



South Wokingham Distributor Road - Spine Road and Western Gateway Phase 1

Drainage SuDS Coordination Technical Note

WMHP-TG-SRWG1-RP-HI-0510

Revision: P02

Date: 23/09/2024

South Wokingham Distributor Road - Spine Road and Western Gateway Phase 1

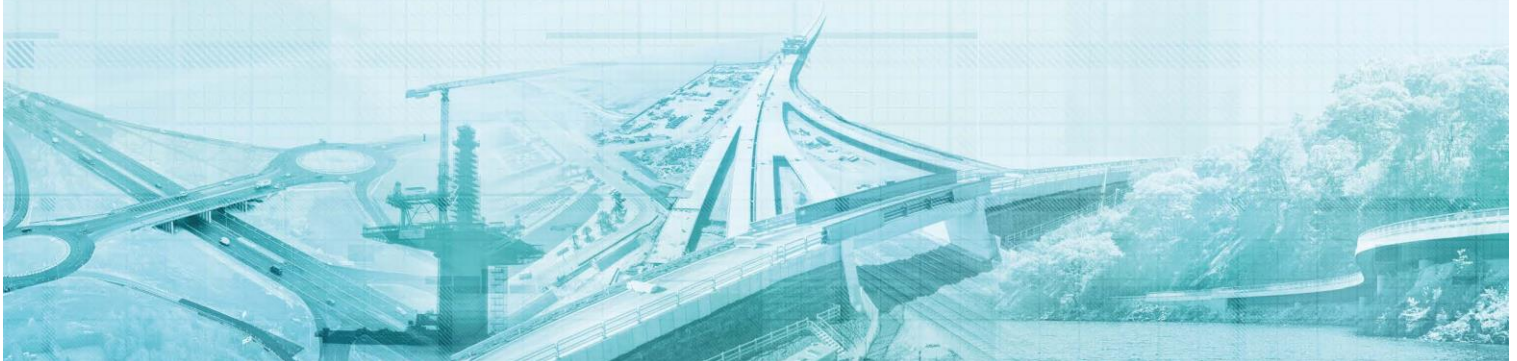
Drainage SuDS Coordination Technical Note

Wokingham Borough Council

Document no: WMHP-TG-SRWG1-RP-HI-0510

Revision: P02

Date: 23/09/2024



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Document Issue Record

Project:	South Wokingham Distributor Road - Spine Road and Western Gateway Phase 1
Report Title:	Drainage SuDS Coordination Technical Note
Client:	Wokingham Borough Council
Document No:	WMHP-TG-SRWG1-RP-HI-0510
Revision:	P02
Status	S3 - Suitable for review and comment (for approval)
Date:	23/09/2024
Filename:	WMHP-TG-SRWG1-RP-HI-0510-P02

Rev	Date	Description and Purpose of Issue	Prepared	Reviewed	Approved
P01	15/10/2021	For Review and Comment	JC	BH	JC
P02	23/09/2024	Revised for Planning Condition Discharge	JB	DJF	JC

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1. Introduction

This technical note contains documents and/or references prepared by Tony Gee (TG) on behalf of Balfour Beatty (BB) for surface water drainage along the proposed South Wokingham Distributor Road (SWDR) Spine Road and Western Gateway Phase 1 to demonstrate the design is coordinated with the South Wokingham Strategic Development Location (SDL) to discharge planning condition 19 of the consented scheme application ref 192928.

2. Design background and coordination

The overall water management strategy and flood risk assessment for the SDL south of the railway and west of Waterloo Road was developed by WSP on behalf of Wokingham Borough Council (WBC). This strategy is outlined in the Flood Risk Assessment (FRA) document 66439-FRA-001 (V3) dated February 2021 included in planning application 192928.

WSP also developed a drainage strategy for the SWDR highway runoff which identified discharge point and rates. Following a review of this strategy, TG developed an alternative drainage strategy that retained many of the principles already agreed with WBC, including SuDS rain gardens, whilst providing the required attenuation and treatment of the SWDR surface water runoff in the form of grassed detention basins adjacent to the highway earthworks. This alternative strategy, referred to as the Hybrid Drainage Strategy, was outlined in TG document WMHP-TG-SRWG1-SK-HI-0021 developed using the water management strategy design data from WSP. TG prepared a Technical Note document reference WMHP-TG-SRWG1-RP-HI-0504 to expand on the principles illustrated on WMHP-TG-SRWG1-SK-HI-0021. This document was shared with WBC, BB and the developers, with no serious concerns raised, and subsequently gained approval from WBC to become the SWDR highways drainage strategy for planning and detailed design.

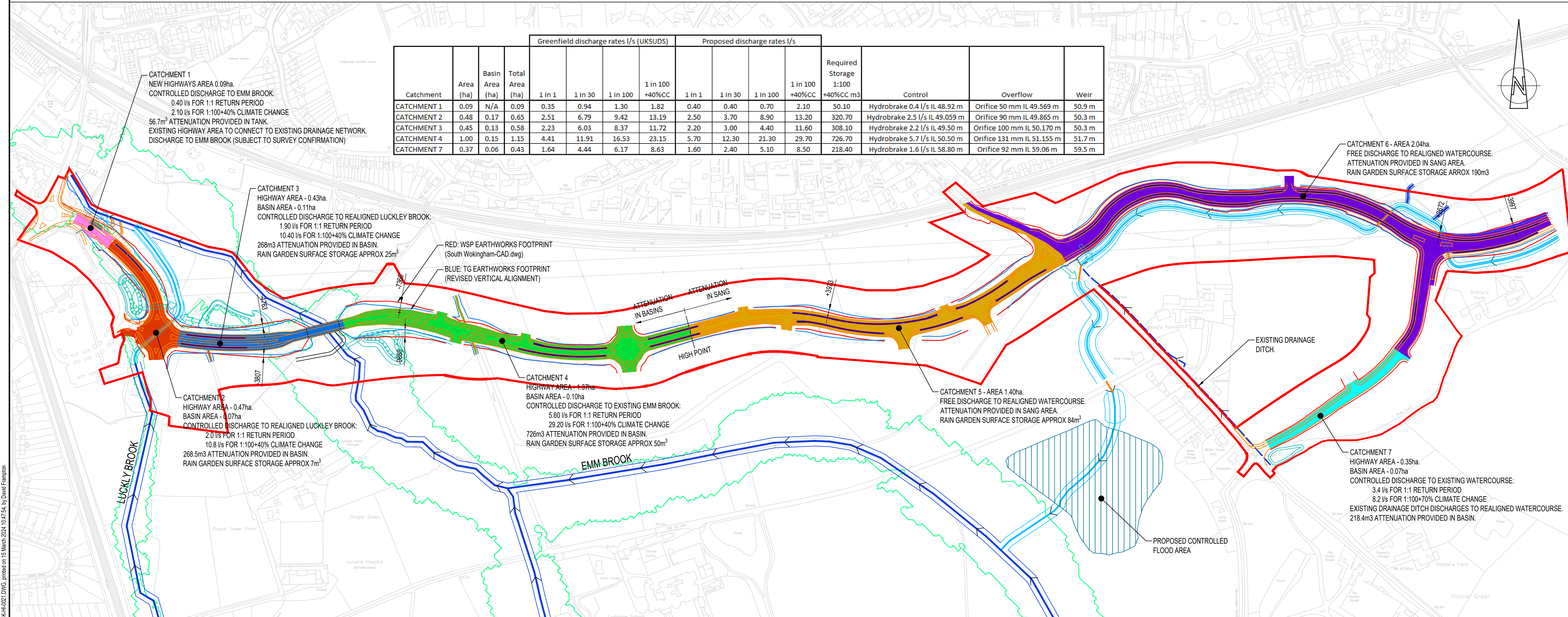
From the work undertaken for this hybrid drainage strategy TG provided hydraulic calculations, surface water discharge flows from the SWDR, and the location of earthworks associated with SuDS attenuation basins and the highway embankments that interface with the floodplain, which were subsequently included in the fluvial modelling undertaken by WSP. The Hydraulic Modelling Report document reference 66439-HMA-01 was included in planning application 192928. The flood modelling work undertaken for the SWDR has also been shared with both SDL applicants for inclusion in their respective planning applications.

TG engaged with the relevant stakeholders and interested parties throughout the design development, in particular undertaking coordination with the developers of the adjoining sites outlined in planning applications 190900, 191068 and 192325, preparing document WMHP-TG-SRWG1-SK-HI-0022 to illustrate the proposed drainage features of the SWDR and developer masterplans on a single plan. This document was continuously updated through the coordination meetings and sharing of information from all parties until the final version P10 which is appended to this document.

The SWDR detailed drainage design submitted for planning condition discharge is consistent with the hybrid drainage strategy WMHP-TG-SRWG1-RP-HI-0504 included in the Environmental Statement Addendum Volume 3 Appendix 10-4 and referenced in the Hydraulic Modelling Report document reference 66439-HMA-01 for planning application 192928. A further revision of the document was accepted under the application for a non-material amendment 240738.

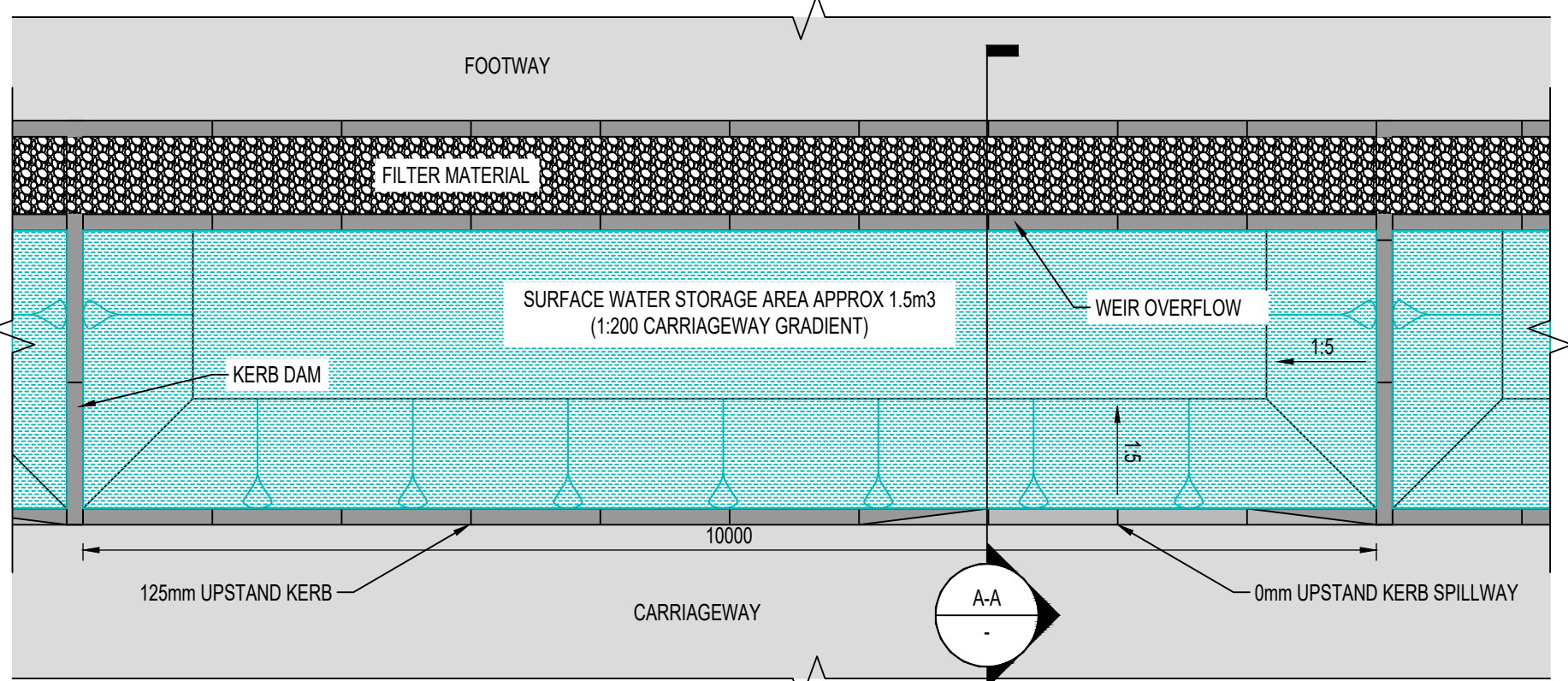
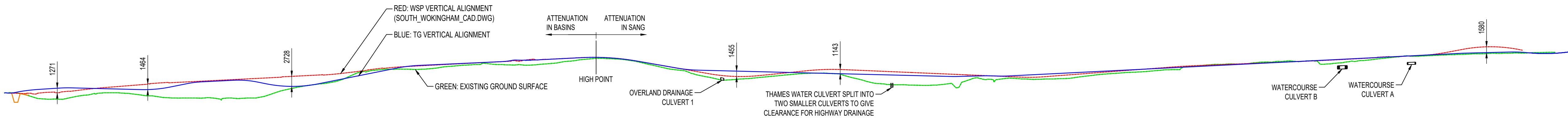
Appendix A - WMHP-TG-SRWG1-SK-HI-0021 rev P09

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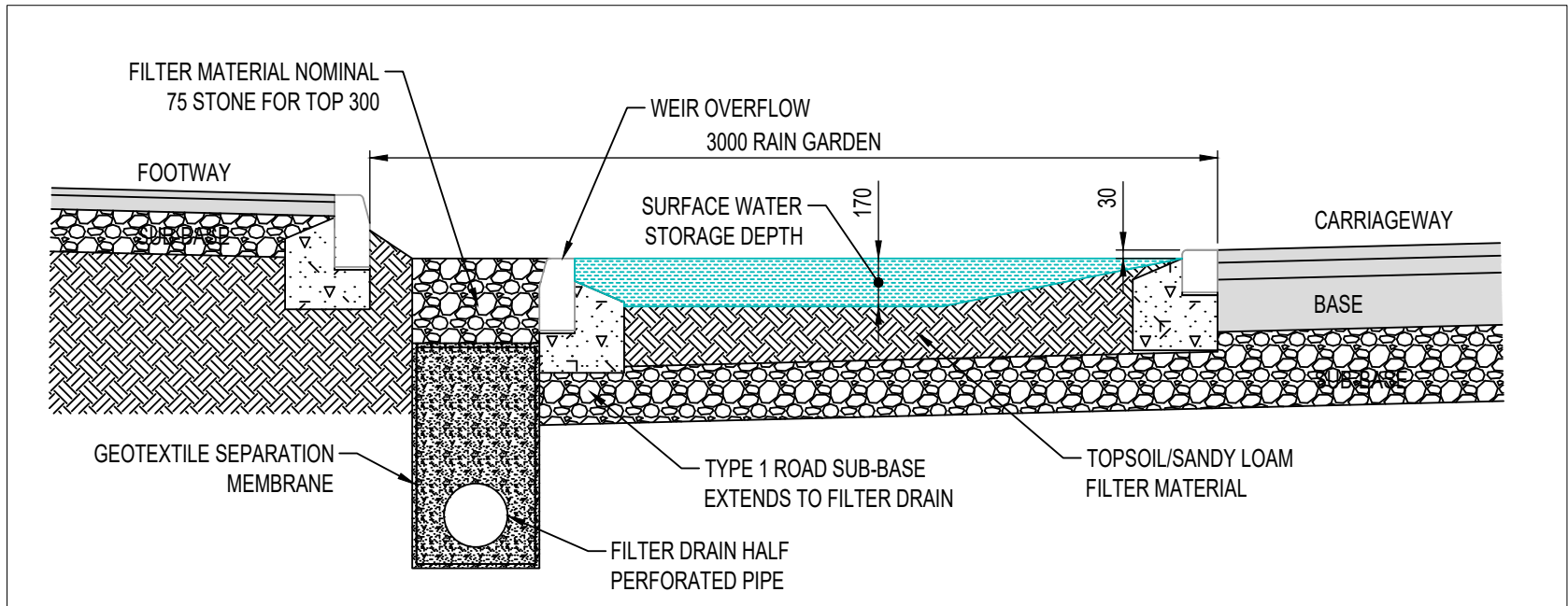


PLAN LAYOUT
SCALE 1:50

LONG SECTION
SCALE 1:25



"RAIN GARDEN" PLAN DETAIL
SCALE 1:50



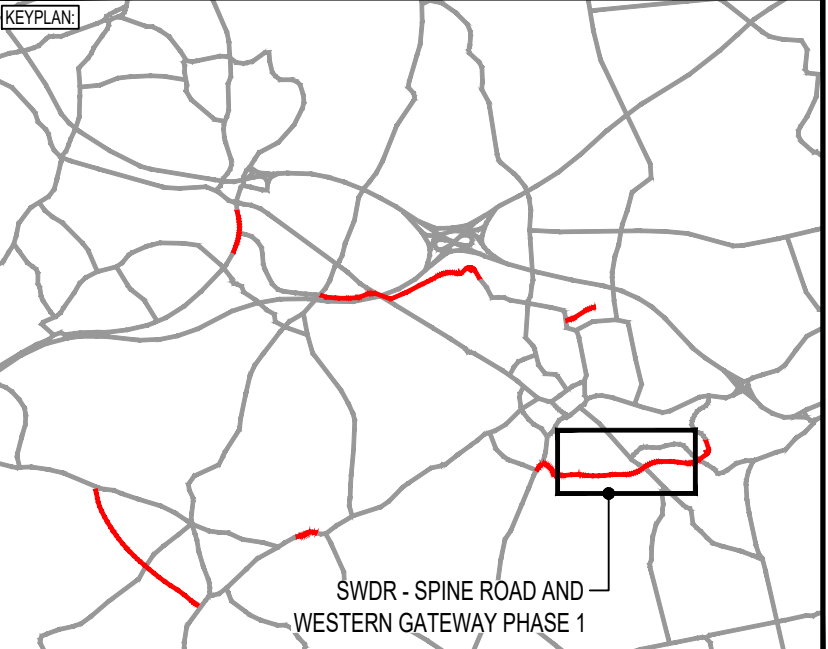
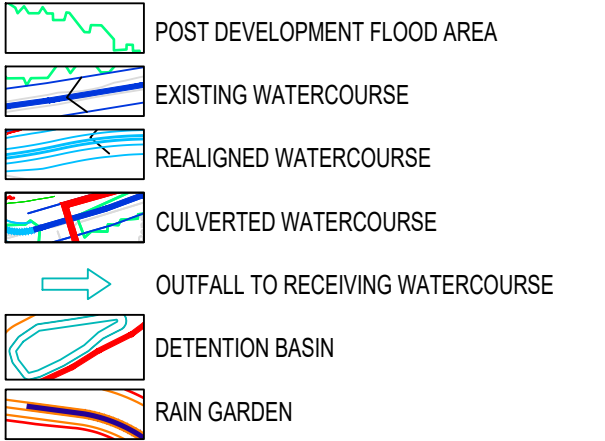
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NOTES:

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LEGEND:



REV	DATE	BY	DESCRIPTION	CHK	APP
P09	15/03/2024	DJF	UPDATES TO CATCHMENT 1 FOLLOWING VE	JC	JC
P08	01/09/2020	JC	WATERCOURSE INFORMATION ADDED	JC	JC
P07	21/08/2020	DJF	UPDATES TO CATCHMENTS 1, 2 & 3	JPG	JC

DRAWING STATUS: FOR INFORMATION S2

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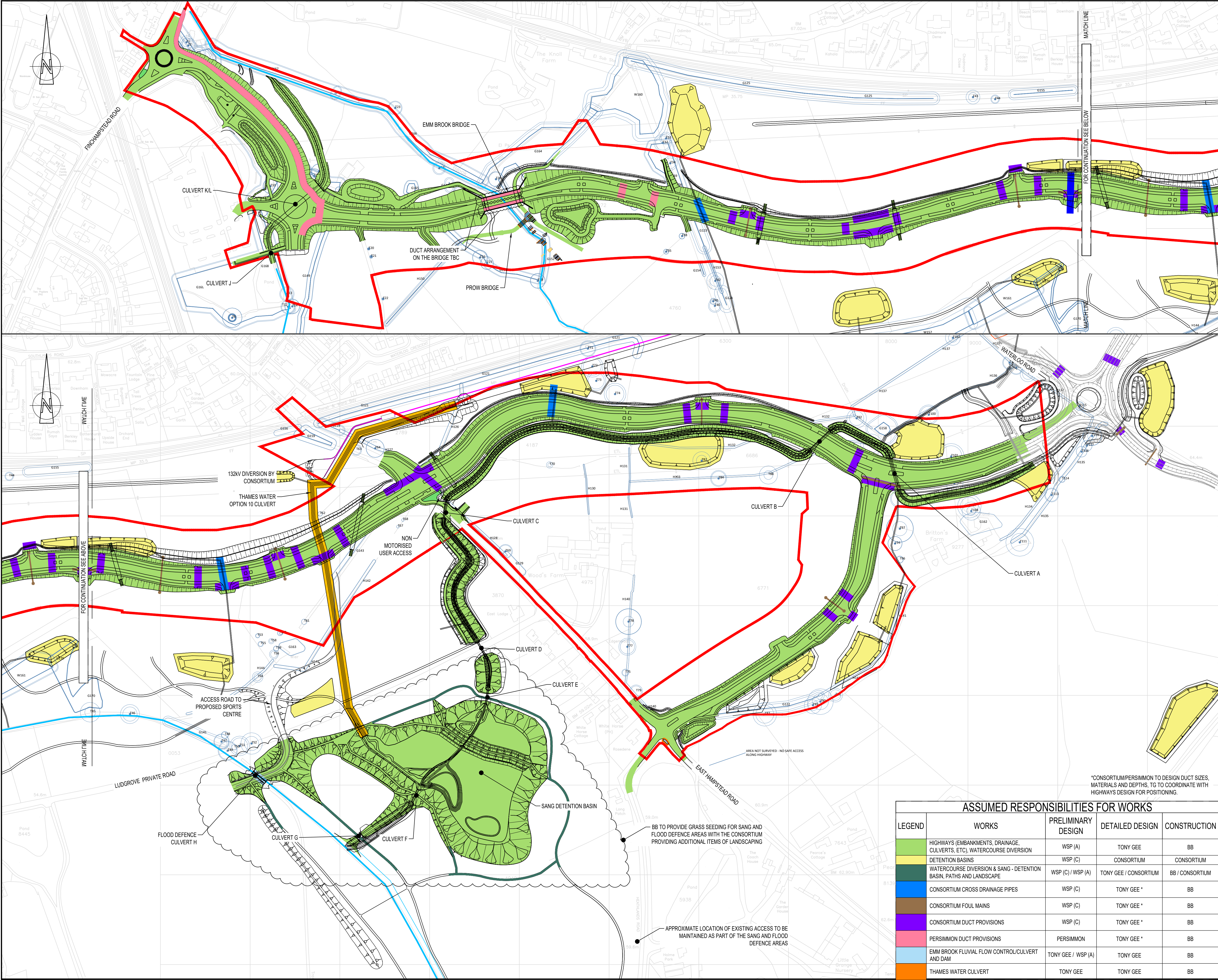
CLIENT: WOKINGHAM BOROUGH COUNCIL
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PROJECT: WOKINGHAM MAJOR HIGHWAYS PROGRAMME
SPINE ROAD AND WESTERN GATEWAY PHASE 1

TITLE: HIGHWAY DRAINAGE
HYBRID STRATEGY
PRELIMINARY DESIGN
SHEET 1

SCALE @ A1: DO NOT SCALE	CHECKED: JC	APPROVED: ARL
PROJECT NO: C118047	DESIGNED: JC	DRAWN: DJF
DRAWING NO: WMHP-TG-SRWG1-SK-HI-0021	DATE: March 24	REV: P09

Appendix B - WMHP-TG-SRWG1-SK-HI-0022 rev P10



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1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

2. ALL LEVELS ARE IN METRES AOD UNLESS NOTED OTHERWISE.

3. CONSORTIUM DUCT REQUIREMENTS TO BE AS SHOWN ON EASTERN GATEWAY DRAWING WMHP-TG-EG-DR-DD-0514, WHERE POSSIBLE

4. PERSIMMON DUCT REQUIREMENTS TO BE AS SHOWN ON DRAWING PHTV/U/22/XS/05, WHERE POSSIBLE.

5. THIS PLAN ILLUSTRATES THE MAIN ENGINEERED FEATURES AND EXCLUDES SOFTER ELEMENTS SUCH AS LANDSCAPING AND PATHS.

REFERENCE DRAWINGS/MODELS INCLUDE:

70001684-D-102 SANG update 19-12-03 (DATE RECEIVED: 12/12/19)

P19-0052_08E Phase 2b SANG landscape strategy draft (DATE RECEIVED: 10/12/19)

1684-D-012-C electricity supply (DATE RECEIVED: 26/11/19)

1684-UD-028-B-33kv (DATE RECEIVED: 17/09/19)

1684-UD-029-B-132kv (DATE RECEIVED: 17/09/19)

1684-UD-027-A-Water (DATE RECEIVED: 26/11/19)

3e-P18-2684_31 Illustrative Landscape Masterplan (DATE RECEIVED: 02/10/19)

70001684-D-010 (DATE RECEIVED: 25/09/19)

WMHP-TG-SRWG1-M2-DD-0512 (TONY GEE MODEL)

WMHP-TG-SRWG1-M2-H1-0001 (TONY GEE MODEL)

WMHP-TG-SRWG1-M2-SE-4001 (TONY GEE MODEL)

xRed Line Boundary_v5.0 (DATE RECEIVED: 05/10/19)

xtoposurvey (DATE RECEIVED: 09/08/19)

1684-UD-033 [0.2] -XRef: 2020-02-12 SDR utility crossing locations [0.2] (DATE RECEIVED: 13/02/2020)

PHTV/U/22-XS-05-A.pdf (DATE RECEIVED: 28/01/2020)

XCulvert and ditch realignment (DATE RECEIVED: 14/02/2020)

REDLINE BOUNDARY (SEE REFERENCE ABOVE)

EXISTING WATERCOURSE TO REMAIN

KEYPLAN

SWDR - SPINE ROAD AND WESTERN GATEWAY PHASE 1

P10	02/08/2024	JB	REVISED FOR PLANNING DISCHARGE	JC	JC
P09	14/09/2020	BH	HIGHWAY ALIGNMENT AND SANG LANDSCAPING UPDATED	BH	JC
P08	02/08/2020	TCH	HIGHWAY ALIGNMENT UPDATED	BH	JC
REV	DATE	BY	DESCRIPTION	CHK	APP

DRAWING STATUS:

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S2

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PROJECT:

WOKINGHAM MAJOR HIGHWAYS PROGRAMME

SPINE ROAD AND WESTERN GATEWAY PHASE 1

TITLE:

SPINE ROAD -

DESIGN COORDINATION

SHEET 1

SCALE @ A1:	DO NOT SCALE	CHECKED:	CW	APPROVED:	ARL
PROJECT NO:	C118047	DESIGNED:	AJP	DRAWN:	AJP
DRAWING No:	WMHP-TG-SRWG1-SK-HI-0022	DATE:	SEPTEMBER 20	REV:	P10

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Appendix C - WMHP-TG-SRWG1-RP-HI-0504 rev P03



South Wokingham Distributor Road - Spine Road and Western Gateway Phase 1

Preliminary Hybrid Drainage Design Technical Note

WMHP-TG-SRWG1-RP-HI-0504

Revision: P03

Date: 15/03/2024

South Wokingham Distributor Road - Spine Road and Western Gateway Phase 1

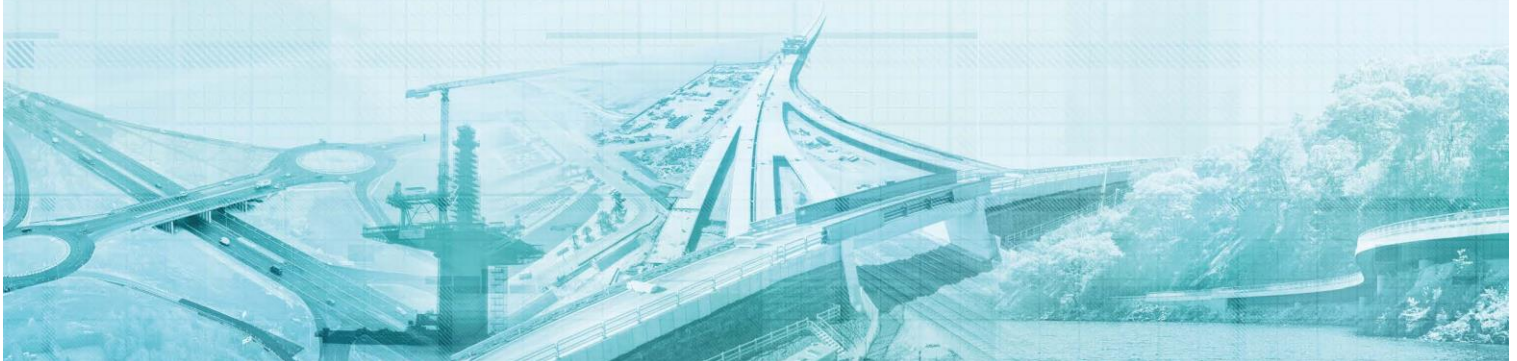
Preliminary Hybrid Drainage Design Technical Note

Wokingham Borough Council

Document no: WMHP-TG-SRWG1-RP-HI-0504

Revision: P03

Date: 15/03/2024



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Document Issue Record

Project:	South Wokingham Distributor Road - Spine Road and Western Gateway Phase 1
Report Title:	Preliminary Hybrid Drainage Design Technical Note
Client:	Wokingham Borough Council
Document No:	WMHP-TG-SRWG1-RP-HI-0504
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Status	S3 - Suitable for review and comment (for approval)
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Filename:	WMHP-TG-SRWG1-RP-HI-0504-P03

Rev	Date	Description and Purpose of Issue	Prepared	Reviewed	Approved
P01	03/04/20	For Review and Comment	DJF	JC	ARL
P02	21/08/20	Updated following design revision and comments	DJF	JC	JC
P03	15/03/24	Update to sections 3, 3.1, Appendix A & B following Roundabout VE design	DJF	JC	JC

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Appendix

Appendix A - WMHP-TG-SRWG1-SK-HI-0021

Appendix B - Drainage Modelling Results

1. Introduction

This technical note describes the hybrid drainage strategy, for surface water drainage along the proposed South Wokingham Distributor Road (SWDR) Spine Road and Western Gateway Phase 1.

The site is partially located in a floodplain and intersects both the Emm Brook and Luckley Brook. The area has a seasonally high water table and limited ground permeability.

The hybrid drainage strategy has been developed in parallel to the planning process, in close collaboration with Wokingham Borough Council, WSP and Balfour Beatty. It is an amendment of the design that was initially proposed in previous concept and preliminary drainage strategy documents, WMHP-TG-SRWG1-RP-HI-0502 and WMHP-TG-SRWG1-RP-HI-0503 respectively.

These amendments are required following the value engineering of the vertical alignment, identification of land constraints through collaborating with the land developer design teams, to incorporate access requirements from WBC, and receipt of additional topographical survey data.

The design was developed on the following assumptions:

- The catchment outfalls into the river networks aren't submerged
- No river flood event is happening at the same time as the worst design storm event
- Storage features are empty at the beginning of the design storm event
- The water table doesn't affect the capacity of the storage basins
- The proposed changes to the vertical geometry of mainline and connecting roads are acceptable
- The land for attenuation features and their accesses is made available by the developers

Attenuation features have been sized using Source Control in Microdrainage; the time area diagrams were derived as output of the pipe networks modelled in DrawNet in Microdrainage.

The shape and size of the attenuation features is subject to further refinement during detailed design and there is scope to reduce the volume of some catchments should WBC's preference for a minimum discharge rate of 5 l/s be applied.

The updated strategy is presented on WMHP-TG-SRWG1-SK-HI-0021 revision P09, appended to this document.

2. Highway Drainage Strategy

The premise of the drainage strategy is to attenuate surface water for run-off from up to 1:100 year + 40% climate change storm events in a geocellular tank within the highway footprint and open detention basins in close proximity to the highway earthworks to minimise land requirements. Each attenuation feature will have a flow control to limit the discharge rate to corresponding Greenfield rate for each return period up to 1:100 + 40% climate change for its catchment calculated using the UKSUDS.com online tool.

Run-off will be collected using rain garden SuDS features and traditional road gullies. The vast majority of surface water run-off will be collected in rain gardens (detailed on WMHP-TG-SRWG1-SK-HI-0021) that are contiguous with the carriageway along the links between junctions, with road gullies collecting the remainder of run-off at junctions.

Rain garden SuDS features will be shallow grassed depressions at approx. 10 m intervals that store run-off for high frequency short duration storms at the surface. The stored run-off then infiltrates to an underlying filter drain that conveys the run-off to the open detention basins. Rain garden SuDS features will be utilised as much as practicable where geometry and other constraints permit.

Road gullies will be used only where the rain gardens are not practicable, such as at junctions, and these will connect the filter drain to convey run-off to the basins.

Beyond the rain gardens and gullies surface water will be conveyed through filter drains before being discharged either to a dedicated highway drainage detention basin, designed to attenuate storms of all frequencies and durations up to 1:100 year + 40% climate change, or a wetland detention basin/meadow that provides combined attenuation for the SWDR, existing Thames Water discharge and realigned watercourse that ensures the downstream flood levels are no higher than the baseline.

Discharge from each of the basins will generally be controlled by a single location using features such as an orifice plate or hydrobrake chamber. Detention basins will discharge to an existing or realigned watercourse that is, or connects to, the Emm Brook at a maximum rate equal to the 1:100 + 40% climate change greenfield rate.

Discharge from the SANG will be controlled by a single culvert to the Emm Brook with a primary fluvial flood flow control downstream of this outfall.

Water treatment is intended to be provided through rain garden infiltration into the filter drain, with secondary treatment provided in the detention basin, prior to discharge. Where it is not possible to install rain gardens, due to alignment constraints or other features, gullies will collect run-off and discharge it into the filter material with secondary treatment provided in the detention basin, prior to discharge. Each catchment will be assessed during detailed design, to ensure sufficient water treatment is provided.

TG has been provided with the modelled floodplain extent for the 1:100 + 70% climate change event in WBC's flood risk assessment (FRA) undertaken by WSP. TG has identified that two of the detention basins required for this hybrid drainage strategy lie in the floodplain which are likely to reduce the capacity. TG has also reduced the overall height and extent of earthworks passing through the floodplain area which is likely to increase the capacity.

Both the detention basin and earthworks features will be provided to WBC to allow an updated fluvial modelling exercise to be undertaken to establish the revised floodplain and any modification to the proposed upstream restrictions should the flood level around Finchampstead Road be higher than the baseline modelled prediction for the 1:100 + 70% climate change event.

3. Proposed Catchments and Networks

The site is made up of 7 separate catchments, with a total highway surface area of 6.15ha. Table 1 identifies the individual highway catchment areas for each catchment as well as details on the attenuation type and volume.

Table 1: Catchment Details

Catchment	Highway Area (ha)	Approximate Rain Garden Volume (m ³)	Attenuation Basin Volume (m ³)
1	0.09	0	56.7 (Attenuation Tank)
2	0.47	7	268.5
3	0.43	25	268
4	1.37	50	726.7
5	1.40	84	Refer to FRA
6	2.04	190	Refer to FRA
7	0.35	0	218.4

3.1. Catchment 1

Catchment 1 discharges to a combination of the existing highway drainage network, and via an attenuation tank into the Emm Brook.

The existing hardstanding catchment will remain mostly unaltered, with some amendments to inlets to account for the updated alignment. This area will continue to discharge via the existing carrier pipes into the Emm Brook.

The proposed drainage network intends to capture the portion of the catchment area that is equivalent to the existing greenfield area ($\approx 0.09\text{ha}$), and discharge this via a 56.7m^3 attenuation tank, situated in the central island of the roundabout, at a controlled rate, equal to Greenfield run-off, into the Emm Brook. The remainder of the catchment will discharge via the existing drainage network, again into the Emm Brook.

Proposed discharge rates have been summarised on WMHP-TG-SRWG1-SK-HI-0021 revision P09.

3.2. Catchments 2 to 4

Catchments 2 to 4 will be attenuated using a combination of rain gardens and detention basins. Surface water collection is via spillways into rain gardens with additional collection using road gullies

Catchment 2 basin is to be located to the northwest of the proposed Tesco roundabout, with maintenance access provided via the proposed link. The basin is to discharge to the Luckley

Brook in line with greenfield rates, which are detailed on sketch WMHP-TG-SRWG1-SK-HI-0021 revision P09.

Catchment 3 basin is to be located to the north of the SWDR mainline to the west of the Emm Brook Bridge, with maintenance access provided via an access track off the mainline. The basin is to discharge to the diverted Luckley Brook in line with greenfield rates, which are detailed on sketch WMHP-TG-SRWG1-SK-HI-0021 revision P09, through a complex flow control.

Catchment 4 basin is to be located to the south of the mainline to the east of the Emm Brook Bridge, maintenance access will be provided via an access track from the future development access to the east. The basin is to discharge to the Emm Brook in line with greenfield rates, which are detailed on sketch WMHP-TG-SRWG1-SK-HI-0021 revision P09, through a complex flow control.

3.3. Catchments 5 and 6

Catchments 5 and 6 follow the same strategy as catchments 2 to 4, however due to restricted space around the highway, attenuation for these catchments is achieved in the proposed SANG wetland area to the south of the scheme.

The majority of surface water collection is via spillways into rain gardens, with additional collection via road gullies. Following collection, the surface water is then conveyed and discharged freely to the diverted water course conveyance channel which discharges to the SANG where it is attenuated. It is then discharged at a controlled rate into the Emm Brook.

Discharge rates from the highway run-off have been accommodated in the overall attenuation requirements in the water management strategy and flood risk assessment (FRA) produced by WSP. The volume of attenuation required for the highway's drainage is approximately 1,082 m³, which accounts for approximately 2% of the total volume of the SANG detention basin.

3.4. Catchment 7

Surface water collection is via spillways into the rain gardens with additional collection using road gullies, with run-off conveyed to an adjacent detention basin via filter drains.

The basin is located at the southern end of the link to Easthampstead Road on the east side. This location is dependent on the realignment of the existing PROW that runs through the site as well as determining the exact location of the existing water main.

The water is then discharged to the existing drainage ditch that runs parallel to Easthampstead Road, in line with greenfield rates, which are detailed on sketch WMHP-TG-SRWG1-SK-HI-0021 revision P09, through a complex flow control. The existing drainage ditch that runs parallel to Easthampstead Road discharges to the realigned watercourse and into the SANG. Discharge from this catchment is further attenuated in the SANG flood control area, before being discharged to the Emm Brook.

4. Overland Drainage Strategy

The site falls generally from north to south towards the Emm Brook and tributaries. Overland run-off will be conveyed along the northern earthworks extent via open ditches to new culverts at existing valley locations in the existing ground.

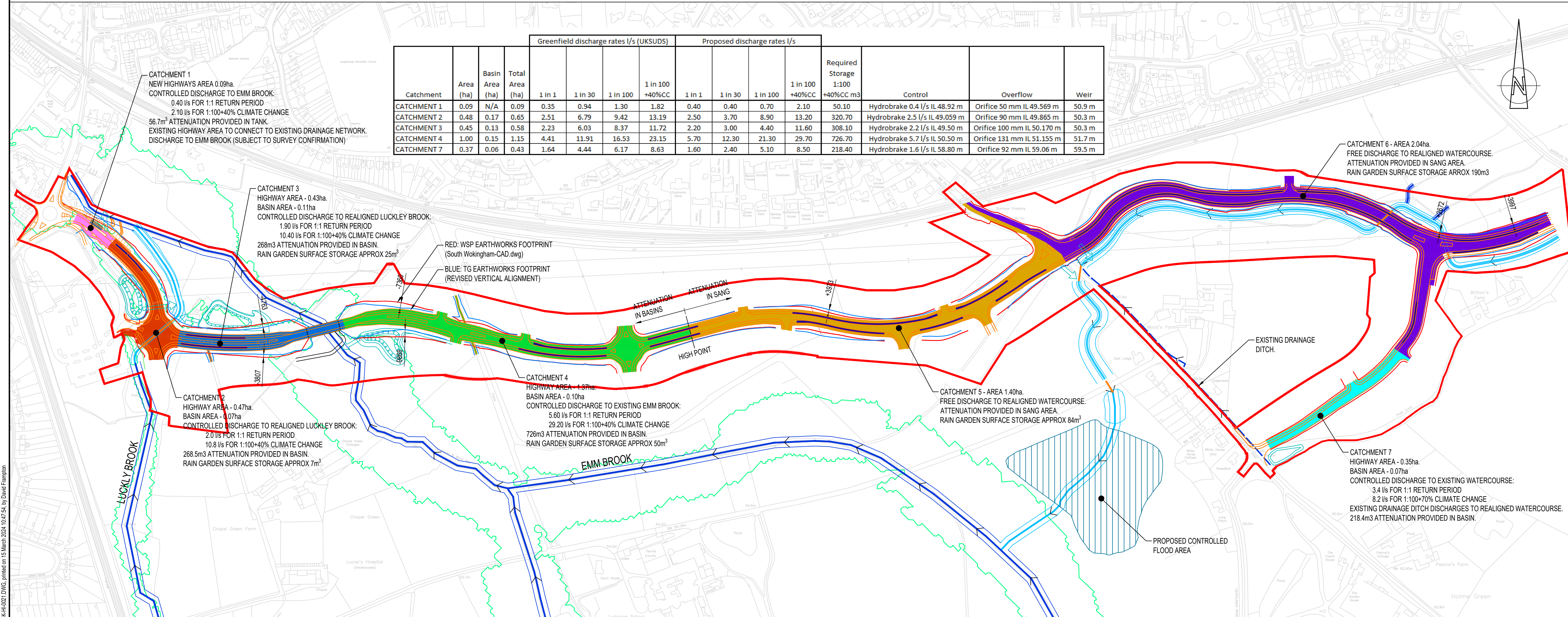
Run-off will then be conveyed via new culverts below the SWDR and discharge at the south extent of the earthworks before continuing to the ordinary watercourses in the same manner as the existing situation.

Culverts sizes are based on the overland catchments between the railway boundary to the north of SWDR and the SWDR earthworks north extent.

These culverts and ditches are designed to be permanent but are likely to be temporary due to the proposed future development of the areas surrounding the SWDR.

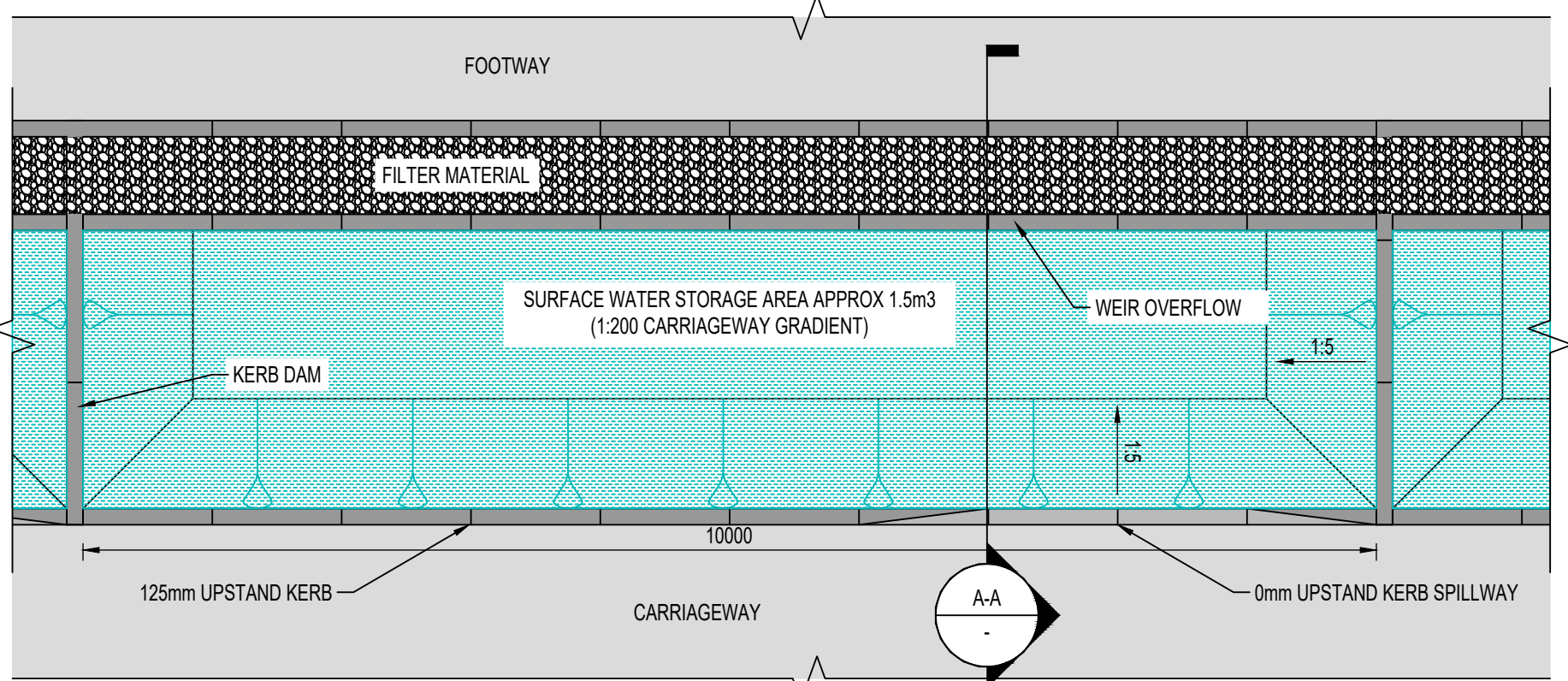
Appendix A - WMHP-TG-SRWG1-SK-HI-0021

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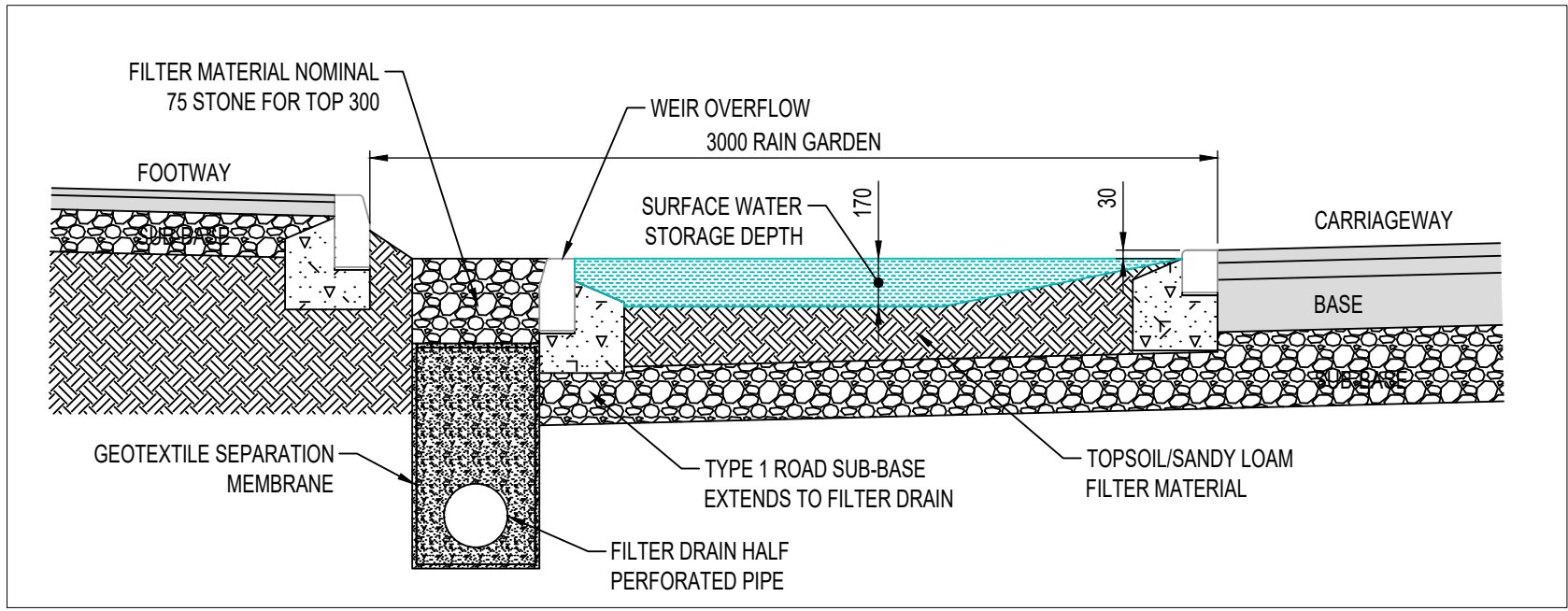


PLAN LAYOUT
SCALE 1:50

LONG SECTION
SCALE 1:25



"RAIN GARDEN" PLAN DETAIL
SCALE 1:50



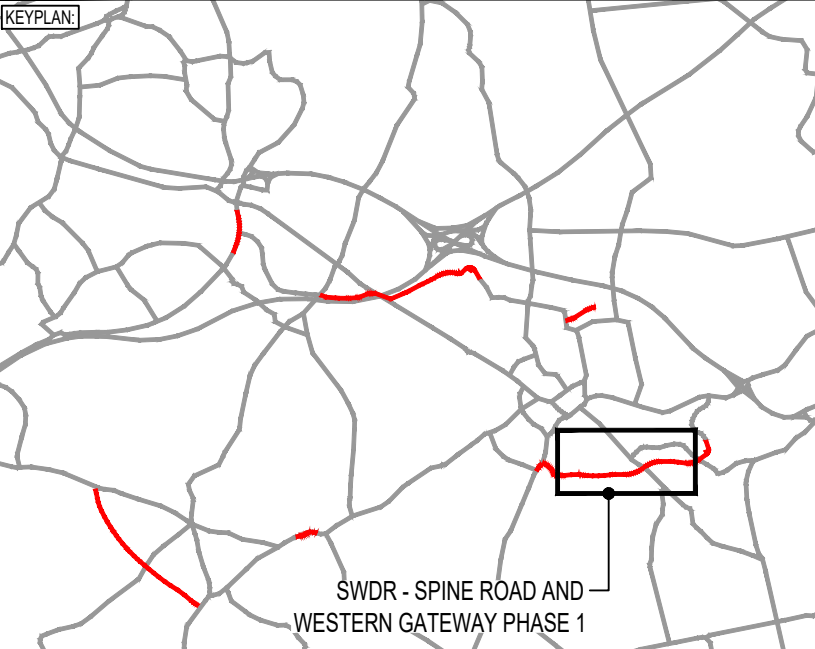
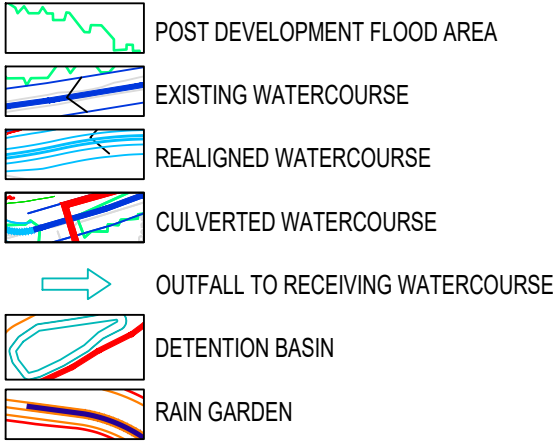
SECTION A-A
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NOTES:

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LEGEND:



P09	15/03/2024	DJF	UPDATES TO CATCHMENT 1 FOLLOWING VE	JC	JC
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PROJECT: WOKINGHAM MAJOR HIGHWAYS PROGRAMME
SPINE ROAD AND WESTERN GATEWAY PHASE 1

TITLE: HIGHWAY DRAINAGE
HYBRID STRATEGY
PRELIMINARY DESIGN

SCALE @ A1: DO NOT SCALE	CHECKED: JC	APPROVED: ARL
PROJECT NO: C118047	DESIGNED: JC	DRAWN: DJF
DRAWING NO: WMHP-TG-SRWG1-SK-HI-0021	DATE: March 24	REV: P09

Appendix B - Drainage Modelling Results

Tony Gee & Partners LLP							Page 1
Hardy House, 140 High Street Esher Surrey, KT10 9QJ							
Date 15/03/2024 11:03 File TANK 1 IN 100 YEAR.SRCX				Designed by djf Checked by			
Innovyze				Source Control 2020.1			
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
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60 min Summer	49.556	0.507	0.4	0.0	0.4	38.3	O K
120 min Summer	49.651	0.602	0.4	0.0	0.4	45.5	O K
180 min Summer	49.701	0.652	0.4	0.0	0.4	49.3	O K
240 min Summer	49.728	0.679	0.5	0.3	0.7	51.3	O K
360 min Summer	49.739	0.690	0.5	0.4	0.9	52.2	O K
480 min Summer	49.739	0.690	0.5	0.4	0.9	52.2	O K
600 min Summer	49.739	0.690	0.5	0.4	0.9	52.1	O K
720 min Summer	49.738	0.689	0.5	0.4	0.9	52.1	O K
960 min Summer	49.735	0.686	0.5	0.4	0.8	51.9	O K
1440 min Summer	49.727	0.678	0.5	0.3	0.7	51.3	O K
2160 min Summer	49.708	0.659	0.4	0.0	0.5	49.8	O K
2880 min Summer	49.672	0.623	0.4	0.0	0.4	47.1	O K
4320 min Summer	49.604	0.555	0.4	0.0	0.4	42.0	O K
5760 min Summer	49.543	0.494	0.4	0.0	0.4	37.4	O K
7200 min Summer	49.488	0.439	0.4	0.0	0.4	33.2	O K
8640 min Summer	49.437	0.388	0.4	0.0	0.4	29.3	O K
10080 min Summer	49.388	0.339	0.4	0.0	0.4	25.6	O K
15 min Winter	49.400	0.351	0.4	0.0	0.4	26.5	O K
30 min Winter	49.508	0.459	0.4	0.0	0.4	34.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer	128.336	0.0	23.4	0.0	23		
30 min Summer	84.360	0.0	29.6	0.0	37		
60 min Summer	52.892	0.0	39.3	0.0	66		
120 min Summer	32.091	0.0	47.6	0.0	126		
180 min Summer	23.662	0.0	52.6	0.0	184		
240 min Summer	18.958	0.0	56.1	0.6	242		
360 min Summer	13.760	0.0	61.0	2.5	360		
480 min Summer	10.974	0.0	64.6	3.9	416		
600 min Summer	9.199	0.0	67.3	4.7	478		
720 min Summer	7.961	0.0	68.9	5.0	542		
960 min Summer	6.333	0.0	69.2	4.8	682		
1440 min Summer	4.580	0.0	66.2	2.9	984		
2160 min Summer	3.307	0.0	88.8	0.2	1496		
2880 min Summer	2.622	0.0	93.9	0.0	1932		
4320 min Summer	1.888	0.0	101.0	0.0	2768		
5760 min Summer	1.494	0.0	107.2	0.0	3576		
7200 min Summer	1.245	0.0	111.7	0.0	4392		
8640 min Summer	1.073	0.0	115.4	0.0	5192		
10080 min Summer	0.946	0.0	118.6	0.0	5960		
15 min Winter	128.336	0.0	26.0	0.0	22		
30 min Winter	84.360	0.0	30.9	0.0	37		
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Hardy House, 140 High Street Esher Surrey, KT10 9QJ							
Date 15/03/2024 11:03 File TANK 1 IN 100 YEAR.SRCX			Designed by djf Checked by				
Innovyze			Source Control 2020.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	49.618	0.569	0.4	0.0	0.4	43.0	O K
120 min Winter	49.725	0.676	0.5	0.2	0.7	51.1	O K
180 min Winter	49.763	0.714	0.5	0.9	1.4	54.0	O K
240 min Winter	49.773	0.724	0.5	1.1	1.6	54.7	O K
360 min Winter	49.776	0.727	0.5	1.2	1.6	55.0	O K
480 min Winter	49.781	0.732	0.5	1.2	1.7	55.3	O K
600 min Winter	49.781	0.732	0.5	1.2	1.7	55.3	O K
720 min Winter	49.779	0.730	0.5	1.2	1.7	55.2	O K
960 min Winter	49.772	0.723	0.5	1.1	1.6	54.7	O K
1440 min Winter	49.759	0.710	0.5	0.9	1.3	53.7	O K
2160 min Winter	49.743	0.694	0.5	0.5	1.0	52.4	O K
2880 min Winter	49.728	0.679	0.5	0.3	0.7	51.3	O K
4320 min Winter	49.660	0.611	0.4	0.0	0.4	46.2	O K
5760 min Winter	49.571	0.522	0.4	0.0	0.4	39.5	O K
7200 min Winter	49.491	0.442	0.4	0.0	0.4	33.4	O K
8640 min Winter	49.414	0.365	0.4	0.0	0.4	27.6	O K
10080 min Winter	49.320	0.271	0.4	0.0	0.4	20.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
60 min Winter	52.892	0.0	44.0	0.0	66		
120 min Winter	32.091	0.0	53.3	0.3	122		
180 min Winter	23.662	0.0	58.9	3.4	178		
240 min Winter	18.958	0.0	62.9	6.0	230		
360 min Winter	13.760	0.0	68.3	9.2	286		
480 min Winter	10.974	0.0	72.4	11.3	360		
600 min Winter	9.199	0.0	75.5	12.5	434		
720 min Winter	7.961	0.0	77.4	13.2	508		
960 min Winter	6.333	0.0	78.3	13.5	654		
1440 min Winter	4.580	0.0	75.7	11.7	954		
2160 min Winter	3.307	0.0	99.5	7.6	1428		
2880 min Winter	2.622	0.0	105.1	3.6	1932		
4320 min Winter	1.888	0.0	112.3	0.0	2984		
5760 min Winter	1.494	0.0	120.1	0.0	3864		
7200 min Winter	1.245	0.0	125.1	0.0	4688		
8640 min Winter	1.073	0.0	129.3	0.0	5536		
10080 min Winter	0.946	0.0	132.9	0.0	6264		
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Date 21/08/2020 17:43 File Catchment 2 hydrobrakeG...			Designed by jc3 Checked by				
Innovyze			Source Control 2016.1.1				
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	49.370	0.370	2.0	0.0	2.0	128.1	O K
30 min Summer	49.463	0.463	2.0	3.0	4.7	166.0	O K
60 min Summer	49.541	0.541	2.0	6.0	7.8	200.2	O K
120 min Summer	49.598	0.598	2.0	7.2	9.1	226.6	O K
180 min Summer	49.615	0.615	2.0	7.6	9.5	234.4	O K
240 min Summer	49.622	0.622	2.0	7.7	9.6	237.8	O K
360 min Summer	49.627	0.627	2.0	7.8	9.7	239.8	O K
480 min Summer	49.627	0.627	2.0	7.8	9.7	240.0	O K
600 min Summer	49.623	0.623	2.0	7.7	9.6	238.4	O K
720 min Summer	49.618	0.618	2.0	7.6	9.5	235.9	O K
960 min Summer	49.604	0.604	2.0	7.4	9.3	229.4	O K
1440 min Summer	49.574	0.574	2.0	6.7	8.6	215.4	O K
2160 min Summer	49.535	0.535	2.0	5.9	7.7	197.8	O K
2880 min Summer	49.507	0.507	2.0	5.1	6.9	185.3	O K
4320 min Summer	49.475	0.475	2.0	3.6	5.3	171.2	O K
5760 min Summer	49.453	0.453	2.0	2.5	4.2	162.0	O K
7200 min Summer	49.434	0.434	2.0	1.7	3.4	154.2	O K
8640 min Summer	49.417	0.417	2.0	1.0	2.7	147.0	O K
10080 min Summer	49.397	0.397	2.0	0.3	2.1	138.9	O K
15 min Winter	49.408	0.408	2.0	0.6	2.4	143.5	O K
30 min Winter	49.507	0.507	2.0	5.1	6.9	185.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer	128.336	0.0	124.3	0.0	22		
30 min Summer	84.360	0.0	161.2	14.6	36		
60 min Summer	52.892	0.0	212.3	46.0	64		
120 min Summer	32.091	0.0	257.9	80.3	122		
180 min Summer	23.662	0.0	285.3	100.4	170		
240 min Summer	18.958	0.0	304.8	114.1	196		
360 min Summer	13.760	0.0	331.9	131.8	258		
480 min Summer	10.974	0.0	352.9	144.4	326		
600 min Summer	9.199	0.0	369.7	153.4	394		
720 min Summer	7.961	0.0	383.8	160.1	462		
960 min Summer	6.333	0.0	406.6	167.7	598		
1440 min Summer	4.580	0.0	438.4	168.7	864		
2160 min Summer	3.307	0.0	481.0	154.7	1252		
2880 min Summer	2.622	0.0	508.3	139.1	1616		
4320 min Summer	1.888	0.0	547.8	110.9	2384		
5760 min Summer	1.494	0.0	580.4	84.5	3176		
7200 min Summer	1.245	0.0	604.6	58.0	4032		
8640 min Summer	1.073	0.0	624.8	32.4	4920		
10080 min Summer	0.946	0.0	641.7	9.1	5848		
15 min Winter	128.336	0.0	138.4	1.8	22		
30 min Winter	84.360	0.0	180.2	29.4	35		
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Date 21/08/2020 17:44 File Catchment 3 hydrobrakeG...			Designed by jc3 Checked by				
Innovyze			Source Control 2016.1.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	50.132	0.132	2.1	2.4	4.4	129.6	O K
30 min Summer	50.169	0.169	2.1	4.5	6.5	167.3	O K
60 min Summer	50.203	0.203	2.1	6.7	8.6	202.0	O K
120 min Summer	50.228	0.228	2.1	7.8	9.7	227.7	O K
180 min Summer	50.234	0.234	2.1	8.0	9.9	234.8	O K
240 min Summer	50.237	0.237	2.1	8.1	10.0	237.6	O K
360 min Summer	50.238	0.238	2.1	8.1	10.1	238.3	O K
480 min Summer	50.237	0.237	2.1	8.1	10.0	237.1	O K
600 min Summer	50.234	0.234	2.1	8.0	9.9	234.3	O K
720 min Summer	50.230	0.230	2.1	7.9	9.8	230.6	O K
960 min Summer	50.222	0.222	2.1	7.6	9.5	222.1	O K
1440 min Summer	50.207	0.207	2.1	7.0	8.8	205.7	O K
2160 min Summer	50.187	0.187	2.1	5.7	7.6	185.8	O K
2880 min Summer	50.173	0.173	2.1	4.7	6.7	170.6	O K
4320 min Summer	50.151	0.151	2.1	3.4	5.4	148.8	O K
5760 min Summer	50.135	0.135	2.1	2.5	4.5	132.6	O K
7200 min Summer	50.123	0.123	2.1	1.9	4.0	120.0	O K
8640 min Summer	50.113	0.113	2.1	1.4	3.4	110.8	O K
10080 min Summer	50.104	0.104	2.1	0.9	3.0	101.7	O K
15 min Winter	50.148	0.148	2.1	3.1	5.2	145.2	O K
30 min Winter	50.189	0.189	2.1	5.8	7.7	187.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer	128.336	0.0	132.6	18.7	22		
30 min Summer	84.360	0.0	174.5	44.7	36		
60 min Summer	52.892	0.0	218.9	77.2	64		
120 min Summer	32.091	0.0	265.7	112.6	122		
180 min Summer	23.662	0.0	293.9	133.1	168		
240 min Summer	18.958	0.0	314.1	147.0	194		
360 min Summer	13.760	0.0	341.9	164.6	258		
480 min Summer	10.974	0.0	363.6	177.2	326		
600 min Summer	9.199	0.0	381.1	185.8	394		
720 min Summer	7.961	0.0	395.7	191.9	462		
960 min Summer	6.333	0.0	419.7	198.9	598		
1440 min Summer	4.580	0.0	455.4	200.3	866		
2160 min Summer	3.307	0.0	493.4	187.2	1256		
2880 min Summer	2.622	0.0	521.6	169.7	1644		
4320 min Summer	1.888	0.0	563.4	139.2	2420		
5760 min Summer	1.494	0.0	594.4	113.0	3168		
7200 min Summer	1.245	0.0	619.5	89.1	3896		
8640 min Summer	1.073	0.0	640.4	67.1	4672		
10080 min Summer	0.946	0.0	658.4	47.7	5456		
15 min Winter	128.336	0.0	148.6	28.0	22		
30 min Winter	84.360	0.0	195.5	60.2	35		
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Innovyze Source Control 2016.1.1		

Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	50.227	0.227	2.1	7.8	9.7	226.7	O K
120 min Winter	50.256	0.256	2.1	8.7	10.7	257.2	O K
180 min Winter	50.265	0.265	2.1	9.0	11.0	266.6	O K
240 min Winter	50.266	0.266	2.1	9.0	11.0	268.0	O K
360 min Winter	50.265	0.265	2.1	9.0	11.0	267.3	O K
480 min Winter	50.262	0.262	2.1	8.9	10.9	263.5	O K
600 min Winter	50.256	0.256	2.1	8.7	10.7	257.6	O K
720 min Winter	50.250	0.250	2.1	8.5	10.5	251.0	O K
960 min Winter	50.237	0.237	2.1	8.1	10.0	237.2	O K
1440 min Winter	50.213	0.213	2.1	7.3	9.2	212.5	O K
2160 min Winter	50.188	0.188	2.1	5.8	7.7	186.7	O K
2880 min Winter	50.170	0.170	2.1	4.6	6.6	168.2	O K
4320 min Winter	50.145	0.145	2.1	3.0	5.0	142.8	O K
5760 min Winter	50.127	0.127	2.1	2.1	4.2	124.0	O K
7200 min Winter	50.114	0.114	2.1	1.4	3.5	111.7	O K
8640 min Winter	50.103	0.103	2.1	0.9	3.0	100.4	O K
10080 min Winter	50.092	0.092	2.1	0.5	2.6	89.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	52.892	0.0	245.2	98.6	62
120 min Winter	32.091	0.0	298.1	138.9	118
180 min Winter	23.662	0.0	329.8	162.5	174
240 min Winter	18.958	0.0	351.8	178.5	202
360 min Winter	13.760	0.0	383.0	199.3	274
480 min Winter	10.974	0.0	407.3	214.3	350
600 min Winter	9.199	0.0	426.9	225.2	424
720 min Winter	7.961	0.0	443.3	233.5	498
960 min Winter	6.333	0.0	470.2	243.7	638
1440 min Winter	4.580	0.0	510.1	249.1	910
2160 min Winter	3.307	0.0	552.5	236.4	1300
2880 min Winter	2.622	0.0	584.1	215.1	1700
4320 min Winter	1.888	0.0	630.9	170.6	2504
5760 min Winter	1.494	0.0	665.8	130.5	3280
7200 min Winter	1.245	0.0	693.8	93.2	4040
8640 min Winter	1.073	0.0	717.2	59.8	4928
10080 min Winter	0.946	0.0	737.4	31.2	5752

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Hardy House, 140 High Street Esher Surrey, KT10 9QJ							
Date 21/08/2020 17:45 File Catchment 4 hydrobrakeG...			Designed by jc3 Checked by				
Innovyze			Source Control 2016.1.1				
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	51.172	0.672	5.7	0.2	5.7	349.8	O K
30 min Summer	51.322	0.822	5.7	10.7	15.5	452.2	O K
60 min Summer	51.447	0.947	5.7	17.1	22.2	544.5	O K
120 min Summer	51.538	1.038	5.7	20.2	25.5	615.2	O K
180 min Summer	51.563	1.063	5.7	21.0	26.3	635.5	O K
240 min Summer	51.573	1.073	5.7	21.3	26.7	643.9	O K
360 min Summer	51.578	1.078	5.7	21.4	26.8	648.2	O K
480 min Summer	51.576	1.076	5.7	21.4	26.8	646.9	O K
600 min Summer	51.569	1.069	5.7	21.2	26.6	641.0	O K
720 min Summer	51.559	1.059	5.7	20.8	26.2	632.9	O K
960 min Summer	51.535	1.035	5.7	20.1	25.4	612.9	O K
1440 min Summer	51.483	0.983	5.7	18.3	23.5	571.7	O K
2160 min Summer	51.417	0.917	5.7	15.9	20.9	521.2	O K
2880 min Summer	51.369	0.869	5.7	13.8	18.7	486.0	O K
4320 min Summer	51.315	0.815	5.7	10.0	14.7	446.8	O K
5760 min Summer	51.280	0.780	5.7	6.8	11.5	422.5	O K
7200 min Summer	51.251	0.751	5.7	4.5	9.1	402.4	O K
8640 min Summer	51.222	0.722	5.7	2.4	7.2	383.1	O K
10080 min Summer	51.179	0.679	5.7	0.3	5.7	354.6	O K
15 min Winter	51.235	0.735	5.7	3.4	8.2	391.6	O K
30 min Winter	51.394	0.894	5.7	14.9	19.9	504.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer	129.089	0.0	346.8	0.2	23		
30 min Summer	84.848	0.0	453.0	50.8	37		
60 min Summer	53.188	0.0	583.6	137.9	64		
120 min Summer	32.259	0.0	708.3	230.6	122		
180 min Summer	23.779	0.0	783.3	284.7	170		
240 min Summer	19.047	0.0	836.7	321.3	196		
360 min Summer	13.827	0.0	911.1	368.3	258		
480 min Summer	11.024	0.0	968.5	401.3	328		
600 min Summer	9.241	0.0	1014.7	424.7	396		
720 min Summer	7.997	0.0	1053.5	441.7	464		
960 min Summer	6.361	0.0	1116.7	460.5	598		
1440 min Summer	4.600	0.0	1207.4	457.7	866		
2160 min Summer	3.321	0.0	1316.5	413.9	1252		
2880 min Summer	2.633	0.0	1391.4	370.1	1620		
4320 min Summer	1.896	0.0	1501.1	291.6	2384		
5760 min Summer	1.500	0.0	1587.2	217.9	3224		
7200 min Summer	1.251	0.0	1653.5	145.0	4040		
8640 min Summer	1.077	0.0	1708.9	71.2	4928		
10080 min Summer	0.949	0.0	1755.8	6.5	5944		
15 min Winter	129.089	0.0	387.2	10.1	23		
30 min Winter	84.848	0.0	506.8	92.7	36		
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Date 21/08/2020 17:46 File Catchment 7 hydrobrakeG...			Designed by jc3 Checked by				
Innovyze			Source Control 2016.1.1				
Summary of Results for 100 year Return Period (+40%)							
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	59.035	0.235	1.6	0.0	1.6	101.9	O K
30 min Summer	59.100	0.300	1.6	0.7	2.2	133.2	O K
60 min Summer	59.158	0.358	1.6	3.4	4.8	162.1	O K
120 min Summer	59.200	0.400	1.6	5.4	6.8	183.9	O K
180 min Summer	59.213	0.413	1.6	5.8	7.1	190.7	O K
240 min Summer	59.219	0.419	1.6	5.9	7.3	193.4	O K
360 min Summer	59.223	0.423	1.6	6.0	7.4	195.8	O K
480 min Summer	59.225	0.425	1.6	6.1	7.5	196.7	O K
600 min Summer	59.224	0.424	1.6	6.1	7.4	196.3	O K
720 min Summer	59.222	0.422	1.6	6.0	7.4	195.1	O K
960 min Summer	59.215	0.415	1.6	5.8	7.2	191.4	O K
1440 min Summer	59.198	0.398	1.6	5.4	6.7	182.8	O K
2160 min Summer	59.178	0.378	1.6	4.4	5.8	172.2	O K
2880 min Summer	59.162	0.362	1.6	3.6	5.0	164.0	O K
4320 min Summer	59.138	0.338	1.6	2.3	3.8	152.1	O K
5760 min Summer	59.120	0.320	1.6	1.6	3.1	142.8	O K
7200 min Summer	59.106	0.306	1.6	1.0	2.5	136.1	O K
8640 min Summer	59.091	0.291	1.6	0.4	2.0	128.7	O K
10080 min Summer	59.071	0.271	1.6	0.1	1.6	118.8	O K
15 min Winter	59.061	0.261	1.6	0.0	1.6	114.3	O K
30 min Winter	59.131	0.331	1.6	2.0	3.5	148.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)		
15 min Summer	129.089	0.0	95.0	0.0	23		
30 min Summer	84.848	0.0	121.9	2.8	37		
60 min Summer	53.188	0.0	166.7	22.2	66		
120 min Summer	32.259	0.0	202.7	49.5	122		
180 min Summer	23.779	0.0	224.3	66.0	178		
240 min Summer	19.047	0.0	239.7	77.3	202		
360 min Summer	13.827	0.0	261.0	92.0	262		
480 min Summer	11.024	0.0	277.4	102.3	330		
600 min Summer	9.241	0.0	290.5	109.6	398		
720 min Summer	7.997	0.0	301.4	114.7	464		
960 min Summer	6.361	0.0	318.7	120.4	600		
1440 min Summer	4.600	0.0	341.1	121.1	866		
2160 min Summer	3.321	0.0	380.7	110.0	1256		
2880 min Summer	2.633	0.0	402.0	97.0	1648		
4320 min Summer	1.896	0.0	432.1	73.1	2460		
5760 min Summer	1.500	0.0	460.3	51.6	3232		
7200 min Summer	1.251	0.0	479.3	31.7	4104		
8640 min Summer	1.077	0.0	495.0	14.1	5008		
10080 min Summer	0.949	0.0	507.8	1.3	5856		
15 min Winter	129.089	0.0	105.7	0.0	23		
30 min Winter	84.848	0.0	135.3	10.8	36		
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