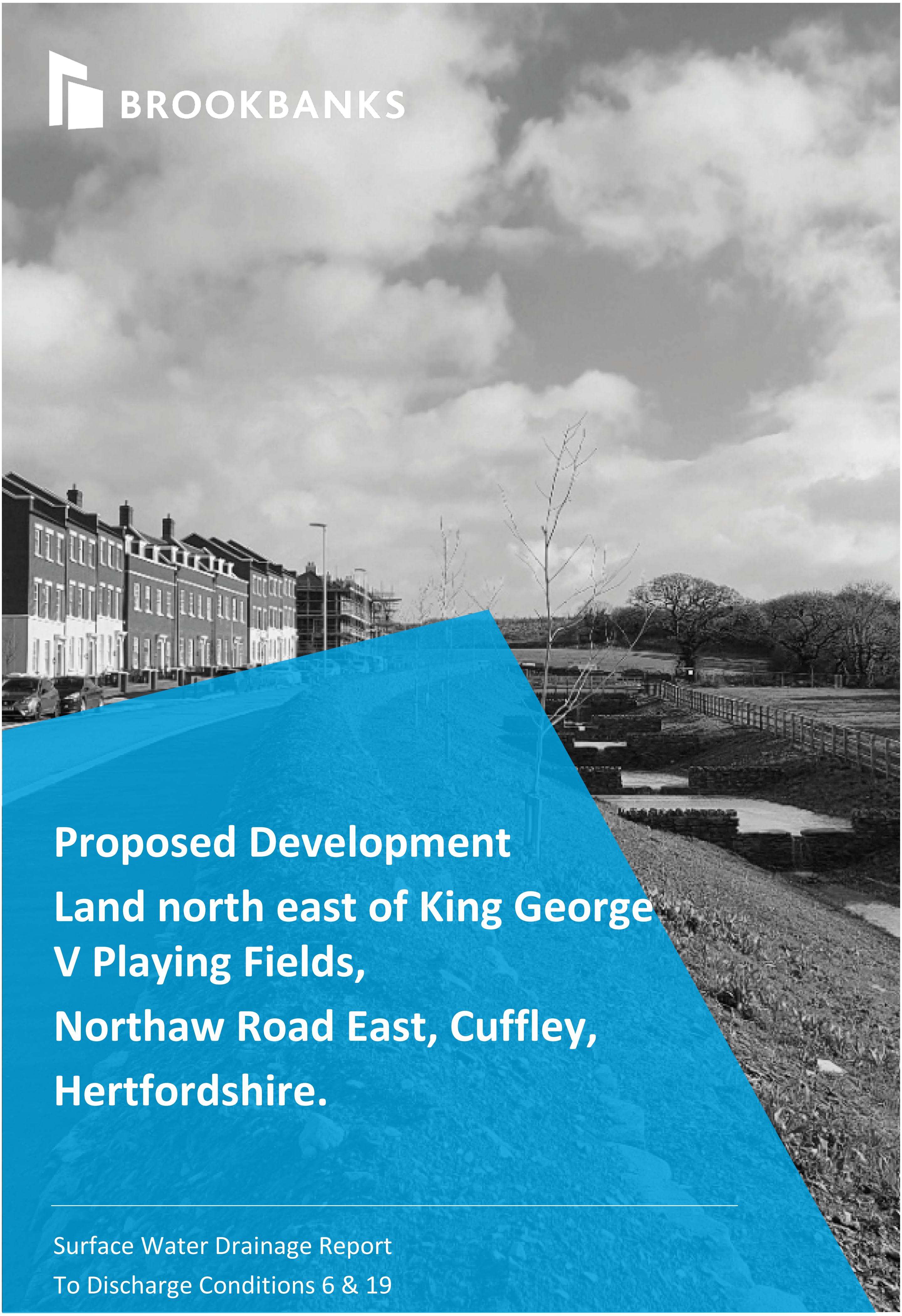

BROOKBANKS

Proposed Development

Land north east of King George V Playing Fields, Northaw Road East, Cuffley, Hertfordshire.

Surface Water Drainage Report

To Discharge Conditions 6 & 19

Document Control Sheet

Document Title	Drainage Report
Document Ref	10929/SWDR rev4
Project Name	Northaw Road East, Cuffley, Hertfordshire
Project Number	10929
Client	Bellway

Document Status

Rev	Issue Status	Prepared / Date	Checked / Date	Approved / Date
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2	Final	NJO / 09.11.22	TM / 17.11.22	RM / 17.11.22
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Appendix A – Drawing P1848.01 rev.L (sourced by AAP Architecture Ltd)

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Basin 2 -- Velocity, Volume & Depth Graphs

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Drawing 10929-500-004D – Exceedance Plan

Drawing 10929-500-005A – Basin and Swale Cross-sections

1 Introduction

1.1 Brookbanks Consulting (BCL) is appointed by Bellway Homes to produce a surface water drainage report for a residential development on Land north east of King George V playing fields, Northaw Road East, Cuffley.

1.2 This Report has been prepared in order to satisfy the following surface water drainage planning conditions with respect to the outline planning permission (ref. S6/2015/1342/PP) issued 31st March 2022 by Welwyn Hatfield.

1.3 ***Condition 6. Surface Water -***

No development shall take place until a detailed surface water drainage scheme for the site based on the approved drainage strategy and sustainable drainage principles has been submitted to and approved in writing by the Local Planning Authority. The drainage strategy should demonstrate the surface water run-off generated up to and including the 1 in 100year plus climate change critical event will not exceed the run off from the undeveloped site following the corresponding rainfall event. The scheme shall also include:

a) Detailed engineering drawings of the proposed SuDS features including cross section drawings, their size, volume, depth and any inlet and outlets features including any connecting pipe runs.

b) Final detailed post development network calculations for all storm events up to the 1 in 100year plus 40% climate change event with half drain down times less than 24 hours.

c) Assessment of the surface water flow path and the volumes to be managed as part of the development.

d) Exceedance flow routes for storms greater than the 1 in 100year plus 40% climate change event.

e) Final detailed management plan to include arrangements for adoption and other arrangements to secure the operation throughout its lifetime.

The mitigation measures shall be fully implemented prior to occupation and maintained in accordance with the timing/ phasing arrangements embodied within the scheme or any other period as may subsequently be agreed in writing by the Local Planning Authority.

Reason: To reduce the risk and impact of flooding by ensuring the satisfactory storage and disposal of surface water from the site; and to ensure surface water can be managed in a sustainable manner in accordance with Policy R7 and R10 of the Welwyn Hatfield District Plan 2005; Policy SADM14 of the draft Local Plan Proposed Submission August 2016; and the National Planning Policy Framework.

1.4 ***Condition 19. Surface Water -***

The development hereby permitted must be carried out in accordance with the approved Flood Risk Assessment prepared by Brookbanks (ref. 10710 FRA01 Rv0 dated 11 June 2021) and the following mitigation measures detailed within the Flood Risk Assessment.

a) Limiting the surface water run off generated by the critical storm events so that it will not exceed the surface water run off rate of 8.2 l/s during the 1 in 100year plus 40% climate change event.

b) Providing storage to ensure no increase in surface water volumes up to the 1 in 100year plus 40% climate change event providing a minimum of 1,494m^3 (or such volume agreed with the LLFA) of total storage volume in attenuation basin and swale.

c) Discharge of surface water from the private drain into the ordinary watercourse south of the site.

The mitigation measures shall be fully implemented prior to occupation and maintained in accordance with the timing/ phasing arrangements embodied within the scheme or any other period as may subsequently be agreed in writing by the Local Planning Authority.

Reason: To reduce the risk and impact of flooding by ensuring the satisfactory storage and disposal of surface water from the site; and to ensure surface water can be managed in a sustainable manner in accordance with Policy R7 and R10 of the Welwyn Hatfield District Plan 2005; Policy SADM14 of the draft Local Plan Proposed Submission August 2016; and the National Planning Policy Framework This report should be read in in accordance with the engineering drawings and other documents included in the Reserved Matters submission.

1.5 This report should be read in in accordance with the engineering drawings and other documents included in the Reserved Matters submission.

2 Surface Water Drainage

Background

2.1 The strategic surface water drainage scheme is based on the principles set out in the Flood Risk Assessment (FRA) (ref. 10710/FRA01/rev0) submitted and approved as part of the outline planning application.

2.2 The FRA outlined the drainage strategy for the development which included for flows to discharge via detention basins 1 and 2 to an existing ordinary watercourse flowing along the southern boundary of the Site conveying flows generally in a south easterly direction towards the Northaw Brook.

Baseline Conditions

2.3 The FRA includes baseline site discharge assessments using the nationally accepted IoH124 methodology for small rural catchments. Local policy is to employ IoH124 in a manner set out by CIRIA C697. This methodology requires that, for catchments of less than 50ha, the IoH assessment is completed for a 50ha area with the results linearly interpolated to determine the flow rate value based on the ratio of the development to 50ha.

2.4 The baseline IoH run-off rates are shown on Table 2.1 below:

Event	IOH scaled to (l/s/ha)
1 in 1 year	3.30
Qbar	3.88
1 in 100 year	12.39

Table 2.1: IoH124 baseline discharge rates

2.5 To determine the permitted rates of run-off from the development, the future impermeable catchment areas must be derived. This has been based on a BCL measured ratio from previous projects. Calculations below show these ratios and areas and how this correlate to the rates of discharge.

2.6 The calculations for this are shown in Table 2.2 below:

Catchment	Impermeable Area (ha)	Existing 100year run-off (l/s)	Proposed 100year run-off (l/s)
1	2.046	25.35	6.5
2	0.072	0.89	1.7

Table 2.2: IoH124 baseline discharge rates

2.7 Using these methods, development at the site will comply with the requirements set out in paragraph 9 of the Technical Guide to the National Planning Policy Framework (NPPF), with the discharge of surface water from the proposed developments not exceeding that of the existing greenfield sites, thus ensuring that there is no material increase in the flood risk to surrounding areas.

2.8 The proposed discharge rate from Basin 2 has been increased from the baseline greenfield rate, as such a small rate would have led to a small opening being required in the flow control which would have the potential for blockage.

2.9 Assessments have thereafter been completed to determine the characteristics of proposed SuDS features to be situated within the development. Best practice methods have been employed by performing detention routing calculations for both the 1 in 2year, 1 in 30year and 1 in 100 years + 40% climate change events.

Surface Water Strategy

2.10 The preferred option for the disposal of surface water utilises two outfall points into the existing ditch to the south of the Site.

2.10 Calculations have determined the volumes required to attenuate storm water discharges from the Site during the critical 1 in 100 year + 40% climate change storm event.

2.11 Peak discharges will be limited to the equivalent to the mean annual storm (Qbar), estimated by the IoH124 calculations above, representing a circa 69% reduction on peak greenfield rates. Table 2.3 below summarises the overall detention requirements.

Catchment 1	Impermeable Area (ha)	Proposed 100year run-off (l/s)	Detention volume during 1:100year (+40%cc) event
1	2.169	6.5	1,940
Swale			21.0
2	0.079	1.7	42.8
TOTAL	2.248	8.2	2,003.8

Table 2.3: Summary run off and basin storage volumes

2.12 Hydraulic calculations include Volume : Time graphs for each basin which demonstrate the half drain down times during the critical 1 in 100 year + 40% climate change storm event are approximately 2256 minutes and 252 minutes for Basins 1 and 2 respectively.

2.13 Detailed MD hydraulic calculations are included in Appendix C.

Drainage Proposals

2.14 Preliminary assessment of the requirements for storm drainage have been based on the following criteria:

Criteria	Measure/Rate/Factor
Impermeability factor – Residential	0.55
Impermeability factor – Highways	1.00
Urban Creep allowance	10%
Sewer design return period	1 in 2 year
Sewer flood protection	1 in 30 years
Fluvial / Development flood protection	1 in 100 years
M5-60	20.0 mm
Ratio r	0.40
Minimum cover to sewers	1.2 m
Minimum velocity	1.0 m/sec
Pipe ks value	0.6 mm
Climate change	40%

Table 2.4: Drainage Criteria and Measures

2.15 A surface water sewer layout serving the development has been shown on Drawing No's 10929-500-001 & 002 included in Appendix B to demonstrate the layout of the drainage system and location of proposed SuDS features.

2.16 Hydraulic design and analysis of the strategic surface water drainage systems has been completed using the MD Network module for various storm events up to the 1 in 100year (+40%cc) maximum design storm event. The surface water system including the detention basins has been tested against the 1:2year, 1:30year and the 1 in 100year (+40%cc) events using FEH2013 rainfall data.

2.17 Surface water sewers have been designed in accordance with the Sewerage Sector Guidance Appendix C - Design & Construction Guidance (DCG) (formerly Sewers for Adoption) and will be offered to Thames Water (TW) or New Appointment and Variations (NAV) for adoption under a Section 104 agreement. Further detailing of the drainage design will be undertaken as part of the Section 104 submission to TW.

2.18 Surface water sewers have been designed in accordance with DCG standards for no pipe surcharging during a 1 in 2 year storm event and no surface flooding during a 1 in 30 year storm event.

2.19 The surface water system has also be checked against storms up to the 1 in 100 year (+40%cc) event, in accordance with DCG requirements. Results show there is no surface water flooding from the system during the 1 in 100 year (+40%cc) event.

2.20 Impermeable areas have been measured from the Cuffley Appraisal Layout included in Appendix A. An urban creep factor of 10% has been applied to plot development impermeable areas to allow for future urban expansion. A schedule of impermeable areas is included in the Appendix.

Overland Flows

2.21 The FRA identified that an overland surface water flow paths crosses the existing site. The flow path follows the natural topography from the higher ground to the north of the site down to the watercourse flowing along the southern boundary.

2.22 The approved FRA however concluded that 'given the baseline site characteristics and further mitigating measures to be implemented residual flood risk from an overland flow mechanism is considered of a low probability'.

2.23 Extracts from EA Surface water flood mapping GIS data are included in Figure 2.5. This shows the extents of medium risk – chance of flooding between 1 in 100 Year Return (1%) and 1 in 30 Year Return (3.3%). The flood extents extends north into the proposed development area from the existing watercourse. Extracts also indicate the depth of flooding to be generally 0.0 - 0.15m within the site. The majority of the proposed development will be within areas that have a very low potential risk of flooding from surface water.

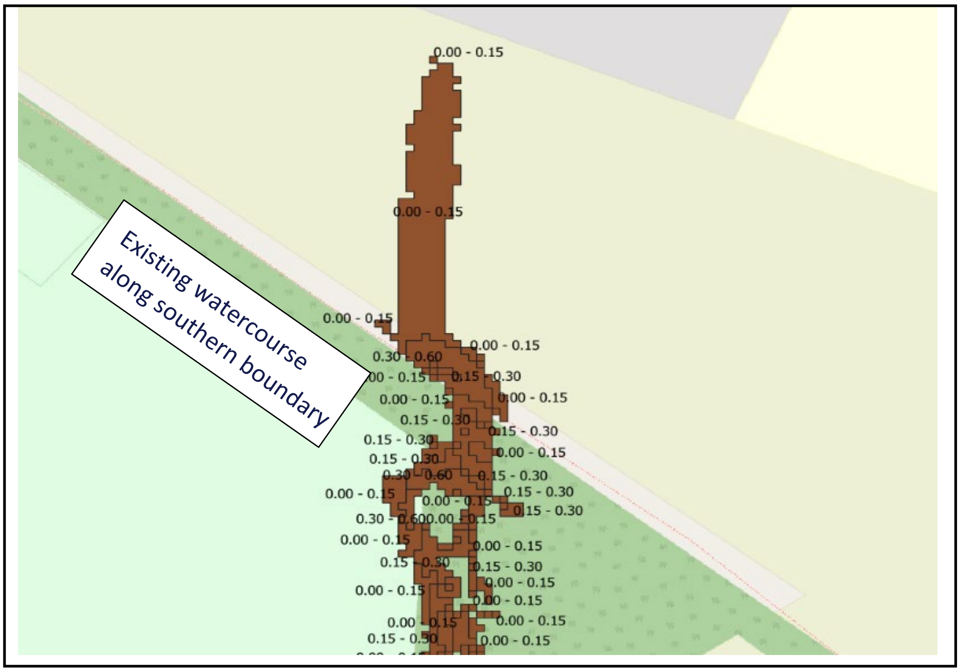


Figure 2.5: EA Surface water flood mapping 1:100year event

2.24 The new development will manage the existing surface water flood extents by developing the site with residential dwellings and altering the site topography. A new stormwater drainage and SuDS management system will also be constructed which will alter the surface run off regimes within the site. Surface water flows generated within the proposed site will now be collected by the new drainage scheme and exceedance routes associated with the drainage infrastructure have been established.

2.25 Although of a low flood risk, during the 1 in 100 year (+40%cc) event the potential for a surface water flow path originating at the north of the site from South Drive has also been considered. Surface water flood modelling has been undertaken to assess this impact at the request of the LLFA. Technical note 10929-TN01 accompanies this report and provides the modelling results for the existing baseline and post development conditions for the 1 in 1000yr and 1 in 100yr+ 40%CC rainfall events. Flood modelling demonstrates that the proposed surface water drainage system can manage the potential surface water flooding effectively.

2.26 The inflow hydrograph from the flood modelling has been added to PN 2.008 (MH S13) in the Micro Drainage model to replicate the impact of the surface water flooding collecting within the proposed carpark area south of South Drive and then being passes into the drainage network. This causes a marginal increase (< 100m3) in the volume requirement at Basin 1 due to the inflow for the critical 960min 1:100year (+40%cc) return period event. Exceedance from the pipe system is not an issue as the critical storm duration (15-30minutes) for the pipes will have passed before the surface water flood inflow commences (peak occurring after 960mins).

2.27 The revised basin area and volume is detailed on Drawings 10929-500-001 & 002 included in Appendix B and shows that the depth of the pond remains at 1.4m +0.3m freeboard with the proposed volume increased by a change in the pond area. 10929-500-004 D - Exceedance Plan is also included in the Appendix.

Exceedance Flows

2.27 As a result of extreme rainfall it is inevitable that the capacities of sewers and other drainage systems will be exceeded on occasion. Periods of exceedance occur when the rate of surface runoff exceeds the drainage system inlet capacity, when the pipe system becomes overloaded, or when the outfall becomes restricted due to flood levels in the receiving water.

2.28 Underground conveyance cannot economically or sustainably be built large enough for the most extreme events and, as a result, there will be occasions when surface water runoff will exceed the design capacity of drains. When drainage system capacity is exceeded the excess water (exceedance flow) is conveyed above ground, and will travel along streets and paths, and across open space areas.

2.29 The topography of the majority of the site falls towards the existing watercourse flowing along the southern boundary.

2.30 The proposed levels for the development site will replicate the existing topography, subject to acceptable development gradients, and strategic drainage exceedance flow paths have been designed to follow above ground routes towards the southern boundary.

2.31 Drawing 10929-500-004 - Exceedance Plan shows exceedance flow directions have been established through the strategic highway network of the development with flows routed to discharge at crossings to the southern boundary.

2.32 Basins and swales have also been designed with freeboard allowances above maximum design storm event water levels and spare capacity is available for exceedance run-off during more extreme events.

Water Quality

2.33 Impermeable surfaces collect pollutants from a wide variety of sources including cleaning activities, wear from car tyres, vehicle oil and exhaust leaks and general atmospheric deposition (source: CIRIA C609). The implementation of SUDS in development drainage provides a significant benefit in removal of pollutant from development run-off.

2.34 The SuDS Manual C753 describes a 'Simple Index Approach' for assessing the pollution risk of surface run-off to the receiving environment using indices for likely pollution levels for different land uses and SUDS performance capabilities. A 'Simple Index Approach' assessment has been undertaken below.

2.35 CIRIA document C753 Table 26.2, as shown in Table 2.5 below, indicates the minimum treatment indices appropriate for contributing pollution hazards for different land use classifications. To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index.

2.36 For Phase 1B (typically a residential type development), run-off from low traffic roads such as cul-de-sacs and individual property driveways pose the worst case pollution hazard.

Land Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4

Table 2.6 CIRIA 753 Table 26.2 Pollution Hazard Indices

Type of SUDS component	Total suspended solids (TSS)	Metals	Hydro-carbons
Detention Basin	0.5	0.5	0.6
Swales	0.5	0.6	0.6

Table 2.7 CIRIA 753 Table 26.3 SuDS Mitigation Indices for discharges to surface waters.

2.37 To provide the correct level of treatment, an assessment needs to be made of the mitigation provided by each SuDS feature. Table 26.3 of The SuDS Manual CIRIA document C753 shown as Table 2.6 for discharges to surface waters indicate the treatment mitigation indices provided by each SuDS feature.

2.38 Typically the strategic surface water system provides treatment of flows utilising a minimum of two SuDS features. Catchment 1 drains via a swale and detention basin 1. However with only a small area of plot development (0.079ha) within catchment 2, it is considered detention basin 2 will be sufficient to cater for the pollution risks posed. Pollution mitigation indices for treatment scenarios are shown in Table 2.7.

2.39 The SuDS management train being promoted for the development has been tailored to encourage passive treatment and from the above assessment in accordance with the 'Simple Index Approach' procedure, ref: Table 2.7, the combined SuDS pollution mitigation proposals are sufficient to manage the pollution hazards arising from the development.

Catchment Ref:	Pollution Hazard/ Mitigation Indices	Total suspended solids (TSS)	Metals	Hydro-carbons
1	Pollution Mitigation Indices (Swale>Basin1)	0.75	0.85	0.90
	Water Pollution Management	Sufficient	Sufficient	Sufficient
2	Pollution Mitigation Indices (Basin2)	0.50	0.50	0.60
	Water Pollution Management	Sufficient	Sufficient	Sufficient

Table 2.7: Simple Index Approach Assessment

Implementation

2.40 The anticipated build programme is 26 months – starting October 2022. 40 units being delivered year 23/24 and 81 units being delivered in 24/25.

2.41 Implementation of the storm water management system will be undertaken prior to first occupation of dwellings.

3.0 SuDS Maintenance

3.1 In accordance with condition 20 within the outline planning permission, upon completion of the drainage works for the site in accordance with the timing/ phasing arrangements, a management and maintenance plan for the SuDS features and drainage system will be submitted to and approved in writing by the Local Planning Authority. The management and maintenance plan will include:

i. Provision of complete set of as-built drawings for site drainage
ii. Maintenance and operational activities
iii. Arrangements for adoption and other measures to secure the operations of the scheme throughout its lifetime.

Background

3.2 Storm water from the proposed main access road and residential development will drain into the basin 1 in the south east of the site which has downstream flow controls prior to discharging into the existing watercourse. A small area of residential development drains to basin 2 in the south of the site which also has downstream flow controls prior to discharging into the existing watercourse.

3.3 Basins 1 and 2 have storage volumes of approximately 1,940m^3 and 48m^3 respectively during the 1 in 100 year (+40%cc) storm event.

3.4 The control chambers to the detention basins both incorporate a hydrobrake flow control set to limit discharges to the greenfield Qbar rate of 6.5 l/s and 1.7 l/s respectively during storms up to the 1 in 100 year (+40%cc) event.

3.5 In accordance with legislative requirements, the detention proposals have been assessed for the potential effects of climate change. The 1 in 100 year (1% AEP) return events have been modelled with 40% climate change allowance and show the detention basin performs adequately by retaining the additional flows within the system while maintaining a minimum 300mm freeboard.

3.6 Discharges of surface water to the existing watercourse will be subject to Land drainage consent.

SuDS Maintenance & Management Arrangements

3.7 The upstream surface water sewer system draining to the detention basin will be offered to TW or NAV for adoption under a section 104 agreement for future adoption and maintenance.

3.8 The detention basins, including the downstream headwall, control chamber and outlet pipe and grass swale will be managed and maintained by a private management company on behalf of the developer.

3.9 Detailed plans and design drawings indicating features and areas which are to be maintained by the private management company will be included in the management and maintenance plan.

3.10 The development layout provides adequate access and working areas in order to undertake the above maintenance procedures. Formal rights of access will be provided, where necessary, to the management company, if required.

Maintenance Schedules

3.11 The management and maintenance plan will include best practice guidance based on typical maintenance regimes for SuDS features as shown in the tables below:

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris	Monthly or as required
	Cut grass for spillways and access routes	Monthly during growing season or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly or when required
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly for 12 months, then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually or as required
	Manage wetland plants in outlet pool- where provided	Annually
Occasional Maintenance	Reseed areas of poor vegetation growth.	As required
	Prune and trim any trees and remove cuttings	Every 2 years or as required
	Remove sediment from inlets, outlet and forebay and main basin	Every 5 years or as required

Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Re-alignment of rip-rap	As required
	Repair/ rehabilitate inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels.	As required

Table 3.1: Recommended maintenance activities for Detention basins

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris	Monthly or as required
	Cut grass to retain grass height with specified design range	Monthly during growing season or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding > 48 hours	Monthly or when required
	Inspect vegetation coverage	Monthly for six months, quarterly for 2 years , then half yearly
	Inspect inlets and facility surface for silt accumulation, and establish appropriate silt removal frequencies	Six Monthly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	As required

	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 3.2: Recommended maintenance activities for swales

4.0 Foul Water Drainage

Background

4.1 The foul water drainage scheme is based on the principles set out in the Flood Risk Assessment (FRA) (ref. 10710/FRA01/rev0) submitted and approved as part of the outline planning application.

4.2 The FRA outlined the drainage strategy for the development which included for flows to discharge to an existing public sewer crossing within the site.

Point of Connection

4.3 Foul drainage proposals have been developed in consultation with TW that provide for an on-site connection to the existing public sewer crossing within the site.

4.4 TW are instructed to undertake a modelling study to assess the impacts of the development. At the time of writing this report timescales are awaited from TW to confirm the delivery date for the modelling study results.

4.5 Water companies have a statutory obligation through the Water Industry Act 1991, 2003 et al., to provide capital investment in strategic treatment infrastructure to meet development growth. This investment planning is managed and regulated by OFWAT through the Asset Management Plan (AMP) process. The five yearly cyclical process requires that water companies allocate finances to a range of strategic projects to meet their statutory obligations.

4.6 Where development programming requirements necessitate the reinforcement of facilities ahead of allocation in an AMP period, mechanisms are available to ensure the infrastructure can be delivered in a timely fashion, to meet the development programme.

5.0 Summary

5.1 The purpose of this Report is to set out details of the proposed surface water drainage scheme to manage surface water run-off from the development, as required by Conditions 6 and 19 of the outline planning permission.

5.2 A strategy for storm drainage at the site has been developed to meet both national and local policy. The above proposals employ means of drainage to comply with NPPF guidance, together with SFRA and other national and local guidance.

5.3 The drainage proposals will manage storm water by way of a SUDS management train and ensure peak discharges from the developed land provide betterment from the appraised baseline rates.

5.4 The proposals will also provide to maintain the quality of water discharged from the development during the construction and operational stages.

5.5 The storm water management proposals will improve the amenity and biodiversity of the site.

5.6 The storm water system has been designed so that it is suitable for adoption by TW or NAV for future maintenance. Future maintenance of the non- adoptable SuDS elements of the system will be undertaken by a private management company for the site.

5.7 Implementation of the storm water management system will be undertaken prior to first occupation of dwellings.

5.8 This Report demonstrates that against the requirements of the relevant conditions a suitable scheme for the discharge of surface water has been designed in accordance with the approved Surface Water Drainage Strategy contained within the approved FRA. The drainage scheme, designed and constructed in accordance with DCG standards with outfalls at agreed points of discharge, will be put in place to minimise the impacts of development during the construction and operational stages and cater for future phases of development.

6.0 Limitations

6.1 The conclusions and recommendations contained herein are limited to those given the general availability of background information and the planned usage of the site.

6.2 Third party information has been used in the preparation of this report, which Brookbanks Consulting Ltd, by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Brookbanks Consulting Ltd accepts no liability for same.

6.3 The benefits of this report are provided solely to Bellway Homes for the proposed development only.

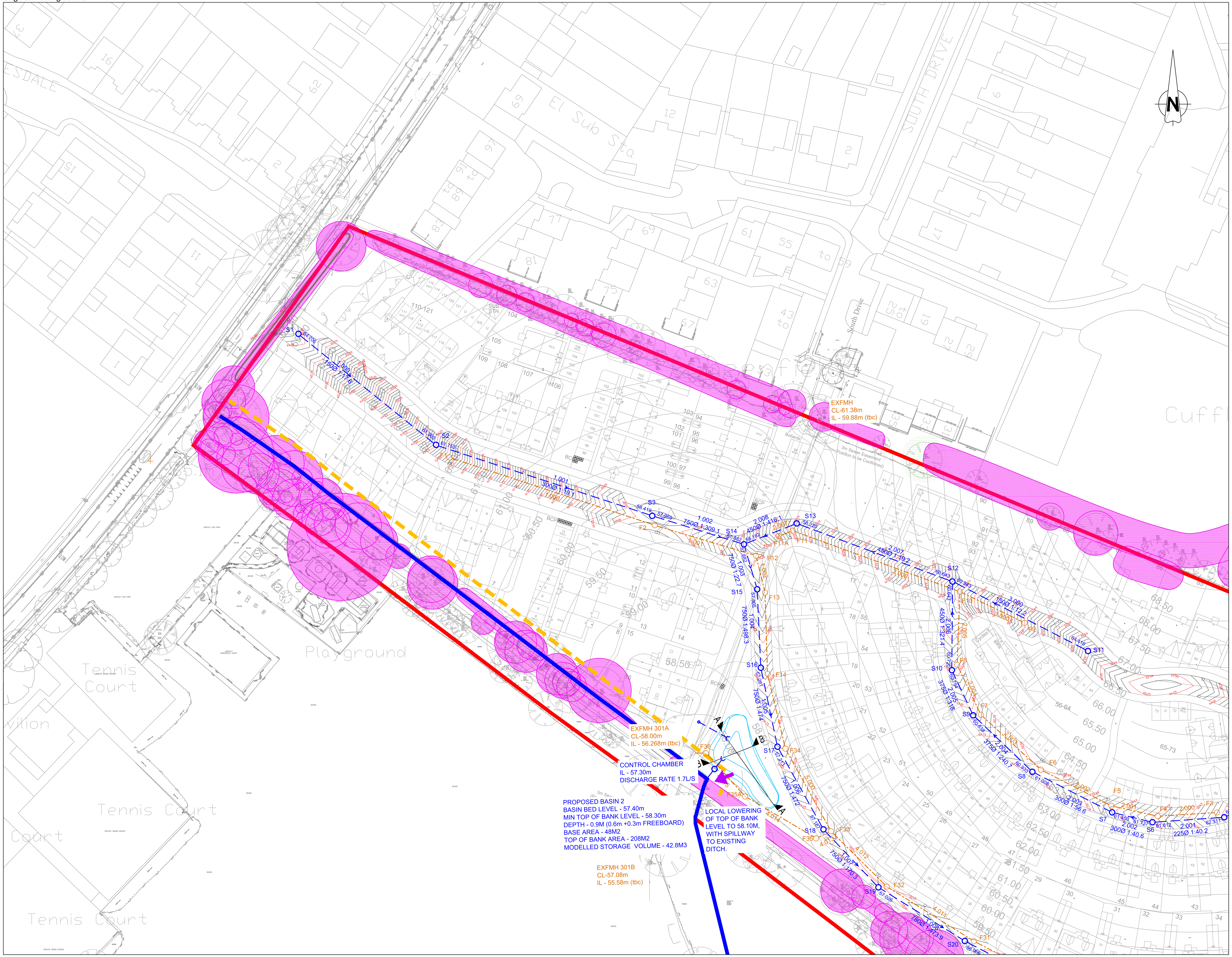
6.4 Brookbanks Consulting Ltd excludes third party rights for the information contained in the report.

Appendix A - Cuffley Appraisal Layout Plan

Block 1
110-121
Block 2
56-64
Block 3
65-73
3m Sewer Easement
(Position to be Confirmed)
Bollards
BCP
Cycles
Pond
Attenuation pond
Possible
Future
Access

Appendix B - Drainage Plans

Original Drawing Size A1



NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless otherwise stated.
3. Brookbanks Consulting Ltd has prepared this drawing for the sole use of the client. The drawing may not be relied upon by any other party without the express agreement of the client and Brookbanks Consulting Ltd. Where any data supplied by the client or from other sources has been used, it has been assumed that the information is correct. No responsibility can be accepted by Brookbanks Consulting Ltd for inaccuracies in the data supplied by any other party. The drawing has been produced based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.
4. No part of this drawing may be copied or duplicated without the express permission of Brookbanks Consulting Ltd.
5. Precise line and level of the existing foul water sewer are to be notified to the Engineer prior to the commencement of the works.

KEY:

- Site Boundary
- Existing Foul water
- Proposed Foul water sewer
- Proposed Surface water sewer
- Existing Watercourse
- Watercourse 5m offset
- Proposed SuDS Basin 1 in 3 slopes
- Basin spillway
- Proposed Basin 1 Outfall Route
- Root protection zones
- Proposed Swale

D	Basin 2 Volume ammended	NO	TM	TM	18.04.23
C	PN1.002 & 1.003 amended. Basin notes amended.	NO	TM	TM	12.01.23
B	Amended to comply with LLFA comments	NO	DC	TM	08/11/22
A	Drainage and Basins amended	HG	DC	RM	17.10.22
-	First Issue	HG	DC	TM	16.06.22

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Bellway

Land at Cuffley
Hertfordshire

Foul & Surface Water
Drainage Strategy

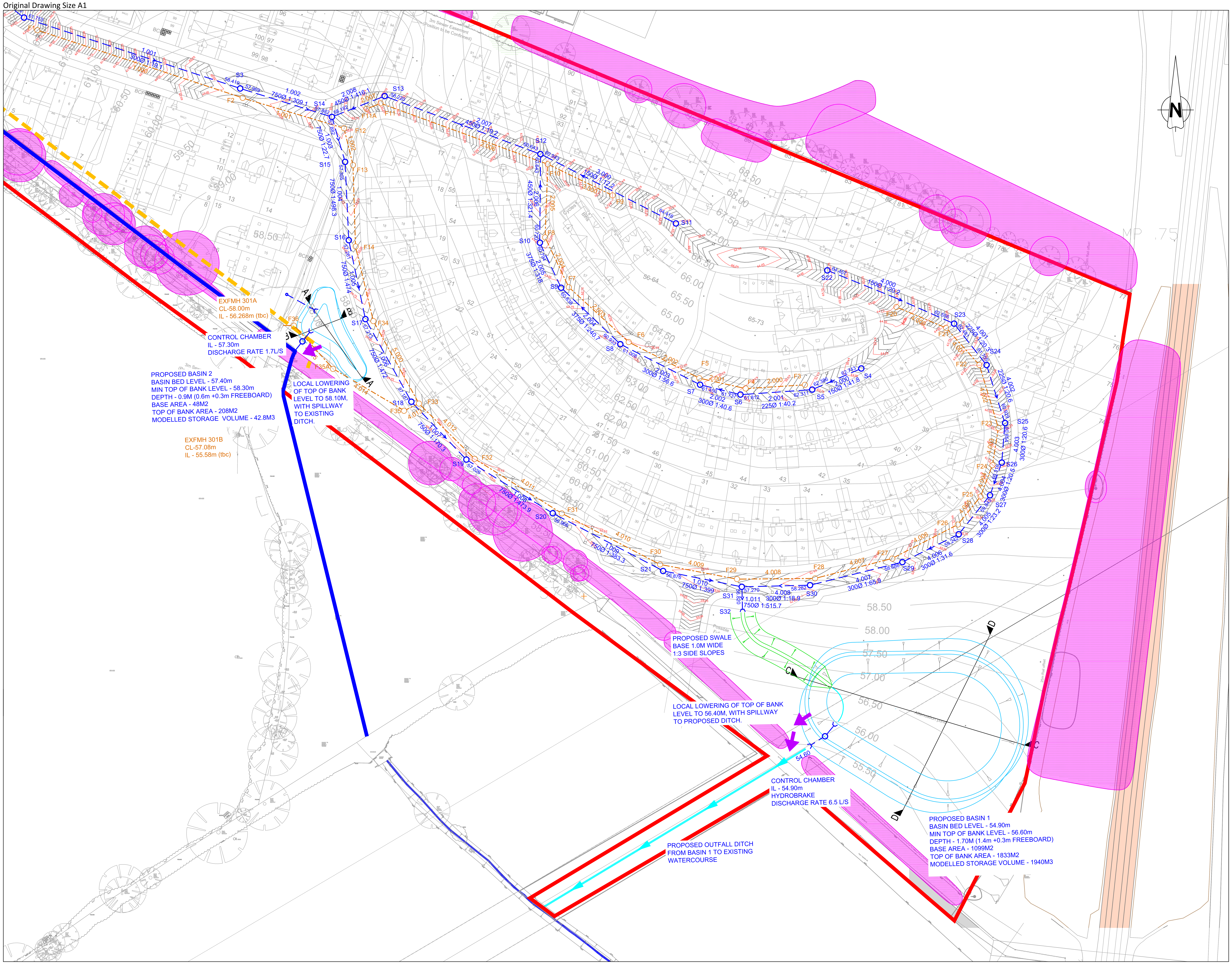
Status		Status Date
Approval		June 2022
Drawn	Checked	Date
HG	DC	16.06.22
Scale	Number	Rev
1:500	10929-500-001	D

0 10 20 30 40 50
METRES

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT HIS OWN RISK.

P:\10929\CAD\BCL\Working Drawings\10929-500-001D,002D - Drainage Layouts.dwg

Original Drawing Size A1



NOTES:

1. Do not scale from this drawing.
2. All dimensions are in metres unless otherwise stated.
3. Brookbanks Consulting Ltd has prepared this drawing for the sole use of the client. The drawing may not be relied upon by any other party without the express agreement of the client and Brookbanks Consulting Ltd. Where any data supplied by the client or from other sources has been used, it has been assumed that the information is correct. No responsibility can be accepted by Brookbanks Consulting Ltd for inaccuracies in the data supplied by any other party. The drawing has been produced based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.
4. No part of this drawing may be copied or duplicated without the express permission of Brookbanks Consulting Ltd.
5. Precise line and level of the existing foul water sewer are to be notified to the Engineer prior to the commencement of the works.

KEY:

- Site Boundary
- Existing Foul water
- Proposed Foul water sewer
- Proposed Surface water sewer
- Existing Watercourse
- Watercourse 5m offset
- Proposed SuDS Basin 1 in 3 slopes
- Basin spillway
- Proposed Basin 1 Outfall Route
- Root protection zones
- Proposed Swale

D	Basin 2 Volume ammended	NO	TM	TM	18.04.23
C	PN1.002 & 1.003 amended. Basin notes amended.	NO	TM	TM	12.01.23
B	Amended to comply with LLFA comments	NO	DC	TM	08/11/22
A	Drainage and Basins amended	HG	DC	RM	17.10.22
-	First Issue	HG	DC	TM	16.06.22

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Bellway

Land at Cuffley
Hertfordshire

Foul & Surface Water
Drainage Strategy 2

Status		Status Date
Approval		June 2022
Drawn	Checked	Date
HG	DC	16.06.22
Scale	Number	Rev
1:500	10929-500-002	D

0 10 20 30 40 50
METRES

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT HIS OWN RISK.

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Appendix C - MD Hydraulic calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 530950 201600 TL 30950 01600
Data Type	Catchment
Maximum Rainfall (mm/hr)	100
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	49.394	2.802	17.6	0.060	5.00	0.0	0.600		o	150	Pipe/Conduit	
1.001	63.543	3.334	19.1	0.213	0.00	0.0	0.600		o	300	Pipe/Conduit	
1.002	26.894	0.087	309.1	0.323	0.00	0.0	0.600		o	750	Pipe/Conduit	
2.000	14.931	0.357	41.8	0.043	5.00	0.0	0.600		o	150	Pipe/Conduit	
2.001	20.083	0.499	40.2	0.050	0.00	0.0	0.600		o	225	Pipe/Conduit	
2.002	11.639	0.287	40.6	0.094	0.00	0.0	0.600		o	300	Pipe/Conduit	
2.003	25.002	0.442	56.6	0.015	0.00	0.0	0.600		o	300	Pipe/Conduit	
2.004	22.863	0.095	240.7	0.096	0.00	0.0	0.600		o	375	Pipe/Conduit	
2.005	13.993	0.044	318.0	0.115	0.00	0.0	0.600		o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	63.18	5.34	64.705	0.060	0.0	0.0	0.0	2.41	42.6	10.3
1.001	61.75	5.63	61.753	0.273	0.0	0.0	0.0	3.62	255.7	45.7
1.002	60.41	5.92	57.969	0.596	0.0	0.0	0.0	1.59	700.8	97.5
2.000	64.08	5.16	62.743	0.043	0.0	0.0	0.0	1.56	27.6	7.5
2.001	63.28	5.32	62.311	0.093	0.0	0.0	0.0	2.07	82.2	15.9
2.002	62.89	5.40	61.737	0.187	0.0	0.0	0.0	2.48	175.0	31.9
2.003	61.92	5.60	61.450	0.202	0.0	0.0	0.0	2.09	148.1	33.9
2.004	60.37	5.93	60.933	0.298	0.0	0.0	0.0	1.16	128.5	48.7
2.005	59.31	6.16	60.838	0.413	0.0	0.0	0.0	1.01	111.6	66.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
2.006	24.744	0.077	321.4	0.023	0.00	0.0	0.600		o	450	Pipe/Conduit	
3.000	42.499	3.473	12.2	0.096	5.00	0.0	0.600		o	150	Pipe/Conduit	
2.007	46.504	2.423	19.2	0.084	0.00	0.0	0.600		o	450	Pipe/Conduit	
2.008	15.813	0.038	416.1	0.062	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.003	13.070	0.577	22.7	0.071	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.004	21.923	0.044	498.3	0.033	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.005	22.543	0.048	474.0	0.016	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.006	26.430	0.056	472.0	0.079	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.007	22.308	0.131	170.3	0.041	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.008	28.432	0.060	473.9	0.087	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.009	34.881	0.091	383.3	0.078	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.010	22.342	0.056	399.0	0.050	0.00	0.0	0.600		o	750	Pipe/Conduit	
4.000	38.426	1.901	20.2	0.087	5.00	0.0	0.600		o	150	Pipe/Conduit	
4.001	14.716	0.726	20.3	0.044	0.00	0.0	0.600		o	225	Pipe/Conduit	
4.002	17.029	0.826	20.6	0.063	0.00	0.0	0.600		o	225	Pipe/Conduit	
4.003	11.064	0.538	20.6	0.074	0.00	0.0	0.600		o	300	Pipe/Conduit	
4.004	9.703	0.473	20.5	0.013	0.00	0.0	0.600		o	300	Pipe/Conduit	
4.005	13.963	0.601	23.2	0.020	0.00	0.0	0.600		o	300	Pipe/Conduit	
4.006	17.562	0.556	31.6	0.018	0.00	0.0	0.600		o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.006	57.69	6.52	60.720	0.436	0.0	0.0	0.0	1.13	179.5	68.1
3.000	63.65	5.24	64.416	0.096	0.0	0.0	0.0	2.90	51.2	16.5
2.007	56.98	6.69	60.643	0.616	0.0	0.0	0.0	4.66	740.7	95.1
2.008	55.88	6.95	58.220	0.678	0.0	0.0	0.0	0.99	157.5	102.6
1.003	55.73	6.99	57.882	1.345	0.0	0.0	0.0	5.89	2604.2	203.0
1.004	54.58	7.28	57.305	1.378	0.0	0.0	0.0	1.25	550.8	203.7
1.005	53.46	7.58	57.261	1.394	0.0	0.0	0.0	1.28	564.9	203.7
1.006	52.22	7.92	57.213	1.473	0.0	0.0	0.0	1.28	566.1	208.3
1.007	51.61	8.10	57.157	1.514	0.0	0.0	0.0	2.14	946.2	211.6
1.008	50.36	8.47	57.026	1.601	0.0	0.0	0.0	1.28	565.0	218.4
1.009	49.06	8.87	56.966	1.679	0.0	0.0	0.0	1.42	628.8	223.1
1.010	48.25	9.14	56.876	1.729	0.0	0.0	0.0	1.39	616.2	225.9
4.000	63.46	5.28	64.457	0.087	0.0	0.0	0.0	2.25	39.8	15.0
4.001	63.04	5.37	62.481	0.131	0.0	0.0	0.0	2.92	116.1	22.4
4.002	62.56	5.47	61.755	0.194	0.0	0.0	0.0	2.89	115.1	32.9
4.003	62.31	5.52	60.854	0.268	0.0	0.0	0.0	3.48	246.2	45.2
4.004	62.08	5.57	60.316	0.281	0.0	0.0	0.0	3.49	246.5	47.2
4.005	61.74	5.64	59.843	0.301	0.0	0.0	0.0	3.28	231.5	50.3
4.006	61.24	5.74	59.242	0.319	0.0	0.0	0.0	2.81	198.5	52.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
4.007	26.605	0.404	65.9	0.056	0.00	0.0	0.600		o	300	Pipe/Conduit	
4.008	19.096	1.012	18.9	0.035	0.00	0.0	0.600		o	300	Pipe/Conduit	
1.011	3.610	0.007	515.7	0.031	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.012	26.348	1.000	26.3	0.000	0.00	0.0		0.030	\/	-1	Pipe/Conduit	
1.013	20.106	0.200	100.5	0.000	0.00	0.0	0.600		o	1200	Pipe/Conduit	
1.014	4.629	0.300	15.4	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.007	60.17	5.97	58.686	0.375	0.0	0.0	0.0	1.94	137.2	61.1
4.008	59.76	6.06	58.282	0.410	0.0	0.0	0.0	3.64	257.0	66.4
1.011	48.11	9.19	56.820	2.170	0.0	0.0	0.0	1.23	541.3	282.7
1.012	47.81	9.29	56.588	2.170	0.0	0.0	0.0	4.34	17354.7	282.7
1.013	47.55	9.38	55.100	2.170	0.0	0.0	0.0	3.73	4220.5	282.7
1.014	47.49	9.40	54.900	2.170	0.0	0.0	0.0	4.02	284.3	282.7

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.014	35	55.500	54.600	0.000	0	0

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 34, DS/PN: 1.014, Volume (m³): 22.7

Unit Reference	MD-SHE-0113-6500-1400-6500
Design Head (m)	1.400
Design Flow (l/s)	6.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	54.900
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	6.5	Kick-Flo®	0.862	5.2
Flush-Flo™	0.412	6.5	Mean Flow over Head Range	-	5.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.0	0.800	5.6	2.000	7.7	4.000	10.7	7.000	13.9
0.200	6.0	1.000	5.6	2.200	8.0	4.500	11.3	7.500	14.4
0.300	6.4	1.200	6.0	2.400	8.4	5.000	11.8	8.000	14.8
0.400	6.5	1.400	6.5	2.600	8.7	5.500	12.4	8.500	15.3
0.500	6.4	1.600	6.9	3.000	9.3	6.000	12.9	9.000	15.7
0.600	6.3	1.800	7.3	3.500	10.0	6.500	13.4	9.500	16.1

Storage Structures for Storm

Tank or Pond Manhole: 34, DS/PN: 1.014

Invert Level (m) 54.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1085.0	1.700	1816.0

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 530950 201600 TL 30950 01600 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Winter	2	+0%					64.754	-0.101	0.000
1.001	2	15 Winter	2	+0%					61.833	-0.220	0.000
1.002	3	15 Winter	2	+0%	100/15 Summer				58.167	-0.552	0.000
2.000	4	15 Winter	2	+0%	100/15 Summer				62.796	-0.097	0.000
2.001	5	15 Winter	2	+0%	100/15 Summer				62.376	-0.160	0.000
2.002	6	15 Winter	2	+0%	100/15 Summer				61.828	-0.209	0.000
2.003	7	15 Winter	2	+0%	100/15 Summer				61.545	-0.205	0.000
2.004	8	15 Winter	2	+0%	30/15 Summer				61.111	-0.197	0.000
2.005	9	15 Winter	2	+0%	30/15 Summer				61.060	-0.153	0.000
2.006	10	15 Winter	2	+0%	30/15 Winter				60.915	-0.255	0.000
3.000	11	15 Winter	2	+0%	100/15 Summer				64.473	-0.093	0.000
2.007	12	15 Winter	2	+0%					60.748	-0.345	0.000
2.008	13	15 Winter	2	+0%	30/15 Summer				58.540	-0.130	0.000
1.003	14	15 Winter	2	+0%	100/15 Summer				58.076	-0.556	0.000
1.004	15	15 Winter	2	+0%	30/15 Summer				57.688	-0.367	0.000
1.005	16	15 Winter	2	+0%	30/15 Summer				57.625	-0.386	0.000
1.006	17	15 Winter	2	+0%	30/15 Winter				57.560	-0.403	0.000
1.007	18	15 Winter	2	+0%	100/15 Summer				57.467	-0.441	0.000
1.008	19	15 Winter	2	+0%	30/15 Summer				57.413	-0.363	0.000
1.009	20	15 Winter	2	+0%	30/15 Winter				57.353	-0.364	0.000
1.010	21	15 Winter	2	+0%	30/15 Summer				57.291	-0.335	0.000
4.000	22	15 Winter	2	+0%	100/15 Summer				64.520	-0.087	0.000
4.001	23	15 Winter	2	+0%	100/15 Winter				62.549	-0.157	0.000
4.002	24	15 Winter	2	+0%	100/15 Summer				61.836	-0.144	0.000
4.003	25	15 Winter	2	+0%	100/15 Summer				60.947	-0.207	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.23			9.5	OK	
1.001	2	0.16			38.4	OK	
1.002	3	0.16			82.3	OK	
2.000	4	0.27			6.9	OK	
2.001	5	0.18			13.6	OK	
2.002	6	0.20			26.3	OK	
2.003	7	0.22			28.5	OK	
2.004	8	0.37			41.2	OK	
2.005	9	0.65			55.5	OK	
2.006	10	0.39			58.5	OK	
3.000	11	0.31			15.4	OK	
2.007	12	0.12			82.1	OK	
2.008	13	0.85			90.3	OK	
1.003	14	0.15			178.4	OK	
1.004	15	0.48			180.7	OK	
1.005	16	0.45			179.7	OK	
1.006	17	0.43			185.7	OK	
1.007	18	0.31			187.2	OK	
1.008	19	0.44			189.3	OK	
1.009	20	0.38			190.1	OK	
1.010	21	0.43			192.4	OK	
4.000	22	0.36			13.8	OK	
4.001	23	0.19			19.7	OK	
4.002	24	0.28			28.4	OK	
4.003	25	0.21			38.5	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
4.004	26	15 Winter	2	+0%	100/15 Summer				60.414	-0.202	0.000
4.005	27	15 Winter	2	+0%	100/15 Summer				59.939	-0.204	0.000
4.006	28	15 Winter	2	+0%	100/15 Summer				59.347	-0.195	0.000
4.007	29	15 Winter	2	+0%	30/15 Summer				58.823	-0.163	0.000
4.008	30	15 Winter	2	+0%	100/15 Summer				58.385	-0.197	0.000
1.011	31	15 Winter	2	+0%	30/15 Winter				57.252	-0.318	0.000
1.012	32	15 Winter	2	+0%					56.705	-0.883	0.000
1.013	33	15 Winter	2	+0%					55.369	-0.931	0.000
1.014	34	480 Winter	2	+0%	2/180 Winter				55.270	0.070	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.004	26	0.23			40.3	OK	
4.005	27	0.22			43.0	OK	
4.006	28	0.27			45.4	OK	
4.007	29	0.43			52.7	OK	
4.008	30	0.26			57.1	OK	
1.011	31	0.63			224.2	OK	
1.012	32	0.02			222.7	OK	
1.013	33	0.11			223.1	OK*	
1.014	34	0.05			6.5	SURCHARGED*	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 530950 201600 TL 30950 01600 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Winter	30	+0%					64.784	-0.071	0.000
1.001	2	15 Winter	30	+0%					61.892	-0.161	0.000
1.002	3	15 Winter	30	+0%	100/15 Summer				58.319	-0.400	0.000
2.000	4	15 Winter	30	+0%	100/15 Summer				62.830	-0.063	0.000
2.001	5	15 Winter	30	+0%	100/15 Summer				62.422	-0.114	0.000
2.002	6	15 Winter	30	+0%	100/15 Summer				61.896	-0.141	0.000
2.003	7	15 Winter	30	+0%	100/15 Summer				61.618	-0.132	0.000
2.004	8	15 Winter	30	+0%	30/15 Summer				61.425	0.117	0.000
2.005	9	15 Winter	30	+0%	30/15 Summer				61.328	0.115	0.000
2.006	10	15 Winter	30	+0%	30/15 Winter				61.171	0.001	0.000
3.000	11	15 Winter	30	+0%	100/15 Summer				64.511	-0.055	0.000
2.007	12	15 Winter	30	+0%					60.822	-0.271	0.000
2.008	13	15 Winter	30	+0%	30/15 Summer				58.796	0.126	0.000
1.003	14	15 Winter	30	+0%	100/15 Summer				58.219	-0.413	0.000
1.004	15	15 Winter	30	+0%	30/15 Summer				58.100	0.045	0.000
1.005	16	15 Winter	30	+0%	30/15 Summer				58.035	0.024	0.000
1.006	17	15 Winter	30	+0%	30/15 Winter				57.966	0.002	0.000
1.007	18	15 Winter	30	+0%	100/15 Summer				57.875	-0.032	0.000
1.008	19	15 Winter	30	+0%	30/15 Summer				57.815	0.038	0.000
1.009	20	15 Winter	30	+0%	30/15 Winter				57.738	0.022	0.000
1.010	21	15 Winter	30	+0%	30/15 Summer				57.647	0.021	0.000
4.000	22	15 Winter	30	+0%	100/15 Summer				64.564	-0.043	0.000
4.001	23	15 Winter	30	+0%	100/15 Winter				62.593	-0.113	0.000
4.002	24	15 Winter	30	+0%	100/15 Summer				61.899	-0.081	0.000
4.003	25	15 Winter	30	+0%	100/15 Summer				61.017	-0.137	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.53			22.1	OK	
1.001	2	0.44			106.7	OK	
1.002	3	0.44			233.2	OK	
2.000	4	0.63			16.0	OK	
2.001	5	0.48			35.8	OK	
2.002	6	0.55			73.1	OK	
2.003	7	0.60			78.9	OK	
2.004	8	1.02			111.9	SURCHARGED	
2.005	9	1.79			153.2	SURCHARGED	
2.006	10	1.05			157.8	SURCHARGED	
3.000	11	0.72			35.7	OK	
2.007	12	0.33			220.1	OK	
2.008	13	2.25			239.6	SURCHARGED	
1.003	14	0.41			490.9	OK	
1.004	15	1.31			490.5	SURCHARGED	
1.005	16	1.22			488.6	SURCHARGED	
1.006	17	1.14			486.6	SURCHARGED	
1.007	18	0.82			496.0	OK	
1.008	19	1.13			489.0	SURCHARGED	
1.009	20	0.99			495.7	SURCHARGED	
1.010	21	1.10			490.7	SURCHARGED	
4.000	22	0.83			32.1	OK	
4.001	23	0.48			49.3	OK	
4.002	24	0.72			74.0	OK	
4.003	25	0.56			103.0	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
4.004	26	15 Winter	30	+0%	100/15 Summer				60.490	-0.126	0.000
4.005	27	15 Winter	30	+0%	100/15 Summer				60.012	-0.131	0.000
4.006	28	15 Winter	30	+0%	100/15 Summer				59.433	-0.109	0.000
4.007	29	15 Winter	30	+0%	30/15 Summer				59.111	0.125	0.000
4.008	30	15 Winter	30	+0%	100/15 Summer				58.467	-0.115	0.000
1.011	31	15 Winter	30	+0%	30/15 Winter				57.577	0.007	0.000
1.012	32	15 Winter	30	+0%					56.779	-0.809	0.000
1.013	33	600 Winter	30	+0%					55.627	-0.673	0.000
1.014	34	600 Winter	30	+0%	2/180 Winter				55.627	0.427	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.004	26	0.62			107.5	OK	
4.005	27	0.60			114.6	OK	
4.006	28	0.71			120.9	OK	
4.007	29	1.15			142.1	SURCHARGED	
4.008	30	0.69			153.9	OK	
1.011	31	1.61			572.7	SURCHARGED	
1.012	32	0.04			570.1	OK	
1.013	33	0.04			74.8	OK*	
1.014	34	0.05			6.4	SURCHARGED*	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 530950 201600 TL 30950 01600 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Winter	100	+40%					64.824	-0.031	0.000
1.001	2	15 Winter	100	+40%					61.958	-0.095	0.000
1.002	3	15 Winter	100	+40%	100/15 Summer				59.723	1.004	0.000
2.000	4	15 Winter	100	+40%	100/15 Summer				63.214	0.321	0.000
2.001	5	15 Winter	100	+40%	100/15 Summer				62.846	0.310	0.000
2.002	6	15 Winter	100	+40%	100/15 Summer				62.570	0.533	0.000
2.003	7	15 Winter	100	+40%	100/15 Summer				62.369	0.619	0.000
2.004	8	15 Winter	100	+40%	30/15 Summer				62.011	0.703	0.000
2.005	9	15 Winter	100	+40%	30/15 Summer				61.751	0.538	0.000
2.006	10	15 Winter	100	+40%	30/15 Winter				61.318	0.148	0.000
3.000	11	15 Winter	100	+40%	100/15 Summer				65.277	0.711	0.000
2.007	12	15 Winter	100	+40%					60.884	-0.209	0.000
2.008	13	15 Winter	100	+40%	30/15 Summer				60.123	1.453	0.000
1.003	14	15 Winter	100	+40%	100/15 Summer				59.690	1.058	0.000
1.004	15	15 Winter	100	+40%	30/15 Summer				59.507	1.452	0.000
1.005	16	15 Winter	100	+40%	30/15 Summer				59.313	1.302	0.000
1.006	17	15 Winter	100	+40%	30/15 Winter				59.111	1.148	0.000
1.007	18	15 Winter	100	+40%	100/15 Summer				58.908	1.001	0.000
1.008	19	15 Winter	100	+40%	30/15 Summer				58.689	0.913	0.000
1.009	20	15 Winter	100	+40%	30/15 Winter				58.452	0.735	0.000
1.010	21	15 Winter	100	+40%	30/15 Summer				58.198	0.572	0.000
4.000	22	15 Winter	100	+40%	100/15 Summer				65.611	1.004	0.000
4.001	23	15 Winter	100	+40%	100/15 Winter				62.760	0.054	0.000
4.002	24	15 Winter	100	+40%	100/15 Summer				62.407	0.427	0.000
4.003	25	15 Winter	100	+40%	100/15 Summer				61.527	0.373	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.97			40.3	OK	
1.001	2	0.80			193.9	OK	
1.002	3	0.72			380.6	FLOOD RISK	
2.000	4	1.05			26.7	SURCHARGED	
2.001	5	0.76			56.9	SURCHARGED	
2.002	6	0.83			111.8	SURCHARGED	
2.003	7	0.92			122.2	SURCHARGED	
2.004	8	1.64			180.3	SURCHARGED	
2.005	9	2.96			253.3	SURCHARGED	
2.006	10	1.77			265.6	SURCHARGED	
3.000	11	1.10			54.4	SURCHARGED	
2.007	12	0.56			371.3	OK	
2.008	13	3.55			377.1	SURCHARGED	
1.003	14	0.60			714.4	SURCHARGED	
1.004	15	1.91			713.4	SURCHARGED	
1.005	16	1.77			708.6	SURCHARGED	
1.006	17	1.71			730.7	SURCHARGED	
1.007	18	1.23			743.3	FLOOD RISK	
1.008	19	1.77			764.5	FLOOD RISK	
1.009	20	1.56			780.7	SURCHARGED	
1.010	21	1.77			793.5	SURCHARGED	
4.000	22	1.23			47.3	FLOOD RISK	
4.001	23	0.72			73.6	SURCHARGED	
4.002	24	1.08			110.7	SURCHARGED	
4.003	25	0.84			154.5	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
4.004	26	15 Winter	100	+40%	100/15 Summer				61.185	0.569	0.000
4.005	27	15 Winter	100	+40%	100/15 Summer				60.814	0.671	0.000
4.006	28	15 Winter	100	+40%	100/15 Summer				60.383	0.841	0.000
4.007	29	15 Winter	100	+40%	30/15 Summer				59.821	0.835	0.000
4.008	30	15 Winter	100	+40%	100/15 Summer				58.801	0.219	0.000
1.011	31	15 Winter	100	+40%	30/15 Winter				57.937	0.367	0.000
1.012	32	15 Winter	100	+40%					56.856	-0.732	0.000
1.013	33	960 Winter	100	+40%					56.241	-0.059	0.000
1.014	34	960 Winter	100	+40%	2/180 Winter				56.241	1.041	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.004	26	0.89			153.6	SURCHARGED	
4.005	27	0.85			162.7	SURCHARGED	
4.006	28	1.01			171.3	SURCHARGED	
4.007	29	1.64			201.7	SURCHARGED	
4.008	30	0.96			213.6	SURCHARGED	
1.011	31	2.80			1000.5	SURCHARGED	
1.012	32	0.07			999.2	OK	
1.013	33	0.05			93.9	OK*	
1.014	34	0.05			6.4	SURCHARGED*	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 530950 201600 TL 30950 01600 Cv (Winter) 0.840

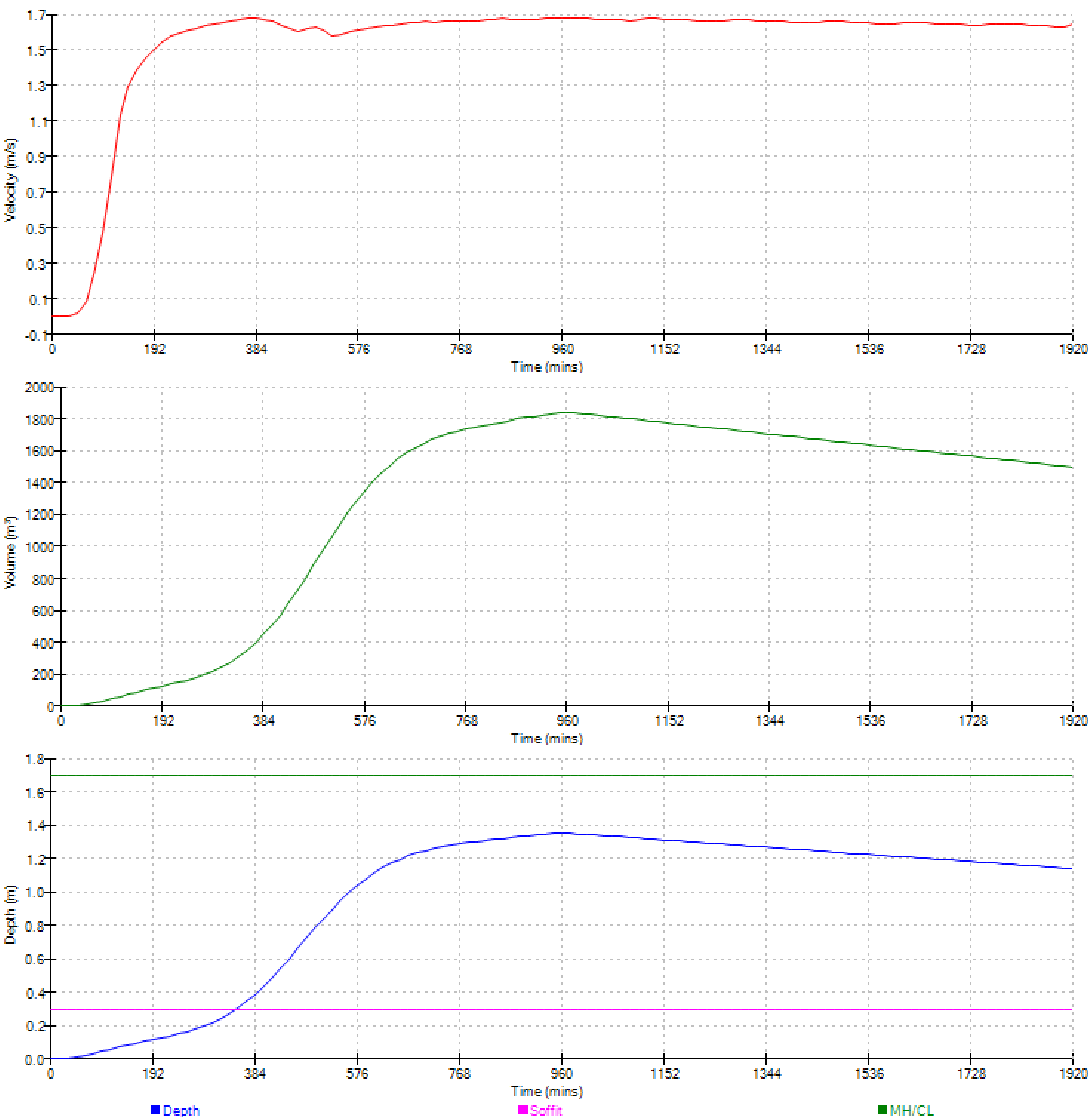
Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.014	34	960 Winter	100	+40%	2/180 Winter				56.253	1.053	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.014	34	0.05			6.4	SURCHARGED*	

Graphs for Pipe 1.014 US/MH 34 (Storm)
960 minute 100 year Winter I+40%
Status: OK*



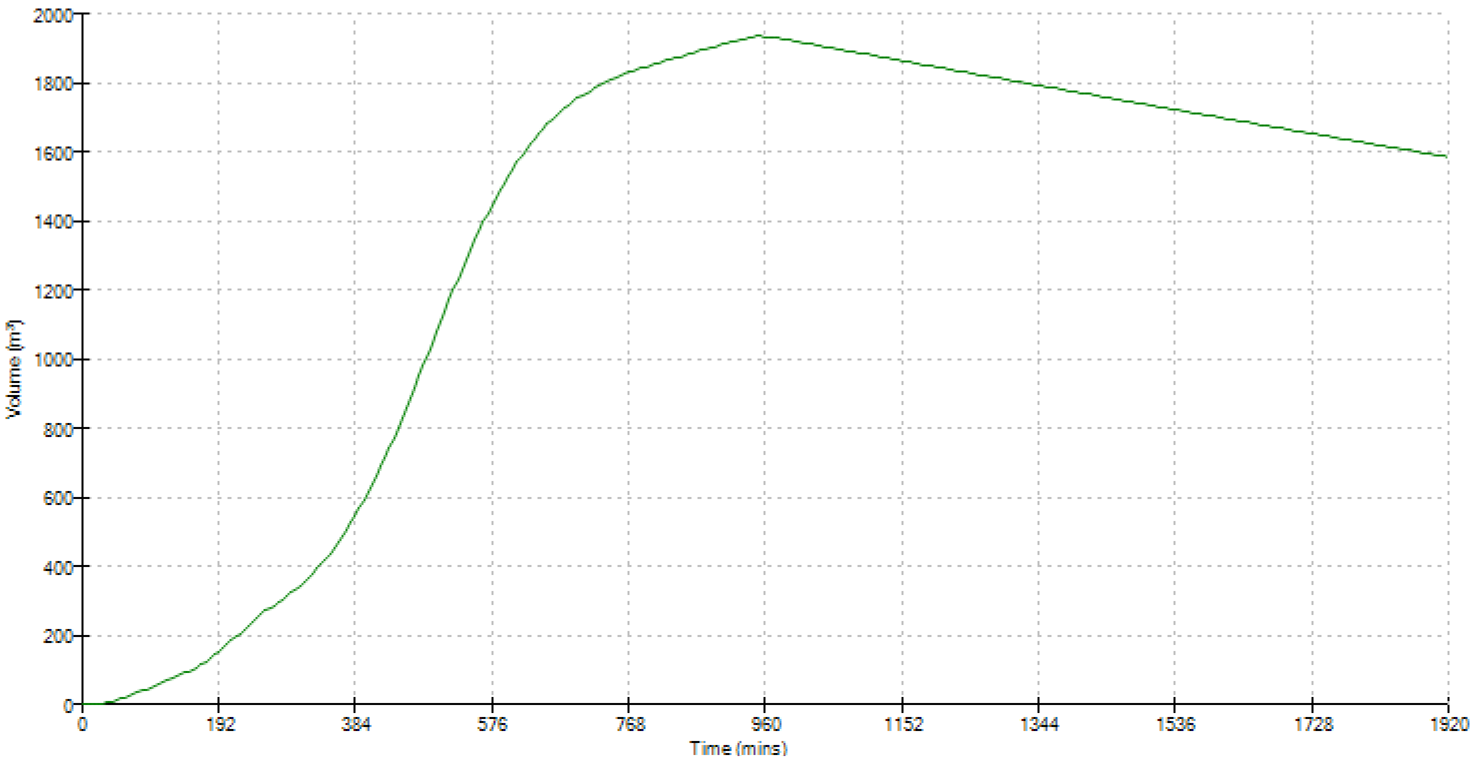
Summary of Results for 960 minute 100 year Winter (Storm)

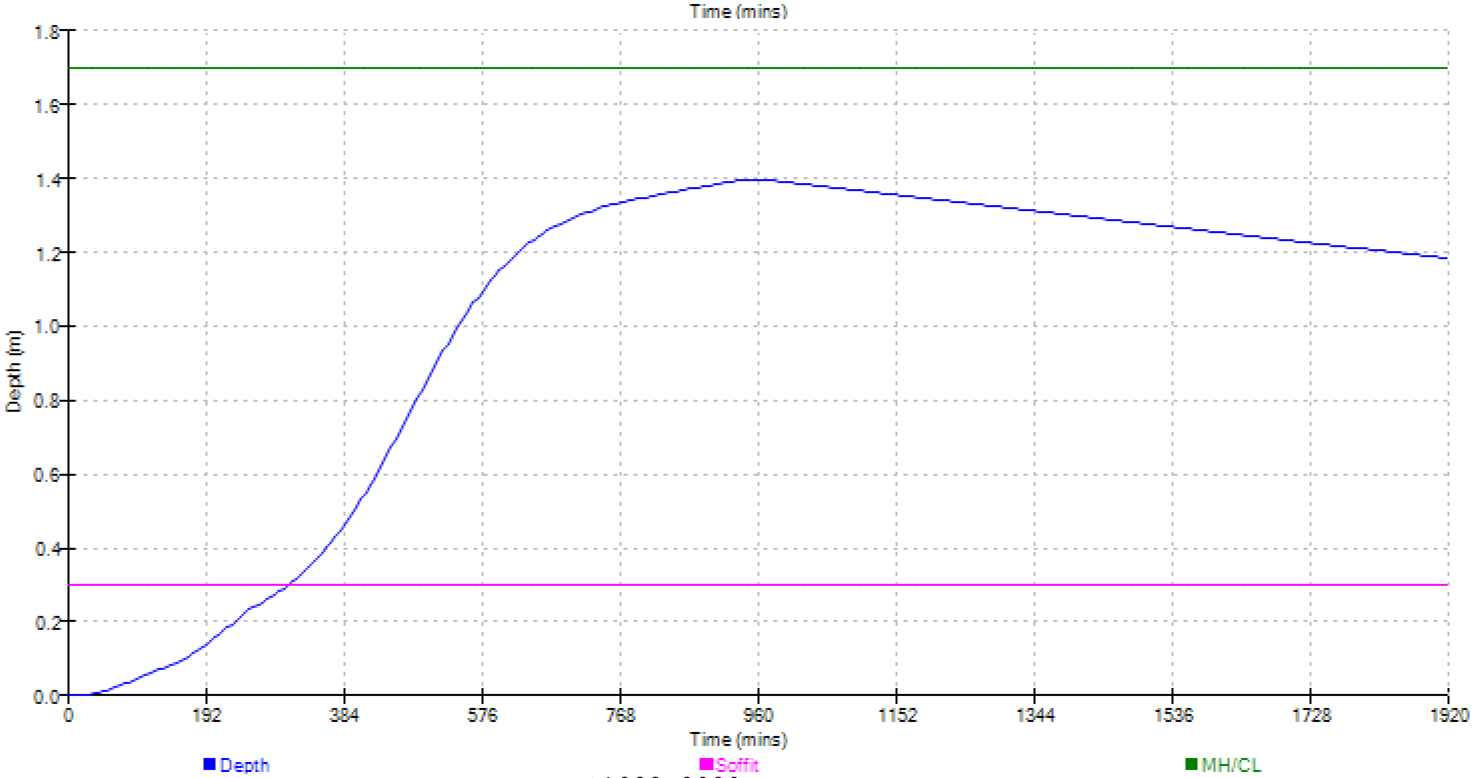
Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.014	34	56.298	1.098	0.000	0.05			6.5	SURCHARGED*

Basin 1 Graphs with additional influence from surface water flooding

Graphs for Pipe 1.014 US/MH 34 (Storm)
960 minute 100 year Winter
Status: OK*





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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Catchment
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 530950 201600 TL 30950 01600 Cv (Winter) 0.840

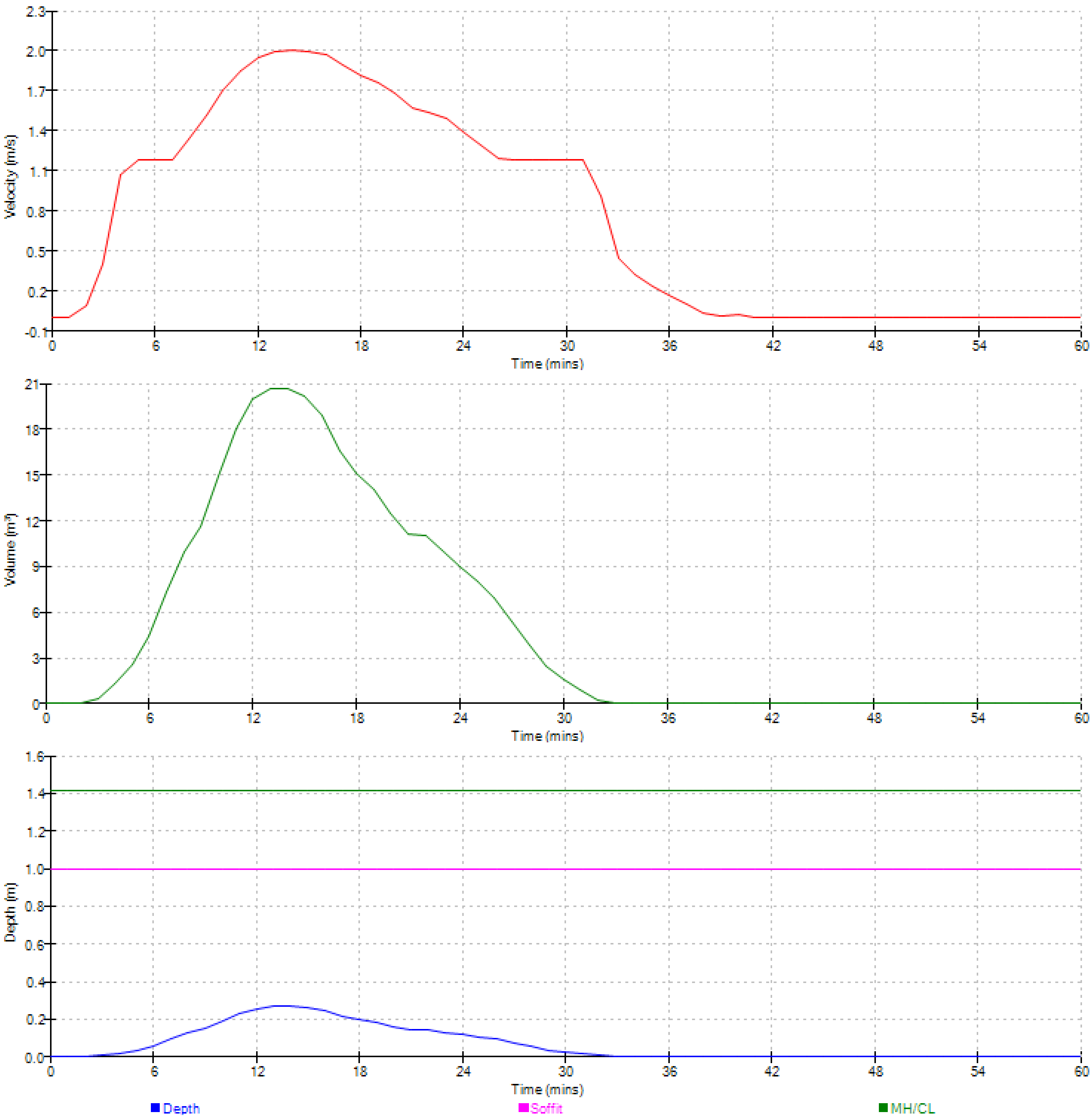
Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.012	32	15 Winter	100	+40%					56.856	-0.732	0.000	0.07

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.012	32			999.2	OK	

Graphs for Pipe 1.012 US/MH 32 (Storm)
15 minute 100 year Winter I+40%
Status: OK



Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	57.707	0.307	1.7	20.9	O K
30 min Summer	57.765	0.365	1.7	26.3	O K
60 min Summer	57.807	0.407	1.7	30.7	O K
120 min Summer	57.853	0.453	1.7	35.8	O K
180 min Summer	57.864	0.464	1.7	37.0	O K
240 min Summer	57.862	0.462	1.7	36.7	O K
360 min Summer	57.847	0.447	1.7	35.1	O K
480 min Summer	57.828	0.428	1.7	32.9	O K
600 min Summer	57.806	0.406	1.7	30.5	O K
720 min Summer	57.781	0.381	1.7	27.9	O K
960 min Summer	57.731	0.331	1.7	23.0	O K
1440 min Summer	57.643	0.243	1.7	15.4	O K
2160 min Summer	57.546	0.146	1.7	8.3	O K
2880 min Summer	57.496	0.096	1.6	5.2	O K
4320 min Summer	57.468	0.068	1.2	3.5	O K
5760 min Summer	57.455	0.055	1.0	2.8	O K
7200 min Summer	57.449	0.049	0.8	2.5	O K
8640 min Summer	57.445	0.045	0.7	2.3	O K
10080 min Summer	57.442	0.042	0.6	2.1	O K
15 min Winter	57.736	0.336	1.7	23.5	O K
30 min Winter	57.799	0.399	1.7	29.8	O K
60 min Winter	57.845	0.445	1.7	34.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.200	0.0	22.3	21
30 min Summer	97.440	0.0	28.8	36
60 min Summer	59.640	0.0	35.3	64
120 min Summer	38.010	0.0	45.0	122
180 min Summer	28.627	0.0	50.8	180
240 min Summer	23.170	0.0	54.9	210
360 min Summer	16.917	0.0	60.1	274
480 min Summer	13.383	0.0	63.4	340
600 min Summer	11.099	0.0	65.7	408
720 min Summer	9.497	0.0	67.5	474
960 min Summer	7.387	0.0	70.0	598
1440 min Summer	5.157	0.0	73.3	840
2160 min Summer	3.587	0.0	76.5	1172
2880 min Summer	2.777	0.0	78.9	1500
4320 min Summer	1.949	0.0	83.1	2204
5760 min Summer	1.528	0.0	86.9	2936
7200 min Summer	1.277	0.0	90.8	3672
8640 min Summer	1.110	0.0	94.6	4360
10080 min Summer	0.991	0.0	98.5	5104
15 min Winter	151.200	0.0	25.0	21
30 min Winter	97.440	0.0	32.3	36
60 min Winter	59.640	0.0	39.5	64

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	57.898	0.498	1.7	41.0	O K
180 min Winter	57.912	0.512	1.7	42.8	O K
240 min Winter	57.912	0.512	1.7	42.7	O K
360 min Winter	57.893	0.493	1.7	40.5	O K
480 min Winter	57.869	0.469	1.7	37.6	O K
600 min Winter	57.842	0.442	1.7	34.4	O K
720 min Winter	57.811	0.411	1.7	31.0	O K
960 min Winter	57.737	0.337	1.7	23.6	O K
1440 min Winter	57.606	0.206	1.7	12.5	O K
2160 min Winter	57.494	0.094	1.6	5.0	O K
2880 min Winter	57.470	0.070	1.3	3.7	O K
4320 min Winter	57.452	0.052	0.9	2.7	O K
5760 min Winter	57.445	0.045	0.7	2.3	O K
7200 min Winter	57.440	0.040	0.6	2.0	O K
8640 min Winter	57.437	0.037	0.5	1.8	O K
10080 min Winter	57.435	0.035	0.5	1.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	38.010	0.0	50.4	120
180 min Winter	28.627	0.0	57.0	176
240 min Winter	23.170	0.0	61.5	230
360 min Winter	16.917	0.0	67.3	288
480 min Winter	13.383	0.0	71.0	366
600 min Winter	11.099	0.0	73.6	442
720 min Winter	9.497	0.0	75.6	518
960 min Winter	7.387	0.0	78.4	646
1440 min Winter	5.157	0.0	82.1	872
2160 min Winter	3.587	0.0	85.7	1152
2880 min Winter	2.777	0.0	88.4	1476
4320 min Winter	1.949	0.0	93.1	2204
5760 min Winter	1.528	0.0	97.3	2912
7200 min Winter	1.277	0.0	101.7	3672
8640 min Winter	1.110	0.0	106.0	4328
10080 min Winter	0.991	0.0	110.4	5120

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 530950 201600 TL 30950 01600	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.079

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.040	4	8	0.039

Model Details

Storage is Online Cover Level (m) 58.300

Tank or Pond Structure

Invert Level (m) 57.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	48.0	0.900	208.0

Hydro-Brake® Optimum Outflow Control

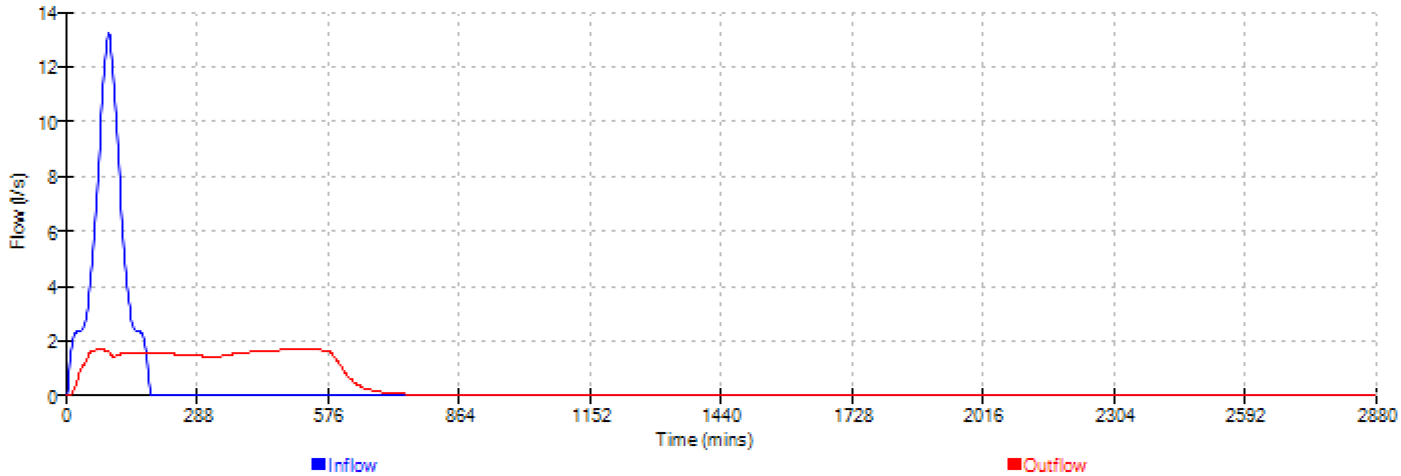
Unit Reference	MD-SHE-0068-1700-0600-1700
Design Head (m)	0.600
Design Flow (l/s)	1.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	68
Invert Level (m)	57.400
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

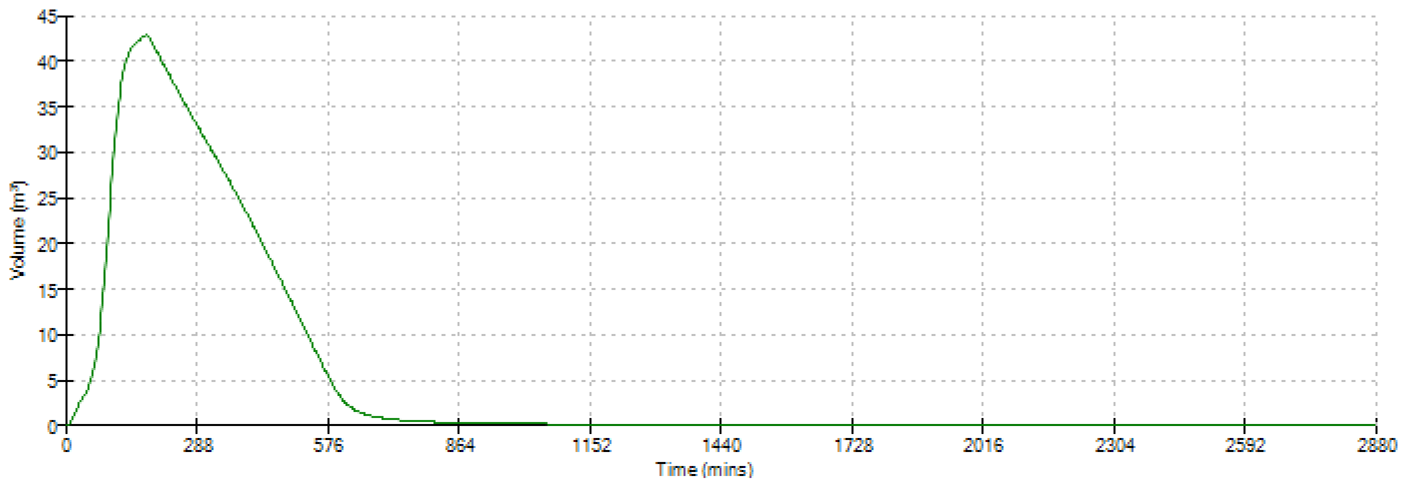
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	1.7	Kick-Flo®	0.393	1.4
Flush-Flo™	0.178	1.7	Mean Flow over Head Range	-	1.5

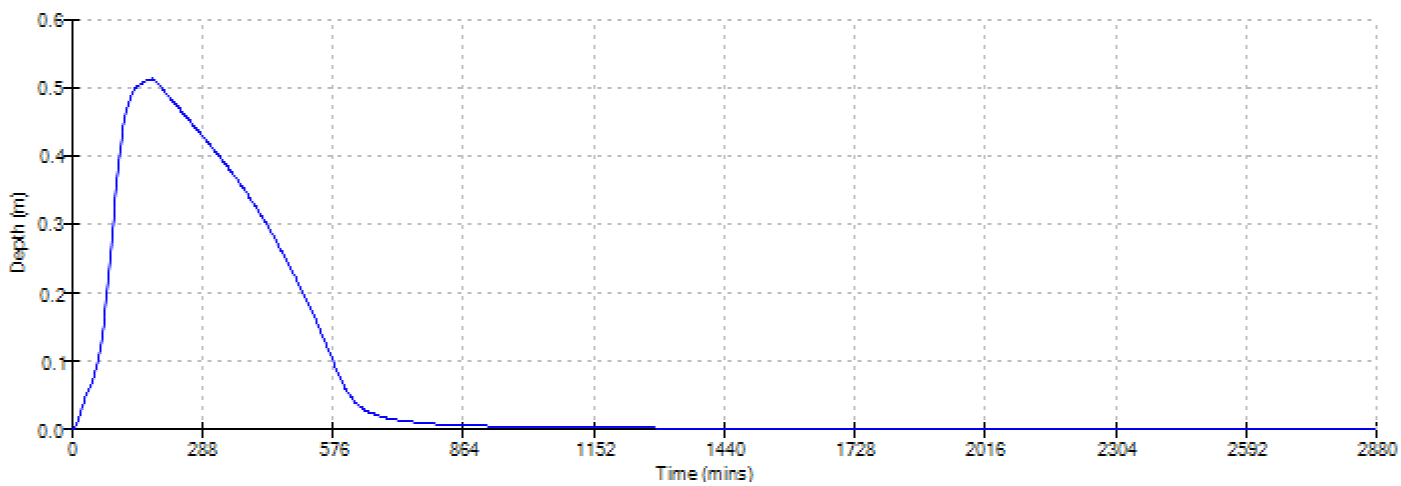
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	0.800	1.9	2.000	2.9	4.000	4.1	7.000	5.3
0.200	1.7	1.000	2.1	2.200	3.1	4.500	4.3	7.500	5.5
0.300	1.6	1.200	2.3	2.400	3.2	5.000	4.5	8.000	5.7
0.400	1.4	1.400	2.5	2.600	3.3	5.500	4.7	8.500	5.8
0.500	1.6	1.600	2.7	3.000	3.6	6.000	4.9	9.000	6.0
0.600	1.7	1.800	2.8	3.500	3.8	6.500	5.1	9.500	6.2

Event: 180 min Winter





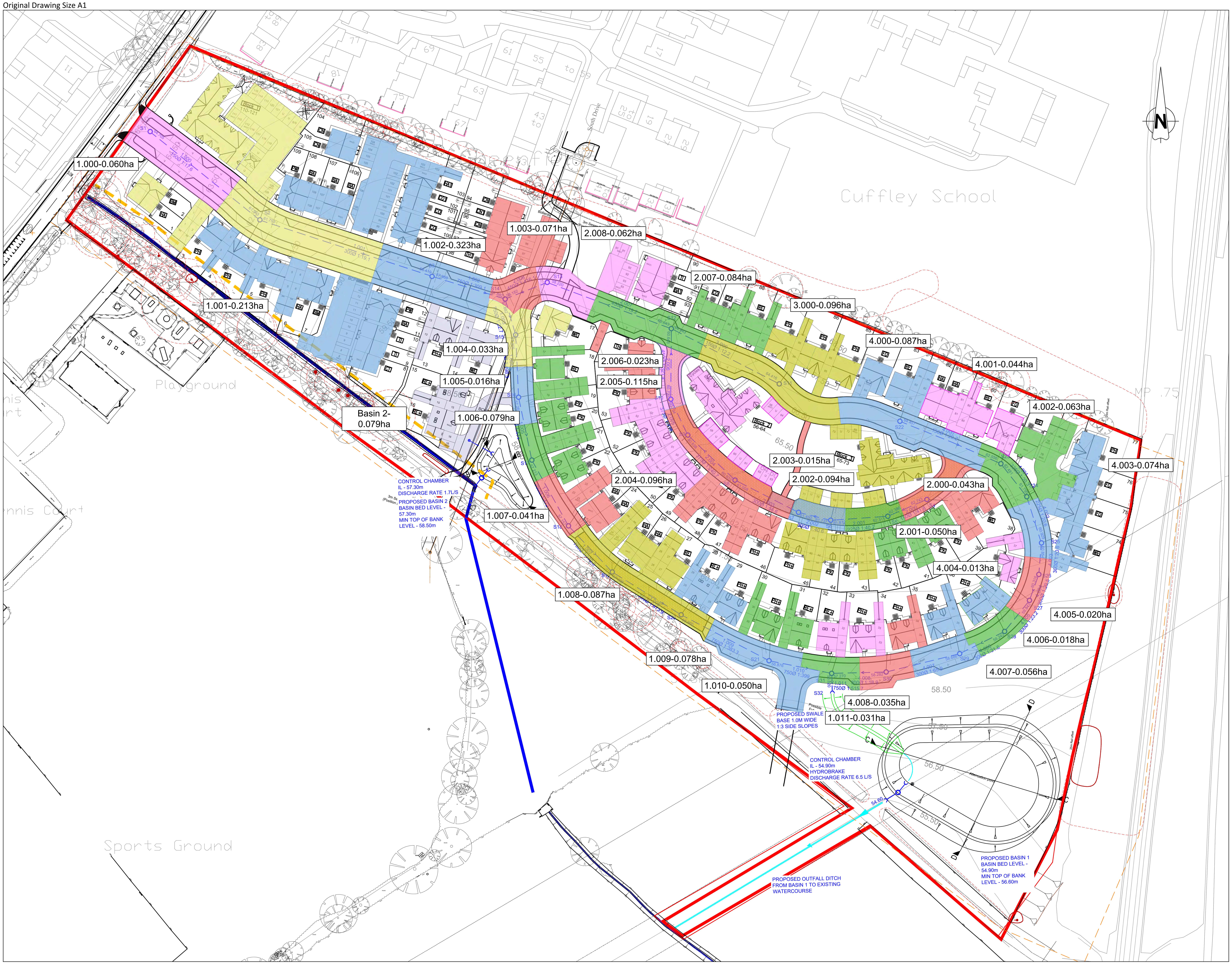


10929-Cuffley
Impermeable Areas

PN	USMH	ROAD	PRIVATE	PRIVATE +10% UC	TOTAL
1.000	1	0.060	0.000	0.000	0.060
1.001	2	0.084	0.117	0.129	0.213
1.002	3	0.060	0.239	0.263	0.323
2.000	4	0.021	0.020	0.022	0.043
2.001	5	0.015	0.032	0.035	0.050
2.002	6	0.000	0.085	0.094	0.094
2.003	7	0.015	0.000	0.000	0.015
2.004	8	0.049	0.043	0.047	0.096
2.005	9	0.017	0.089	0.098	0.115
2.006	10	0.000	0.021	0.023	0.023
3.000	11	0.054	0.038	0.042	0.096
2.007	12	0.044	0.036	0.040	0.084
2.008	13	0.025	0.034	0.037	0.062
1.003	14	0.020	0.046	0.051	0.071
1.004	15	0.023	0.009	0.010	0.033
1.005	16	0.016	0.000	0.000	0.016
1.006	17	0.015	0.058	0.064	0.079
1.007	18	0.017	0.022	0.024	0.041
1.008	19	0.042	0.041	0.045	0.087
1.009	20	0.047	0.028	0.031	0.078
1.010	21	0.018	0.029	0.032	0.050
4.000	22	0.052	0.032	0.035	0.087
4.001	23	0.000	0.040	0.044	0.044
4.002	24	0.024	0.035	0.039	0.063
4.003	25	0.020	0.049	0.054	0.074
4.004	26	0.000	0.012	0.013	0.013
4.005	27	0.020	0.000	0.000	0.020
4.006	28	0.018	0.000	0.000	0.018
4.007	29	0.024	0.029	0.032	0.056
4.008	30	0.020	0.014	0.015	0.035
1.011	31	0.000	0.028	0.031	0.031
1.012	32			0.000	0.000
1.013	33			0.000	0.000
1.014	34			0.000	0.000
BASIN 1		**0.820**	**1.226**		**2.169**
BASIN 2		0.000	0.072	0.079	**0.079**
TOTAL		**0.820**	**1.298**		**2.248**

Appendix D – Additional Drawings

Original Drawing Size A1



NOTES:

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5. Impermeable areas shown include a 10% allowance for urban creep.

KEY:

- Site Boundary
- Proposed surface water sewer
- Existing Watercourse
- Watercourse 5m offset
- Potential Culvert
- SuDS Basin 1 in 3 slopes
- Proposed Outfall Route
- Proposed Swale

C	PN1.002 & 1.003 amended	NO	NO	TM	12.01.23
B	Areas updated to include urban creep allowance	NO	NO	TM	08.11.22
A	Updated to suit the latest housing layout	MA	NO	TM	12.08.22
-	First Issue	HG	DC	TM	16.06.22

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Bellway

Land at Cuffley
Hertfordshire

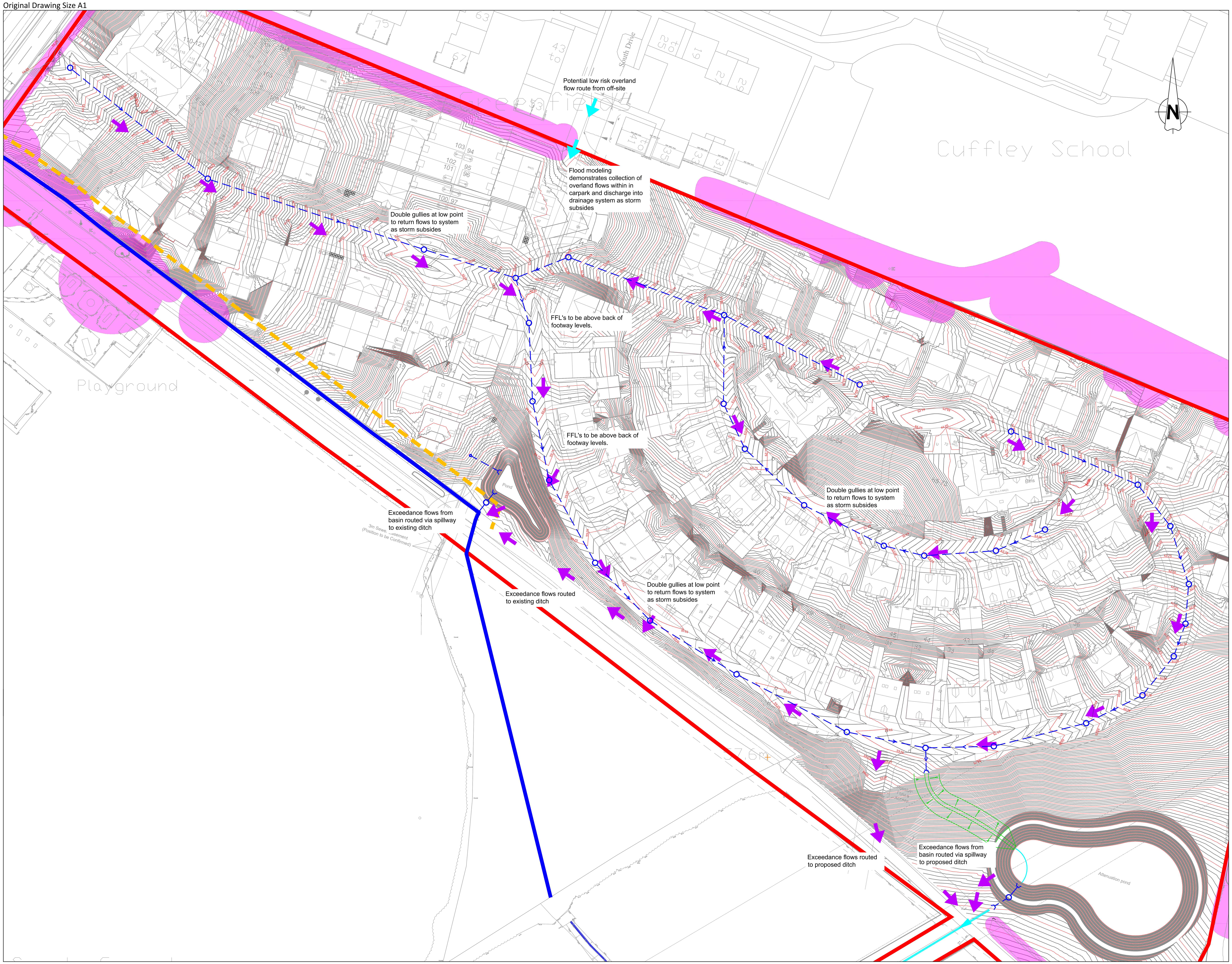
Surface Water
Catchment Plan

Status		Status Date
Approval		June 2022
Drawn	Checked	Date
HG	DC	16.06.22
Scale	Number	Rev
N.T.S.	10929-500-003	C

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT HIS OWN RISK.

P:\10929\CAD\BCL\Working Drawings\10929-500-003C - Catchment Plan.dwg

Original Drawing Size A1



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KEY:

- Site Boundary
- Existing Foul water
- Proposed Foul water sewer
- Proposed Surface water sewer
- Existing Watercourse
- Watercourse 5m offset
- Proposed SuDS Basin 1 in 3 slopes
- Proposed Basin 1 Outfall Route
- Root protection zones
- Proposed Swale
- Existing Overland Flow Route from off-site to be collected in drainage system
- Exceedance Flows
- Major Contour (0.25m)
- Minor Contour (0.05m)

D	Overland flow route amended	NO	TM	TM	18.04.23
C	Proposed contours added. Exceedance route notes added.	NO	TM	TM	12.01.23
B	Amended to comply with LLFA comments	NO	DC	TM	08/11/22
A	Drainage and Basins amended	HG	DC	RM	17.10.22
-	First Issue	HG	DC	TM	16.06.22

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Bellway

Land at Cuffley
Hertfordshire

Exceedance Plan
Drainage Strategy

Status		Status Date
Approval		June 2022
Drawn	Checked	Date
HG	DC	16.06.22
Scale	Number	Rev
N.T.S.	10929-500-004	D

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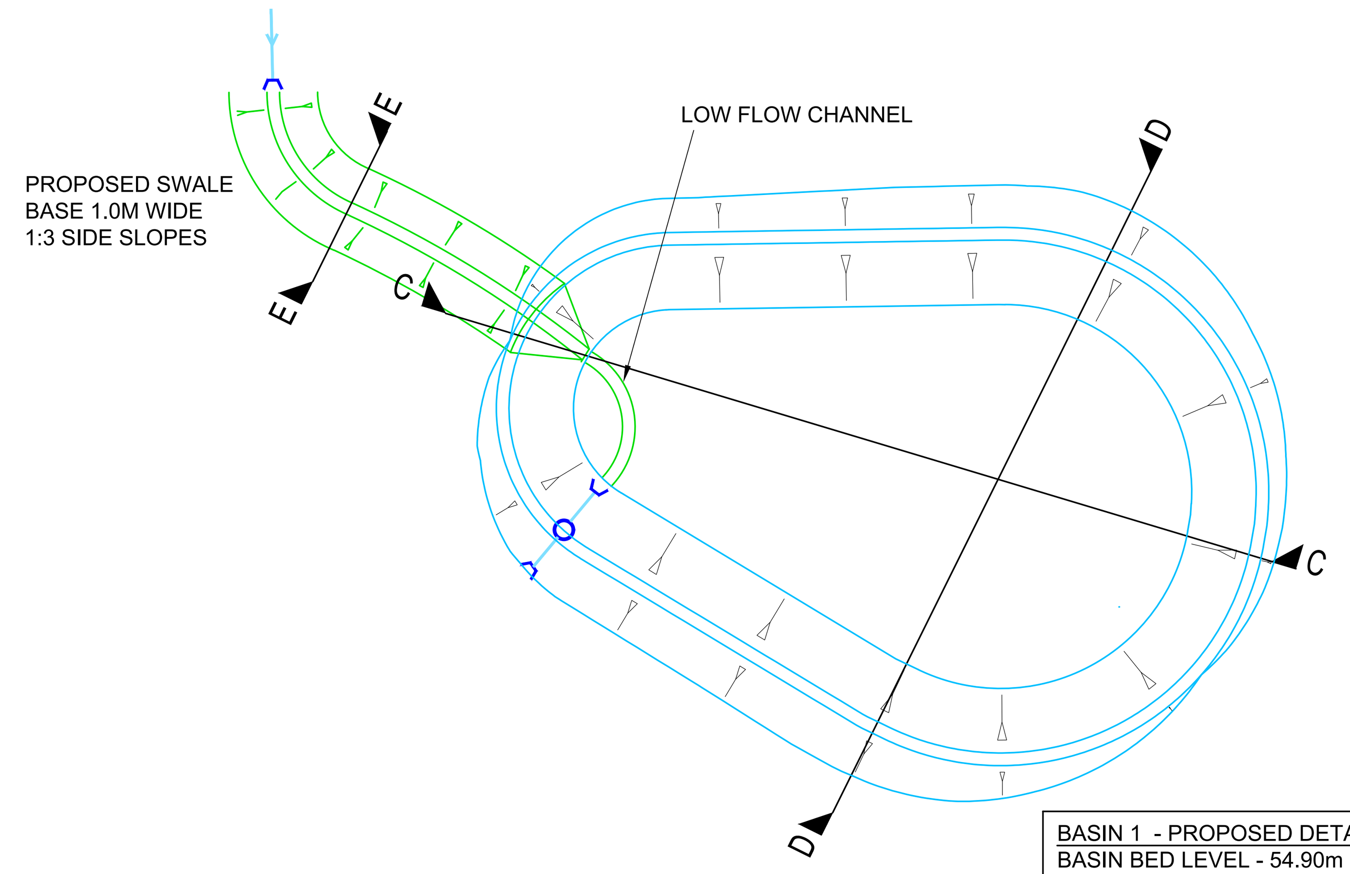
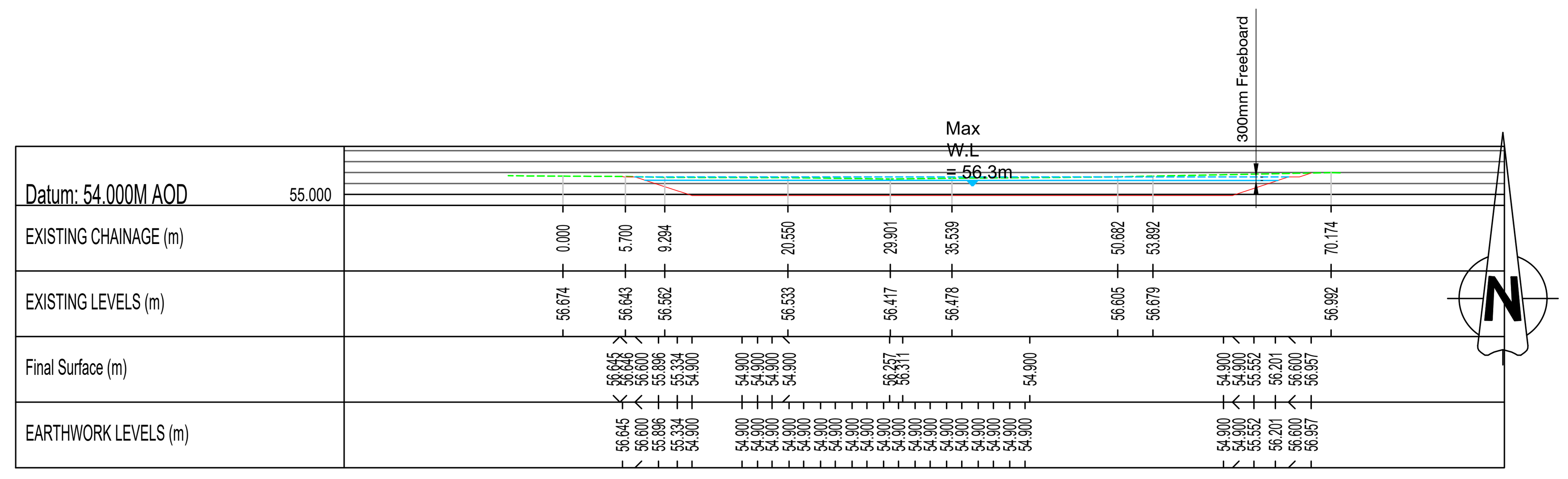
P:\10929\CAD\BCL\Working Drawings\10929-500-004D - Exceedance Plan.dwg

Original Drawing Size A1

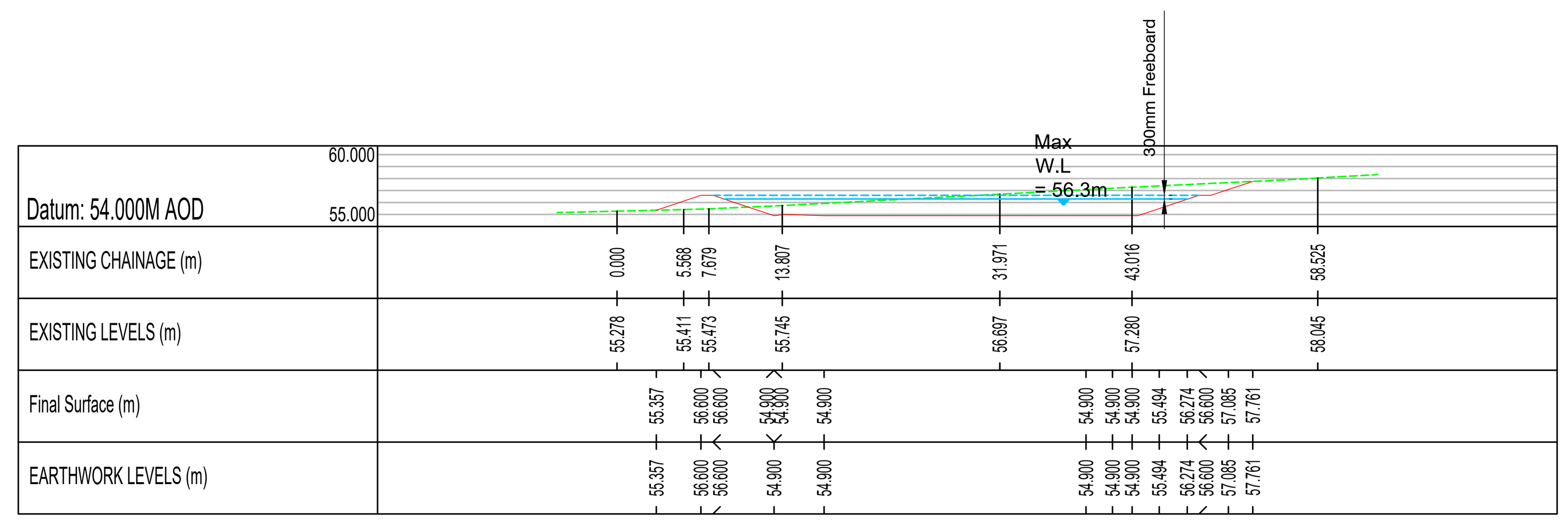


BASIN 1 - PROPOSED DETAILS
BASIN BED LEVEL - 54.90m
MIN TOP OF BANK LEVEL - 56.60m
DEPTH - 1.70M (1.4m +0.3m FREEBOARD)
BASE AREA - 1099M2
TOP OF BANK AREA - 1833M2
PROPOSED STORAGE VOLUME - 1940M3

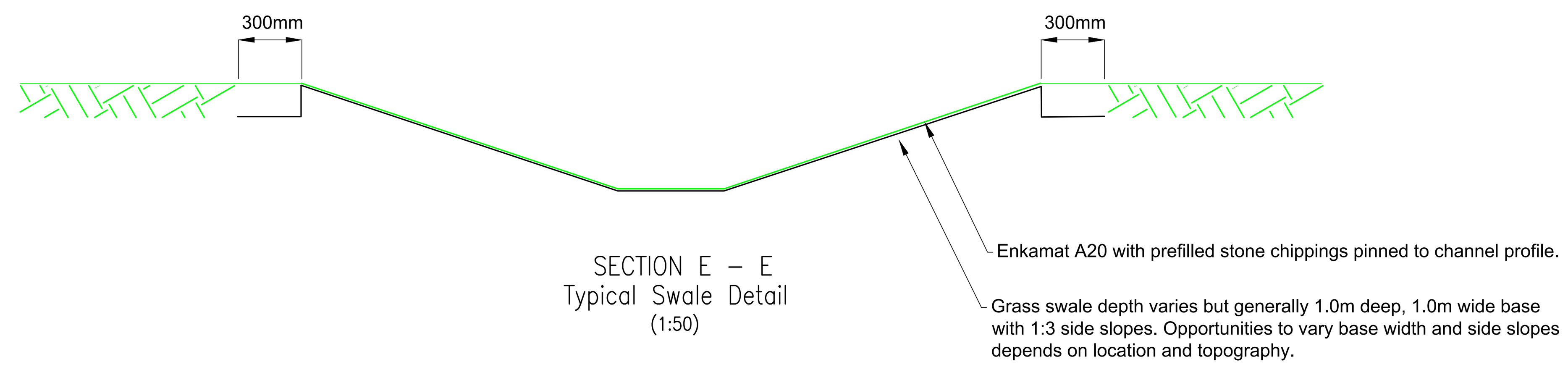
Plan on Basin 1
(1:500)



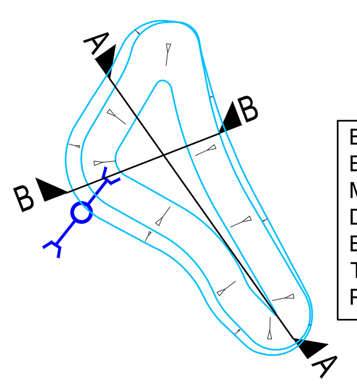
Basin 1 - Section C-C
(1:500)



Basin 1 - Section D-D
(1:500)

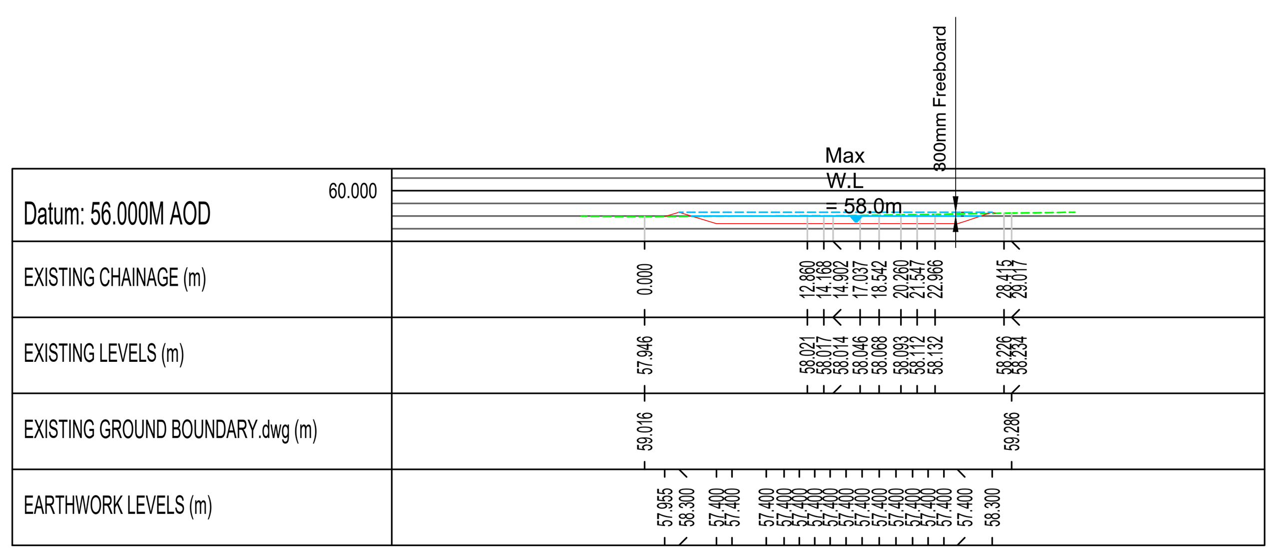


SECTION E – E
Typical Swale Detail
(1:50)

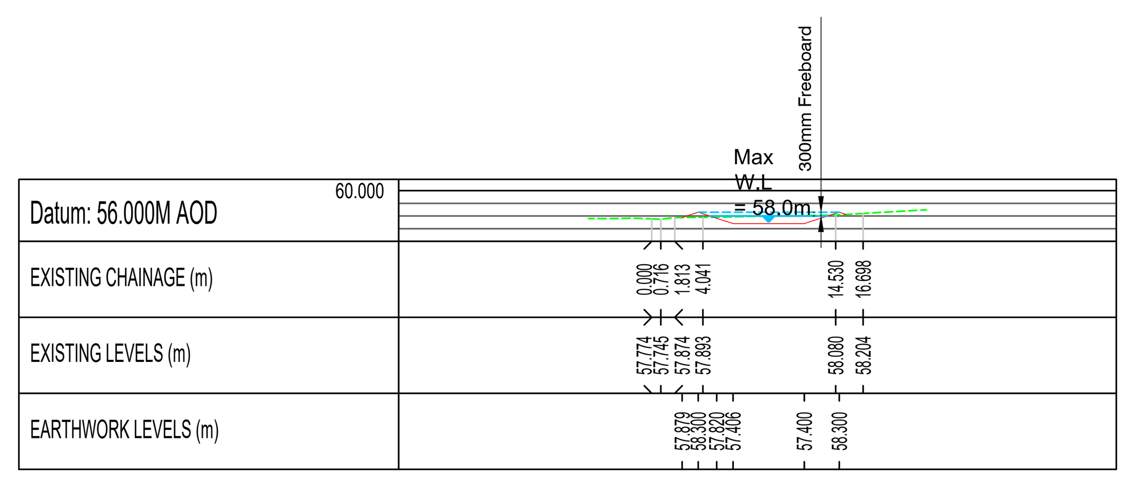


BASIN 2 - PROPOSED DETAILS
BASIN BED LEVEL - 57.40m
MIN TOP OF BANK LEVEL - 58.30m
DEPTH - 0.9M (0.6m +0.3m FREEBOARD)
BASE AREA - 48M2
TOP OF BANK AREA - 208M2
PROPOSED STORAGE VOLUME - 42.8M3

Plan on Basin 2
(1:500)



Basin 2 - Section A-A
(1:500)



Basin 2 - Section B-B
(1:500)

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KEY:

- Existing Ground Levels
- Proposed Basin Levels
- Max Water Levels

A	Basin 2 in increased volume for surface water flooding	NJO DC	TM	18.04.23
-	First Issue	NJO DC	TM	08.11.22

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Bellway

Land at Cuffley
Hertfordshire

Basins 1 & 2 and Swale
Cross-Sections

Status		Status Date
Approval		Nov 2022
Drawn	**Checked**	**Date**
HG	DC	08.11.22
Scale	**Number**	**Rev**
N.T.S.	10929-500-005	A

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P:\10929\CAD\BCL\Working Drawings\10929-500-005A - Attenuation Basin Cross sections.dwg

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