will be used to control surface water discharge.

6.15 In terms of water quality, filter drains and vegetated swales promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

6.16 The strategy also supports amenity by integrating swales and ponds into the landscape, creating visually appealing features that can enhance the character of the surrounding environment.

6.17 Finally, the inclusion of vegetated components contributes to biodiversity, offering habitats for flora and fauna and supporting ecological connectivity within the scheme.

6.18 Collectively, these measures ensure compliance with SuDS principles while delivering a resilient and environmentally sensitive drainage solution.

7. WORKS NO.22: M40 JUNCTION 9 DRAINAGE STRATEGY

Proposals

7.1 The proposed improvements in this location include alterations of the existing M40 Junction 9 roundabout. The extent of the works is illustrated in **Figure 7.1**.

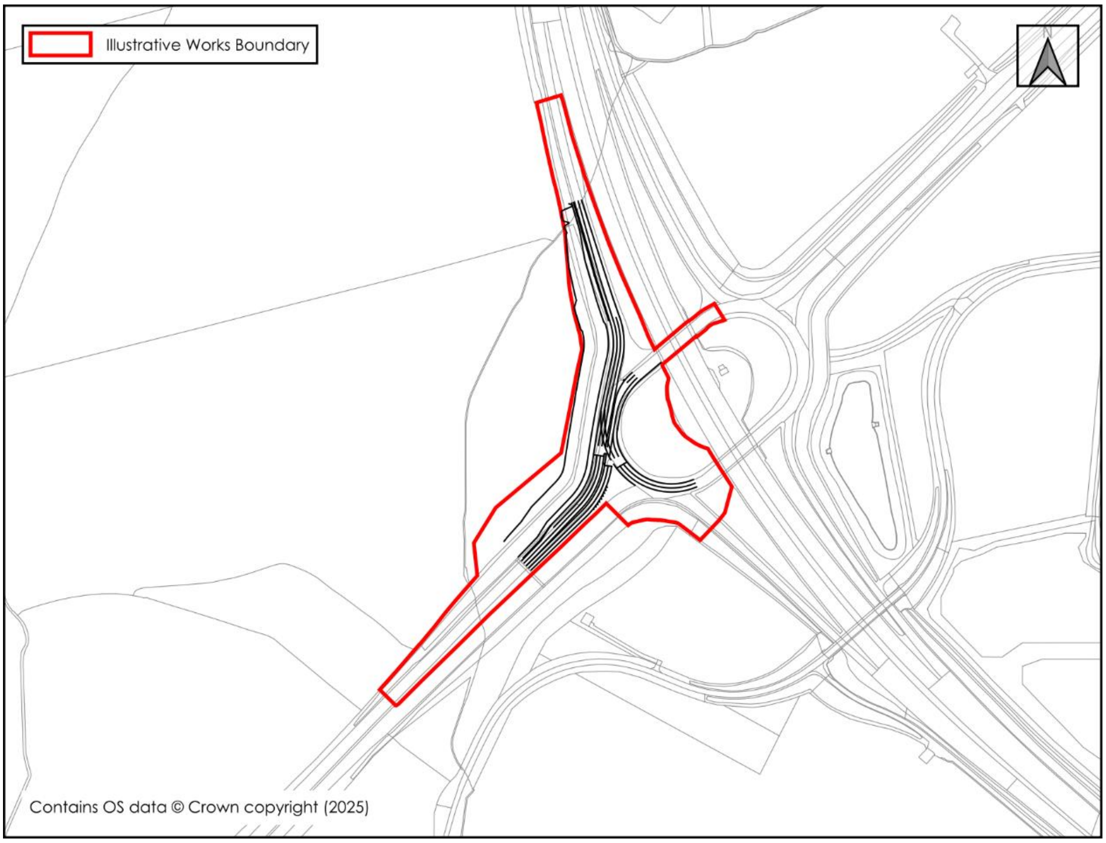

Figure 7.1: Illustrative Works Boundary - Works No. 22

Point of Discharge

7.2 The western arm of the Junction 9 roundabout is shown, on NH GDMS, to be served by an existing drainage system that is assumed to outfall to an existing drainage ditch located to the south of the western arm of the Junction 9 roundabout.

7.3 A portion of existing drainage run located at the base of the Junction 9 western arm embankment, will need to be abandoned and diverted to facilitate the proposed highway modification works.

7.4 It is proposed that the existing drain, located at the bottom of the existing embankment, will be replaced by a new filter drain run, to be located at the new post-development embankment toe, which will drain back into the existing NH drainage system prior to the network crossing the A34 towards the proposed network outfall point.

Drained Areas

7.5 Adequate data is not available to confirm the size of the existing catchment, but GDMS indicates the A34 catchment for the existing drainage run serving the western arm of the Junction 9 roundabout is approximately 0.376ha, which equates to a peak flow of 59.3l/s during the 1 in 100-year 30-minute storm, as calculated using the Modified Rational Method described in **Figure 3.1**. No existing attenuation features have been identified.

7.6 The drainage catchment for the existing drainage system will be confirmed through the detailed design works.

7.7 The proposed works will introduce the following additional drained areas:

- Total new impermeable carriageway: 0.115ha
- Total drainage area following completion of highway modification works = 0.491ha

Proposed Drainage Strategy

7.8 It is proposed that this will drain as per the existing scenario toward the existing drainage ditch via the existing NH network.

7.9 The extended carriageway will be drained via kerb drainage into a filter drain to be located at the toe of the amended embankment for the western arm of the Junction 9 roundabout.

7.10 Upstream of the connection back into the existing NH network, an orifice plate will be utilised to limit the peak flows from the new filter drain to 59.3l/s (or 157.63l/s/ha of a future calculated existing drained catchment area) to ensure the calculated peak flow does not increase as a result of the highway modification works.

7.11 A series of orifice plates will be used across the length of the filter drain to maximise the storage capacity of the new drainage system.

7.12 Storage will be provided in the form of a filter drain to provide attenuation of peak flows for the new drained areas. In the critical 1 in 100 year +25% climate change event, 123m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 140m³ is stored in the critical event.

7.13 The proposed drainage strategy drawings and calculations are included in **Appendix 8** and **Appendix 9** respectively.

Sustainable Drainage Systems

7.14 Due to the nature of these works consisting of amendments to an existing drainage system within a confined area, there is limited scope for the addition of new SuDS. However, the proposed drainage strategy incorporates filter drains.

7.15 From a water quantity perspective, filter drain provides attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. An orifice flow control will be used to control surface water discharge.

7.16 In terms of water quality, filter drains promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

8. WORKS NO.23 AND 24: MIDDLETON STONEY RELIEF ROAD DRAINAGE STRATEGY

Proposals

8.1 The proposals include for construction of the MSRR connecting B430 and B4030 including a shared use cycle track. The extent of the proposed works is shown in **Figure 8.1**. The southeastern 400m of Heyford Park Link Road will also be included in the drainage catchment because of the local topography.

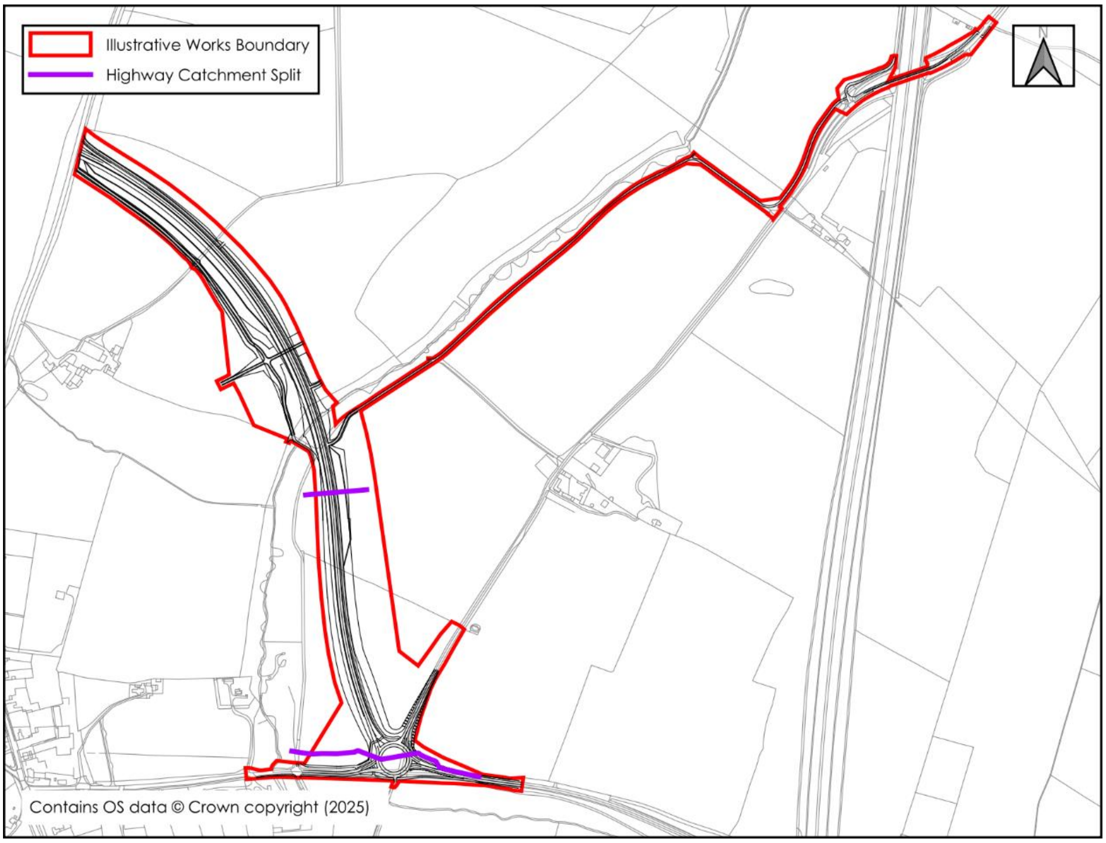

Figure 8.1: Illustrative Works Boundary - Works No. 23 and 24

Point of Discharge

8.2 As discussed in **Section 3**, the drainage strategy will assume that infiltration is not viable, however this should be confirmed at the detailed design stage.

8.3 Based on the topography of the works location and levels of the proposed new highways, the drainage system will be split into three catchments, with two outfall points to Gagle Brook. The proposed catchment split is illustrated on **Figure 8.1**.

8.4 Surface water runoff from the proposed MSRR will discharge into Gagle Brook at two locations. Gagle Brook flows to the south west beneath the proposed new highway before running broadly parallel to the southern section of the relief road and then onwards to the south east.

8.5 The first discharge point is situated near the midpoint of the relief road, prior to Gagle Brook crossing beneath the proposed alignment; this connection will be made to the east of the carriageway. The second discharge point is located at the southern end of the scheme, upstream of the brook passing beneath Bicester Road at an existing bridge west of the proposed new roundabout. These discharge locations have been selected to align with the existing topography and mimic the existing drainage catchment as much as possible.

8.6 Where Bicester road is to be upgraded to a new roundabout, it is not possible to drain the southern portion of the new roundabout, or southern arm which tie into Bicester Road, to the new MSRR drainage system attenuation basins. Therefore, this portion of the development will drain downstream of the southern catchment flow control, with the Bicestyer Road catchment being limited to the peak 1 in 100-year 30-mintue storm brownfield discharge rate.

8.7 The drainage strategy will include:

- Two attenuation ponds for the northern catchment.
- Two attenuation ponds for the southern catchment.
- Filter drains for the Bicester Road catchment.

Proposed Drainage Strategy

8.8 As stated in **Section 3**, surface water runoff from any new drained areas will be restricted to 2.0l/s/ha, with the exception of the highway amendment works to Bicester Road, which will continue to drain at the existing peak brownfield rate for the 1 in 100-year 30-minute storm.

8.9 The proposed drainage strategy will be split into 3 separate networks as described below:

- Northern Catchment;
- Southern Catchment; and
- Bicester Road.

8.10 The proposed drainage strategy drawings and calculations are included in **Appendix 10** and **Appendix 11** respectively.

<u>Northern Catchment</u>

8.11 The northern part of the relief road and the southeastern 400m of Heyford Park Link Road will discharge into Gagle brook via two attenuation basins. Surface water will be conveyed using swales, where possible, or gullys. Embankments and foot/cycleways away from the carriageway will be drained using filter drains and toe drains.

8.12 For the Northern Catchment, the proposed drained areas are as follows:

- Total impermeable carriageway: 2.76ha
- Total embankments and verges: 1.87ha (50% of total)
- Total SuDS Pond footprint: 0.67ha
- Total design drainage area: 10.6ha

8.13 The proposed drained area has been measured as 5.30ha, which equates to a proposed discharge rate of 10.6l/s. Storage will be provided in the attenuation basins. In the critical 1 in 100 year +25% climate change event, 5,326m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 5,804m³ is stored in the critical event and over 300mm of freeboard is available for both design scenarios.

8.14 It is acknowledged there are existing ditches around the southern portion of Heyford Park Link Road and these may present a viable outfall solution for that part of the road. At this stage, we have conservatively provided sufficient attenuation as part of the MSRR drainage strategy.

Southern Catchment

8.15 The southern part of the relief road will discharge into Gagle brook via two attenuation basins. Surface water will be conveyed using swales where possible, where possible, or gullys and filter drains. Embankments and foot/cycleways away from the carriageway will be drained using filter drains and toe drains.

8.16 For the Northern Catchment, the proposed drained areas are as follows:

- Total impermeable carriageway: 0.84ha
- Total embankments and verges: 1.05ha (50% of total)
- Total SuDS Pond footprint: 0.28ha
- Total design drainage area: 2.17ha

8.17 The proposed drained area has been measured as 2.17ha, which equates to a proposed discharge rate of 4.3l/s. Storage will be provided in the attenuation basins. In the critical 1 in 100 year +25% climate change event, 1,916m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 2,152m³ is stored in the critical event and over 300mm of freeboard is available for both design scenarios.

Bicester Road

8.18 Due to the area's topography, the section of Bicester Road due to be modified into a roundabout is unable to connect into the proposed attenuation ponds via gravity.

8.19 Due to limited space and depth available in the area, the proposed drainage strategy for this area will match the existing runoff rate as calculated using the modified rational method to calculate the existing peak rate during the 1 in 100-year 30-minute storm.

8.20 The existing highway runoff from Bicester Road into Gagle Brook has been estimated to be 0.20ha, which equates to a peak flow of 31.5l/s during the 1 in 100-year 30-minute storm, as calculated using the Modified Rational Method described in **Figure 3.1**

8.21 The proposed works will introduce the following additional drained areas:

- Total new impermeable carriageway and pedestrian / cycle paths: 0.41ha
- Total verges: 0.25ha (50% of 0.50ha)
- Total new drained area = 0.66ha

8.22 It is proposed that this will drain as per the existing scenario toward Gagle Brook via the new outfall associated with the Southern Catchment. A vortex flow will be placed system outfall, limiting flows to 31.5l/s (or 157.63l/s/ha of a future calculated existing drained catchment area) to the Southern Catchment drainage system, downstream from this catchment's flow control, to ensure the calculated peak flow does not increase as a result highway modification works.

8.23 Storage will be provided in the form of oversized pipes and filter drains to provide attenuation of peak flows for the new drained areas. A vortex flow control will also be placed upstream within the system; to maximise the storage capacity of the filter drains across the network.

8.24 Storage will be provided in the form of a filter drain to provide attenuation of peak flows for the new drained areas. In the critical 1 in 100 year +25% climate change event, 192m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 207m³ is stored in the critical event. During the 1 in 100-year + 40% critical event, there is minor flooding of the system anticipated; however, this exceedance water will pool within verge between the proposed filter drains and be temporarily stored on site, above ground, until water levels in the system drop.

Sustainable Drainage Systems

8.25 The proposed drainage strategy incorporates a combination of swales, detention ponds, and filter drains, delivering multiple benefits aligned with the four pillars of SuDS.

8.26 From a water quantity perspective, detention ponds, swales and filter drains provide attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. Vortex flow control devices will be used to control surface water discharge.

8.27 In terms of water quality, filter drains and vegetated swales promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

8.28 The strategy also supports amenity by integrating swales and ponds into the landscape, creating visually appealing features that can enhance the character of the surrounding environment.

8.29 Finally, the inclusion of vegetated components contributes to biodiversity, offering habitats for flora and fauna and supporting ecological connectivity within the scheme.

8.30 Collectively, these measures ensure compliance with SuDS principles while delivering a resilient and environmentally sensitive drainage solution.

9. MINOR WORKS DRAINAGE STRATEGIES

9.1 The minor works proposed that have been scoped into this SDS are as follows:

- Works No. 13 – Camp Road/Chilgrove Drive Junction and Bridleway
- Works No. 21 – Ardley Bypass PROW
- Works No. 24 – MSRR Pedestrian and cyclist connectivity
- Works No. 25 – B430 shared use cycle track
- Works No. 26 – Quarry Cottages turning head and PROW
- Works No. 33 – Cycle lane to Middleton Road

9.2 The above works have been grouped together as they will all share the same proposed minor drainage mitigation works to locally manage flows from these works.

9.3 These areas will be drained via local filter drains, positioned adjacent to the new minor impermeable areas, which will either discharge via infiltration, subject to successful localised testing at detailed design, or to the nearest local drainage receptor at 2l/s/ha.

9.4 On the basis that the new pedestrian / cycle paths will be surfaced with bound materials, a generic attenuation calculation for a 25m filter drain run has been undertaken. It has been assumed that the paths will be 3m wide, which results in an assumed 75m^3 of impermeable surfacing per 25m length of Path.

9.5 A conservative infiltration rate of $5x10^{-6}$m/s has been assumed to demonstrate that a filter drain would be sufficient to drain these new minor impermeable surfaces associated with the minor works. The supporting calculation is presented as **Appendix 12**. Minor flooding in the region of 0.5m^3 per 25m stretch of a filter drain run is anticipated during the 1 in 100-year + 40% critical storm; however, these exceedance flows would be locally stored above ground on site, on the adjacent pedestrian / cycle paths, before draining back into the system once water levels drop.

9.6 If any new paths are to be surfaced with unbound materials, surface water flows will infiltrate to the ground and drain as existing. In these instances, no filter drain would be necessary.

9.7 A typical section of the proposed pedestrian / cycle paths and the proposed filter drains is provided as **Appendix 13**.

10. SUMMARY

10.1 This statement and supporting appendices demonstrate that the drainage design for the development will comply with the relevant local and national standards, specifically the hierarchy of discharge, runoff rate and volume criterion.

10.2 This SDS is intended to support a Development Consent Order application and as such the level of detail included is commensurate and subject to the nature of the proposals.

10.3 It is envisaged that the final drainage strategy will be determined during the detailed design stage, as the development layout is finalised and additional survey works have been undertaken to the confirm the existing drainage arrangements that are currently unknown.

APPENDICES

Appendix 1: Topographical Survey

N

Station	Easting	Northing	Level
B1	454492.228	227864.244	121.171
B2	454455.789	227798.863	121.255
B3	454361.026	227622.737	121.153
B4	454315.209	227540.290	120.475
B5	454290.232	227439.153	120.046
B6	454267.084	227332.027	120.411
B7	454248.309	227230.291	120.231
B8	454218.762	227109.458	120.404
B9	454206.355	227004.704	120.725
B10	454162.670	226874.727	120.912
B11	454106.983	226768.937	119.980
B12	454055.803	226654.823	119.571
B13	454015.739	226535.910	119.352
B14	453984.078	226372.443	119.056
B15	453953.021	226246.398	117.999
B16	453913.574	226122.057	117.359
B17	453852.163	225877.928	115.845
B18	453823.659	225724.434	114.910
B19	453773.162	225577.772	113.634
B20	453756.412	225470.419	112.474
B21	453746.200	225360.019	111.206
B22	453700.315	225158.587	108.779
B23	453648.377	224922.386	106.498
B24	453597.060	224788.270	105.353
B25	453548.982	224677.792	105.151
B26	453518.562	224573.256	104.825
B27	453492.897	224442.299	103.714
B28	453445.554	224334.173	102.624
B29	453382.773	224158.231	97.121
DJ1	454716.420	223312.914	94.560
DJ2	454833.310	223285.741	92.071
DJ6	455820.969	222965.163	88.551
DJ7	455926.740	222918.076	87.728
DJ10	451877.239	225713.353	118.179
DJ11	451817.297	225725.127	118.973
DJ12	452543.978	224385.077	107.456
DJ13	452502.007	224430.541	107.822
DJ14	452417.419	224394.726	107.834
GH5	453766.968	225562.831	113.396
GH7	453580.999	225635.090	114.154
GH8	453456.665	225696.578	114.124
GH9	453220.040	225803.893	108.935
GH10	453085.871	225790.902	108.407
GH11	452909.907	225765.733	109.558
GH12	452722.745	225726.455	113.894
GH13	452532.700	225715.600	117.469
GH14	452323.006	225692.407	119.453
GH15A	452176.731	225686.034	120.421
SA1	453877.631	223507.339	86.748
SA2	454047.509	223493.861	86.238

OS Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

This survey has been orientated to the Ordnance Survey (O.S) National Grid OSGB36(15) via Global Navigation Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGM15GB transformation models.

The survey has been correlated to this point and a further one or more OSGB36 (15) points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:

Buildings
Wall
Kerb line
Line marking
Drop kerb
Centre line
Top of bank
Overhead Cable
Concrete edge
Tarmac edge
Grass verge
Canopy/Overhang
Verge
Bottom of bank
1 / 100.000 — Station and Name / Station Level
Tree / Bush / Sapling
Area of Undergrowth
Woodland
R: Ridge Level
E: Eaves Level
F: Flat Roof Level
Gate

Fence types:

I\W Interwoven
I\R Iron Railings
W\M Wire Mesh
P\R Post & Rail
P\W Post & Wire
C\L Chain Link
W\P Wooden Panels
C\B Close Boarded
S\P Steel Palisade

IC	Inspection chamber	Bo	Bollard
PInv	Pipe invert	IB	Illuminated bollard
Gy	Gully	Bin	Rubbish bin
Bg	Back gully	Vp	Vent pipe
Dp	Down pipe	Grl	Ground light
Pipe	Pipe above ground	Lbox	Letter box
MH	Manhole	Stmp	Tree Stump
WL	Water level	Sty	Stile
Fl	Flood light	IFL	Internal floor level
Lp	Lamp post	THL	Threshold level
Tp	Telegraph post	Sp	Sign post
Ep	Electricity post	TH	Trialhole
Tl	Traffic light	BH	Borehole
Bus	Bus stop	ELC	Electric
Sv	Stop valve	BT	British Telecom
St	Stop tap	C'box	Control box
Er	Earth rod	TT	Tactile
Wm	Water meter	BP	Brick paved
Gas	Gas valve	CPS	Concrete paving slabs
Av	Air valve	CVR	Cover
ICU	Unidentified inspection	R/wall	Retaining wall
Wo	Wash out	TWL	Top of Wall Level
Re	Rodding eye	TCL	Tree canopy level
BB	Belisha beacon	G:	Girth
CTV	Cable tv	MG	Multi girth
Mkr	Marker post	IC	Inspection chamber
Gmkr	Gas marker post	CL:	Cover level
So	Soffit	IL:	Invert level
Fh	Fire hydrant	UTR	Unable to raise

Rev	Date	Description	Drawn	Q. Ref.
7	August 2022	Additional Areas	DH/WA	GH14485
5	01.10.21	Additional topo	BG	GH11448
4	31.08.21	Additional topo & mobile mapping	BG/SHill	GH11448
3	15.07.21	Priority blue area surveyed	BG	GH11068
2	14.09.20	Topo extension	TC	GH8475
6	July 2022	Additional areas	TC	GH14331

greenhatch group

Topographical Surveys
Site Engineering
Utility / CCTV Surveys
Measured Building Surveys
3D Laser Scanning
Revit & BIM Models

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Regents Park
London
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CLIENT

Cuvette Property Consulting Ltd

PROJECT

**Ardley
Bicester
OX27 7PJ**

TITLE

Topographical Survey

SCALE	DATE
A0@ 1: 10000	May 2020
DRAWN	QUALITY REF
TS	GH7506

Level datum: *See note*
Grid orientation: *See note*
Job number: *36646*

Drawing No.: *36646_T* Rev.: *7*

Comments

This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

Appendix 2: Greenfield Runoff Rate and Volume Calculations and Rainfall Intensities

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

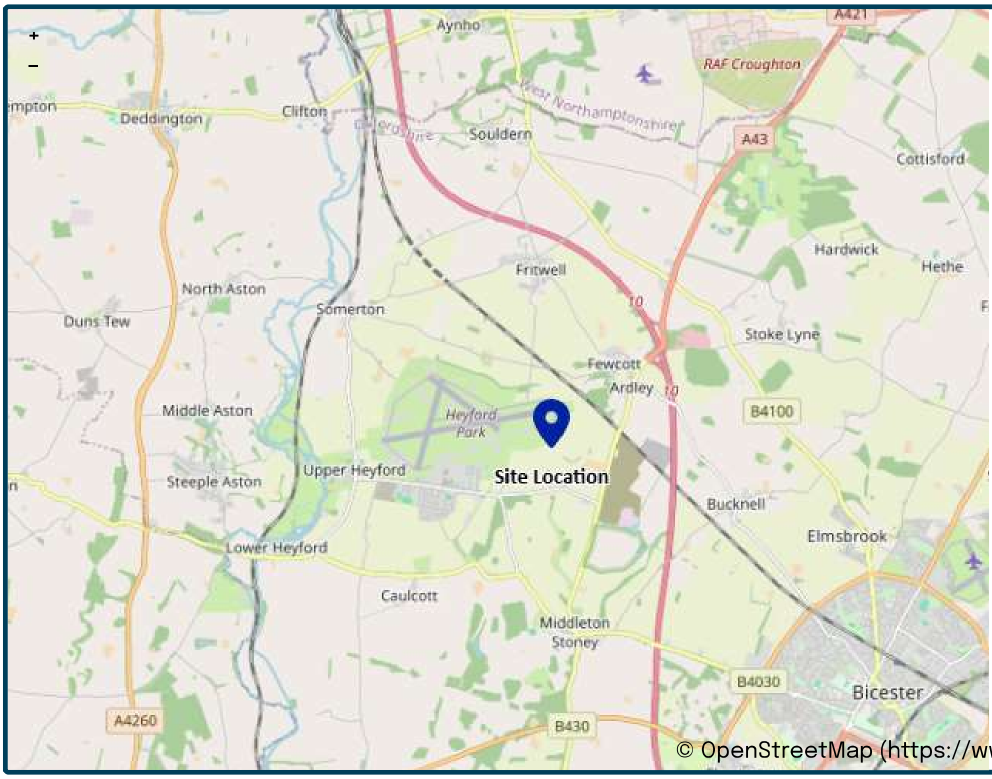
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	09/12/2025
Calculated by	M. Bailey
Reference	OxSRFI - IH124
Model version	2.2.2

Location

Site name	OxSRFI
Site location	Oxfordshire



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Site easting (British National Grid)	453018
Site northing (British National Grid)	226084

Site details

Total site area (ha)	1 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value	Map value	
SAAR (mm)	659 mm		659
How should SPR be derived?	WRAP soil type		
WRAP soil type	1		1
SPR	0.1		
QBar (IH124) (l/s)	0.2 l/s		

Growth curve factors

	My value	Map value	
Hydrological region	6		6
1 year growth factor	0.85		
2 year growth factor	0.88		
10 year growth factor	1.62		
30 year growth factor	2.3		
100 year growth factor	3.19		
200 year growth factor	3.74		

Results

Method	IH124
Flow rate 1 year (l/s)	0.1 l/s
Flow rate 2 year (l/s)	0.1 l/s
Flow rate 10 years (l/s)	0.3 l/s
Flow rate 30 years (l/s)	0.4 l/s
Flow rate 100 years (l/s)	0.5 l/s
Flow rate 200 years (l/s)	0.6 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	Check Discharge Volume	✓
Summer CV	0.750	Skip Steady State	x	Starting Level (m)		100 year 360 minute (m³)	48

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	**Climate Change (CC %)**	**Additional Area (A %)**	**Additional Flow (Q %)**
100	40	0	0

Pre-development Discharge Volume

Site Makeup	Greenfield	Soil Index	1	Return Period (years)	100	Betterment (%)	0
Greenfield Method	FSR/FEH	SPR	0.10	Climate Change (%)	0	PR	0.078
Positively Drained Area (ha)	1.000	CWI	100.444	Storm Duration (mins)	360	Runoff Volume (m³)	48

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	x	Starting Level (m)			

Storm Durations

30

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	0	0	0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 30 minute summer	222.646	63.001	100 year 30 minute winter	156.243	63.001

Appendix 3: A43 HEWRAT Assessment Results

DETAILED RESULTS

Back To Top | Go To Interface

Summary of predictions

	Soluble - Acute Impact: Copper	Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Prediction of impact *Step1*										
Step2										
Step3										

In Runoff

Step 1

		Copper	Zinc
		RST24	
Allowable Exceedances/year		1	1
No. of exceedances/year		**60.80**	**39.10**
No. of exceedances/worst year		76	48
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**20.40**	**12.80**
No. of exceedances/worst year		29	18
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		26.43	58.25
90%ile		50.59	122.59
95%ile		66.30	162.04
99%ile		104.70	307.07

Step 1

Toxicity Threshold

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	**80.70**	**96.40**	**1.30**	**15.30**	**52.30**	**15.30**	**13.20**	**28.60**
No. of exceedances/worst year	93	106	5	27	66	27	21	38
	(mg/kg)	*(mg/kg)*	*(mg/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*	*(ug/kg)*
Toxicity	197	315	3.5	16770	875	2355	245	515
Event Statistics Mean	405	1316	1	10600	1834	1760	112	496
90%ile	876	2971	1	28184	4876	4679	299	1319
95%ile	1155	4029	2	56234	9729	9335	596	2632
99%ile	1615	7123	4	112202	19411	18626	1189	5251

In River (no mitigation)

Step 2

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		**0**	**0**
No. of exceedances/worst year		0	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		**0**	**0**
No. of exceedances/worst year		0	0
No. of exceedances/summer		0	0
No. of exceedances/worst summer		0	0
Annual average concentration (ug/l)		0.22	0.59
		(ug/l)	*(ug/l)*
Thresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		0.86	2.02
90%ile		2.20	5.23
95%ile		3.39	10.39
99%ile		10.57	25.63

Step 2

Velocity 0.56 m/s — Tier 2 is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

		Copper	Zinc
		RST24	
Allowable Exceedances/year		2	2
No. of exceedances/year		-	-
No. of exceedances/worst year		-	-
No. of exceedances/summer		-	-
No. of exceedances/worst summer		-	-
		RST6	
Allowable Exceedances/year		1	1
No. of exceedances/year		-	-
No. of exceedances/worst year		-	-
No. of exceedances/summer		-	-
No. of exceedances/worst summer		-	-
Annual average concentration (ug/l)		-	-
		(ug/l)	*(ug/l)*
Thresholds hresholds	***RST24***	21	385
Thresholds	***RST6***	42	770
Event Statistics Mean		-	-
90%ile		-	-
95%ile		-	-
99%ile		-	-

DI -

Details of the chosen rainfall site

SAAR (mm)	**750**
Altitude (m)	**120**
Easting	**4073**
Northing	**2872**
Coastal distance (km)	**120**

highways england

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	B	C	D	E	F	Totals	Return Period (years)
			Additional columns for use if other roads drain to the same outfall						
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse	Surface watercourse				
D2	Length of road draining to outfall *(m)*	7,800	201	490	3,245				
D3	Road Type *(A-road or Motorway)*	A	A	A	M				
D4	If A road, is site urban or rural?	Rural	Rural	Rural	Rural				
D5	Junction type	No junction	No junction	No junction	Slip road				
D6	Location (response time for emergency services)	< 20 minutes	< 20 minutes	< 20 minutes	< 20 minutes				
D7	Traffic flow (AADT two way)	42,253	201	15,889	14,049				
D8	% HGV	13.9	2.9	8.4	19.8				
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29	0.29	0.29	0.29				
D9	Risk of accidental spillage	0.00485	0.00000	0.00007	0.00096	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45	0.45				
D11	Risk of pollution incident	0.00218	0.00000	0.00003	0.00043	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**				
D13	Return period without pollution reduction measures	0.00218	0.00000	0.00003	0.00043	0.00000	0.00000	0.0026	378
D14	Existing measures factor	0.5	0.5	0.5	1				
D15	Return period with existing pollution reduction measures	0.00109	0.00000	0.00002	0.00043	0.00000	0.00000	0.0015	651
D16	Proposed measures factor	0.5	0.5	0.5	0.5				
D17	Residual with proposed Pollution reduction measures	0.00055	0.00000	0.00001	0.00021	0.00000	0.00000	0.0008	1302

Justification for choice of existing measures factors:

Individual routes amalgamated and calculated together with mean average traffic data taken. This has been carried out holistically to look at all routes using the same outfall.

Four columns are calculated as shown below:

Column A = A43
Column B = B430
Column C = B4100
Column D = Slip Road

The individual routes are shown in choice justification column.

Justification for choice of proposed measures factors:

M40 J10 NB diverge (to Ardley Roundabout)
B430 (north of Ardley Road)
M40 J10 NB merge (from Ardley Roundabout)
New Link - M40 J10A NB diverge
M40 J10 SB diverge (to Padbury junction)
B4100 east of Baynard's Green
B4100 west of Baynard's Green
A43 between Ardley and Cherwell junctions
A43 between Cherwell and Padbury junctions
A43 between Padbury and Baynard's Green junctions
A43 north of Baynard's Green
M40 SB merge at J10

Spillage Factor

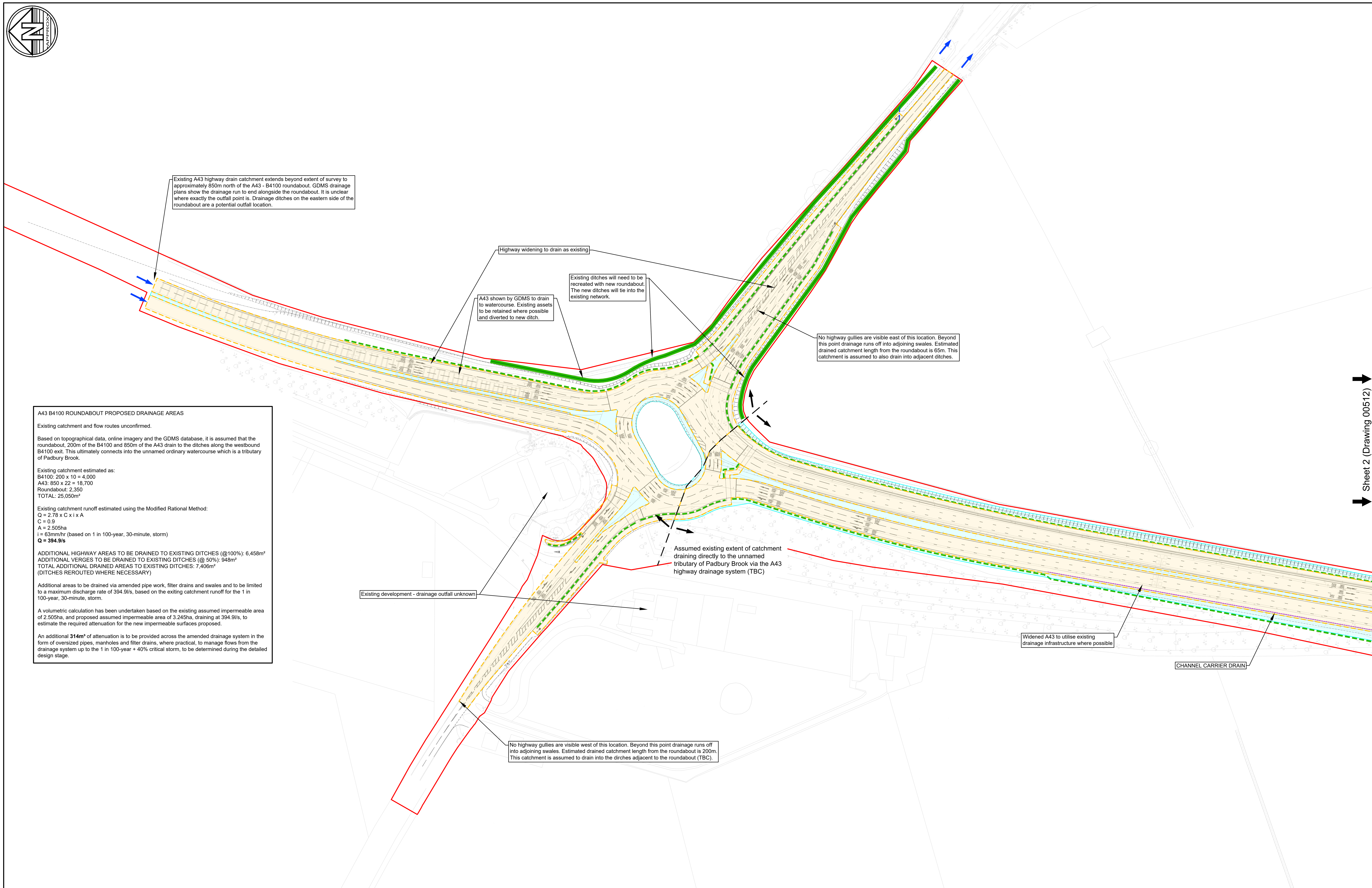
	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

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

The worksheet should be read in conjunction with DMRB 11.3.10.

Appendix 4: M40 Junction 10 Drainage Drawings



A43 B4100 ROUNDABOUT PROPOSED DRAINAGE AREAS

Existing catchment and flow routes unconfirmed.

Based on topographical data, online imagery and the GDMS database, it is assumed that the roundabout, 200m of the B4100 and 850m of the A43 drain to the ditches along the westbound B4100 exit. This ultimately connects into the unnamed ordinary watercourse which is a tributary of Padbury Brook.

Existing catchment estimated as:
B4100: 200 x 10 = 4,000
A43: 850 x 22 = 18,700
Roundabout: 2,350
TOTAL: 25,050m²

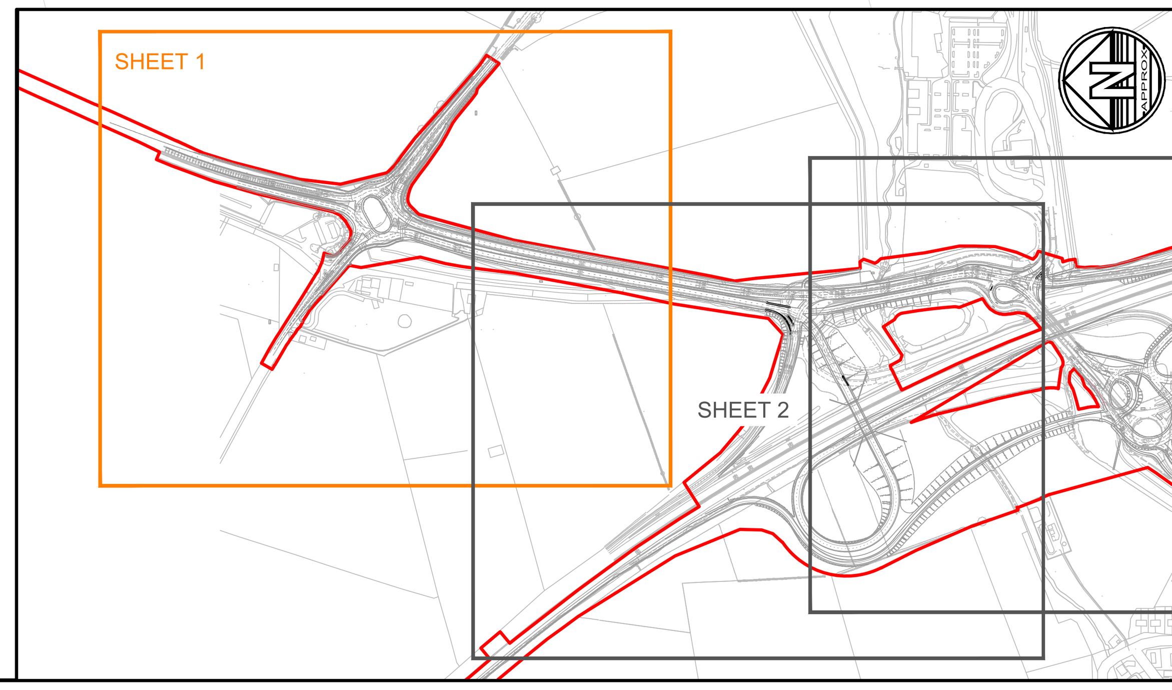
Existing catchment runoff estimated using the Modified Rational Method:
Q = 2.78 x C x i x A
C = 0.9
A = 2.505ha
i = 63mm/hr (based on 1 in 100-year, 30-minute, storm)
Q = 394.9/s

ADDITIONAL HIGHWAY AREAS TO BE DRAINED TO EXISTING DITCHES (@100%): 6,458m²
ADDITIONAL VERGES TO BE DRAINED TO EXISTING DITCHES (@ 50%): 948m²
TOTAL ADDITIONAL DRAINED AREAS TO EXISTING DITCHES: 7,406m²
(DITCHES REROUTED WHERE NECESSARY)

Additional areas to be drained via amended pipe work, filter drains and swales and to be limited to a maximum discharge rate of 394.9l/s, based on the exiting catchment runoff for the 1 in 100-year, 30-minute, storm.

A volumetric calculation has been undertaken based on the existing assumed impermeable area of 2.505ha, and proposed assumed impermeable area of 3.245ha, draining at 394.9l/s, to estimate the required attenuation for the new impermeable surfaces proposed.

An additional **314m³** of attenuation is to be provided across the amended drainage system in the form of oversized pipes, manholes and filter drains, where practical, to manage flows from the drainage system up to the 1 in 100-year + 40% critical storm, to be determined during the detailed design stage.



Key Plan
(Scale (1:10000))

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- PROPOSED CATCHMENT SPLIT
- PROPOSED CHANNEL CARRIER DRAIN
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED IMPERMEABLE HIGHWAY AND FOOT/CYCLE PATH AREAS
- EXTENT OF VERGES AND BANKS

General Notes

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7. Enclosed highway GA based on drawings: OxSRFI-BWB-LSI-01-DR-CH-0101 and OxSRFI-BWB-LSI-02-DR-CH-0102

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:3 and a minimum 300mm freeboard during the 1 in 100-year + 25% critical storm event, with a sensitivity test undertaken using the 1 in 100-year + 40% critical storm to ensure that the basins have sufficient capacity to accommodate the additional volume during this event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Drainage for the proposed highway works is to be split into 6 catchments which each ultimately discharge into the unnamed tributary of Padbury Brook.
9. The widened Baynard's Green roundabout will drain as existing via ditches which will be diverted.
10. Junction 10 of the M40 will be split into 4 basins and a filter drain:
    - The northwest and southwestern basins are new and will drain nearby proposed roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The northeast basin is an existing basin that will be modified by the proposals. It will drain nearby roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The southeast basin is an existing basin which is currently assumed to discharge primarily via infiltration, There is a a weir overflow for extreme events. It is assumed to drain a significant length of the M40 (to be confirmed). It is proposed to add additional area to this basin, and remove part of its existing catchment such that the net change is negligible. Thus no changes are proposed for the basin. Refer to drawing 'OxSRFI-BWB-EWE-ZZ-DR-CD-00516' for more details.
    - Due to level constraints, the eastern junction embankments will be drained via a filter drain located at the toe of the embankment that will drain either via infiltration or to the unnamed tributary of Padbury Brook at 2l/s/ha.

10. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Rev	Date	Details of issue / revision	Drw	Rev
P02	20.02.26	Preliminary issue	TLB	RJ
P01	20.01.26	Draft issue	TLB	

Issues & Revisions

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Client

OXFORDSHIRE RAILFREIGHT LTD.

Project Title

OxSRFI
OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

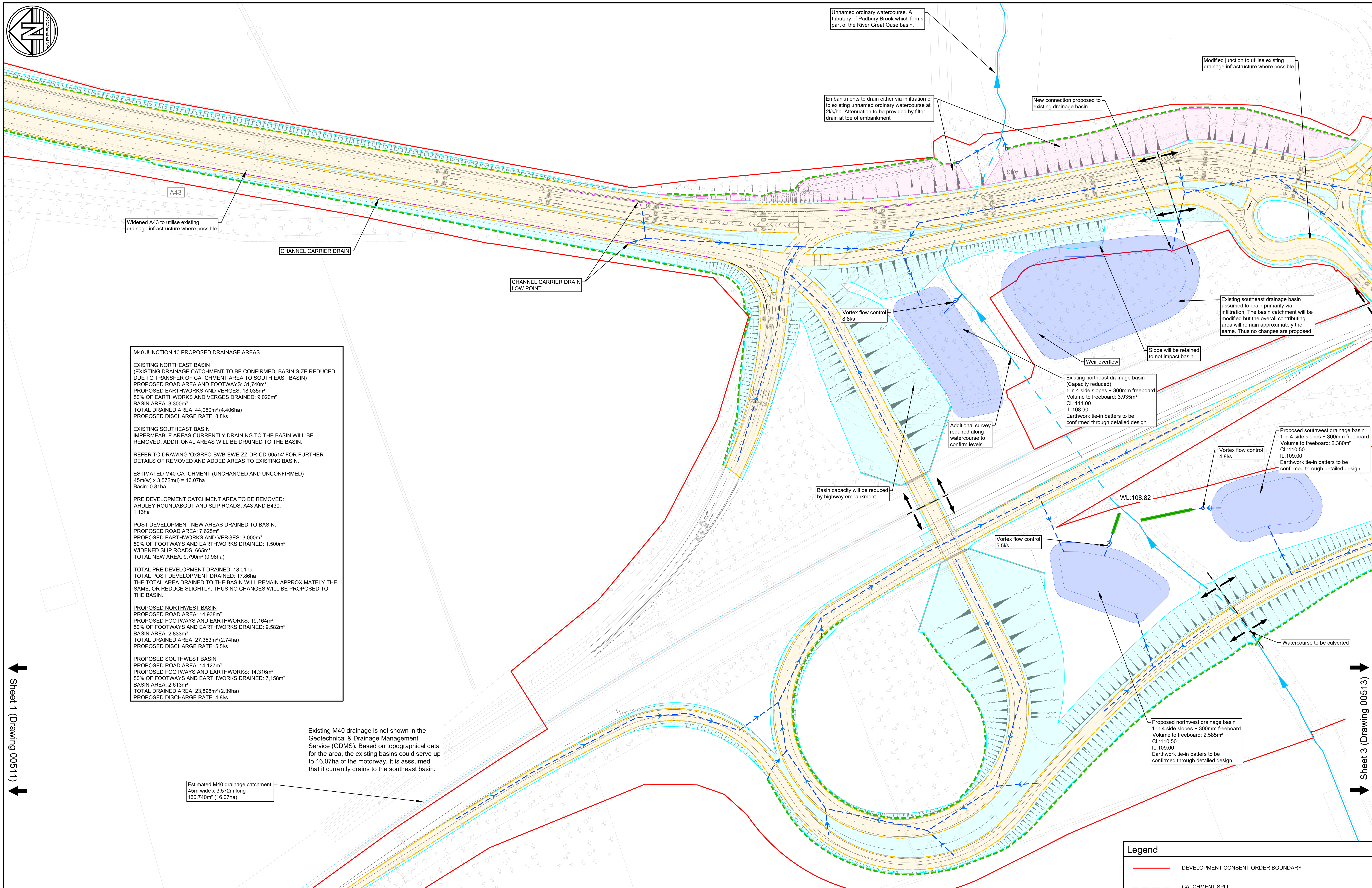
M40 JUNCTION 10 MODIFICATIONS DRAINAGE STRATEGY (SHEET 1 OF 3)

Drawn:	TLB	Reviewed:	RJ
BWB Ref:	NTH2479	Date:	20.01.26
Scale@A1:	1:1250		

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00511	S1	P02



M40 JUNCTION 10 PROPOSED DRAINAGE AREAS

EXISTING NORTHEAST BASIN
(EXISTING DRAINAGE CATCHMENT TO BE CONFIRMED, BASIN SIZE REDUCED DUE TO TRANSFER OF CATCHMENT AREA TO SOUTH EAST BASIN)
PROPOSED ROAD AREA AND FOOTWAYS: 31,740m²
PROPOSED EARTHWORKS AND VERGES: 18,035m²
50% OF EARTHWORKS AND VERGES DRAINED: 9,020m²
BASIN AREA: 3,300m²
TOTAL DRAINED AREA: 44,060m² (4.406ha)
PROPOSED DISCHARGE RATE: 8.8l/s

EXISTING SOUTHEAST BASIN
IMPERMEABLE AREAS CURRENTLY DRAINING TO THE BASIN WILL BE REMOVED. ADDITIONAL AREAS WILL BE DRAINED TO THE BASIN.

REFER TO DRAWING 'OxSRFO-BWB-EWE-ZZ-DR-CD-00514' FOR FURTHER DETAILS OF REMOVED AND ADDED AREAS TO EXISTING BASIN.

ESTIMATED M40 CATCHMENT (UNCHANGED AND UNCONFIRMED)
45m(w) x 3,572m(l) = 16.07ha
Basin: 0.81ha

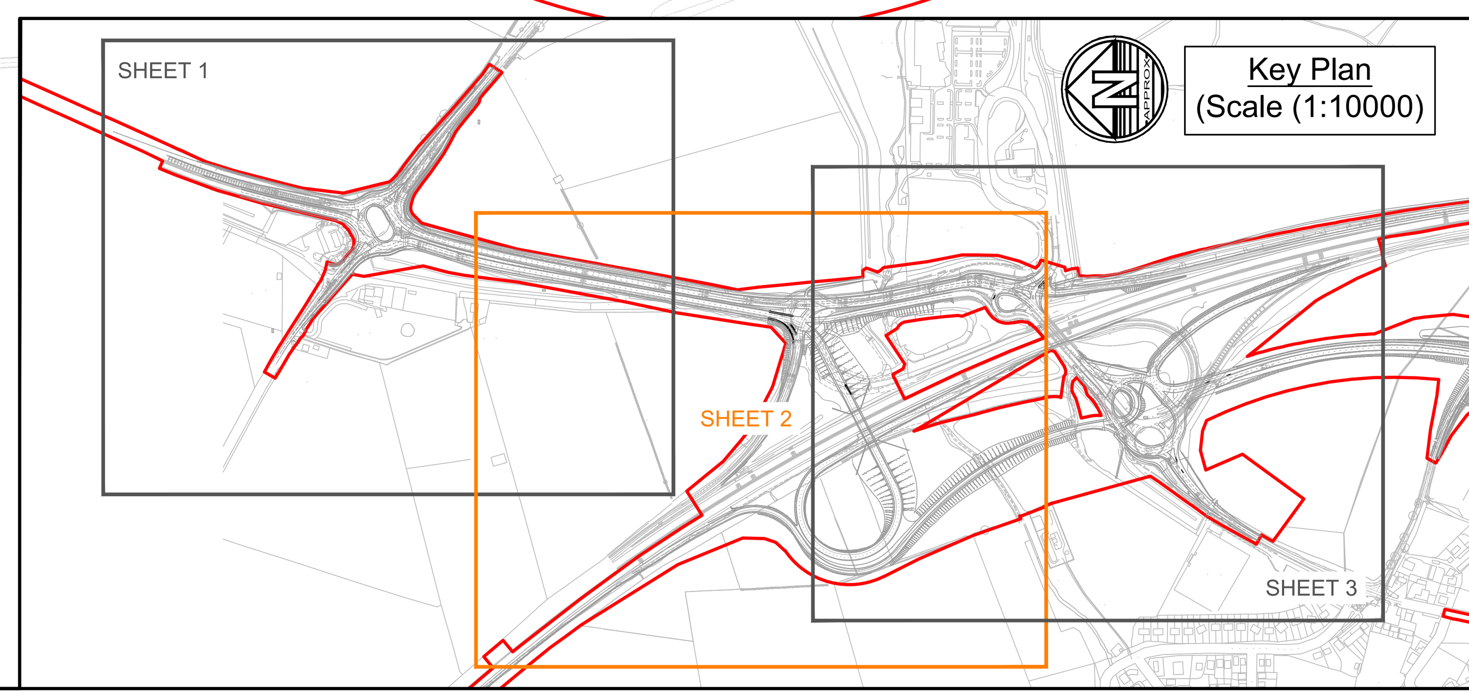
PRE DEVELOPMENT CATCHMENT AREA TO BE REMOVED:
ARDLEY ROUNDABOUT AND SLIP ROADS, A43 AND B430:
1.13ha

POST DEVELOPMENT NEW AREAS DRAINED TO BASIN:
PROPOSED ROAD AREA: 7,625m²
PROPOSED EARTHWORKS AND VERGES: 3,000m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 1,500m²
WIDENED SLIP ROADS: 665m²
TOTAL NEW AREA: 9,790m² (0.98ha)

TOTAL PRE DEVELOPMENT DRAINED: 18.01ha
TOTAL POST DEVELOPMENT DRAINED: 17.86ha
THE TOTAL AREA DRAINED TO THE BASIN WILL REMAIN APPROXIMATELY THE SAME, OR REDUCE SLIGHTLY. THUS NO CHANGES WILL BE PROPOSED TO THE BASIN.

PROPOSED NORTHWEST BASIN
PROPOSED ROAD AREA: 14,938m²
PROPOSED FOOTWAYS AND EARTHWORKS: 19,164m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 9,582m²
BASIN AREA: 2,833m²
TOTAL DRAINED AREA: 27,353m² (2.74ha)
PROPOSED DISCHARGE RATE: 5.5l/s

PROPOSED SOUTHWEST BASIN
PROPOSED ROAD AREA: 14,127m²
PROPOSED FOOTWAYS AND EARTHWORKS: 14,316m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 7,158m²
BASIN AREA: 2,613m²
TOTAL DRAINED AREA: 23,898m² (2.39ha)
PROPOSED DISCHARGE RATE: 4.8l/s



Legend

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- CATCHMENT SPLIT
- PROPOSED CHANNEL CARRIER DRAIN
- EXISTING WATERCOURSE (OPEN CHANNEL)
- EXISTING WATERCOURSE (CULVERTED)
- PROPOSED SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AND FOOT/CYCLE PATH AREAS
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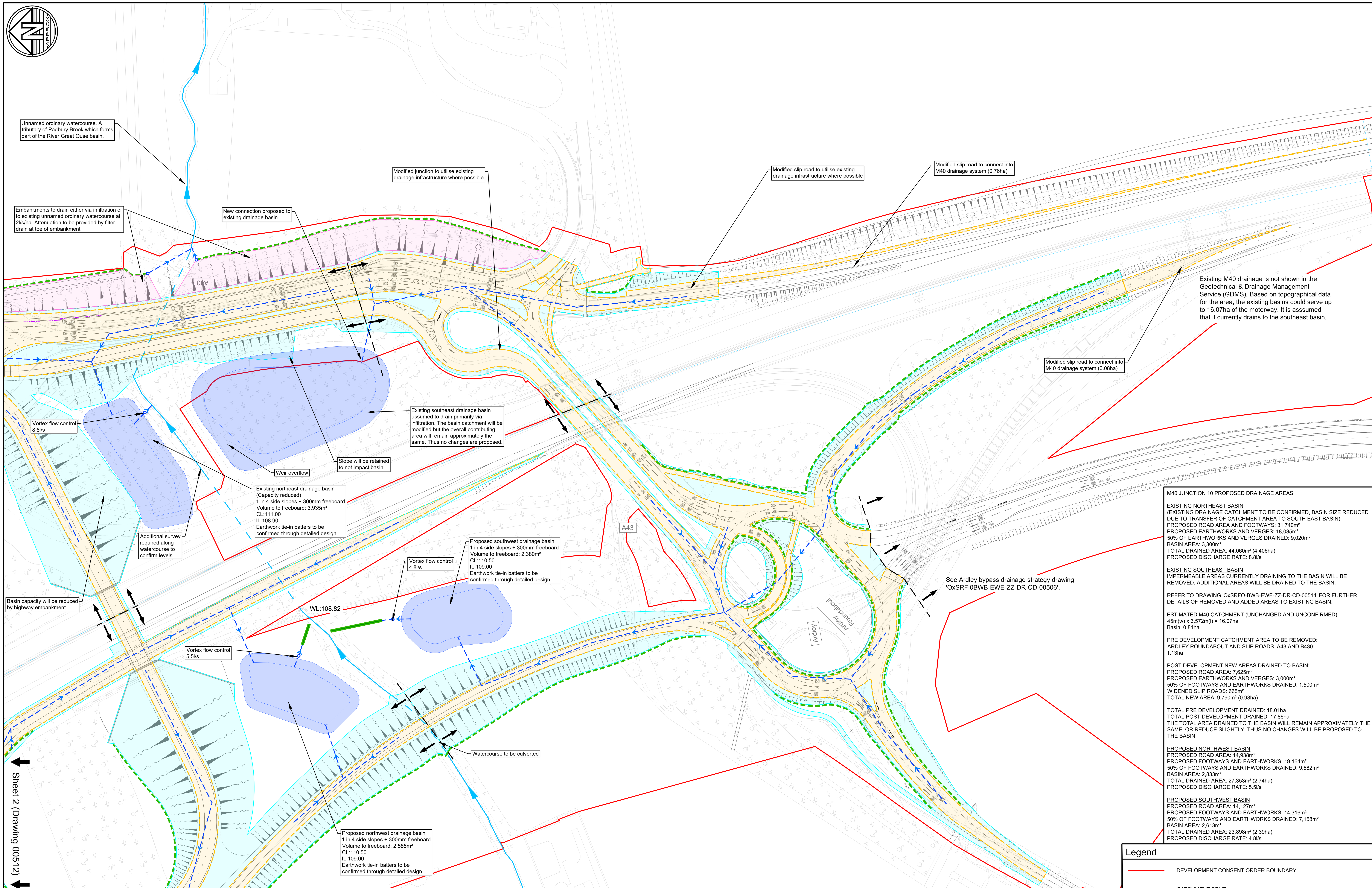
Drawing Title
M40 JUNCTION 10 MODIFICATIONS DRAINAGE STRATEGY (SHEET 2 OF 3)

Drawn:	TLB	Reviewed:	RJ		
BWB Ref:	NTH2479	Date:	20.01.26	Scale@A1:	1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00512	S1	P02



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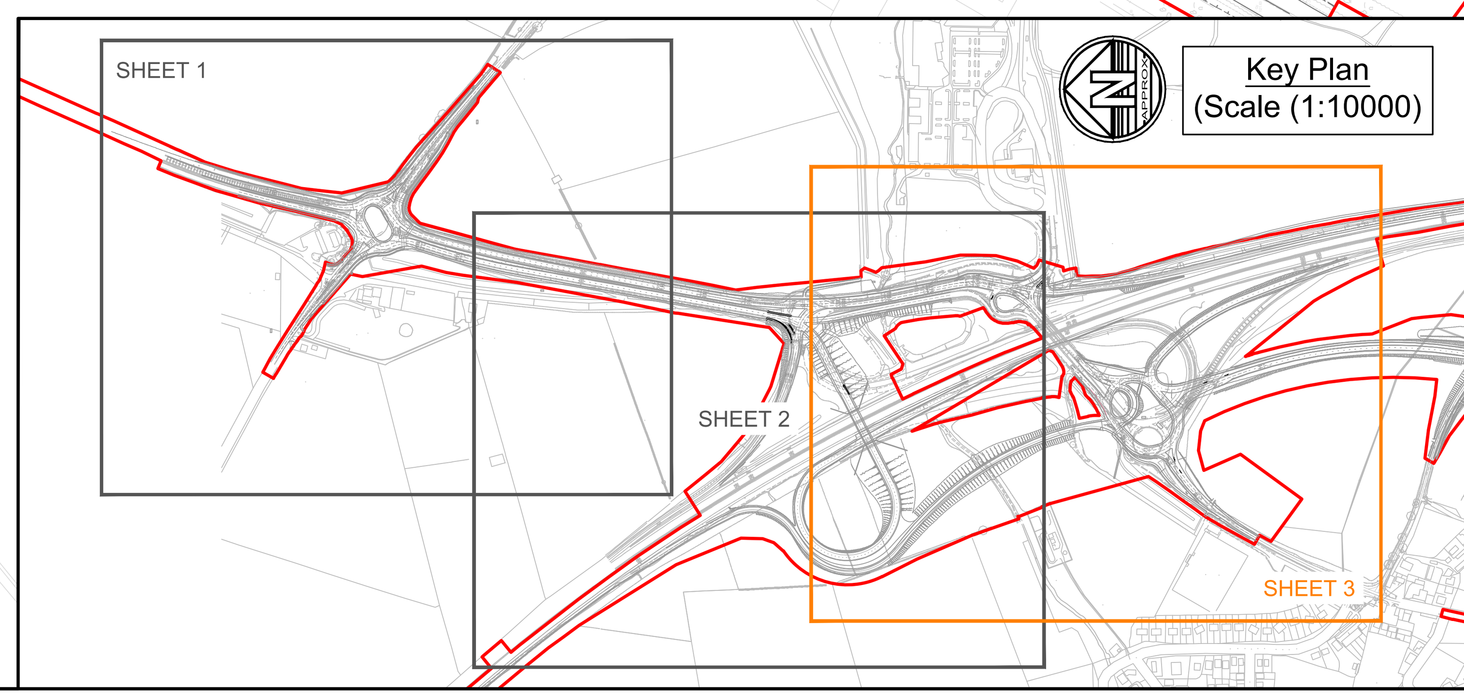

Key Plan
(Scale (1:10000)

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6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Drainage for the proposed highway works is to be split into 6 catchments which each ultimately discharge into the unnamed tributary of Padbury Brook.
9. The widened Baynard's Green roundabout will drain as existing via ditches which will be diverted.
10. Junction 10 of the M40 will be split into 4 basins and a filter drain:
    - The northwest and southwestern basins are new and will drain nearby proposed roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The northeast basin is an existing basin that will be modified by the proposals. It will drain nearby roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The southeast basin is an existing basin which is currently assumed to discharge primarily via infiltration, There is a a weir overflow for extreme events. It is assumed to drain a significant length of the M40 (to be confirmed). It is proposed to add additional area to this basin, and remove part of its existing catchment such that the net change is negligible. Thus no changes are proposed for the basin. Refer to drawing 'OxSRFI-BWB-EWE-ZZ-DR-CD-00516' for more details.
    - Due to level constraints, the eastern junction embankments will be drained via a filter drain located at the toe of the embankment that will drain either via infiltration or to the unnamed tributary of Padbury Brook at 2l/s/ha.
10. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Issues & Revisions

Rev	Date	Details of issue / revision	Drw	Rev
P02	20.02.26	Preliminary issue	TLB	RJ
P01	20.01.26	Draft issue	TLB	RJ

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Project Title
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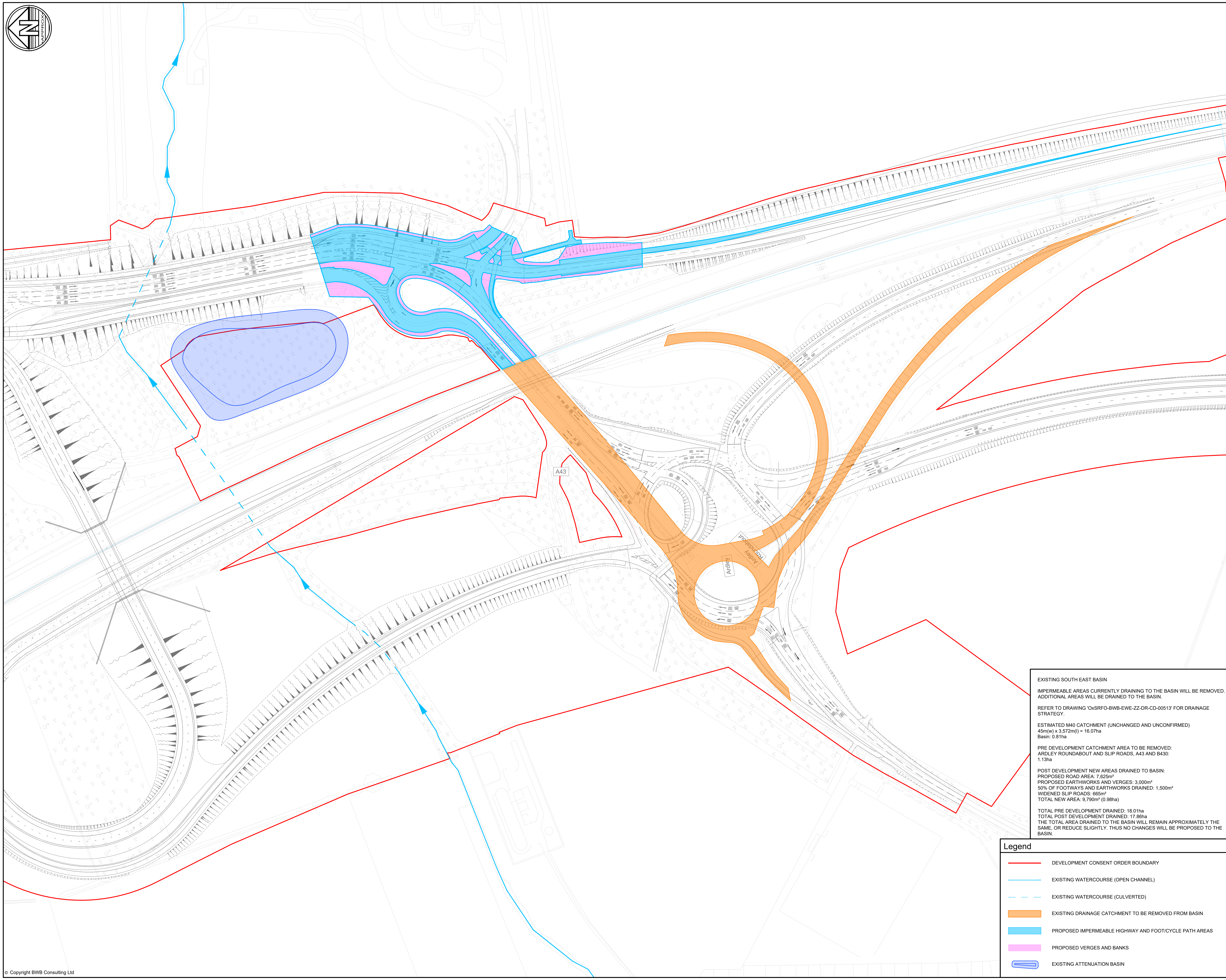
Drawing Title
M40 JUNCTION 10 MODIFICATIONS DRAINAGE STRATEGY (SHEET 3 OF 3)

Drawn:	TLB		Reviewed:	RJ	
BWB Ref:	NTH2479	Date:	20.01.26	Scale@A1:	1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00513	S1	P02



General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on drawings:
OxSRFI-BWB-LSI-01-DR-CH-0101 and
OxSRFI-BWB-LSI-02-DR-CH-0102

EXISTING SOUTH EAST BASIN

IMPERMEABLE AREAS CURRENTLY DRAINING TO THE BASIN WILL BE REMOVED. ADDITIONAL AREAS WILL BE DRAINED TO THE BASIN.

REFER TO DRAWING 'OxSRFO-BWB-EWE-ZZ-DR-CD-00513' FOR DRAINAGE STRATEGY.

ESTIMATED M40 CATCHMENT (UNCHANGED AND UNCONFIRMED)
45m(w) x 3,572m(l) = 16.07ha
Basin: 0.81ha

PRE DEVELOPMENT CATCHMENT AREA TO BE REMOVED:
ARDLEY ROUNDABOUT AND SLIP ROADS, A43 AND B430:
1.13ha

POST DEVELOPMENT NEW AREAS DRAINED TO BASIN:
PROPOSED ROAD AREA: 7,625m²
PROPOSED EARTHWORKS AND VERGES: 3,000m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 1,500m²
WIDENED SLIP ROADS: 665m²
TOTAL NEW AREA: 9,790m² (0.98ha)

TOTAL PRE DEVELOPMENT DRAINED: 18.01ha
TOTAL POST DEVELOPMENT DRAINED: 17.86ha
THE TOTAL AREA DRAINED TO THE BASIN WILL REMAIN APPROXIMATELY THE SAME, OR REDUCE SLIGHTLY. THUS NO CHANGES WILL BE PROPOSED TO THE BASIN.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE (OPEN CHANNEL)
- EXISTING WATERCOURSE (CULVERTED)
- EXISTING DRAINAGE CATCHMENT TO BE REMOVED FROM BASIN
- PROPOSED IMPERMEABLE HIGHWAY AND FOOT/CYCLE PATH AREAS
- PROPOSED VERGES AND BANKS
- EXISTING ATTENUATION BASIN

Rev	Date	Details of issue / revision	Drw	Rev
P01	20.02.26	Preliminary issue	MPB	RJ

Issues & Revisions

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Drawing Title

M40 JUNCTION 10 EXISTING BASIN CATCHMENT TRANSFER PLAN

Drawn:	MPB		Reviewed:	RJ	
BWB Ref:	NTH2479	Date:	20.02.26	Scale@A1:	1:1250

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00514	S1	P01

Appendix 5: M40 Junction 10 Drainage Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	✓
CV	0.900	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Existing Area	2.505	5.00	2.000	8.966	123.773	2.000	0.000
Existing + Proposed Area	3.245	5.00	2.200	8.966	101.075	2.200	0.000

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	x	Starting Level (m)			

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	0	0	0	100	40	0	0
100	25	0	0				

Node Existing Area Online Orifice Control

Flap Valve	x	Invert Level (m)	0.000	Design Flow (l/s)	394.9	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Depth (m)	1.000	Diameter (m)	0.464		

Node Existing + Proposed Area Online Orifice Control

Flap Valve	x	Invert Level (m)	0.000	Design Flow (l/s)	394.9	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Depth (m)	1.000	Diameter (m)	0.464		

Node Existing Area Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	0.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	29

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	659.5	659.5	1.000	659.5	750.5	1.001	0.0	750.5

Node Existing + Proposed Area Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	0.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	39

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	968.9	968.9	1.000	968.9	1079.2	1.001	0.0	1079.2

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	Existing Area	40	0.707	0.707	830.7	484.3047	0.0000	OK
60 minute summer	Existing + Proposed Area	42	0.708	0.708	1076.2	707.0521	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
60 minute summer	Existing Area	Orifice	310.0	871.0
60 minute summer	Existing + Proposed Area	Orifice	310.2	1114.6

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	Existing Area	40	0.889	0.889	1038.4	608.2755	0.0000	OK
60 minute summer	Existing + Proposed Area	42	0.890	0.890	1345.2	888.1582	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
60 minute summer	Existing Area	Orifice	364.2	1090.7
60 minute summer	Existing + Proposed Area	Orifice	364.5	1397.9

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
60 minute summer	Existing Area	41	1.002	1.002	1163.0	684.9292	0.0000	OK
60 minute summer	Existing + Proposed Area	42	1.003	1.003	1506.6	998.9811	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
60 minute summer	Existing Area	Orifice	394.6	1222.3
60 minute summer	Existing + Proposed Area	Orifice	394.7	1567.9

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Northeast Basin	4.406	5.00	111.000		19.538	54.148	2.000	109.000
Northwest Basin	2.740	5.00	110.500		38.598	30.228	1.500	109.000
Southwest Basin	2.390	5.00	110.500		48.014	36.029	1.500	109.000
2			110.500	1200	40.734	33.612	1.650	108.850
3			110.500	1200	42.688	34.797	1.700	108.800
4			110.500	1200	23.633	57.694	1.650	108.850

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Northwest Basin	2	20.000	0.600	109.000	108.850	0.150	133.3	150	5.38	50.0
3.000	Southwest Basin	3	15.000	0.600	109.000	108.800	0.200	75.0	150	5.22	50.0
2.000	Northeast Basin	4	15.000	0.600	109.000	108.850	0.150	100.0	150	5.25	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.868	15.3	693.2	1.350	1.500	2.740	0.0	150	0.885
3.000	1.162	20.5	604.6	1.350	1.550	2.390	0.0	150	1.184
2.000	1.005	17.8	1114.6	1.850	1.500	4.406	0.0	150	1.023

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.000	133.3	150	Circular	110.500	109.000	1.350	110.500	108.850	1.500
3.000	15.000	75.0	150	Circular	110.500	109.000	1.350	110.500	108.800	1.550
2.000	15.000	100.0	150	Circular	111.000	109.000	1.850	110.500	108.850	1.500

Link	US Node	Node Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Northwest Basin	Junction	2	1200	Manhole	Adoptable
3.000	Southwest Basin	Junction	3	1200	Manhole	Adoptable
2.000	Northeast Basin	Junction	4	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Northeast Basin	19.538	54.148	111.000	2.000		0	2.000	109.000	150
Northwest Basin	38.598	30.228	110.500	1.500		0	1.000	109.000	150
Southwest Basin	48.014	36.029	110.500	1.500		0	3.000	109.000	150
2	40.734	33.612	110.500	1.650	1200	1	1.000	108.850	150
3	42.688	34.797	110.500	1.700	1200	1	3.000	108.800	150
4	23.633	57.694	110.500	1.650	1200	1	2.000	108.850	150

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m^3/ha)	20.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	x	Starting Level (m)			

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	25	0	0	100	40	0	0

Node Northeast Basin Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	109.000	Min Outlet Diameter (m)	0.145
Downstream Link	2.000	Design Depth (m)	1.800	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	8.8	Orifice Diameter (m)	0.118

Node Northwest Basin Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	109.000	Min Outlet Diameter (m)	0.145
Downstream Link	1.000	Design Depth (m)	1.200	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	5.5	Orifice Diameter (m)	0.100

Node Southwest Basin Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	109.000	Min Outlet Diameter (m)	0.095
Downstream Link	3.000	Design Depth (m)	1.200	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	4.8	Orifice Diameter (m)	0.094

Node Northeast Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	108.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1501.0	1501.0	2.100	3300.0	3335.3

Node Northwest Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	109.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1701.0	1701.0	1.500	2832.0	2859.5

Node Southwest Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	109.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1567.0	1567.0	1.500	2613.0	2640.4

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.96%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Northeast Basin	1440	110.563	1.563	120.4	3594.0750	0.0000	SURCHARGED
2160 minute winter	Northwest Basin	2100	110.052	1.052	52.9	2244.3490	0.0000	SURCHARGED
2160 minute winter	Southwest Basin	2100	110.005	1.005	46.1	1959.6600	0.0000	SURCHARGED
8640 minute winter	2	3840	108.912	0.062	5.5	0.0000	0.0000	OK
15 minute summer	3	44	108.849	0.049	4.8	0.0000	0.0000	OK
60 minute winter	4	32	108.924	0.074	8.8	0.0000	0.0000	OK

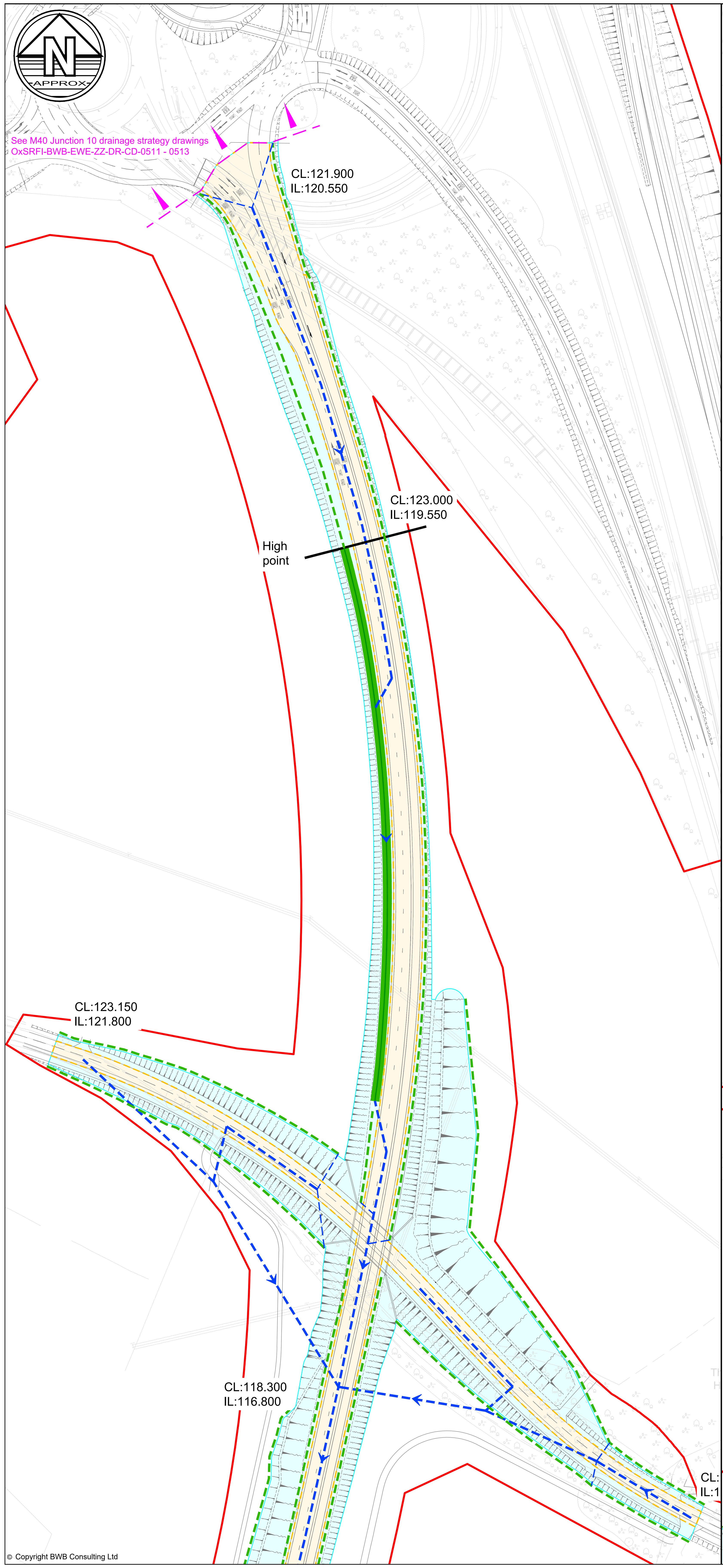
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	Northeast Basin	2.000	4	8.8	0.993	0.496	0.1329	661.2
2160 minute winter	Northwest Basin	1.000	2	5.5	0.795	0.358	0.1383	569.9
2160 minute winter	Southwest Basin	3.000	3	4.8	0.942	0.234	0.0764	494.2

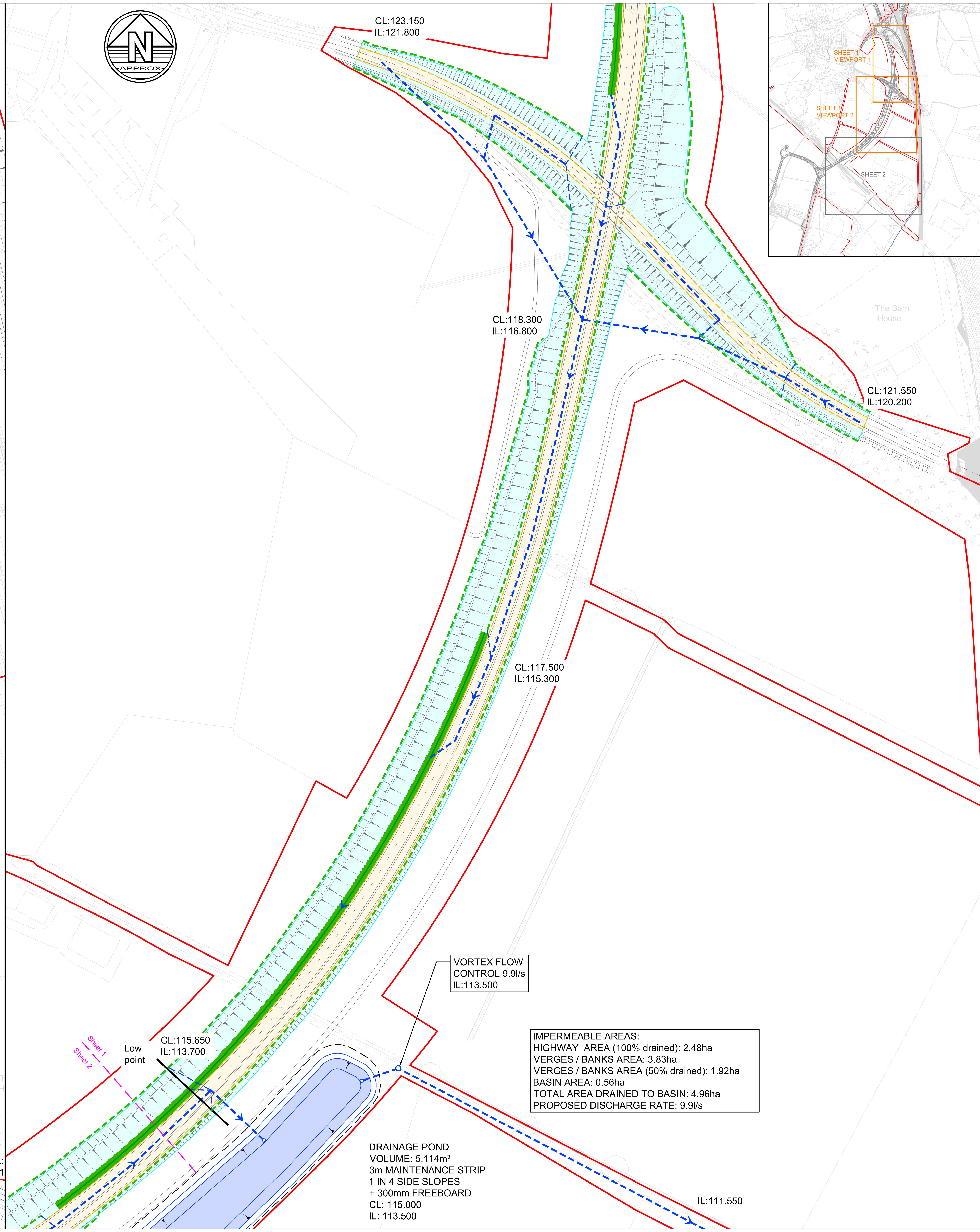
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	Northeast Basin	2100	110.725	1.725	95.2	4086.1400	0.0000	FLOOD RISK
2160 minute winter	Northwest Basin	2100	110.170	1.170	59.2	2549.2400	0.0000	SURCHARGED
2160 minute winter	Southwest Basin	2100	110.119	1.119	51.7	2226.7480	0.0000	SURCHARGED
960 minute winter	2	405	108.912	0.062	5.5	0.0000	0.0000	OK
180 minute winter	3	88	108.849	0.049	4.8	0.0000	0.0000	OK
30 minute summer	4	18	108.924	0.074	8.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute winter	Northeast Basin	2.000	4	8.8	0.993	0.496	0.1329	971.5
2160 minute winter	Northwest Basin	1.000	2	5.5	0.795	0.358	0.1383	596.1
2160 minute winter	Southwest Basin	3.000	3	4.8	0.942	0.234	0.0764	516.5

Appendix 6: Ardley Bypass Drainage Drawings





IMPERMEABLE AREAS:
HIGHWAY AREA (100% drained): 2.48ha
VERGES / BANKS AREA: 3.83ha
VERGES / BANKS AREA (50% drained): 1.92ha
BASIN AREA: 0.56ha
TOTAL AREA DRAINED TO BASIN: 4.96ha
PROPOSED DISCHARGE RATE: 9.9l/s

General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-02-DR-CH-102_S3_P03 and OxSRFI-BWB-LSI-03-DR-CH-103_S3_P03

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 25% critical storm event, with a sensitivity test undertaken using the 1 in 100-year + 40% critical storm to ensure that the basins have sufficient capacity to accommodate the additional volume during this event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
- PROPOSED SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P02	20.02.26	Drainage adjusted to latest highway arrangement	TLB	RJ
P01	23.03.23	Issued for comment	LDR	DG

Issues & Revisions

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OXFORDSHIRE RAILFREIGHT LTD.

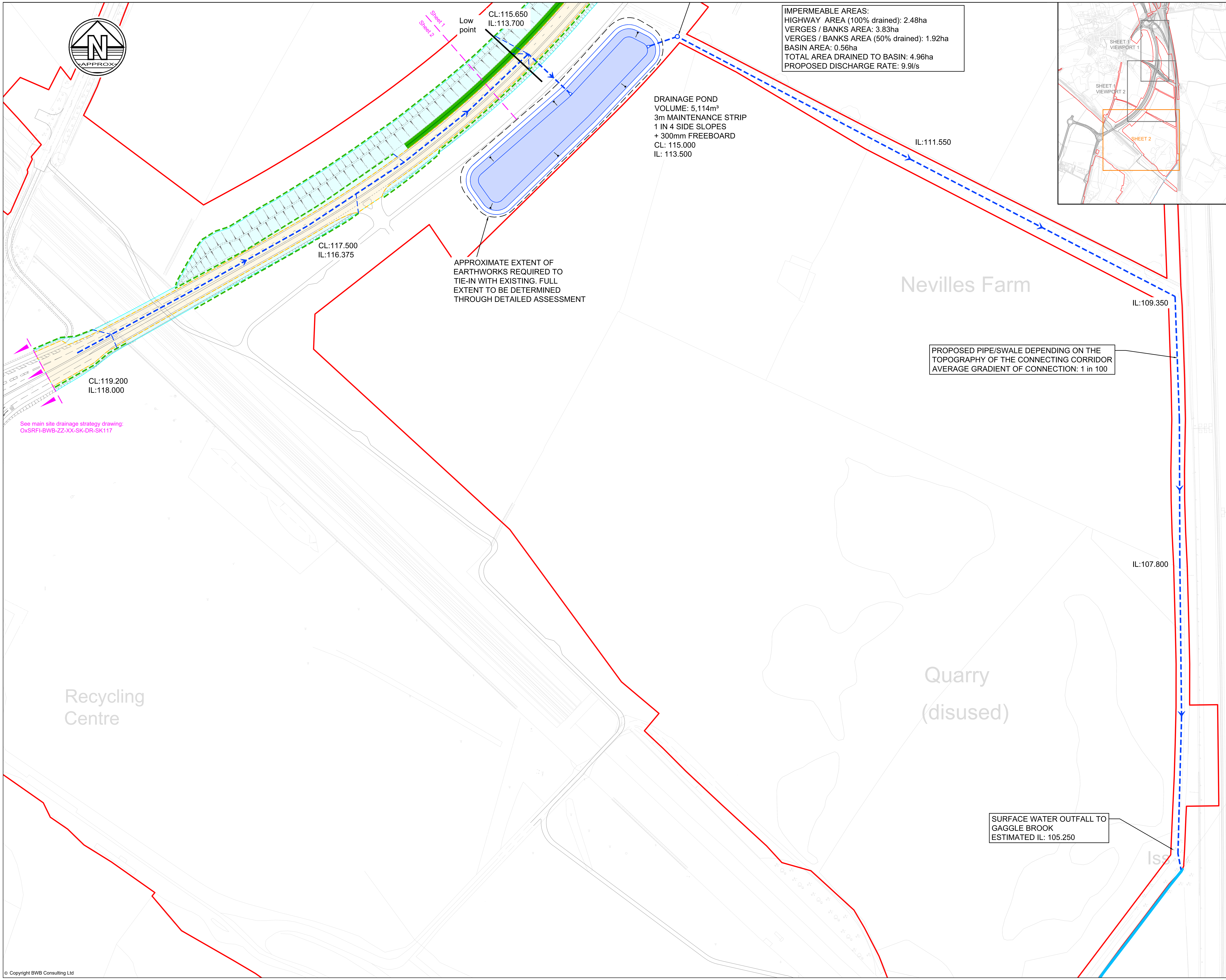
Project Title
OxSRFI
OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title
ARDLEY BYPASS ROAD DRAINAGE STRATEGY SHEET 1

Drawn:	LDR		Reviewed:	DG	
BWB Ref:	NTH2479	Date:	23.03.23	Scale@A1:	1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00506	S1	P02



General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-02-DR-CH-102_S3_P03 and OxSRFI-BWB-LSI-03-DR-CH-103_S3_P03

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 25% critical storm event, with a sensitivity test undertaken using the 1 in 100-year + 40% critical storm to ensure that the basins have sufficient capacity to accommodate the additional volume during this event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
- PROPOSED SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P02	20.02.26	Drainage adjusted to latest highway arrangement	TLB	RJ
P01	23.03.23	Issued for comment	LDR	DG

Issues & Revisions

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Client

OXFORDSHIRE RAILFREIGHT LTD.

Project Title

OxSRFI
OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

ARDLEY BYPASS ROAD DRAINAGE STRATEGY SHEET 2

Drawn:	LR	Reviewed:	DG
BWB Ref:	NTH2479	Date:	23.03.23
Scale@A1:	1:1250		

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00507	S1	P02

Appendix 7: Ardley Bypass Drainage Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	✓
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Pond	4.960	5.00	115.000	20.816	32.824	1.500	113.500

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	x	Starting Level (m)			

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	25	0	0	100	40	0	0

Node Pond Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	113.500	Design Flow (l/s)	9.9	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Depth (m)	1.200	Min Outlet Diameter (m)	0.145	Orifice Diameter (m)	0.130

Node Pond Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	113.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	3370.0	3370.0	1.500	5600.0	5627.8

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	Pond	2100	114.471	0.971	96.0	4037.9230	0.0000	OK

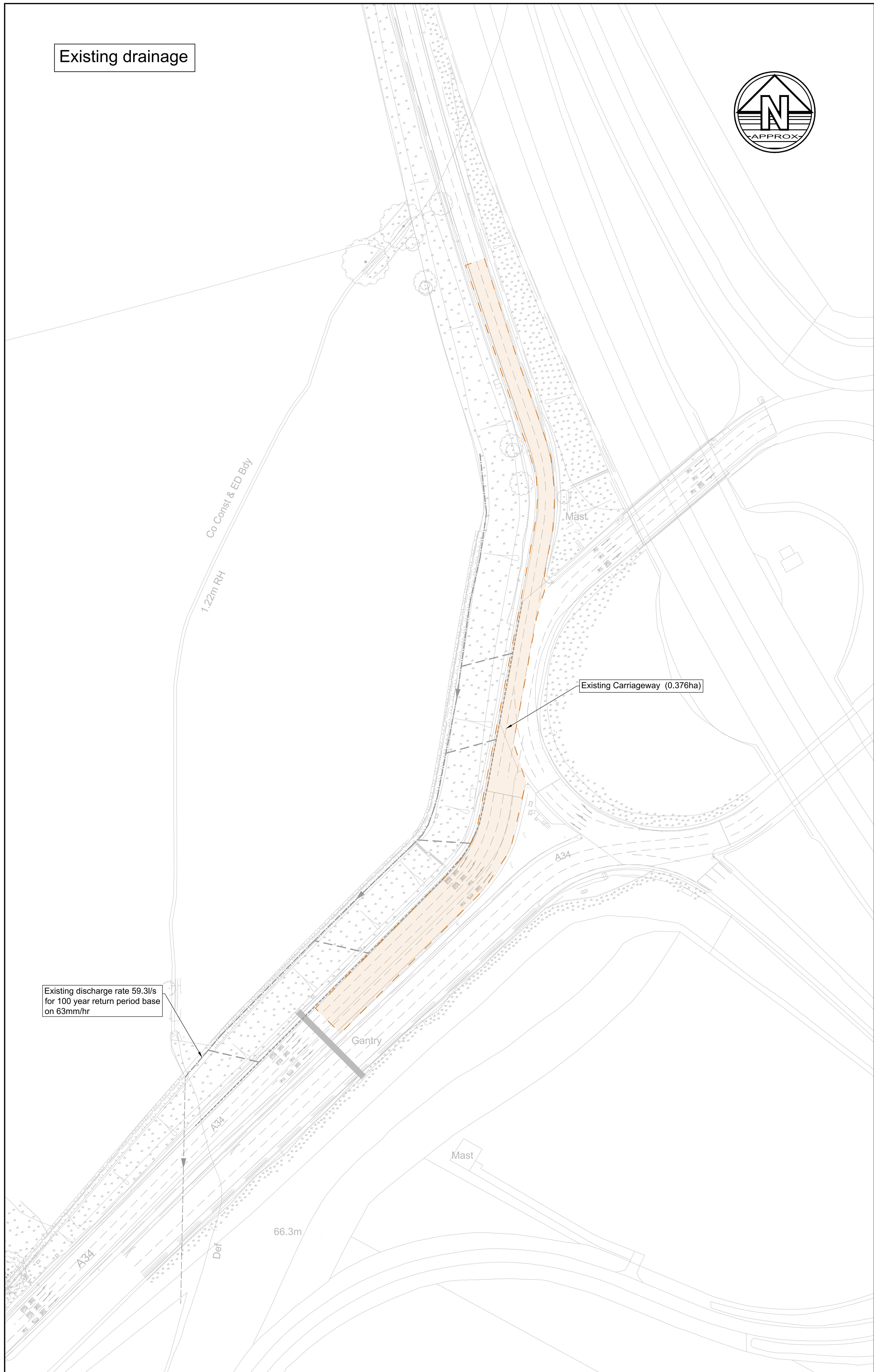
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2160 minute winter	Pond	ACO Q-Brake	9.9	1064.9

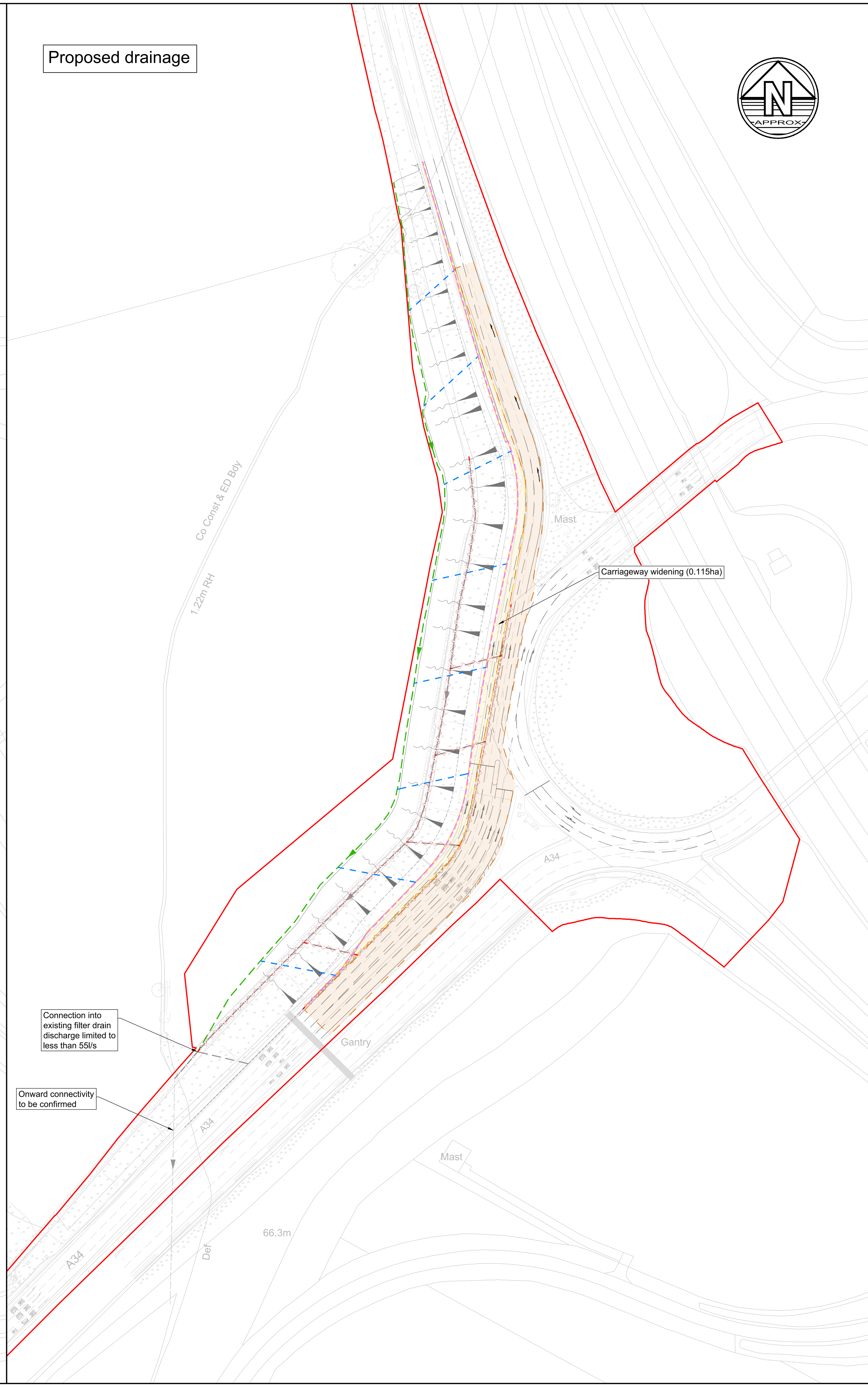
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	Pond	2100	114.584	1.084	107.5	4597.2430	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2160 minute winter	Pond	ACO Q-Brake	9.9	1107.9

Appendix 8: M40 Junction 9 Drainage Drawings





General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on drawings: OxSRFI-BWB-LSI-01-DR-CH-0101 and OxSRFI-BWB-LSI-02-DR-CH-0102

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
2. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
3. Existing discharge rate calculated using the modified rational method:
   2.78 x Imp Area (ha) x Rainfall (mm) x C = Q(l/s)
   2.78 x 0.376ha x 63mm/h x 0.9 = **59.3l/s**

Legend

DEVELOPMENT CONSENT ORDER BOUNDARY

EXISTING
- KERB DRAIN
- FILTER DRAIN
- SURFACE WATER OUTLET

PROPOSED
- EXISTING DRAINAGE TO BE REMOVED
- KERB DRAIN
- FILTER DRAIN
- SURFACE WATER PIPES AND DRAINS
- NEW IMPERMEABLE HIGHWAY AREA
- EXISTING IMPERMEABLE HIGHWAY AREA

Rev	Date	Details of issue / revision	Drw	Rev
P03	20.02.26	Updated to Calculations	GSL	RJ
P02	27.01.26	Updated inline with latest proposals	TLB	RJ
P01	13.03.23	Preliminary Issue	LDR	RJ

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Client

OXFORDSHIRE RAILFREIGHT LTD

Project Title

OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

M40 JUNCTION 9 MODIFICATIONS DRAINAGE STRATEGY

Drawn:	L. Ream	Reviewed:	R. Jobling
BWB Ref:	NTH 2479	Date: 13/03/23	Scale@A1: 1:1000

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSFRI-BWB-EWE-ZZ-DR-CD-00510	S1	P03

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Appendix 9: M40 Junction 9 Drainage Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.900
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	0.60	Enforce best practice design rules	x
CV	0.750	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
1		5.00	67.300	1200	455140.097	219396.965	1.050	66.250
2	0.037	5.00	74.000	1200	455166.808	219360.934	1.050	72.950
3			67.500	1200	455147.436	219343.625	1.446	66.054
4	0.046	5.00	75.200	1200	455176.384	219324.782	1.050	74.150
5			68.000	1200	455153.359	219303.012	2.170	65.830
6	0.054	5.00	75.900	1200	455190.117	219285.417	1.050	74.850
7			68.200	1200	455162.687	219271.549	2.441	65.759
8	0.029	5.00	76.200	1200	455188.378	219238.486	1.050	75.150
9			68.300	1200	455157.337	219231.307	2.629	65.671
10	0.026	5.00	75.800	1200	455180.130	219196.484	1.050	74.750
11			68.200	1200	455149.734	219188.882	2.697	65.503
12	0.062	5.00	75.300	1200	455172.624	219152.381	1.050	74.250
13			67.800	1200	455142.536	219144.569	2.365	65.435
14	0.114	5.00	74.800	1200	455151.645	219106.495	1.050	73.750
15			67.300	1350	455118.306	219111.622	2.002	65.298
16	0.124	5.00	74.000	1200	455116.926	219067.312	1.050	72.950
17			66.500	1350	455085.428	219073.260	1.275	65.225
18			66.200	1350	455059.633	219035.498	1.275	64.925
19			66.000	1350	455049.952	219024.501	1.600	64.400
20			66.000	1350	455048.282	218929.780	2.000	64.000

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	3	53.843	0.600	66.250	66.054	0.196	274.7	150	6.49	50.0
2.000	2	3	25.978	0.600	72.950	66.450	6.500	4.0	150	5.09	50.0
1.001	3	5	41.043	0.600	66.054	65.905	0.149	275.5	150	7.63	50.0
3.000	4	5	31.687	0.600	74.150	66.950	7.200	4.4	150	5.11	50.0
1.002	5	7	32.817	0.600	65.830	65.759	0.071	462.2	225	8.54	50.0
4.000	6	7	30.736	0.600	74.850	67.150	7.700	4.0	150	5.10	50.0
1.003	7	9	40.596	0.600	65.759	65.671	0.088	461.3	225	9.66	50.0
5.000	8	9	31.860	0.600	75.150	67.250	7.900	4.0	150	5.11	50.0
1.004	9	11	43.101	0.600	65.671	65.578	0.093	463.5	300	10.66	50.0
6.000	10	11	31.332	0.600	74.750	67.150	7.600	4.1	150	5.10	50.0
1.005	11	13	44.894	0.600	65.503	65.435	0.068	660.2	300	11.90	50.0
7.000	12	13	31.086	0.600	74.250	66.750	7.500	4.1	150	5.10	50.0
1.006	13	15	40.897	0.600	65.435	65.373	0.062	659.6	375	12.87	50.0
8.000	14	15	33.731	0.600	73.750	66.250	7.500	4.5	150	5.12	50.0
1.007	15	17	50.523	0.600	65.298	65.225	0.073	692.1	375	14.11	47.8
9.000	16	17	32.055	0.600	72.950	65.450	7.500	4.3	150	5.11	50.0
1.008	17	18	45.736	0.600	65.225	64.925	0.300	152.5	375	14.63	46.8
1.009	18	19	14.658	0.600	64.925	64.725	0.200	73.3	375	14.74	46.6
1.010	19	20	94.736	0.600	64.400	64.000	0.400	236.8	375	16.09	42.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.601	10.6	0.0	0.900	1.296	0.000	0.0	0	0.000
2.000	5.076	89.7	5.0	0.900	0.900	0.037	0.0	24	2.728
1.001	0.601	10.6	5.0	1.296	1.945	0.037	0.0	72	0.591
3.000	4.837	85.5	6.2	0.900	0.900	0.046	0.0	27	2.828
1.002	0.602	23.9	11.2	1.945	2.216	0.082	0.0	108	0.590
4.000	5.079	89.8	7.3	0.900	0.900	0.054	0.0	29	3.084
1.003	0.602	23.9	18.4	2.216	2.404	0.136	0.0	148	0.662
5.000	5.053	89.3	4.0	0.900	0.900	0.029	0.0	21	2.545
1.004	0.724	51.1	22.4	2.329	2.322	0.165	0.0	174	0.681
6.000	4.998	88.3	3.6	0.900	0.900	0.026	0.0	21	2.474
1.005	0.604	42.7	26.0	2.397	2.065	0.192	0.0	169	0.633
7.000	4.985	88.1	8.4	0.900	0.900	0.062	0.0	31	3.169
1.006	0.698	77.1	34.4	1.990	1.552	0.254	0.0	204	0.670
8.000	4.785	84.6	15.5	0.900	0.900	0.114	0.0	43	3.645
1.007	0.681	75.2	47.7	1.627	0.900	0.368	0.0	215	0.717
9.000	4.908	86.7	16.7	0.900	0.900	0.124	0.0	45	3.822
1.008	1.465	161.8	62.4	0.900	0.900	0.492	0.0	160	1.368
1.009	2.118	233.9	62.1	0.900	0.900	0.492	0.0	130	1.791
1.010	1.173	129.5	56.8	1.225	1.625	0.492	0.0	173	1.134

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	53.843	274.7	150	Circular	67.300	66.250	0.900	67.500	66.054	1.296
2.000	25.978	4.0	150	Circular	74.000	72.950	0.900	67.500	66.450	0.900
1.001	41.043	275.5	150	Circular	67.500	66.054	1.296	68.000	65.905	1.945
3.000	31.687	4.4	150	Circular	75.200	74.150	0.900	68.000	66.950	0.900
1.002	32.817	462.2	225	Circular	68.000	65.830	1.945	68.200	65.759	2.216
4.000	30.736	4.0	150	Circular	75.900	74.850	0.900	68.200	67.150	0.900
1.003	40.596	461.3	225	Circular	68.200	65.759	2.216	68.300	65.671	2.404
5.000	31.860	4.0	150	Circular	76.200	75.150	0.900	68.300	67.250	0.900
1.004	43.101	463.5	300	Circular	68.300	65.671	2.329	68.200	65.578	2.322
6.000	31.332	4.1	150	Circular	75.800	74.750	0.900	68.200	67.150	0.900
1.005	44.894	660.2	300	Circular	68.200	65.503	2.397	67.800	65.435	2.065
7.000	31.086	4.1	150	Circular	75.300	74.250	0.900	67.800	66.750	0.900
1.006	40.897	659.6	375	Circular	67.800	65.435	1.990	67.300	65.373	1.552
8.000	33.731	4.5	150	Circular	74.800	73.750	0.900	67.300	66.250	0.900
1.007	50.523	692.1	375	Circular	67.300	65.298	1.627	66.500	65.225	0.900
9.000	32.055	4.3	150	Circular	74.000	72.950	0.900	66.500	65.450	0.900
1.008	45.736	152.5	375	Circular	66.500	65.225	0.900	66.200	64.925	0.900
1.009	14.658	73.3	375	Circular	66.200	64.925	0.900	66.000	64.725	0.900
1.010	94.736	236.8	375	Circular	66.000	64.400	1.225	66.000	64.000	1.625

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	3	1200	Junction	
2.000	2	1200	Junction		3	1200	Junction	
1.001	3	1200	Junction		5	1200	Junction	
3.000	4	1200	Junction		5	1200	Junction	
1.002	5	1200	Junction		7	1200	Junction	
4.000	6	1200	Junction		7	1200	Junction	
1.003	7	1200	Junction		9	1200	Junction	
5.000	8	1200	Junction		9	1200	Junction	
1.004	9	1200	Junction		11	1200	Junction	
6.000	10	1200	Junction		11	1200	Junction	
1.005	11	1200	Junction		13	1200	Junction	
7.000	12	1200	Junction		13	1200	Junction	
1.006	13	1200	Junction		15	1350	Junction	
8.000	14	1200	Junction		15	1350	Junction	
1.007	15	1350	Junction		17	1350	Junction	
9.000	16	1200	Junction		17	1350	Junction	
1.008	17	1350	Junction		18	1350	Junction	
1.009	18	1350	Junction		19	1350	Manhole	Adoptable
1.010	19	1350	Manhole	Adoptable	20	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	455140.097	219396.965	67.300	1.050	1200	0	1.000	66.250	150
2	455166.808	219360.934	74.000	1.050	1200	0	2.000	72.950	150
3	455147.436	219343.625	67.500	1.446	1200	1	2.000	66.450	150
						2	1.000	66.054	150
						0	1.001	66.054	150
4	455176.384	219324.782	75.200	1.050	1200	0	3.000	74.150	150
5	455153.359	219303.012	68.000	2.170	1200	1	3.000	66.950	150
						2	1.001	65.905	150
						0	1.002	65.830	225
6	455190.117	219285.417	75.900	1.050	1200	0	4.000	74.850	150
7	455162.687	219271.549	68.200	2.441	1200	1	4.000	67.150	150
						2	1.002	65.759	225
						0	1.003	65.759	225
8	455188.378	219238.486	76.200	1.050	1200	0	5.000	75.150	150
9	455157.337	219231.307	68.300	2.629	1200	1	5.000	67.250	150
						2	1.003	65.671	225
						0	1.004	65.671	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
10	455180.130	219196.484	75.800	1.050	1200	0	6.000	74.750	150
11	455149.734	219188.882	68.200	2.697	1200	1	6.000	67.150	150
						2	1.004	65.578	300
						0	1.005	65.503	300
12	455172.624	219152.381	75.300	1.050	1200	0	7.000	74.250	150
13	455142.536	219144.569	67.800	2.365	1200	1	7.000	66.750	150
						2	1.005	65.435	300
						0	1.006	65.435	375
14	455151.645	219106.495	74.800	1.050	1200	0	8.000	73.750	150
15	455118.306	219111.622	67.300	2.002	1350	1	8.000	66.250	150
						2	1.006	65.373	375
						0	1.007	65.298	375
16	455116.926	219067.312	74.000	1.050	1200	0	9.000	72.950	150
17	455085.428	219073.260	66.500	1.275	1350	1	9.000	65.450	150
						2	1.007	65.225	375
						0	1.008	65.225	375
18	455059.633	219035.498	66.200	1.275	1350	1	1.008	64.925	375
						0	1.009	64.925	375
19	455049.952	219024.501	66.000	1.600	1350	1	1.009	64.725	375
						0	1.010	64.400	375
20	455048.282	218929.780	66.000	2.000	1350	1	1.010	64.000	375

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	360	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	✓	Starting Level (m)			

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	0	0	0	100	40	0	0
100	25	0	0				

Node 18 Online Orifice Control

Flap Valve	x	Invert Level (m)	64.925	Design Flow (l/s)	50.0	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Depth (m)	1.100	Diameter (m)	0.155		

Node 15 Online Orifice Control

Flap Valve	x	Invert Level (m)	65.298	Design Flow (l/s)	10.0	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Depth (m)	2.000	Diameter (m)	0.120		

Node 5 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.001
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.905	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	53	Diameter (mm)	600

Node 7 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.002
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.759	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	56	Diameter (mm)	600

Node 9 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.003
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.671	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	63	Diameter (mm)	750

Node 11 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.004
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.578	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	61	Diameter (mm)	750

Node 13 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.005
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.435	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	69	Diameter (mm)	750

Node 15 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.006
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.373	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	64	Diameter (mm)	750

Node 17 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.007
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.225	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	22	Diameter (mm)	750

Node 18 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.008
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	64.925	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	40	Diameter (mm)	750

Node 3 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	66.054	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	48	Diameter (mm)	600

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	1	42	66.685	0.435	5.8	0.4917	0.0000	SURCHARGED
15 minute summer	2	10	72.996	0.046	18.3	0.0000	0.0000	OK
30 minute summer	3	26	66.683	0.629	19.7	4.8606	0.0000	SURCHARGED
15 minute summer	4	10	74.203	0.053	22.9	0.0000	0.0000	OK
60 minute summer	5	43	66.674	0.844	23.0	4.9116	0.0000	SURCHARGED
15 minute summer	6	10	74.907	0.057	26.9	0.0000	0.0000	OK
60 minute summer	7	43	66.668	0.909	30.0	4.7708	0.0000	SURCHARGED
15 minute summer	8	10	75.191	0.041	14.8	0.0000	0.0000	OK
60 minute summer	9	43	66.653	0.982	30.6	8.0804	0.0000	SURCHARGED
15 minute summer	10	10	74.789	0.039	13.3	0.0000	0.0000	OK
60 minute summer	11	43	66.647	1.144	26.2	9.0002	0.0000	SURCHARGED
15 minute summer	12	10	74.312	0.062	31.3	0.0000	0.0000	OK
60 minute summer	13	43	66.637	1.202	25.3	10.8466	0.0000	SURCHARGED
15 minute summer	14	10	73.841	0.091	57.2	0.0000	0.0000	OK
60 minute summer	15	43	66.633	1.335	43.1	9.9500	0.0000	SURCHARGED
15 minute summer	16	10	73.044	0.094	62.0	0.0000	0.0000	OK
30 minute summer	17	23	65.791	0.566	69.3	4.3528	0.0000	SURCHARGED
30 minute summer	18	23	65.770	0.845	54.0	5.6332	0.0000	SURCHARGED
30 minute summer	19	24	64.549	0.149	42.9	0.2138	0.0000	OK
30 minute summer	20	24	64.146	0.146	42.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	1	1.000	3	-5.8	-0.385	-0.544	0.9479	
15 minute summer	2	2.000	3	18.3	4.006	0.204	0.1866	
30 minute summer	3	1.001	5	10.3	0.685	0.970	0.7226	
30 minute summer	3	Infiltration		0.2				
15 minute summer	4	3.000	5	22.8	4.113	0.267	0.1759	
60 minute summer	5	1.002	7	15.3	0.512	0.641	1.3052	
60 minute summer	5	Infiltration		0.2				
15 minute summer	6	4.000	7	26.8	4.459	0.299	0.1850	
60 minute summer	7	1.003	9	23.7	0.741	0.988	1.6145	
60 minute summer	7	Infiltration		0.2				
15 minute summer	8	5.000	9	14.7	3.751	0.164	0.1248	
60 minute summer	9	1.004	11	20.9	0.658	0.409	3.0351	
60 minute summer	9	Infiltration		0.3				
15 minute summer	10	6.000	11	13.2	3.609	0.150	0.1147	
60 minute summer	11	1.005	13	18.2	0.448	0.426	3.1614	
60 minute summer	11	Infiltration		0.3				
15 minute summer	12	7.000	13	31.2	4.578	0.354	0.2118	
60 minute summer	13	1.006	15	22.2	0.417	0.288	4.5108	
60 minute summer	13	Infiltration		0.3				
15 minute summer	14	8.000	15	57.0	5.155	0.674	0.4081	
60 minute summer	15	1.007	17	29.5	0.767	0.393	5.5725	
60 minute summer	15	Infiltration		0.3				
15 minute summer	16	9.000	17	61.8	5.352	0.713	0.4362	
30 minute summer	17	1.008	18	54.0	0.651	0.334	5.0445	
30 minute summer	17	Infiltration		0.2				
30 minute summer	18	1.009	19	42.9	1.597	0.183	0.3940	
30 minute summer	18	Infiltration		0.2				
30 minute summer	19	1.010	20	42.9	1.066	0.332	3.8187	133.5

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	1	45	67.040	0.790	6.5	0.8935	0.0000	FLOOD RISK
15 minute summer	2	10	73.002	0.052	22.9	0.0000	0.0000	OK
60 minute summer	3	45	67.040	0.986	22.2	8.3236	0.0000	SURCHARGED
15 minute summer	4	10	74.210	0.060	28.6	0.0000	0.0000	OK
60 minute summer	5	44	67.030	1.200	22.2	7.5442	0.0000	SURCHARGED
15 minute summer	6	10	74.914	0.064	33.7	0.0000	0.0000	OK
60 minute summer	7	44	67.024	1.265	29.3	6.8753	0.0000	SURCHARGED
15 minute summer	8	10	75.196	0.046	18.5	0.0000	0.0000	OK
60 minute summer	9	44	67.007	1.336	27.8	11.3126	0.0000	SURCHARGED
15 minute summer	10	10	74.794	0.044	16.7	0.0000	0.0000	OK
60 minute summer	11	44	67.000	1.497	22.6	12.4306	0.0000	SURCHARGED
15 minute summer	12	10	74.320	0.070	39.1	0.0000	0.0000	OK
60 minute summer	13	44	66.989	1.554	27.4	14.4056	0.0000	SURCHARGED
15 minute summer	14	10	73.856	0.106	71.6	0.0000	0.0000	OK
60 minute summer	15	44	66.984	1.686	49.8	13.1857	0.0000	SURCHARGED
15 minute summer	16	10	73.061	0.111	77.5	0.0000	0.0000	OK
30 minute summer	17	23	66.021	0.796	97.0	6.9601	0.0000	SURCHARGED
30 minute summer	18	23	65.994	1.069	66.7	7.9417	0.0000	FLOOD RISK
30 minute summer	19	24	64.561	0.161	48.8	0.2298	0.0000	OK
30 minute summer	20	24	64.157	0.157	48.9	0.0000	0.0000	OK

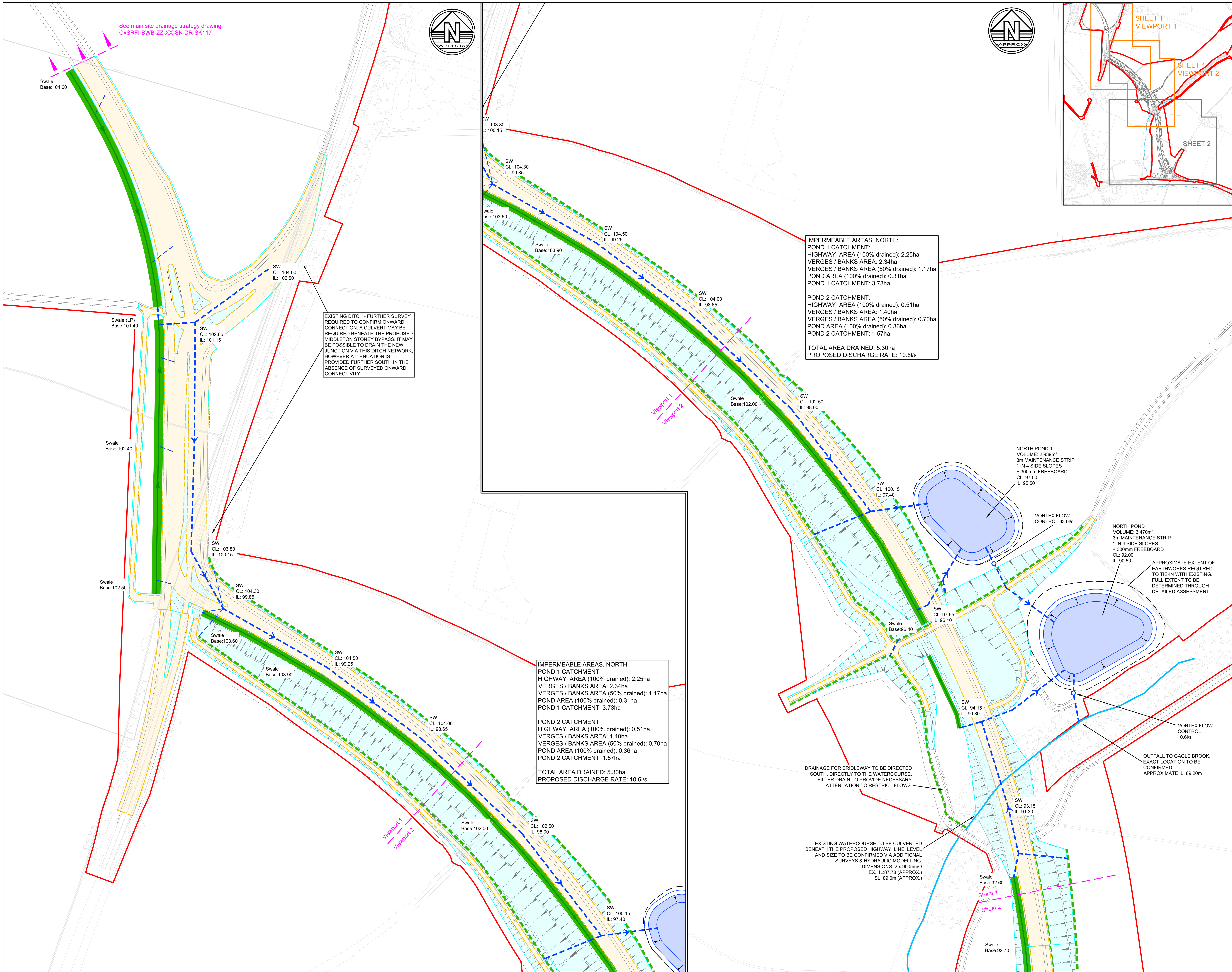
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	1	1.000	3	-6.5	-0.440	-0.615	0.9479	
15 minute summer	2	2.000	3	22.9	4.263	0.255	0.2710	
60 minute summer	3	1.001	5	8.7	0.689	0.821	0.7226	
60 minute summer	3	Infiltration		0.3				
15 minute summer	4	3.000	5	28.5	4.370	0.334	0.2068	
60 minute summer	5	1.002	7	15.7	0.513	0.657	1.3052	
60 minute summer	5	Infiltration		0.3				
15 minute summer	6	4.000	7	33.6	4.736	0.374	0.2180	
60 minute summer	7	1.003	9	21.6	0.716	0.904	1.6145	
60 minute summer	7	Infiltration		0.3				
15 minute summer	8	5.000	9	18.4	3.998	0.206	0.1465	
60 minute summer	9	1.004	11	17.9	0.645	0.350	3.0351	
60 minute summer	9	Infiltration		0.3				
15 minute summer	10	6.000	11	16.6	3.851	0.188	0.1349	
60 minute summer	11	1.005	13	20.7	0.468	0.484	3.1614	
60 minute summer	11	Infiltration		0.4				
15 minute summer	12	7.000	13	39.0	4.854	0.442	0.2495	
60 minute summer	13	1.006	15	25.5	0.397	0.331	4.5108	
60 minute summer	13	Infiltration		0.4				
15 minute summer	14	8.000	15	71.3	5.382	0.843	0.4818	
60 minute summer	15	1.007	17	32.3	0.774	0.429	5.5725	
60 minute summer	15	Infiltration		0.4				
15 minute summer	16	9.000	17	77.2	5.569	0.890	0.4954	
30 minute summer	17	1.008	18	66.7	0.683	0.412	5.0445	
30 minute summer	17	Infiltration		0.3				
30 minute summer	18	1.009	19	48.8	1.653	0.209	0.4332	
30 minute summer	18	Infiltration		0.3				
30 minute summer	19	1.010	20	48.9	1.102	0.377	4.2007	166.2

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	1	46	67.257	1.007	6.2	1.1391	0.0000	FLOOD RISK
15 minute summer	2	10	73.005	0.055	25.7	0.0000	0.0000	OK
60 minute summer	3	45	67.256	1.202	25.3	10.4136	0.0000	FLOOD RISK
15 minute summer	4	10	74.214	0.064	32.1	0.0000	0.0000	OK
60 minute summer	5	45	67.245	1.415	25.5	9.1341	0.0000	SURCHARGED
15 minute summer	6	10	74.918	0.068	37.7	0.0000	0.0000	OK
60 minute summer	7	45	67.239	1.480	29.0	8.1443	0.0000	SURCHARGED
15 minute summer	8	10	75.199	0.049	20.7	0.0000	0.0000	OK
60 minute summer	9	44	67.220	1.549	26.7	13.2638	0.0000	SURCHARGED
15 minute summer	10	10	74.797	0.047	18.6	0.0000	0.0000	OK
60 minute summer	11	44	67.212	1.709	22.9	14.4799	0.0000	SURCHARGED
15 minute summer	12	10	74.325	0.075	43.8	0.0000	0.0000	OK
60 minute summer	13	44	67.202	1.767	33.0	16.5529	0.0000	SURCHARGED
15 minute summer	14	10	73.867	0.117	80.2	0.0000	0.0000	OK
60 minute summer	15	44	67.196	1.898	53.0	15.1322	0.0000	FLOOD RISK
15 minute summer	16	11	73.067	0.117	86.8	0.0000	0.0000	OK
30 minute summer	17	23	66.163	0.938	103.9	8.5667	0.0000	SURCHARGED
30 minute summer	18	23	66.132	1.207	72.1	9.3576	0.0000	FLOOD RISK
30 minute summer	19	24	64.567	0.167	52.2	0.2385	0.0000	OK
30 minute summer	20	24	64.163	0.163	52.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	1	1.000	3	-6.2	-0.439	-0.586	0.9479	
15 minute summer	2	2.000	3	25.7	4.401	0.286	0.2923	
60 minute summer	3	1.001	5	-9.0	0.679	-0.849	0.7226	
60 minute summer	3	Infiltration		0.4				
15 minute summer	4	3.000	5	32.0	4.506	0.374	0.2250	
60 minute summer	5	1.002	7	15.1	0.513	0.630	1.3052	
60 minute summer	5	Infiltration		0.3				
15 minute summer	6	4.000	7	37.6	4.878	0.419	0.2368	
60 minute summer	7	1.003	9	20.8	0.701	0.867	1.6145	
60 minute summer	7	Infiltration		0.3				
15 minute summer	8	5.000	9	20.7	4.129	0.231	0.1594	
60 minute summer	9	1.004	11	17.0	0.651	0.333	3.0351	
60 minute summer	9	Infiltration		0.4				
15 minute summer	10	6.000	11	18.5	3.971	0.209	0.1459	
60 minute summer	11	1.005	13	21.6	0.478	0.506	3.1614	
60 minute summer	11	Infiltration		0.4				
15 minute summer	12	7.000	13	43.6	4.996	0.495	0.3319	
60 minute summer	13	1.006	15	27.5	0.388	0.357	4.5108	
60 minute summer	13	Infiltration		0.5				
15 minute summer	14	8.000	15	79.8	5.458	0.944	0.5335	
60 minute summer	15	1.007	17	33.2	0.777	0.441	5.5725	
60 minute summer	15	Infiltration		0.4				
15 minute summer	16	9.000	17	86.4	5.589	0.996	0.5178	
30 minute summer	17	1.008	18	72.1	0.698	0.446	5.0445	
30 minute summer	17	Infiltration		0.3				
30 minute summer	18	1.009	19	52.2	1.682	0.223	0.4548	
30 minute summer	18	Infiltration		0.3				
30 minute summer	19	1.010	20	52.2	1.121	0.403	4.4103	186.0

Appendix 10: Middleton Stoney Relief Road Drainage Drawings



General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-05-DR-CH-105_S3_P03

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle Paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 25% critical storm event, with a sensitivity test undertaken using the 1 in 100-year + 40% critical storm to ensure that the basins have sufficient capacity to accommodate the additional volume during this event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
- INDICATIVE SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P03	20.02.26	Updated to latest highways proposals	TLB	RJ
P02	25.01.23	Updated to latest highways proposals	RJ	CD
P01	09.11.21	Preliminary issue	RJ	CD

Issues & Revisions

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Client

OXFORDSHIRE RAILFREIGHT LTD.

Project Title

OxSRFI
OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

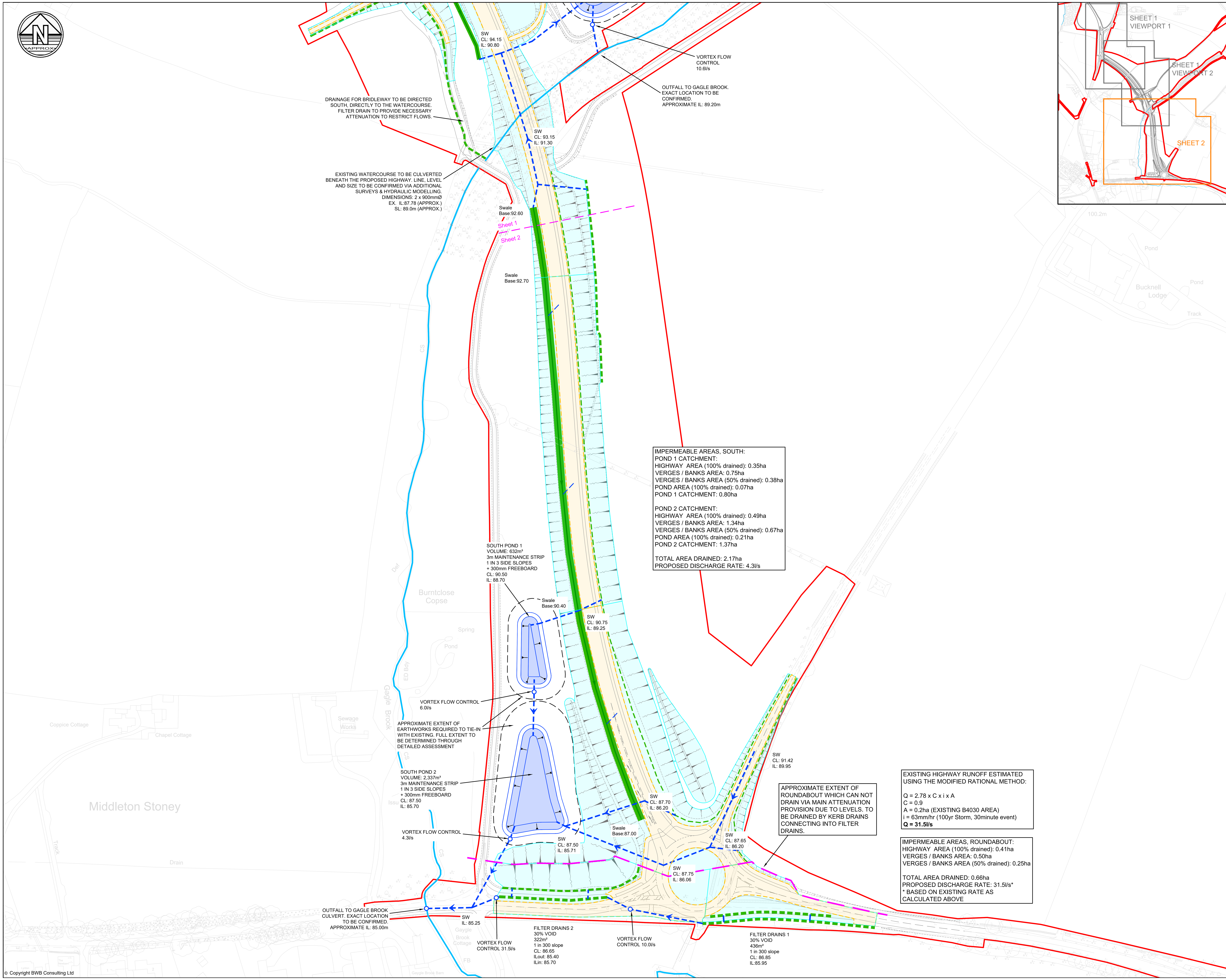
MIDDLETON STONEY RELIEF ROAD DRAINAGE STRATEGY (SHEET 1 OF 2)

Drawn:	RJ			Reviewed:	CD
BWB Ref:	NTH2479	Date:	21.01.26	Scale@A1:	1:1250

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00503	**S1**	**P03**



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6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-05-DR-CH-105_S3_P03

Drainage Notes

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   - Highways and Foot/Cycle Paths = 100%
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3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 25% critical storm event, with a sensitivity test undertaken using the 1 in 100-year + 40% critical storm to ensure that the basins have sufficient capacity to accommodate the additional volume during this event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
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Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
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- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P03	20.02.26	Updated to latest highways proposals	TLB	RJ
P02	25.01.23	Updated to latest highways proposals	RJ	CD
P01	21.01.26	Preliminary issue	TLB	RJ

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OxSRFI
OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

MIDDLETON STONEY RELIEF ROAD DRAINAGE STRATEGY (SHEET 2 OF 2)

Drawn:	TLB	Reviewed:	RJ
BWB Ref:	NTH2479	Date:	21.01.26
Scale@A1:	1:1250		

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00519	S1	P03

Appendix 11: Middleton Stoney Relief Road Drainage Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
North Pond 1	3.730	5.00	97.000		-36.631	79.922	1.500	95.500
North Pond 2	1.570	5.00	92.000		-29.443	70.549	1.500	90.500
South Pond 1	0.800	5.00	90.500		-36.169	20.114	1.800	88.700
South Pond 2	1.370	5.00	87.500		-35.828	10.143	1.800	85.700
1			86.500		-40.984	2.606	1.250	85.250
Filter Drain 1	0.240	5.00	86.850		-20.239	1.347	0.900	85.950
Filter Drain 2	0.410	5.00	86.650		-35.048	3.269	1.250	85.400
2			86.500	1200	-44.494	2.460	1.500	85.000

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	South Pond 1	South Pond 2	35.000	0.600	88.700	85.700	3.000	11.7	150	5.20	50.0
2.001_1	South Pond 2	1	67.700	0.600	85.700	85.250	0.450	150.4	150	6.58	50.0
3.000_1	North Pond 1	North Pond 2	75.000	0.600	95.500	90.500	5.000	15.0	300	5.31	50.0
3.000	Filter Drain 1	Filter Drain 2	100.000	0.600	85.950	85.700	0.250	400.0	300	7.14	50.0
2.001	Filter Drain 2	1	22.000	0.600	85.400	85.250	0.150	146.7	300	7.42	50.0
1.002	1	2	33.500	0.600	85.250	85.000	0.250	134.0	300	7.83	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	2.966	52.4	202.4	1.650	1.650	0.800	0.0	150	3.021
2.001_1	0.817	14.4	549.0	1.650	1.100	2.170	0.0	150	0.832
3.000_1	4.079	288.3	943.6	1.200	1.200	3.730	0.0	300	4.131
3.000	0.780	55.1	60.7	0.600	0.650	0.240	0.0	300	0.790
2.001	1.296	91.6	164.4	0.950	0.950	0.650	0.0	300	1.312
1.002	1.356	95.9	713.4	0.950	1.200	2.820	0.0	300	1.374

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.000	35.000	11.7	150	Circular	90.500	88.700	1.650	87.500	85.700	1.650
2.001_1	67.700	150.4	150	Circular	87.500	85.700	1.650	86.500	85.250	1.100
3.000_1	75.000	15.0	300	Circular	97.000	95.500	1.200	92.000	90.500	1.200
3.000	100.000	400.0	300	Circular	86.850	85.950	0.600	86.650	85.700	0.650
2.001	22.000	146.7	300	Circular	86.650	85.400	0.950	86.500	85.250	0.950
1.002	33.500	134.0	300	Circular	86.500	85.250	0.950	86.500	85.000	1.200

Link	US Node	Node Type	DS Node	Dia (mm)	Node Type	MH Type
2.000	South Pond 1	Junction	South Pond 2		Junction	
2.001_1	South Pond 2	Junction	1		Junction	
3.000_1	North Pond 1	Junction	North Pond 2		Junction	
3.000	Filter Drain 1	Junction	Filter Drain 2		Junction	
2.001	Filter Drain 2	Junction	1		Junction	
1.002	1	Junction	2	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
North Pond 1	-36.631	79.922	97.000	1.500		0	3.000_1	95.500	300
North Pond 2	-29.443	70.549	92.000	1.500		1	3.000_1	90.500	300
South Pond 1	-36.169	20.114	90.500	1.800		0	2.000	88.700	150
South Pond 2	-35.828	10.143	87.500	1.800		1	2.000	85.700	150
						0	2.001_1	85.700	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	-40.984	2.606	86.500	1.250		1	2.001_1	85.250	150
						2	2.001	85.250	300
						0	1.002	85.250	300
Filter Drain 1	-20.239	1.347	86.850	0.900		0	3.000	85.950	300
Filter Drain 2	-35.048	3.269	86.650	1.250		1	3.000	85.700	300
						0	2.001	85.400	300
2	-44.494	2.460	86.500	1.500	1200	1	1.002	85.000	300

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	x	Starting Level (m)			

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	0	0	0	100	40	0	0
100	25	0	0				

Node North Pond 2 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	90.500	Design Flow (l/s)	10.6	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Depth (m)	1.200	Min Outlet Diameter (m)	0.145	Orifice Diameter (m)	0.135

Node South Pond 2 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	85.700	Min Outlet Diameter (m)	0.095
Downstream Link	2.001_1	Design Depth (m)	1.500	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	4.3	Orifice Diameter (m)	0.087

Node South Pond 1 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	88.700	Min Outlet Diameter (m)	0.145
Downstream Link	2.000	Design Depth (m)	1.500	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	6.0	Orifice Diameter (m)	0.101

Node North Pond 1 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	95.500	Min Outlet Diameter (m)	0.295
Downstream Link	3.000_1	Design Depth (m)	1.200	Min Node Diameter (mm)	1200
Replaces Downstream Link	x	Design Flow (l/s)	33.0	Orifice Diameter (m)	0.224

Node Filter Drain 2 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	85.400	Min Outlet Diameter (m)	0.220
Downstream Link	2.001	Design Depth (m)	1.250	Min Node Diameter (mm)	1200
Replaces Downstream Link	x	Design Flow (l/s)	31.5	Orifice Diameter (m)	0.219

Node Filter Drain 1 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	85.950	Min Outlet Diameter (m)	0.145
Downstream Link	3.000	Design Depth (m)	1.250	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	10.0	Orifice Diameter (m)	0.130

Node North Pond 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	90.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2400.0	2400.0	1.500	3630.0	3663.8

Node South Pond 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	88.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	187.0	187.0	1.800	750.0	765.0

Node South Pond 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	85.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1143.0	1143.0	1.800	2139.0	2171.2

Node North Pond 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	95.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1998.0	1998.0	1.500	3128.0	3159.2

Node Filter Drain 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	4.000	Depth (m)	
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	85.950	Length (m)	109.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	115	Slope (1:X)	300.0		

Node Filter Drain 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	4.000	Depth (m)	
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	85.400	Length (m)	92.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	69	Slope (1:X)	300.0		

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	North Pond 1	344	96.210	0.710	244.8	1608.4600	0.0000	SURCHARGED
1440 minute winter	North Pond 2	1680	91.483	0.983	66.2	2756.2770	0.0000	OK
480 minute winter	South Pond 1	464	89.736	1.036	42.1	361.5172	0.0000	SURCHARGED
1440 minute winter	South Pond 2	1680	86.542	0.842	35.7	1157.9500	0.0000	SURCHARGED
60 minute summer	1	86	85.379	0.129	35.8	0.0000	0.0000	OK
60 minute summer	Filter Drain 1	54	86.570	0.620	80.0	57.2711	0.0000	FLOOD RISK
60 minute summer	Filter Drain 2	49	86.298	0.898	146.5	82.2219	0.0000	SURCHARGED
60 minute summer	2	86	85.126	0.126	35.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	North Pond 1	3.000_1	North Pond 2	33.0	2.161	0.114	3.0900	
1440 minute winter	North Pond 2	ACO Q-Brake		10.6				763.2
480 minute winter	South Pond 1	2.000	South Pond 2	6.0	1.554	0.114	0.3611	
1440 minute winter	South Pond 2	2.001_1	1	4.3	0.747	0.298	0.5696	
60 minute summer	1	1.002	2	35.8	1.262	0.373	0.9506	299.9
60 minute summer	Filter Drain 1	3.000	Filter Drain 2	14.1	0.641	0.256	7.0419	
60 minute summer	Filter Drain 2	2.001	1	31.5	1.156	0.344	0.6074	

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	North Pond 1	464	96.417	0.917	245.2	2149.8240	0.0000	SURCHARGED
1440 minute winter	North Pond 2	1680	91.612	1.112	76.0	3175.8890	0.0000	OK
600 minute winter	South Pond 1	585	89.942	1.242	44.1	473.7440	0.0000	SURCHARGED
1440 minute winter	South Pond 2	1680	86.713	1.013	41.8	1442.1680	0.0000	SURCHARGED
30 minute summer	1	80	85.379	0.129	35.8	0.0000	0.0000	OK
60 minute winter	Filter Drain 1	60	86.744	0.794	72.3	80.1061	0.0000	FLOOD RISK
60 minute winter	Filter Drain 2	56	86.574	1.174	132.8	112.7128	0.0000	FLOOD RISK
30 minute winter	2	80	85.126	0.126	35.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	North Pond 1	3.000_1	North Pond 2	33.0	2.156	0.114	3.0900	
1440 minute winter	North Pond 2	ACO Q-Brake		10.6				793.1
600 minute winter	South Pond 1	2.000	South Pond 2	6.0	1.533	0.114	0.3610	
1440 minute winter	South Pond 2	2.001_1	1	4.3	0.769	0.298	0.5938	
30 minute summer	1	1.002	2	35.8	1.262	0.373	0.9506	296.3
60 minute winter	Filter Drain 1	3.000	Filter Drain 2	16.3	0.645	0.296	7.0419	
60 minute winter	Filter Drain 2	2.001	1	31.5	1.156	0.344	0.6063	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	North Pond 1	585	96.540	1.040	230.0	2486.3480	0.0000	SURCHARGED
1440 minute winter	North Pond 2	1680	91.655	1.155	81.3	3318.2930	0.0000	OK
600 minute winter	South Pond 1	585	90.060	1.360	49.3	543.7352	0.0000	SURCHARGED
1440 minute winter	South Pond 2	1680	86.809	1.109	46.6	1608.0030	0.0000	SURCHARGED
240 minute winter	1	124	85.379	0.129	35.8	0.0000	0.0000	OK
60 minute winter	Filter Drain 1	60	86.842	0.892	80.9	92.8856	0.0000	FLOOD RISK
60 minute winter	Filter Drain 2	43	86.650	1.250	143.7	121.0689	10.7063	FLOOD
240 minute winter	2	124	85.125	0.125	35.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute winter	North Pond 1	3.000_1	North Pond 2	33.0	2.145	0.114	3.0899	
1440 minute winter	North Pond 2	ACO Q-Brake		10.6				809.4
600 minute winter	South Pond 1	2.000	South Pond 2	6.0	1.523	0.114	0.3611	
1440 minute winter	South Pond 2	2.001_1	1	4.3	0.779	0.297	0.6041	
240 minute winter	1	1.002	2	35.8	1.261	0.373	0.9501	539.2
60 minute winter	Filter Drain 1	3.000	Filter Drain 2	13.2	0.646	0.240	7.0419	
60 minute winter	Filter Drain 2	2.001	1	31.5	1.156	0.344	0.6045	

Appendix 12: Minor Works Calculations (Pedestrian / Cycle Path Filter Drain)

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.600
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	0.30	Enforce best practice design rules	✓
CV	0.750	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
1	5.00	100.100	1200	50.261	74.814	0.950	99.150
2		100.000	1200	50.261	49.966	0.900	99.100
3		101.000		50.499	46.032	1.210	99.790

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	25.000	0.060	99.150	99.100	0.050	500.0	150	5.78	49.3
1.001	2	3	3.941	0.060	99.800	99.790	0.010	394.1	100	5.92	48.7

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.535	9.4	1.3	0.800	0.750	0.010	0.0	35	0.428
1.001	0.463	3.6	1.3	0.100	1.110	0.010	0.0		

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	25.000	500.0	150	filter drain	100.100	99.150	0.800	100.000	99.100	0.750
1.001	3.941	394.1	100	Circular	100.000	99.800	0.100	101.000	99.790	1.110

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3		Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	50.261	74.814	100.100	0.950	1200	0	1.000	99.150	150
2	50.261	49.966	100.000	0.900	1200	1	1.000	99.100	150
						0	1.001	99.800	100
3	50.499	46.032	101.000	1.210		1	1.001	99.790	100

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	1440	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	✓	Starting Level (m)			

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	0	0	0
10	0	0	0	100	40	0	0
30	0	0	0				

Node 2 Online Orifice Control

Flap Valve	x	Invert Level (m)	99.800	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.001		

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	1	465	99.231	0.081	0.0	0.0911	0.0000	OK
720 minute summer	1.000:50%	465	99.231	0.106	0.2	0.1570	0.0000	OK
720 minute summer	2	465	99.231	0.131	0.1	0.4613	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute summer	1	1.000	1.000:50%	0.0	-0.030	-0.004	0.1430	
720 minute summer	1	1.000	2	0.1	0.222	0.012	0.1845	
720 minute summer	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
720 minute summer	2	Infiltration (1.000)		0.1				

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	448	99.481	0.331	0.1	0.3745	0.0000	SURCHARGED
480 minute winter	1.000:50%	448	99.481	0.356	0.3	0.5143	0.0000	SURCHARGED
480 minute winter	2	448	99.481	0.381	0.2	1.1563	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	1	1.000	1.000:50%	-0.1	-0.012	-0.008	0.2201	
480 minute winter	1	1.000	2	0.2	0.222	0.021	0.2201	
480 minute winter	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
480 minute winter	2	Infiltration (1.000)		0.1				

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.15%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	1	405	99.610	0.460	0.1	0.5203	0.0000	SURCHARGED
600 minute summer	1.000:50%	405	99.610	0.485	0.5	0.7314	0.0000	SURCHARGED
600 minute summer	2	405	99.610	0.510	0.3	1.5199	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	1	1.000	1.000:50%	-0.1	-0.014	-0.010	0.2201	
600 minute summer	1	1.000	2	0.3	0.222	0.031	0.2201	
600 minute summer	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
600 minute summer	2	Infiltration (1.000)		0.1				

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	1	480	99.786	0.636	0.1	0.7192	0.0000	SURCHARGED
720 minute summer	1.000:50%	480	99.786	0.661	0.6	1.0281	0.0000	SURCHARGED
720 minute summer	2	480	99.786	0.686	0.3	2.0151	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

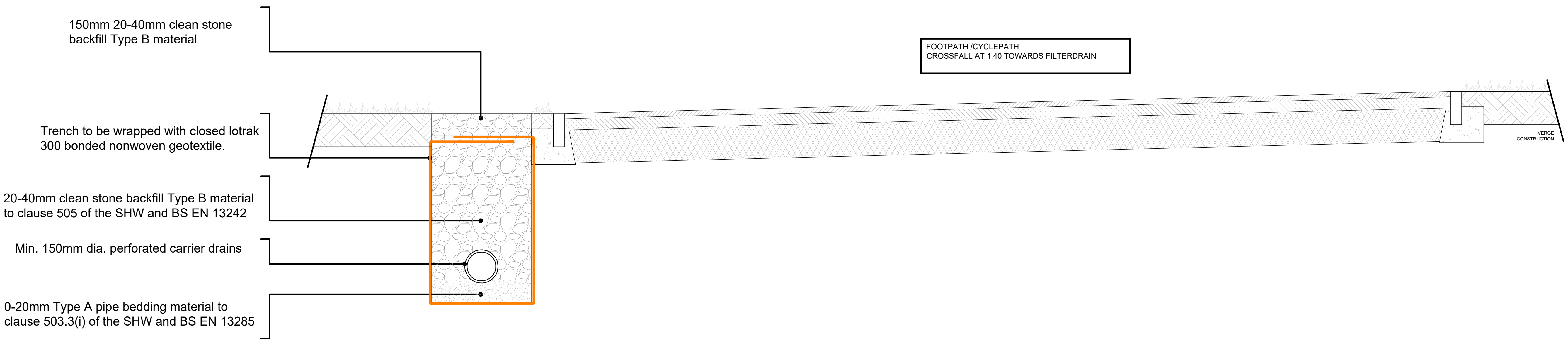
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute summer	1	1.000	1.000:50%	-0.1	-0.014	-0.011	0.2201	
720 minute summer	1	1.000	2	0.3	0.222	0.036	0.2201	
720 minute summer	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
720 minute summer	2	Infiltration (1.000)		0.1				

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	1	375	100.001	0.851	0.2	0.9624	0.0000	FLOOD RISK
480 minute summer	1.000:50%	304	100.001	0.876	1.1	1.3908	0.0000	SURCHARGED
720 minute summer	2	435	100.000	0.900	0.5	2.6197	0.5208	FLOOD
480 minute summer	3	312	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	1	1.000	1.000:50%	-0.2	-0.009	-0.017	0.2201	
600 minute summer	1	1.000	2	0.5	0.222	0.054	0.2201	
720 minute summer	2	1.001	3	0.0	0.000	0.000	0.0001	0.0
720 minute summer	2	Infiltration (1.000)		0.2				

Appendix 13: Minor Works Drawing (Typical Filter Drain Detail)



FILTER DRAIN
TRENCH AND BEDDING DETAIL

Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Key Plan

Issues & Revisions

Rev	Date	Details of issue / revision	Drw	Rev
P1	20.02.26	PRELIMINARY ISSUE	GSL	RJ

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Project Title
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Drawing Title
CYCLEPATH / FOOTPATH DRAINAGE

Drawn:	G LITTLEWOOD	Reviewed:	R JOBLING
BWB Ref:	NTH 2479	Date:	20.02.26
Scale@A3:	1:50		

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OFRI-BWB-EWE-ZZ-DR-CD-0520	S2	P01

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