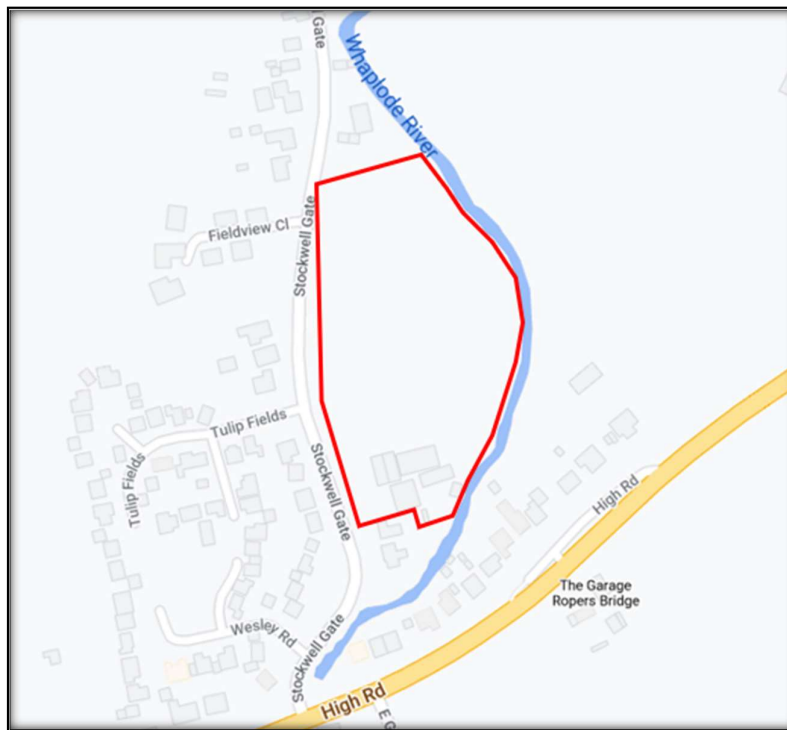


SURFACE & FOUL WATER DRAINAGE STRATEGY
UPON
PROPOSED RESIDENTIAL DEVELOPMENT
LAND EAST OF STOCKWELL GATE,
WHAPLODE, SPALDING, LINCOLNSHIRE
PROJECT NO: SW 22-150
DOCUMENT REF: SW 22-150-REP-01A



FOR MR J. WELCH
C/O ANDREW M WRIGHT LTD.

Contents

1 Introduction	4
2 Site Information	5
2.2 Geology	6
2.2.1 Underlying Strata	6
2.2.2 Infiltration Testing.....	7
2.2.3 Ground Water Table.....	7
2.3 Drainage	7
2.3.1 Foul Water	7
2.3.2 Surface Water	7
2.4 Topography	8
2.4.1 Existing Overland Flood Flows.....	8
3 Proposed Development.....	9
4 Flood Risk	9
5 Surface Water Drainage Strategy	9
5.1 SuDS Considerations	9
5.1.1 Hierarchy.....	9
5.1.1.1 Infiltration	10
5.1.1.2 Watercourse.....	10
5.1.1.3 Surface Water Sewer	10
5.1.1.4 Combined Sewer.....	11
5.1.2 Source Control	11
5.2 Proposals.....	12
5.2.1 Existing Greenfield Run-off Rate.....	12
5.2.2 Proposed Flow Control Rate	12
5.2.3 Drainage Proposals.....	13
5.3 Consultation.....	14
5.4 Hydraulic Modelling	14
5.5 Flood Exceedance	16
5.5.1 Flood Routes.....	16
5.5.2 Off-site Flood Risk Management.....	16
5.6 Management/Maintenance Strategy.....	17
5.6.1 Main Bodies	17
5.6.2 Management Company.....	19
5.6.3 Plot Owners	20

6 Foul Water Drainage Strategy	22
6.1 Proposals.....	22
6.2 Consultation.....	22
6.3 Management/Maintenance Strategy.....	22
6.3.1 Anglian Water.....	23
6.3.2 Plot Owners	23
7 Conclusion	24
Appendix A – Infiltration Test Report.....	25
Appendix B – Anglian Water Asset Map	30
Appendix C – Existing Overland Flood Flows	33
Appendix D – Architectural Site Layout.....	35
Appendix E – Proposed Drainage Strategy Arrangement Drawings	37
Appendix F – Proposed Typical Construction Details	40
Appendix G – IDB Correspondence	42
Appendix H – Proposed Flood Exceedance Route Drawing	45
Appendix J – Proposed Management/Maintenance Drawing.....	47
Appendix K – Anglian Water Correspondence	49
Appendix L – Surface Water System Calculations	58

Revision	Date	Description		
-	August 2022	First Issue	Prepared	M. Pett
			Approved	A.Wilson CEng MIStructE
A	August 2022	Minor Drawing Update	Prepared	M. Pett
			Approved	A.Wilson CEng MIStructE

1 Introduction

Under the instruction of Andrew M Wright Ltd. on behalf of Mr J. Welch, the following drainage strategy report has been prepared for a proposed residential development of 42 dwellings at land off Stockwell Gate, Whaplode.

The object of this report is to clarify the design philosophy followed when preparing the proposed surface & foul water drainage arrangements for the site and to outline the proposed solution in sufficient detail for all relevant parties to be able to comment. This assessment also demonstrates that the proposals are within the guidance contained with the National Planning Policy Framework (NPPF).

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2 Site Information

2.1 Location & Description

The site is approximately 1.867 hectares in size and is located East of Stockwell Gate, Whaplode, National Grid reference TF 332246.



Figure 1: Site Location

The site is predominantly a greenfield site used for agriculture and is accessed via Stockwell Gate to the West. There are a number of existing agricultural buildings and glass houses to the South of the site, which are to be demolished.

The site is bound by residential dwellings/land to the North and South. To the East is a watercourse and the West Stockwell Gate and a watercourse to the most Southern end of the Western boundary.

2.2 Geology

2.2.1 Underlying Strata

The British Geological survey maps indicate the site to be underlain by West Walton Formation, with superficial Tidal Flat Deposits of clay and silt. As shown in the figures below.

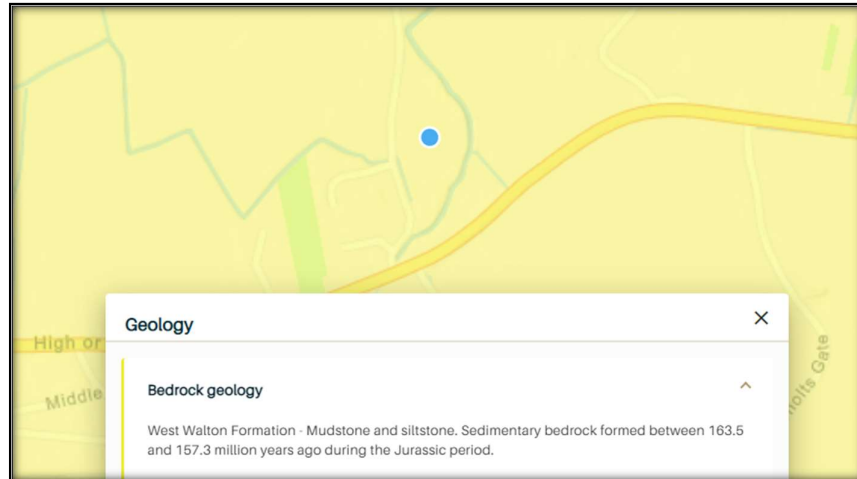


Figure 2: BGS Extract – Bedrock Geology

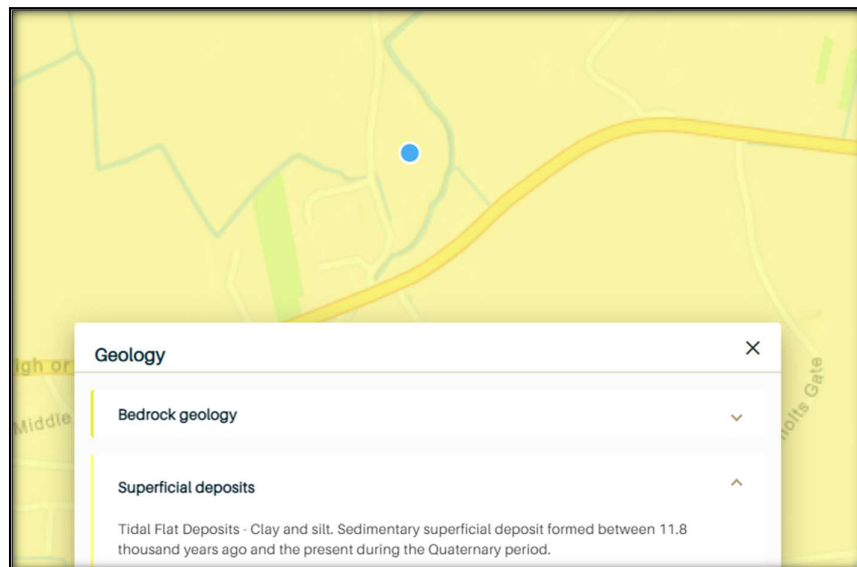


Figure 3: BGS Extract – Superficial Deposits

2.2.2 Infiltration Testing

Infiltration testing was undertaken during March 2022 by Shields Wilson Ltd. The testing demonstrated that the site has some infiltration potential with a rate of 2.38×10^{-6} recorded to be used for design purposes.

The infiltration test logs are included within Appendix A.

2.2.3 Ground Water Table

Open excavations were witnessed with standing water at approx. 1.4m below ground level. During our excavations ground water seepage was witnessed at approx. 1.6m below ground level. Therefore any infiltration features will need to be shallow to maintain 1m from the ground water level from the underside of the feature.

2.3 Drainage

2.3.1 Foul Water

There is a limited amount of existing foul water drainage local to the existing buildings to the South of the site. The outfall method/discharge location is unknown. It is therefore, at this stage, assumed that the proposals will not make use of an existing connection.

Beneath Stockwell Gate are a number of Anglian Water foul water assets, their record map is included within Appendix B.

2.3.2 Surface Water

Similarly to the foul system there is limited surface water drainage local to the existing buildings to the South of the site. Many of the existing buildings discharge rainfall onto the surrounding surface.

The site falls within South Holland Internal Drainage Boards (SHIDB) District, specifically their Catchment P – Holbeach River. There are two watercourses adjacent to the site boundaries both of which are maintained by SHIDB. The Eastern site boundary has P60-Whaplode River to its entire length which has a 9m easement. Whilst the Southern part of the Western boundary has P06-Crown to its edge, again this has a 9m easement.

There is an existing Highway Drain maintained by LCC Highways within the verge between Stockwell Gate and the site boundary which discharges to P06-Crown. This has recently been re-laid to assist restricted surface water discharge from the development, Fieldview Close, West of Stockwell Gate.

The existing watercourses and drains local to the site are indicated on the figure below.

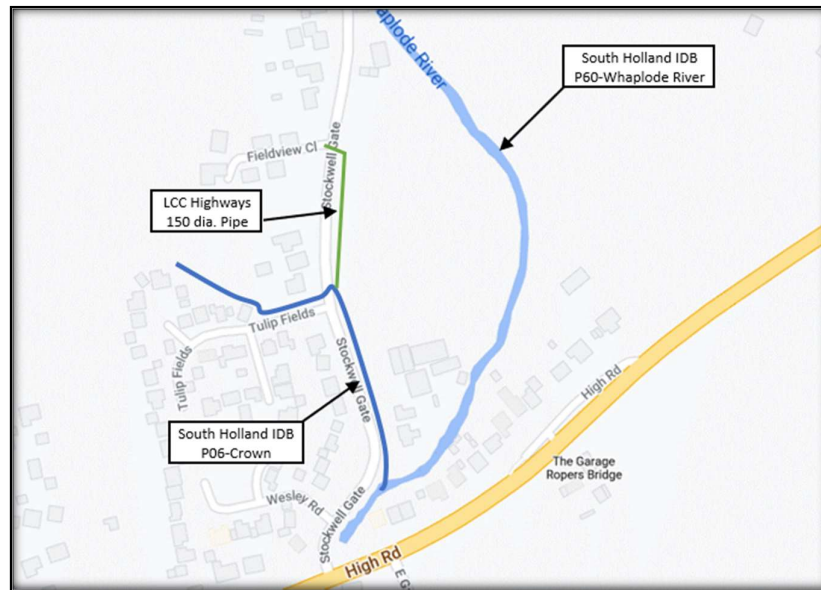


Figure 4: Existing Surface Water Drainage

2.4 Topography

The topographical survey undertaken by MFM, drawing number 16170388-WELCH-STWG-3D-TOPO, Revision A, illustrates that the current site levels vary from 2.8m – 3.7m AOD. Generally levels are higher to the East of the site along the brink of the watercourse, with site levels falling to the West towards Stockwell Gate and the adjacent watercourse. Levels local to the existing buildings are relatively flat sitting at approx. 3.3m AOD.

2.4.1 Existing Overland Flood Flows

The existing overland flood flows are illustrated on drawing SW 22-150-001, included with Appendix C, and generally follow the topography described above. The majority of overland flows would enter the SHIDB maintained drain P06-Crown to the South-West with the remaining to the SHIDB watercourse to the Eastern boundary.

3 Proposed Development

This strategy is based upon Andrew M Wright Ltd. architectural site layout drawing 022103-PD02 revision D1, included within Appendix D.

The proposed development consist of 42 dwellings, together with adoptable access roads, which connect to Stockwell Gate. The majority of the plots drives are accessed directly of the new or existing adoptable Highway, the remaining plots have a shared access-way. There is also Public Open Space adjacent to the IDB easement to the East of the site.

4 Flood Risk

A site-specific flood risk assessment has been prepared by Ellingham Consulting Ltd. Report reference ECL0705.

This has highlighted that the site lies within Flood Zone 3.

The flood risk assessment has identified that floor levels are a minimum of 0.3m above typical ground levels.

It may be necessary to raise some floor levels more than 0.3m above the existing ground levels to achieve gravity surface and foul water outfalls. However, the number of plots that will need raising further are limited, and it is not anticipated these will be more than 0.6m above exiting levels.

5 Surface Water Drainage Strategy

The proposed surface water drainage strategy arrangement is shown on drawings SW 22-150-002 & 003, included within Appendix E.

5.1 SuDS Considerations

5.1.1 Hierarchy

The NPPF guidance advises that surface water discharge from proposed developments should aim to be as high up the following hierarchy as reasonably possible:

1. Into the ground (infiltration) – via soakaways or other infiltration device,
2. To a surface water body – i.e. a watercourse / Internal Drainage Board,
3. To a surface water sewer, highway drain, or another drainage system,
4. To a combined sewer.

5.1.1.1 Infiltration

Infiltration testing on site has demonstrated that there is potential for some surface water run-off to be discharged via this method. As highlighted previously in this report ground water was encountered at a relatively shallow depth.

Therefore, components discharging via this method should be kept at a high level to ensure that there is 1m between the underside of the feature and ground water level.

Furthermore, as the infiltration rate is relatively low, dwellings discharging to geocellular soakaways should be avoided as this concentrates the discharge to a single location.

Given the above points it is proposed to discharge the private and shared driveways via infiltration. These features will remain at a high level and therefore maintain a robust drainage system whilst satisfying the highest level of the SuDS hierarchy.

5.1.1.2 Watercourse

As discussed the site is adjacent to SHIDB maintained watercourses to the East and West. Both watercourses provide potential for a surface water outfall from the site. The silt levels vary between 0.88m – 1.18m AOD and 0.80m AOD for the watercourses to the West and East respectively, approximately 2.4m below anticipated floor levels.

It is therefore proposed surface water collected from the adoptable highway and dwelling roofs is to be discharged to a watercourse. Consequently, the whole of the proposed development will discharge surface water via the two highest levels of the SuDS hierarchy.

SHIDB have provided their maximum design storm water levels for both watercourses and these are shown on the layout drawings. Their 1:100 year plus climate change event levels are particularly high in this area of their catchment, at 2.70m AOD. This level is only nominally lower than the road level, 2.77m AOD, of Stockwell Gate where the proposed development junction is to be formed. Therefore, it is proposed to discharge only a small section of the adoptable highway to the Western watercourse and the remaining to the Eastern watercourse. This will be discussed further within this report.

The required Land Drainage Consents will need to be obtained from SHIDB at the detailed design stage.

5.1.1.3 Surface Water Sewer

The small section of highway discharging to the watercourse to the West will utilise the existing LCC highway drain within the verge prior to discharging to the watercourse approximately 25m downstream.

5.1.1.4 Combined Sewer

Surface water discharge from site via this method is not required.

5.1.2 Source Control

The use of various on-site SuDS features has been explored to improve the water quality of discharge from the site, these are explored in the table below:

SuDS Technique	Commentary	Suitability
Green Roofs	Green roofs are not considered suitable for traditional style dwellings, and considered uneconomical for housing.	No
Permeable Paving	Whilst infiltration techniques are not suitable for large collections of surface water from roofs and highways, the conditions are suitable for the use of permeable surfacing to the private and shared drives. This will be aided by the necessity to build up the levels on the site for the flood risk, and the sub-base construction of the permeable drives will provide plenty of attenuated storage via suitable open graded crushed rock sub-base. The underlying ground conditions are not suitable for the use of a permeable surface for the adopted Highway as the CBR values are below 3% and therefore do not meet LCC Highways adoption criteria.	Yes
Swales	Due to the lack of gradient in Fenland areas swales would require an underdrain, therefore this site may be more suited to the use of filter drains.	No
Filter Strips and Drains	Filter strips and drains will be utilised for surface water collection from the highway where the density of housing allows. Due to the high ground water level the filter drain would be lined with an impermeable membrane.	Yes
Ponds & Wetlands	Ponds and wetlands have been considered unsuitable for this development as these features would have to be located in the public open space and therefore the depth to a permanent water line would be deep and be a safety concern for the public using the POS.	No
Detention Basins	A basin will be utilised within the POS, however as this area primary purpose is for the public to use the basin will be shallow and at a high level. Therefore, only storing water for extreme rainfall events.	Yes
Attenuation Tanks	Tanks will be provided to store the majority of storms underground. This will ensure the drainage system does not surcharge in the 1:2 year event.	Yes

Figure 5: SuDS Technique Summary

5.2 Proposals

5.2.1 Existing Greenfield Run-off Rate

The development site is predominantly greenfield with little information of any existing flow rates from the buildings to be demolished. Therefore, where possible the discharge rate from site should be restricted to the sites QBar. The site area is only 1.867 hectares, therefore as demonstrated by the following QBar calculations existing run off totals 2.65 litres per second.

Greenfield runoff rates	Default	Edited
QBAR (l/s):	2.65	2.65
1 in 1 year (l/s):	2.31	2.31
1 in 30 years (l/s):	6.5	6.5
1 in 100 year (l/s):	9.45	9.45
1 in 200 years (l/s):	11.17	11.17

Figure 6: Existing QBar Calculation Rate

The full QBar calculations are included with the drainage calculation within Appendix L.

5.2.2 Proposed Flow Control Rate

A flow control chamber incorporating a HydroBrake will be introduced into the downstream elements of the proposed drainage system to restrict flows offsite.

It will not be possible to restrict flows off site to the QBar rate established above, as the likelihood of blockage would be high and therefore increase flood risk.

It is therefore proposed to restrict flows to a maximum of 5 litres per second for the majority of the sites surface water discharge. This flow rate ensures an orifice size greater than 100mm which is in accordance with Sewerage Sector Guidance Appendix C, Design and Construction Guidance, a requirement as the system is to be offered for Anglian Water's adoption.

Due to the existing road / surcharge water levels the initial 25m of the proposed adoptable highway is fall towards Stockwell Gate, the opposite direction to the rest of the proposed drainage system. As such this small area, approximately 210m², will have a separate un-restricted outfall. The peak flows for the shortest/most intense storms are as follows:

- 1:2 = 2l/s
- 1:10 = 3.6l/s
- 1:30 = 4.5l/s
- 1:100 = 6l/s
- 1:100+CC = 8l/s

5.2.3 Drainage Proposals

The proposed surface water drainage strategy arrangement is shown on drawings SW 22-150-002 & 003, included within Appendix E. Typical construction details are illustrated on drawing SW 22-150-004, included within Appendix F.

As discussed previously it was not possible to limit the discharge from site to one single outfall location. The surface levels within the proposed bell mouth will be lower than the maximum surcharged water level within the IDB system, therefore a sustainable or robust drainage system could not be provided with a single outfall. This has been discussed at length with SHIDB, and correspondence on the matter is included within the following section.

The hardstanding/impermeable surfacing areas are summarised on the drainage strategy arrangement drawings and within the table below:

Name	Description	Area (m ²)	Discharge Method/Location
A	Proposed Tarmac Road / Footpaths & Filter Drains (as these will be lined)	1,980	Main Drainage System Outfalling To SHIDB System P60 Whaplode River
B	Proposed Tarmac Road / Footpath	210	Secondary Drainage System Outfalling To SHIDB System P06 Crown
C	Proposed Dwelling Roofs	2,760	Main Drainage System Outfalling To SHIDB System P60 Whaplode River
D	Permeable Plot & Shared Driveways	2,490	Infiltrating To Ground At Source

Figure 7: Hardstanding/Impermeable Surface Summary

Approximately 33% of the sites hardstanding/impermeable area is to be the private plot and shared driveways. These are to be constructed with a permeable surface and infiltrate at source, this construction method will provide adequate source control to ensure water quality. The void rock sub-base beneath the surface will be designed in accordance with Interpave guidance and provide enough storage for the 1:100 year event including an allowance for climate change.

The nominal 'Area B' local to the new junction will be collected via gullies and discharge into the existing Highway drain in the grass verge, which in turn discharges to the SHIDB system immediately downstream.

The main drainage system, Area A & C is to discharge to the SHIDB system to the East. The anticipated storm water levels within the SHIBD system are relatively high, however the proposed HydroBrake chamber has been positioned at a level above the 1:2 year water level. This prevents surcharging of the drainage system in lower storm return periods, and provides a robust system with reduced chance of blockage.

Where possible carriageway and footpath surface water run-off is to be collected via adjacent filter strips and drains. This provides cleaning at source as the run-off passes the filter strip and soaks into the lined open graded stone material and

perforated pipe. This in itself provides two treatment trains for Highway run-off adjacent to these features.

There is a comparatively small section of adoptable Highway which cannot utilise collection via filter strips and drains. In accordance with planning policy there are to be social and affordable housing provided within the proposed development. From an economic point, the density of this housing must be greater. The majority of this housing is provided in the approximate area of Plots 25-29 & 34-37. Due to the housing density required it is not viable to utilise filter strips and drains to collect highway water in this area. Therefore, a gully and pipe system will be utilised, treatment will still be provided via the gully pots.

The proposed roof areas denoted as Area C, will be drained via rainwater pipes and underground pipe network local to each plot prior to discharging to the perforated pipe within the filter drains.

The whole of Areas A & C catchments will be conveyed underground to the flow control chamber which restricts flow off site to 5 litres / second. Attenuation is to be provided within the POS in two stages. An underground attenuation system is to be provided to store surface water runoff up to and including the 1:30 year event. Storms above this will be stored within the depression which is to be created within the POS. It is highly unlikely children will be using the POS when water is within the POS as there must have been an extreme storm event just taken place. The side slopes are to be very shallow, at a gradient of 1:5.

Whilst consideration has been made with regards to the safety of SuDS features, a full SuDS risk assessment will be required at the detailed design stage.

5.3 Consultation

During the design of the surface water system we have been in communication with Water Management Alliance (WMA) / SHIDB. We have been provided with water levels of their system and ensured our proposals have been considerate to these levels.

A meeting was held on site to discuss the preferred outfall locations given the high water levels within the SHIDB system. Following the meeting, design proposals were shared with Emma Robertson and Karl Vines, they have confirm that in principle they happy with the current proposals, please refer to Appendix G for the most recent dialogue.

5.4 Hydraulic Modelling

The system has been modelled utilising Causeway Flow+ and the calculation inputs and outputs are included within our calculation package SW 22-150-CAL-C-01, contained with Appendix L.

These calculations demonstrate that the run-off will be safely conveyed and attenuated during storms up to and including the 1 in 100 year event plus climate change allowance.

The calculations show the system has no surcharging during the 1:2 year event. There is no flooding during the 1:30 year event and only nominal flooding during the 1:100+CC event which would be stored local to the chamber or on the surface of the filter strip and drain. The flooding occurs in the shortest most intense storms as demonstrated in the Figure below, for chamber S20 1:100+40%. Consequently the flooding on the surface only last 4 minutes.

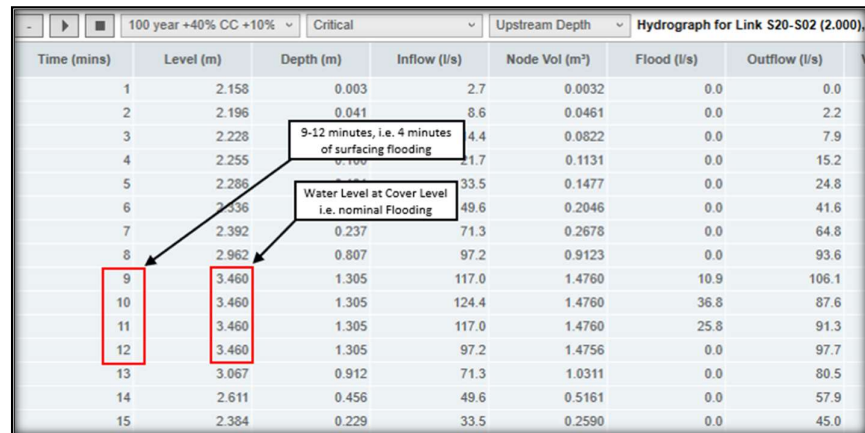


Figure 8: Temporary Flooding Duration

The system has been modelled using both FSR and FEH rainfall data. A 10% allowance for Urban Creep has also been incorporated in accordance with The SuDS Manual and Lincolnshire Development Roads and Sustainable Drainage Design Approach guidance.

As the water levels within the receiving watercourse are relatively high, outputs are also included for the 1:30 and 1:100+CC events with a surcharge. The outputs demonstrate a higher water level within the basin/reduced freeboard. Therefore, this is acceptable as this is less than a 1% chance event.

Peak water levels are summarised on the table shown on drawings SW 22-150-002 & 003. This demonstrates events below the 1:100+CC storm are stored within the underground attenuation system and events of this level and above utilise the storage within the POS depression.

The following figure demonstrates the drain down time of the POS attenuation basin/depression, for the 1:100+CC storm event.

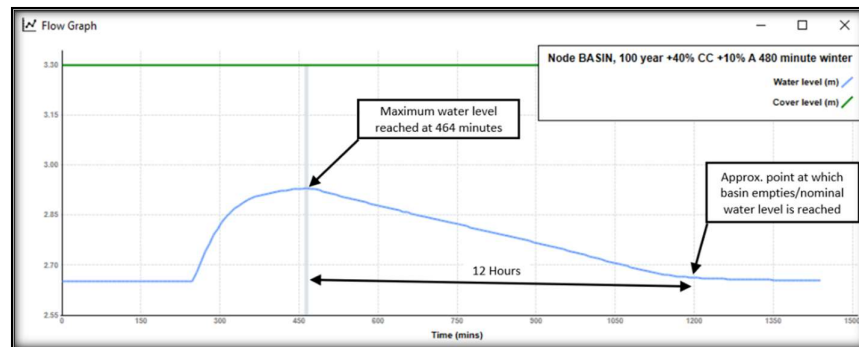


Figure 9: POS Basin/Depression Drain Down Time

5.5 Flood Exceedance

Where possible the proposed site levels have been designed to follow the existing topography. Drawing SW 22-150-005 included with Appendix H demonstrates the proposed flood exceedance routes.

Due to the issues created with the low lying levels of Stockwell Gate and the high water levels of SHIDB system, it was necessary for some of the surface gradients/exceedance paths to vary from the existing scenario.

5.5.1 Flood Routes

The flood route plan clearly demonstrates all overland flows are safely conveyed to either of the SHIDB maintained watercourses to the sites East and West boundaries.

The attenuation basin/depression has approximately 300mm freeboard so offers roughly 300 cubic metres of storage above the worst case modelled storm.

5.5.2 Off-site Flood Risk Management

Proposed site levels have been sympathetic to existing levels particularly at the boundaries. Therefore, no additional flood risk management precautions are required local to the sites boundaries.

5.6 Management/Maintenance Strategy

The proposed system contains various assets which are all required to be in reasonable working order for the systems to function as a whole and operate as anticipated within the design models. These assets should generally be maintained in accordance with The SuDS Manual C753 or manufacturer guidance.

The scope/nature of inspection and maintenance is such that various facilities and structures are inspected and maintained at yearly intervals, as well as after or during use and/or heavy storms, in order that they continue to perform effectively.

The proposed surface water drainage system is to be maintained and owned by several different parties. A management/maintenance plan has been prepared to illustrate who is responsible for each element of the surface water drainage system. This is shown on drawing SW 22-150-006 and is included within Appendix J.

5.6.1 Main Bodies

Various assets are proposed to be offered for adoption by Anglian Water and Lincolnshire County Council (LCC) Highways. It is anticipated that once the scheme has completed its maintenance period and becomes adopted, the maintenance requirements will revert back to the adopting authorities policy.

5.6.1.1 Anglian Water

Anglian Water will be responsible for the following assets:

- Filter drains (below surface) – see maintenance requirements below
- Perforated pipes and chambers within filter drains
- HydroBrake flow control devices
- Underground pipe network and chambers
- Headwalls

These features will be adopted by Anglian Water Services Ltd. under an agreement pursuant to Section 104 of the Water Industry Act.

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

Figure 10: Filter Drain Maintenance Requirements (The SuDS Manual C753)

The HydroBrake should be maintained in accordance with manufacturer guidance, please refer to the below for guidance:

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove sediment and debris from flow control chambers and upstream manholes	Monthly for first 12 months then 6 monthly
Remedial Actions	Replace or clean hydrobrake if performance deteriorates or failure occurs	As necessary
Monitoring	Check flow control to ensure emptying is occurring	Quarterly and post high intensity storm event

Figure 11: HydroBrake Maintenance Requirements

5.6.1.2 LCC Highways

LCC Highways will be responsible for the following assets:

- Carriageway
- Footpaths
- Vehicular crossovers
- Filter drains and filter strips (on surface) – see maintenance requirements below
- Gullies and laterals

These features will be adopted by Lincolnshire County Council Highways under a Section 38 agreement.

Operation and maintenance requirements for filter strips		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (eg oils)	Monthly (at start, then half yearly)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then half yearly)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then half yearly)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then half yearly)
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% of the filter strip area.
Remedial actions	Repair erosion or other damage by re-turfing or reseed	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

Figure 12: Filter Strip Maintenance Requirements (The SuDS Manual C753)

5.6.2 Management Company

A Management Company will be form and be responsible for the following assets:

- Underground attenuation system under the POS – see maintenance requirements below
- POS including the depression/basin – see maintenance requirements below
- Shared driveways to Plots 38-42
- Shared driveway local to Plots 21 & 22 (IDB Access)

Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Figure 13: Attenuation Tanks Maintenance Requirements (The SuDS Manual C753)

Operation and maintenance requirements for detention basins		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	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
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), 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 (as set out in Chapter 23)
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, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseedling or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Figure 14: Detention Basin Maintenance Requirements (The SuDS Manual C753)

5.6.3 Plot Owners

The prospective plot owners will be responsible for the following assets:

- Permeable driveway construction – see maintenance requirements below
- Gutters, downpipes and other building rainwater goods
- Buried pipe networks and chambers local to plot

Operation and maintenance requirements for pervious pavements		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Figure 15: Permeable Paving Maintenance Requirements (The SuDS Manual C753)

6 Foul Water Drainage Strategy

The proposed foul water drainage strategy arrangement is shown on drawings SW 22-150-002 & 003, included within Appendix E.

6.1 Proposals

The proposed dwellings will have their own private buried pipe foul water network. There will be an adopted main sewer beneath the adopted highway conveying the foul water towards the existing Anglian Water network along Stockwell Gate.

Due to the shallow invert of the chambers local to the proposed site entrance junction it is proposed to discharge foul water to the existing sewer local to the North West corner of the site. Discharging to this location enables a gravity foul water system to be achieved for the proposed development. A pipe will run to the frontage of Plots 1-6 in the soft landscaping areas, this pipe will necessitate an easement to Anglian Water requirements.

Pipes and gradients are to be sized using a peak flow calculated in accordance with Sewerage Sector Guidance Appendix C, Design and Construction Guidance, 4000 l/dwelling/day, considering all 42 plots as individual private dwellings.

6.2 Consultation

Consultation with Anglian Water has been sought and a Pre-Planning Assessment Report published by the Authority, this is included within Appendix K.

The report has identified that their system has capacity for the proposed development and it is acceptable for connection to be made local to their existing chamber 1701.

A Section 106 application would be made at the detailed design stage for the proposed connection to existing the Anglian Water system.

6.3 Management/Maintenance Strategy

The proposed system contains various assets which all require to be in reasonable working order for the system to function as a whole and operate as anticipated.

The maintenance schedule for the foul water system, should as a minimum consist of annual inspections and 5 yearly rodding/jetting should no issue be encountered.

The proposed foul water drainage system is to be maintained and owned by several different parties. A management/maintenance plan has been prepared to illustrate who is responsible for each element of the foul water drainage system. This is shown on drawing SW 22-150-006 and is included within Appendix J.

6.3.1 Anglian Water

Anglian Water will be responsible for the following assets:

- Underground pipes (largely beneath the highway)
- Manhole chambers

These features will be adopted by Anglian Water Services Ltd. under an agreement pursuant to Section 104 of the Water Industry Act.

6.3.2 Plot Owners

The prospective plot owners will be responsible for the following assets:

- Building soil and waste goods
- Underground pipes local to plot
- Inspection chambers local to plot

7 Conclusion

In summary:

- Site investigations have been undertaken to assess the infiltration potential.
- Existing site features, topography, drainage assets, etc. have been evaluated.
- Flood Risk Assessment reviewed in accordance with the proposals.
- SuDS hierarchy has been explored;
- Infiltration is possible for unadopted hard surfacing.
- Viable outfalls are feasible for the adjacent watercourse and in principle approval for these discharges from SHIDB have been obtained.
- Various source control features have been reviewed;
- Filter strips and drains are to be incorporated,
- Permeable paving, detention basin and attenuation tank to be utilised.
- Greenfield run-off rate reviewed and discharge rates agreed with SHIDB.
- Hydraulic modelling undertaking for storms ranging from 1:2 – 1:100+CC utilising both FEH and FSR data, an urban creep allowance has been applied, and surcharged outfall models analysed.
- Proposed flood exceedance routes have been at the forefront of design.
- Foul water discharge agreed in principle with Anglian Water, and
- Management and maintenance responsibilities explored for both the surface and foul water systems.

As illustrated by our design proposals on drawings SW 22-150-002, 003, 004 & 005 and the information outlined within this report, it is demonstrable that a viable and robust surface & foul water scheme that complies with the requirements of National Planning Guidance can be provided for the proposed residential development.

Under the proposals outlined within the report, all the drainage features will be either adopted, the responsibility of a Management Company or under private house holder ownership and as such have suitable management and on-going maintenance, these proposals are shown on drawing SW 22-150-006.

Appendix A – Infiltration Test Report



PROPOSED RESIDENTIAL DEVELOPMENT, STOCKWELL GATE

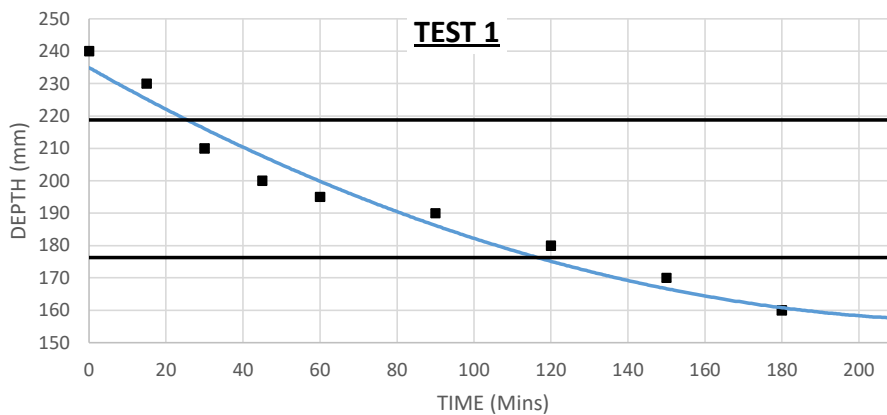
SA01	TEST 1	TEST 2	TEST 3
TIME (Mins)	DEPTH mm (d)	DEPTH mm (d)	DEPTH mm (d)
0	240	250	240
15	230	240	240
30	210	235	240
45	200	235	230
60	195	235	230
90	190	230	220
120	180	220	210
150	170	215	200
180	160	210	190
210	155	205	190

INFILTRATION TEST - HOLE SA01

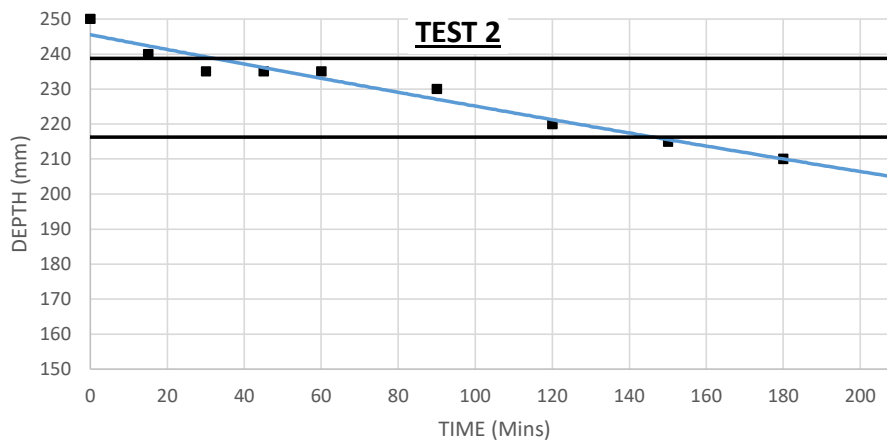
PROJECT NO. 22-150

SITE VISIT: 29-30 / 03 / 2022

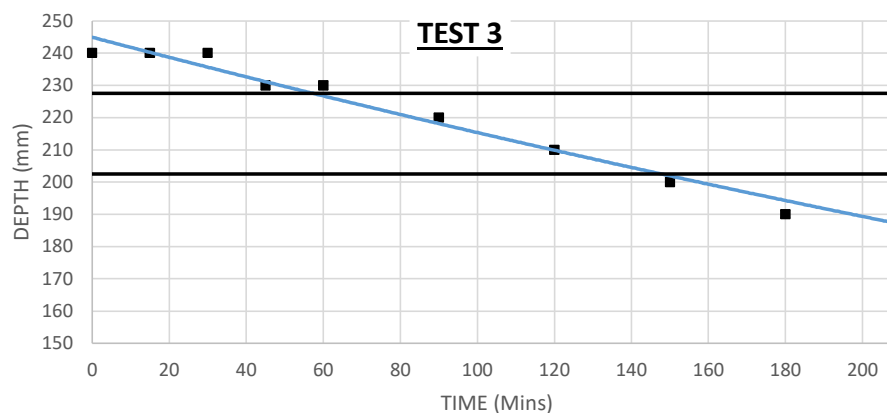
TRIAL PIT DIMENSIONS (m)	
A [L]	1.75
B [W]	0.85
C [D]	1.00



SOIL INFILTRATION RATE, f
TEST 1
6.85231E-06 m/s
0.024668325 m/h



SOIL INFILTRATION RATE, f
TEST 2
3.02309E-06 m/s
0.010883114 m/h



SOIL INFILTRATION RATE, f
TEST 3
4.25754E-06 m/s
0.015327151 m/h

PROPOSED RESIDENTIAL DEVELOPMENT, STOCKWELL GATE

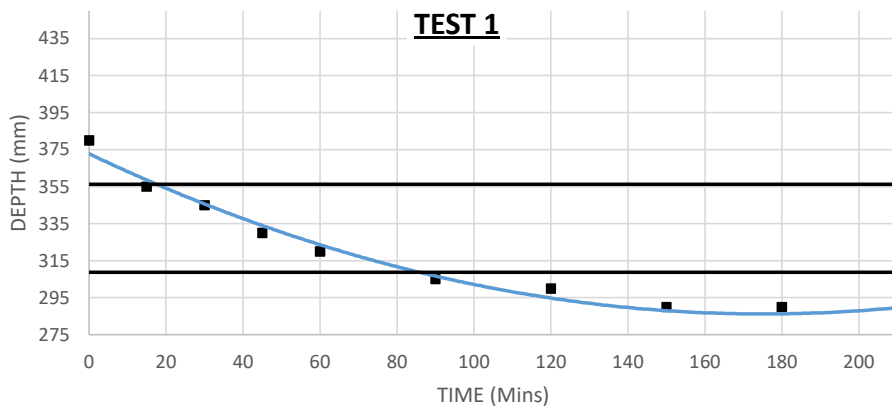
SA02	TEST 1	TEST 2	TEST 3
TIME (Mins)	DEPTH mm (d)	DEPTH mm (d)	DEPTH mm (d)
0	380	440	430
15	355	425	425
30	345	415	420
45	330	410	410
60	320	405	410
90	305	400	400
120	300	395	390
150	290	390	390
180	290	385	385
210	285	385	380

INFILTRATION TEST - HOLE SA02

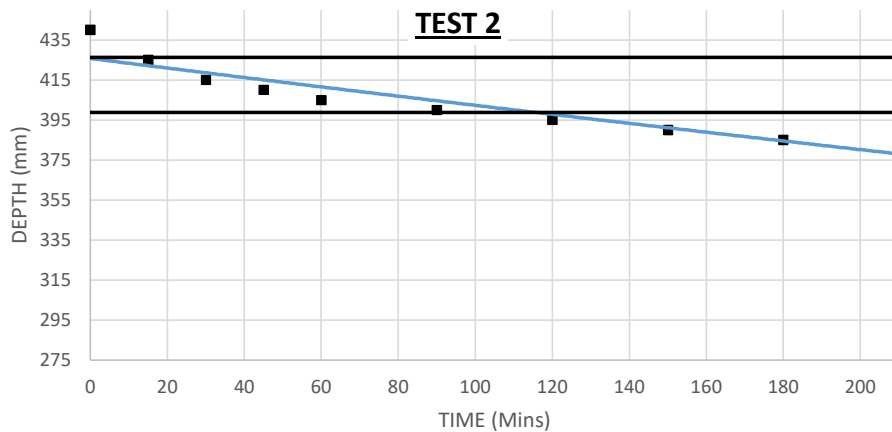
PROJECT NO. 22-150

SITE VISIT: 29-30 / 03 / 2022

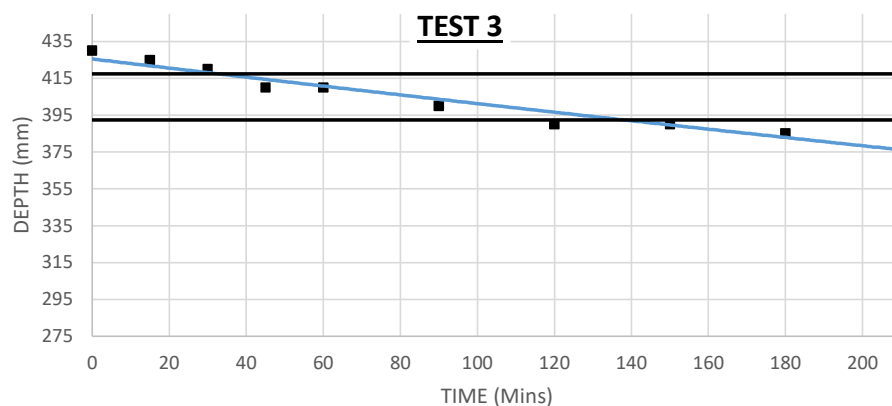
TRIAL PIT DIMENSIONS (m)	
A [L]	1.50
B [W]	0.87
C [D]	1.07



SOIL INFILTRATION RATE, f	
TEST 1	
9.37748E-06 m/s	
0.033758945 m/h	



SOIL INFILTRATION RATE, f	
TEST 2	
4.1671E-06 m/s	
0.015001568 m/h	



SOIL INFILTRATION RATE, f	
TEST 3	
3.81981E-06 m/s	
0.013751317 m/h	

PROPOSED RESIDENTIAL DEVELOPMENT, STOCKWELL GATE

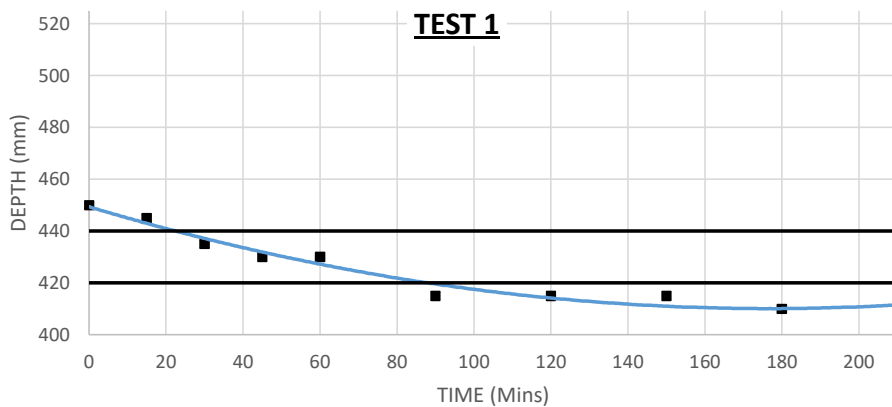
SA03	TEST 1	TEST 2	TEST 3
TIME (Mins)	DEPTH mm (d)	DEPTH mm (d)	DEPTH mm (d)
0	450	515	510
15	445	510	505
30	435	510	505
45	430	505	500
60	430	500	495
90	415	500	490
120	415	495	490
150	415	495	485
180	410	485	480
210	410	480	475

INFILTRATION TEST - HOLE SA03

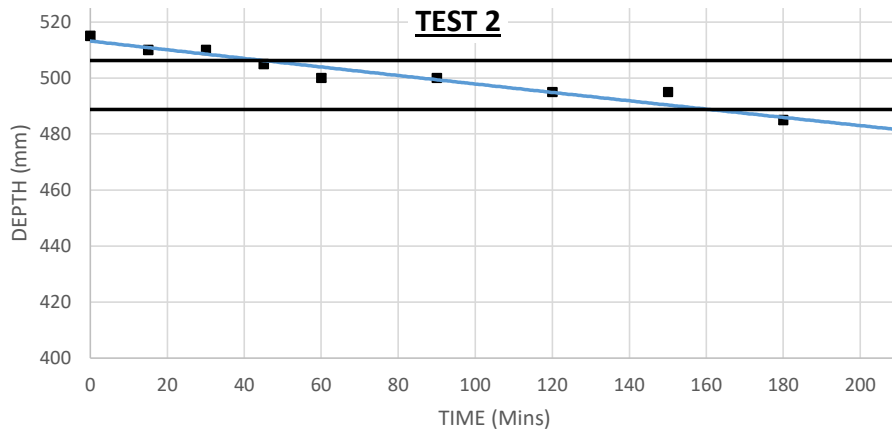
PROJECT NO. 22-150

SITE VISIT: 29-30 / 03 / 2022

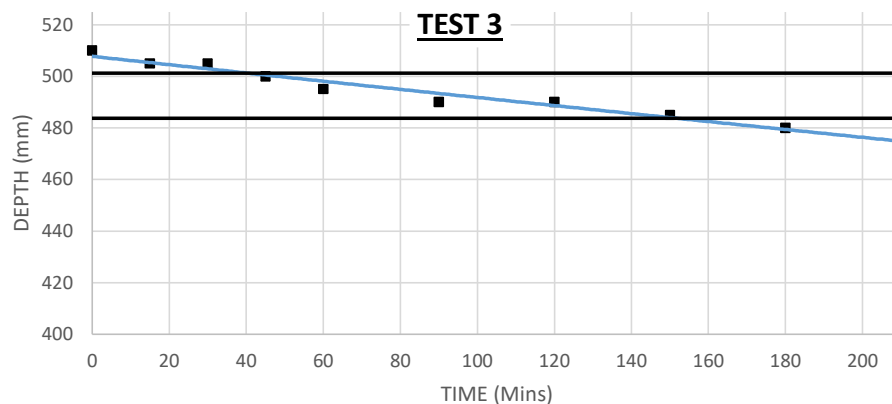
TRIAL PIT DIMENSIONS (m)	
A [L]	1.60
B [W]	0.88
C [D]	1.06



SOIL INFILTRATION RATE, f	
TEST 1	
4.44849E-06 m/s	
0.016014559 m/h	

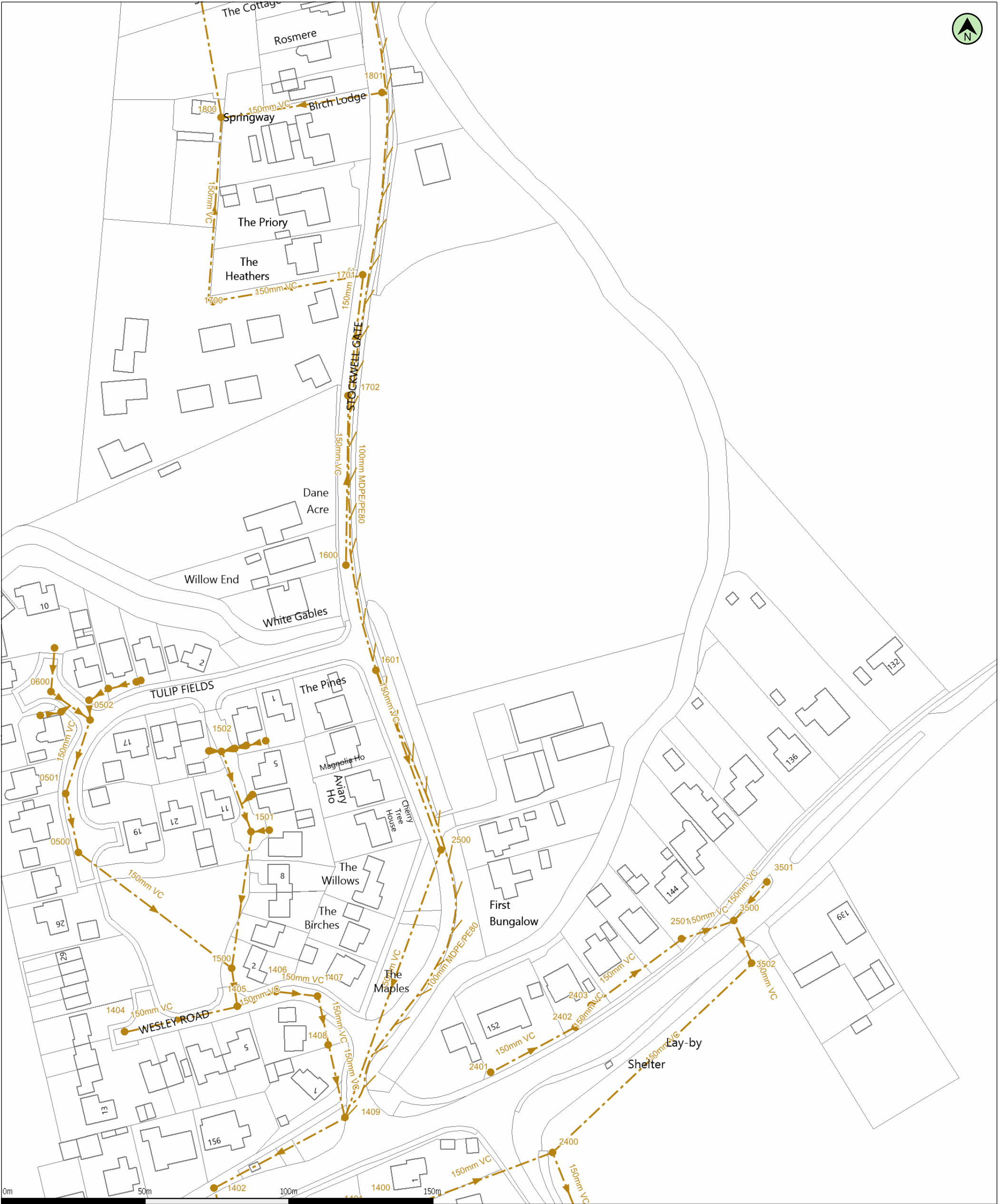


SOIL INFILTRATION RATE, f	
TEST 2	
2.38896E-06 m/s	
0.008600249 m/h	



SOIL INFILTRATION RATE, f	
TEST 3	
2.49755E-06 m/s	
0.008991169 m/h	

Appendix B – Anglian Water Asset Map



(c) Crown copyright and database rights 2022 Ordnance Survey 100019209
Data updated: 31/01/22

Scale: 1:1250
Map Centre: 533235,324634

Date: 28/02/22
Our Ref: 792629 - 1

Wastewater Plan A3
Powered by digdat

Foul Sewer				
Surface Sewer		Outfall*		
Combined Sewer				
Final Effluent		Inlet*		
Rising Main*				
Private Sewer*		Manhole*		
Decommissioned Sewer*				

*(Colour denotes effluent type)

adam@shieldswilson.co.uk
Welch

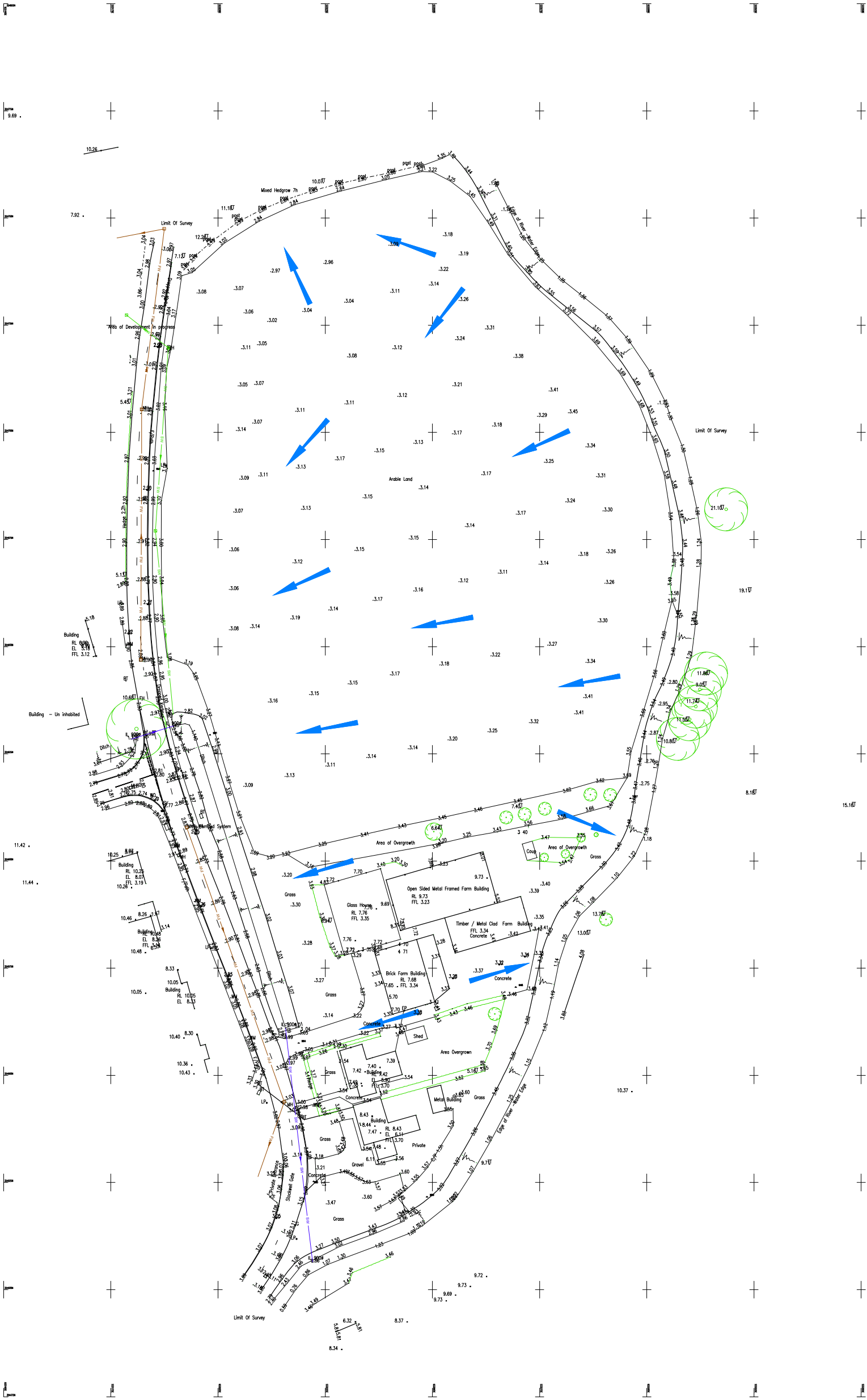


This plan is provided by Anglian Water pursuant to its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2022 Ordnance Survey 100022432. This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

Appendix C – Existing Overland Flood Flows



← DENOTES EXISTING FLOOD EXCEEDANCE ROUTE



- PRELIMINARY - FOR INFORMATION.			MP	AFW	24.05.22
REV.	DESCRIPTION			DRN.	APP. DATE
SHIELDS WILSON e: info@shieldswilson.co.uk t: 01775 729252 STRUCTURAL AND CIVIL ENGINEERING					
STATUS FOR PLANNING					
CLIENT MR WELCH					
PROJECT PROPOSED RESIDENTIAL DEVELOPMENT LAND EAST OF STOCKWELL GATE, WHAPLODE, LINCOLNSHIRE					
TITLE TOPOGRAPHICAL SURVEY SHOWING EXISTING OVERLAND FLOOD FLOWS					
DATE	MAY '22	SCALE 0A1 1:500	DRAWING NO. SW 22-150-001		REV. -
DRAWN	MP				

Appendix D – Architectural Site Layout

All dimensions to be verified on site by Main Contractor before the start of any shop drawings or work whatsoever either on their own behalf or that of sub-contractors.

Report any discrepancies to the Contract Administrator at once.

This drawing is to be read with all relevant Architect's and Engineer's drawings and other relevant information.

Andrew M Wright Ltd. Registered in England & Wales No. 9399024.
Registered office: 22 Church Street, Holbeach, Spalding, Lincs. PE12 7LL

LEGEND: DO NOT SCALE

- Potential affordable dwellings (first homes, shared ownership or rented)
- 3 no. bungalows (2 bed) (with single garage)
- 2 no. houses (1 bed)
- 2 no. bungalows (3 bed) (with single garage)
- 10 no. houses (2 bed)
- 5 no. houses (2 bed)
- 4 no. houses (4 bed) (with double garage)
- 12 no. houses (3 bed) (with single garage)
- 4 no. houses (3 bed)
- Public open space
- RCP Refuse collection point

Note: This site plan forms part of an outline planning application (with all matters reserved). As such, the layout and dwellings shown are indicative only in order to demonstrate what might be possible on the application site.

D1	13.01.22	Draft Issue	AMW	AMW
Revision:	Date:	Description:	Dwn:	Chk:

ANDREW M WRIGHT LTD
CHARTERED ARCHITECT



26 Joys Bank, Holbeach St Johns, Spalding, Lincs, PE12 8SD
Telephone: 01406 540573 Mobile: 07940 914778

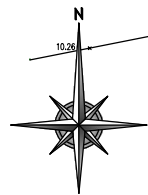
Project: Stockwell Gate
Whaplode
Lincs

Drawing Title: Indicative Site Plan

Client: Mr Welch

Drawn: AMW	Checked: AMW	Date: 13.01.22	Scale: 1:500	Paper Size: A2
Job No.: 002103	Dwg No.: PD02	Stage: Planning	Revision: D1	

Appendix E – Proposed Drainage Strategy Arrangement Drawings



7.92

EXISTING ANGLIAN WATER
FOUL WATER MH
REF: 1701
UNSURVEYED POSITION
CL: 3.062 TBC
IL: 0.993 TBC

NEW F00
CL: 0.000
IL: 1.095

NEW F05
CL: 3.050
IL: 1.130

NEW SW100
CL: 3.350
IL: 2.545

NEW F01
CL: 3.500
IL: 2.500

NEW S10
CL: 3.350
IL: 2.145

NEW S11
CL: 3.350
IL: 2.095

NEW S12
CL: 3.250
IL: 1.990

NEW S13
CL: 3.170
IL: 1.890

NEW S04
CL: 3.200
IL: 1.725

NEW S03
CL: 3.085
IL: 1.745

NEW S02
CL: 3.360
IL: 1.875

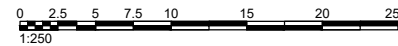
NEW S01
CL: 3.295
IL: 2.145

FIRST 25m OF ADOPTABLE HIGHWAY TO DRAIN
INDEPENDENTLY FROM THE PROPOSED SITES
DRAINAGE SYSTEM. THIS AREA IS TO DRAIN VIA
GULLIES TO AN EXISTING HIGHWAY DRAIN WHICH
DISCHARGES TO SHDB SYSTEM. UN-RESTRICTED
DISCHARGE AGREED IN PRINCIPLE BY SHDB

UNDERGROUND ATTENUATION SYSTEM
INVERT LEVEL: 1.750
STORAGE STRUCTURE DEPTH: 400mm
AVAILABLE STORAGE VOLUME: 239.4m³

PROPOSED FLOW CONTROL CHAMBER:
TO BE FITTED WITH HYDROBRAKE TO RESTRICT DISCHARGE
TO 5.00L/S (PRACTICAL MIN. RATE PREFERRED BY ANGLIAN WATER,
TO PROVIDE MIN. 100mm ORIFICE TO CURRENT SSS DCS)
DISCHARGE RATE AGREED IN PRINCIPLE WITH SOUTH HOLLAND IDB

KEY:	
	EXISTING FOUL SEWER - AWS
	EXISTING FOUL RISING MAIN - AWS
	EXISTING HIGHWAY DRAIN - LOC
	EXISTING SURFACE WATER CULVERT - IDB
	PROPOSED FOUL WATER VACUUM SEWER - S104 ADOPTABLE
	PROPOSED FOUL WATER CHAMBER - S104 ADOPTABLE
	PROPOSED FOUL DRAIN - PRIVATE
	PROPOSED FOUL INSPECTION CHAMBER - PRIVATE
	PROPOSED SURFACE WATER SEWER - S104 ADOPTABLE
	PROPOSED SURFACE WATER CHAMBER - S104 ADOPTABLE
	PROPOSED SURFACE WATER DRAIN - PRIVATE
	PROPOSED SURFACE INSPECTION CHAMBER - PRIVATE
	PROPOSED ROAD GULLY & LATERAL - S38 ADOPTABLE
	PROPOSED FILTER DRAIN - S38 & 104 ADOPTABLE
	PROPOSED UNDERGROUND ATTENUATION TANK - PRIVATE
	EXISTING SITE LEVEL
	PROPOSED SITE LEVEL
	PROPOSED SURFACE FALL
	AREA A - PROPOSED TARMAC ROAD/FOOTPATH/FILTER DRAIN (S38 ADOPTABLE) TOTAL AREA: 1,980m ²
	AREA B - PROPOSED TARMAC ROAD/FOOTPATH (S38 ADOPTABLE) TOTAL AREA: 210m ²
	AREA C - PROPOSED DWELLING ROOFS TOTAL AREA: 2,760m ²
	AREA D - PERMEABLE DRIVEWAYS TO INFILTRATE TO GROUND (PRIVATE/MANAGEMENT COMPANY) TOTAL AREA: 2,490m ²
	TOTAL AREA TO PROPOSED DRAINAGE SYSTEM (AREAS A & C): 4,740m ²



B	MINOR UPDATES FOR CLARITY.	MP	APW	05.08.22
A	DRAWING GENERALLY DEVELOPED FOLLOWING MEETING WITH SHDB.	MP	APW	18.07.22
-	PRELIMINARY - FOR INFORMATION.	MP	APW	24.05.22
REV.	DESCRIPTION	DRN.	APP.	DATE

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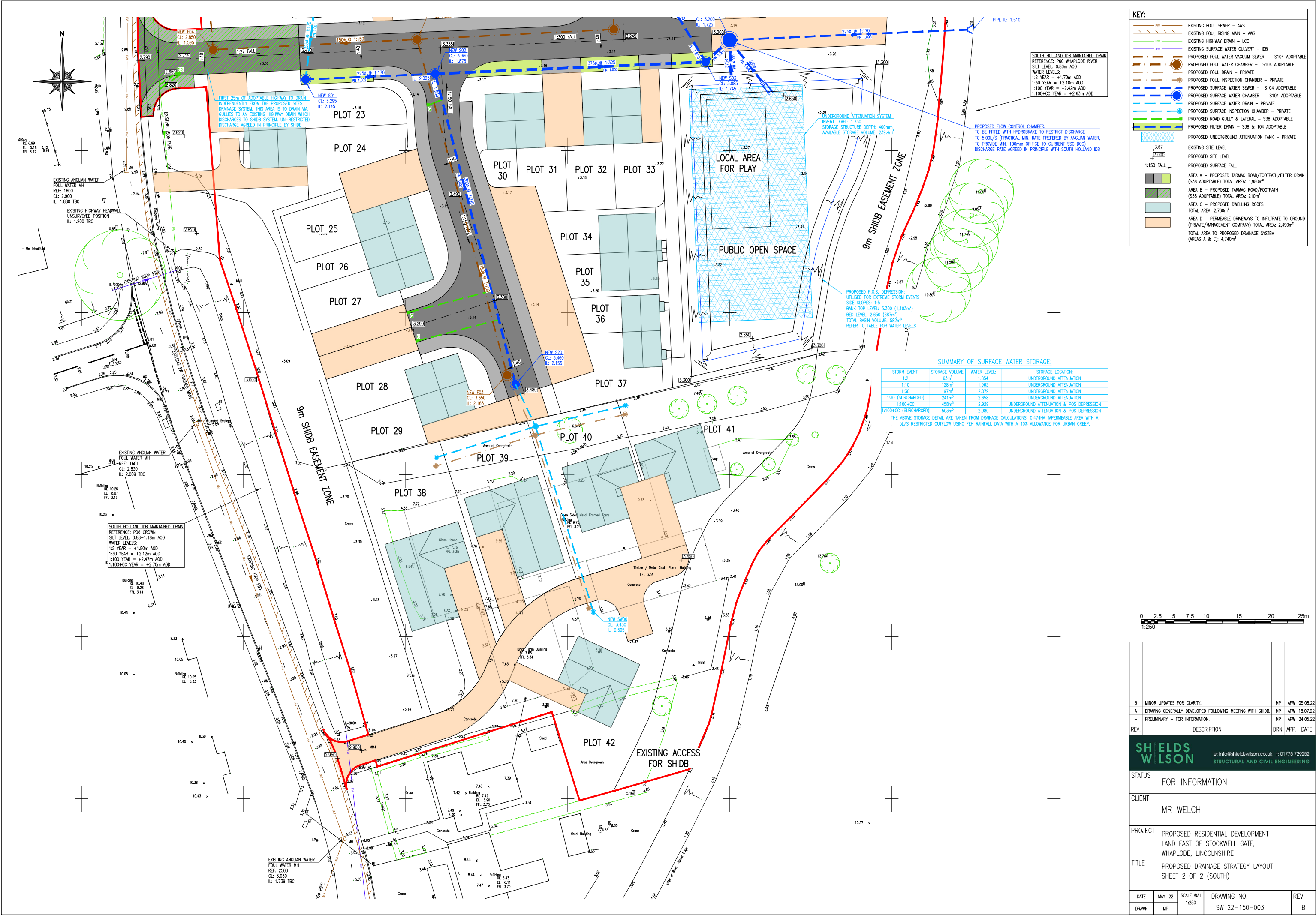
STATUS FOR INFORMATION

CLIENT MR WELCH

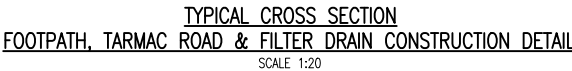
PROJECT PROPOSED RESIDENTIAL DEVELOPMENT
LAND EAST OF STOCKWELL GATE,
WHAPLODE, LINCOLNSHIRE

TITLE PROPOSED DRAINAGE STRATEGY LAYOUT
SHEET 1 OF 2 (NORTH)

DATE	MAY '22	SCALE	0/11 1:250	DRAWING NO.	SW 22-150-002	REV.	B
DRAWN	MP						



Appendix F – Proposed Typical Construction Details

[illegible]

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STATUS	FOR INFORMATION
--------	-----------------

CLIENT MR WELCH

PROJECT	PROPOSED RESIDENTIAL DEVELOPMENT LAND EAST OF STOCKWELL GATE, WHAPLODE, LINCOLNSHIRE
---------	--

TITLE	PROPOSED TYPICAL CONSTRUCTION DETAILS
-------	---------------------------------------

DATE	AUG. '22	SCALE: ①A1 1:20	DRAWING NO. SW 22-150-004	REV. —
DRAWN	MP			

Appendix G – IDB Correspondence

Marcus Pett

From: Emma Robertson <Emma.Robertson@wlma.org.uk>
Sent: 26 July 2022 13:24
To: Marcus Pett
Subject: RE: Proposed Residential Development off Stockwell Gate, Whaplode

Hi Marcus,

Thanks for talking to me just now. Just to confirm I have spoken to Karl and we are happy with this drainage strategy in principle. Please let me know when you would like to apply for consent and I can send over our application form.

Many thanks,
Emma



Emma Robertson, BSc (Hons)
Sustainable Development Officer
Water Management Alliance
Tel: 01553 819600 | emma.robertson@wlma.org.uk

Registered office: Pierpoint House, Horsley's Fields, King's Lynn, Norfolk, PE30 5DD
t: 01553 819600 | e: info@wlma.org.uk | www.wlma.org.uk

WMA members: [Broads Drainage Board](#), [East Suffolk Drainage Board](#), [King's Lynn Drainage Board](#), [Norfolk Rivers Drainage Board](#), [South Holland Drainage Board](#), [Waveney, Lower Yare and Lothingland IDB](#) in association with [Pevensey and Cuckmere Water Level Management Board](#)

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Your feedback is valuable to us, as we continually review and work to improve our services. So, if you have any suggestions, recommendations, questions, compliments or complaints, please complete one of our online forms: [Feedback Form](#) | [Complaint Form](#)

The information in this e-mail, and any attachments, is confidential and intended solely for the use of the individual or entity to whom it is addressed. The views expressed in this e-mail may not represent those of the Board(s). Nothing in this email message amounts to a contractual or legal commitment unless confirmed by a signed communication. All inbound and outbound emails may be monitored and recorded.

With our commitment to ISO 14001, please consider the environment before printing this e-mail.

From: Marcus Pett <marcus@shieldswilson.co.uk>
Sent: 18 July 2022 13:25
To: Emma Robertson <Emma.Robertson@wlma.org.uk>; Karl Vines <Karl.Vines@wlma.org.uk>
Cc: Adam Wilson <adam@shieldswilson.co.uk>
Subject: Proposed Residential Development off Stockwell Gate, Whaplode

Good afternoon Emma/Karl,

Many thanks for your time on site a couple of weeks ago.

We are pleased to update you following our progression with the proposed site drainage system, therefore please refer to the attached updated drawing SW 22-150 – 02A, 03A & 05A.

As requested, we have reduced the number of proposed outfalls to your system. We have been able to achieve a drainage system where, all 42 plots roof area and the majority of the adoptable highway drain to your watercourse to the Eastern boundary. We have restricted this discharge to 5 litres per second as agreed and ensured that the HydroBrake chamber invert is above your maximum 1:2 water level, to prevent surcharging of the system in this event. The system has been hydraulic modelled including surcharged outfalls and the surface water run-off storage volumes and levels are tabulated on drawing 03.

Infiltration testing onsite has demonstrated that infiltration is feasible for unadopted hard surfacing, eg. Private driveways and shared access roads.

There is a small extent of impermeable area local to the existing road which will have to drain separately to the site wide drainage system due to the maximum water levels within your system, as we discussed. We have been able to limit this area to just 210m² by draining the frontage plot roofs to the East, therefore this area comprises of the first 25m of adoptable highway only as annotated on the drawings. As this area is now so small, we propose to discharge run-off at an unrestricted rate into the existing highway drain immediately upstream of your watercourse to the Western boundary. The peak flows for the shortest (15 minutes), most intense storms for this area as follows:

1:2 = 2l/s

1:10 = 3.6l/s

1:30 = 4.5l/s

1:100 = 6l/s

1:100+CC = 8l/s

Given these discharge rates it would not be possible to introduce a HydroBrake that limits discharge rate from site for all but the most extreme, short storms.

To enable our finalisation of the drainage strategy ready for planning submission we would appreciate your agreement in principle to the 2 proposed discharge locations and their rates.

We trust our proposals as shown on the attached drawings and described above are clear, but please do not hesitate to contact me should you have any queries.

Kind regards,

Marcus Pett

Email: marcus@shieldswilson.co.uk

**SHIELDS
WILSON**

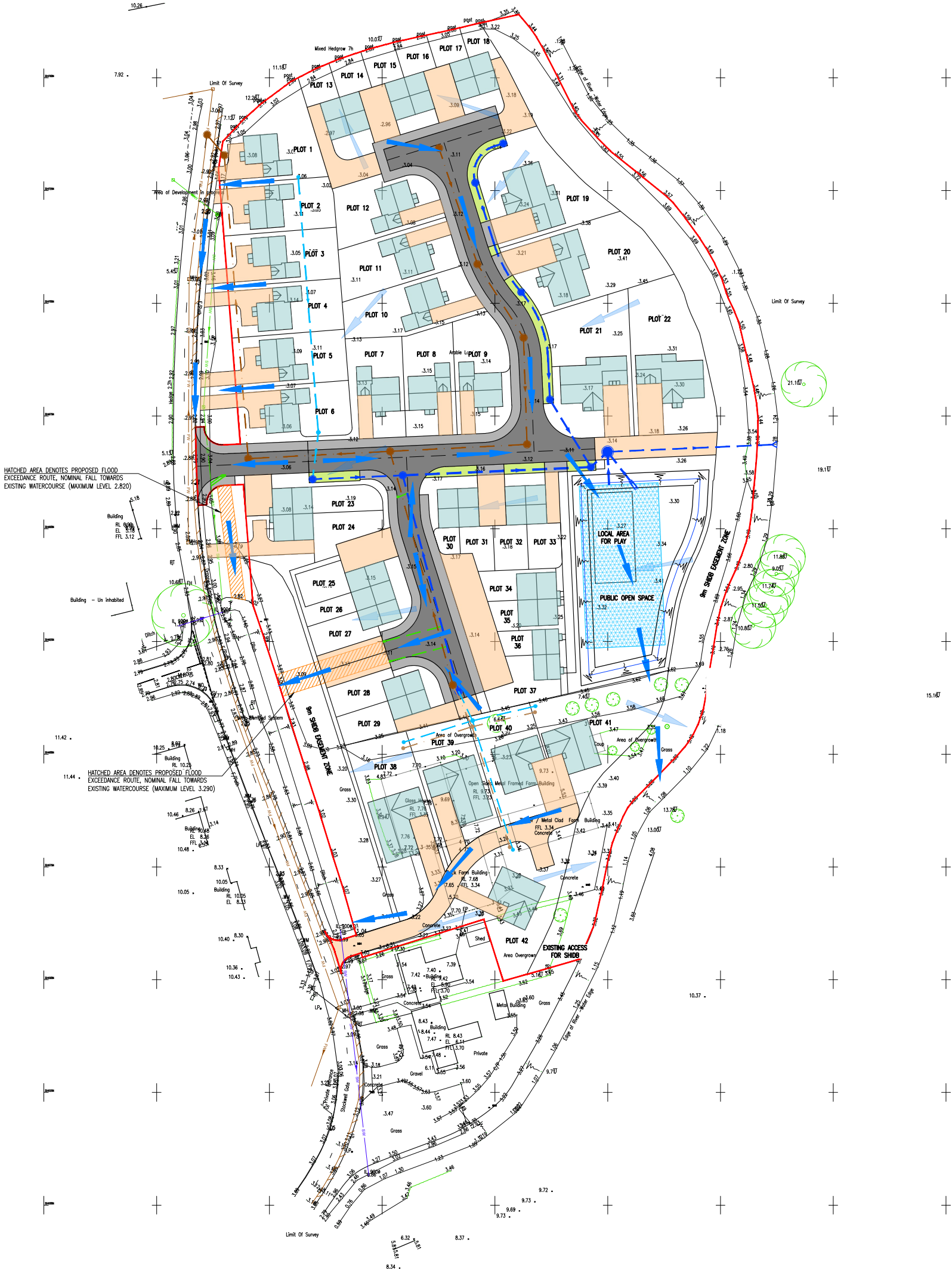
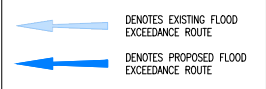
e: info@shieldswilson.co.uk t: 01775 729252

STRUCTURAL AND CIVIL ENGINEERING

For & on behalf of Shields Wilson Limited. Company No: 12611213 Registered office: Bank House, Broad Street, Spalding, PE11 1TB

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Appendix H – Proposed Flood Exceedance Route Drawing



HATCHED AREA DENOTES PROPOSED FLOOD EXCEEDANCE ROUTE, NOMINAL FALL TOWARDS EXISTING WATERCOURSE (MAXIMUM LEVEL 2.820)

HATCHED AREA DENOTES PROPOSED FLOOD EXCEEDANCE ROUTE, NOMINAL FALL TOWARDS EXISTING WATERCOURSE (MAXIMUM LEVEL 3.290)



B	MINOR UPDATES FOR CLARITY.	MP	APW	05.08.22
A	DRAWING GENERALLY DEVELOPED FOLLOWING MEETING WITH SHWB.	MP	APW	18.07.22
-	PRELIMINARY - FOR INFORMATION.	MP	APW	24.05.22
REV.	DESCRIPTION	DRN.	APP.	DATE

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STRUCTURAL AND CIVIL ENGINEERING

STATUS FOR INFORMATION

CLIENT MR WELCH

PROJECT PROPOSED RESIDENTIAL DEVELOPMENT
LAND EAST OF STOCKWELL GATE,
WHAPLODE, LINCOLNSHIRE

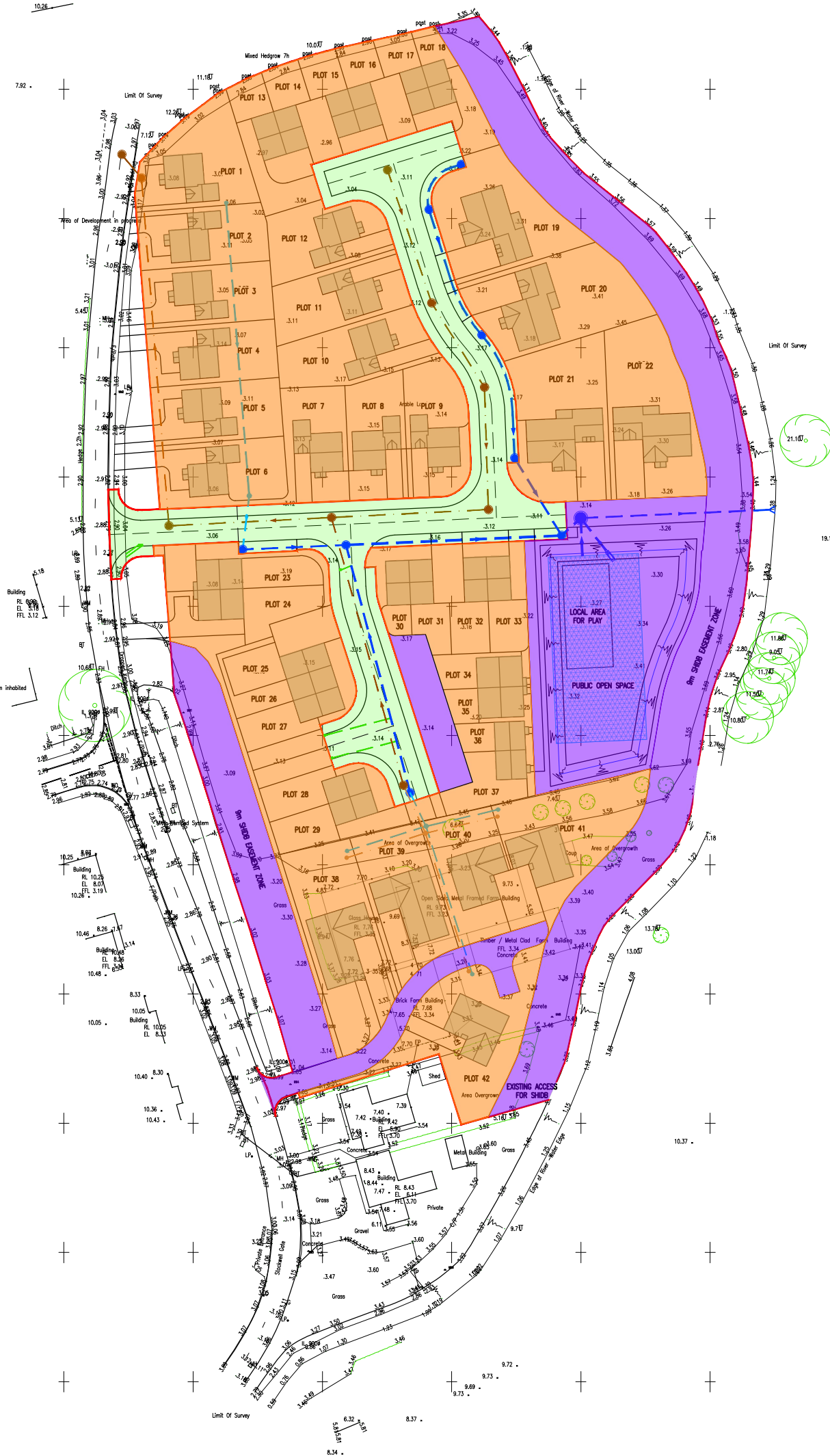
TITLE SITE LAYOUT SHOWING PROPOSED
FLOOD EXCEEDANCE ROUTES

DATE	MAY '22	SCALE	0/1 1:500	DRAWING NO.	SW 22-150-005	REV.	B
DRAWN	MP						

Appendix J – Proposed Management/Maintenance Drawing



ADOPTION / MAINTENANCE KEY:	
	LINCOLNSHIRE COUNTY COUNCIL HIGHWAYS
	MANAGEMENT COMPANY
	PRIVATE PLOT OWNER
	PROPOSED FOUL WATER - S104 ADOPTABLE
	PROPOSED FOUL WATER - MAN. CO. / PRIVATE
	PROPOSED SURFACE WATER - S104 ADOPTABLE
	PROPOSED SURFACE WATER - MAN. CO. / PRIVATE
	PROPOSED SURFACE WATER - LCC HIGHWAYS



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A	MINOR ALTERATIONS TO ARCHITECTS REQUEST.	MP	APW	10.08.22
-	PRELIMINARY - FOR INFORMATION.	MP	APW	05.08.22
REV.	DESCRIPTION	DRN.	APP.	DATE
SHIELDS WILSON e: info@shieldswilson.co.uk t: 01775 729252 STRUCTURAL AND CIVIL ENGINEERING				
STATUS		FOR INFORMATION		
CLIENT		MR WELCH		
PROJECT		PROPOSED RESIDENTIAL DEVELOPMENT LAND EAST OF STOCKWELL GATE, WHAPLODE, LINCOLNSHIRE		
TITLE		PROPOSED MANAGEMENT & MAINTENANCE PLAN		
DATE	AUG '22	SCALE	001 1:500	DRAWING NO.
DRAWN	MP			SW 22-150-006
				REV.
				A

Appendix K – Anglian Water Correspondence



Pre-Planning Assessment Report

Land off Stockwell Gate

InFlow Reference: PPE-0147031

Assessment Type: Used Water

Report published: 17/05/2022



Thank you for submitting a pre-planning enquiry.

This has been produced for N/A.

Your reference number is **PPE-0147031**.

This report can be submitted as a drainage strategy for the development should it seek planning permission.

If you have any questions upon receipt of this report, you can submit a further question via InFlow. Alternatively, please contact the Planning & Capacity team on **07929 786 955** or email planningliaison@anglianwater.co.uk

Section 1 - Proposed development

The response within this report has been based on the following information which was submitted as part of your application:

List of planned developments	
Type of development	No. Of units
Dwellings	42

The anticipated residential build rate is:

Year	Y1
Build rate	42

Development type: Greenfield
Planning application status: Unknown
Site grid reference number: TF3324724660

The comments contained within this report relate to the public water mains and sewers indicated on our records. Your attention is drawn to the disclaimer in the useful information section of this report.

Section 2 - Assets affected

Our records indicate that we have the following types of assets within or overlapping the boundary of your development site as listed in the table below.

Additionally, it is highly recommended that you carry out a thorough investigation of your proposed working area to establish whether any unmapped public or private sewers and lateral drains are in existence. We are unable to permit development either over or within the easement strip without our prior consent. The extent of the easement is provided in the table below.

Please be aware that the existing water mains/public sewers should be located in highway or open space and not in private gardens. This is to ensure available access for any future maintenance and repair and this should be taken into consideration when planning your site layout.

Water and Used water easement information		
Asset type	Pipe size (mm)	Total easement required (m)
Sewer mains	100	3.00 m either side of the centre line

If it is not possible to avoid our assets then these may need to be diverted in accordance with Section 185 of the Water Industry Act (1991). You will need to make a formal application if you would like a diversion to be considered.

Due to the private sewer transfer in October 2011 many newly adopted public used water assets and their history are not indicated on our records. You also need to be aware that your development site may contain private water mains, drains or other assets not shown on our records. These are private assets and not the responsibility of Anglian Water but that of the landowner.

Section 3 - Water recycling services

In examining the used water system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving water recycling centre and determine whether the water recycling centre can cope with the increased flow and effluent quality arising from your development.

Water recycling centre

The foul drainage from the proposed development is in the catchment of Moulton Water Recycling Centre, which currently does not have capacity to treat the flows from your development site.

Anglian Water are obligated to accept the foul flows from your development with the benefit of planning consent and would therefore take the necessary steps to ensure that there is sufficient treatment capacity should the planning authority grant planning permission.

Used water network

Our assessment has been based on development flows connecting to the nearest foul water sewer of the same size or greater pipe diameter to that required to drain the site. The infrastructure to convey foul water flows to the receiving sewerage network is assumed to be the responsibility of the developer. Conveyance to the connection point is considered as Onsite Work and includes all work carried out upstream from of the point of connection, including making the connection to our existing network. This connection point has been determined in reference to the calculated discharge flow and on this basis, a 150mm internal diameter pipe is required to drain the development site. The nearest practicable connection is to the 150mm diameter sewer at manhole 1701 in Stockwell Gate at National Grid Reference NGR TF3318824748. The cover level is 3.06 and the invert level is 0.99. Anglian Water has assessed the impact of gravity flows from the planned development to the public foul sewerage network. We can confirm that this is acceptable as the foul sewerage system, at present, has available capacity for your site. Due to the topography, we have also assessed the impact of a pumped conveyance from the planned development to the public foul sewerage network and we can confirm that this is also acceptable. In line with Design and Construction Guidance, the pumped discharge would need to connect via an intermediate manhole and at least 5 metres of an appropriately sized gravity sewer. The pump rate and configuration of the connection will be determined with your detailed design. You should submit this detail with your Section 106 new connection application. Please note that Anglian Water will request a suitably worded condition at planning application stage to ensure this strategy is implemented to mitigate the risk of flooding.

It is assumed that the developer will provide the necessary infrastructure to convey flows from the site to the network. Consequently, this report does not include any costs for the conveyance of flows.

Surface water disposal

You indicated on the Pre-Planning Application form that a connection to the public surface water sewer network is not required as a connection to a watercourse is to be utilised. It is important to note that there are no public surface water sewers within the vicinity of the proposed development. Therefore Anglian Water would be unable to provide the site with a feasible solution of surface water disposal within the current assets. Alternative methods of surface water disposal will need to be fully investigated, such as infiltration techniques or a discharge to a watercourse, in accordance with the surface water management hierarchy as outlined in Building Regulations Part H. A new surface water sewer can be used as a mechanism to discharge surface water to a watercourse or as part of a Suds scheme where appropriate. Subject to the sewer being designed in accordance with the current version of Sewers for Adoption, the sewer can be put forward for adoption by AW under S104 of the WIA 1991. If the outfall is to a watercourse, the applicant will be required to obtain consent to discharge via the appropriate body.

As you may be aware, Anglian Water will consider the adoption of SuDs provided that they meet the criteria outline in our SuDs adoption manual. This can be found on our [website](#). We will adopt features located in public open space that are designed and constructed, in conjunction with the Local Authority and Lead Local Flood Authority (LLFA), to the criteria within our SuDs adoption manual. Specifically, developers must be able to demonstrate:

1. Effective upstream source control,
2. Effective exceedance design, and

3. Effective maintenance schedule demonstrating that the assets can be maintained both now and in the future with adequate access.

If you wish to look at the adoption of any SuDs then an expression of interest form can be found on our [website](#)

As the proposed method of surface water disposal is not relevant to Anglian Water; we suggest that you contact the relevant Local Authority, Lead Local Flood Authority, the Environment Agency or the Internal Drainage Board, as appropriate.

Trade Effluent

We note that you do not have any trade effluent requirements. Should this be required in the future you will need our written formal consent. This is in accordance with Section 118 of the Water Industry Act (1991).

Used Water Budget Costs

Your development site will be required to pay an Infrastructure charge for each new property connecting to the public water and sewerage network that benefits from Full planning permission. The infrastructure charge replaces the zonal charge as previously identified.

You will be required to pay an infrastructure charge upon connection for each new plot on your development site. The infrastructure charge are types of charges set out in Section 146(2) of the Water Industry Act 1991.

The charge should be paid by anyone who wishes to build or develop a property and is payable upon request of connection.

- The Infrastructure Charge is based on the cost of any reinforcement and upgrades to our existing network ("Network Reinforcements"), whether designed to address strategic or local capacity issues. For more information on our Infrastructure Charge, please see the 'Useful Information' section of this report.

Infrastructure charges are raised on a standard basis of one charge per new connection (one for water and one for sewerage).

The Water Recycling Infrastructure charge for your dwellings is:

Infrastructure charge	Number of units	Total
£ 490	42	£20,580.00

Please note that you should also budget for infrastructure charges on non-household premises where applicable and these will be calculated according to the number and type of water fittings in the premises. This is called the "relevant multiplier" method of calculating the charge and the relevant multiplier will be applied to the figures set out in our 2022-23 Developer Charging Arrangements to arrive at the amount payable. Details of the relevant multiplier for each fitting can be found on our [website](#).

The map displays the Whaplode River and its associated drainage system. Key features include:

- Roads:** WISTLEY ROAD, KEN ORMAN ROAD.
- Drains:** Drain, Willow End, White Gables, The Pines, Wilows, Birches, Maples, bluce, Shelter.
- Pipes:** MDPF PE80, VC, GI.
- Land Parcels:** Various numbered plots (e.g., 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100).
- Other Features:** A red boundary line, a blue line representing the river, and a yellow area labeled "Whaplode River (Drain)".

InFlow Ref: PPE-0147031

Section 5 - Useful information

Water Industry Act – Key used water sections

Section 98:

This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.

Section 102:

This provides you with the right to have an existing sewerage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.

Section 104:

This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.

Section 106:

This provides you with the right to have your constructed sewer connected to the public sewer.

Section 185

This provides you with the right to have a public sewerage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our [website](#) or via our Development Services team on **0345 60 66 087**.

Sustainable drainage systems

Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are not resilient to climate change in the long term. .

Our preferred method of surface water disposal is through the use of Sustainable Drainage Systems or SuDS.

SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our [website](#)

We recommend that you contact the Local Authority and Lead Local Flood Authority (LLFA) for your site to discuss your application.

Private sewer transfers

Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

Surface water sewers and lateral drains that do not discharge to the public sewer, e.g. those that discharged to a watercourse.

Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.

Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.

It is anticipated that all new sewer applications will need to have an approved Section104 application ahead of a Section 106 connection

Encroachment

Anglian Water operates a risk based approach to development encroaching close to our used water infrastructure. We assess the issue of encroachment if you are planning to build within 400 metres of a water recycling centre or, within 15 metres to 100 metres of a pumping station. We have more information available on our [website](#)

Locating our assets

Maps detailing the location of our water and used water infrastructure including both underground assets and above ground assets such as pumping stations and recycling centres are available from [digdat](#)

All requests from members of the public or non-statutory bodies for maps showing the location of our assets will be subject to an appropriate administrative charge.

We have more information on our [website](#)

Charging arrangements

Our charging arrangements and summary for this year's water and used water connection and infrastructure charges can be found on our [website](#)

Section 6 - Disclaimer

The information provided in this report is based on data currently held by Anglian Water Services Limited ('Anglian Water') or provided by a third party. Accordingly, the information in this report is provided with no guarantee of accuracy, timeliness, completeness and is without indemnity or warranty of any kind (express or implied).

This report should not be considered in isolation and does not nullify the need for the enquirer to make additional appropriate searches, inspections and enquiries. Anglian Water supports the plan led approach to sustainable development that is set out in the National Planning Policy Framework ('NPPF') and any infrastructure needs identified in this report must be considered in the context of current, adopted and/or emerging local plans. Where local plans are absent, silent or have expired these needs should be considered against the definition of sustainability holistically as set out in the NPPF.

Whilst the information in this report is based on the presumption that proposed development obtains planning permission, nothing in this report confirms that planning permission will be granted or that Anglian Water will be bound to carry out the works/proposals contained within this report.

No liability whatsoever, including liability for negligence is accepted by Anglian Water or its partners, employees or agents, for any error or omission, or for the results obtained from the use of this report and/or its content.

Furthermore, in no event will any of those parties be liable to the applicant or any third party for any decision made or action taken as a result of reliance on this report.

This report is valid from the date issued and the enquirer is advised to resubmit their request for an up to date report should there be a delay in submitting any subsequent application for water supply/sewer connection(s). Our pre-planning reports are valid for 12 months, however please note Anglian Water cannot reserve capacity and available capacity in our network can be reduced at any time due to increased requirements from existing businesses and houses as well as from new housing and new commercial developments.

Appendix L – Surface Water System Calculations

PROPOSED SURFACE WATER DRAINAGE CALCULATIONS

UPON

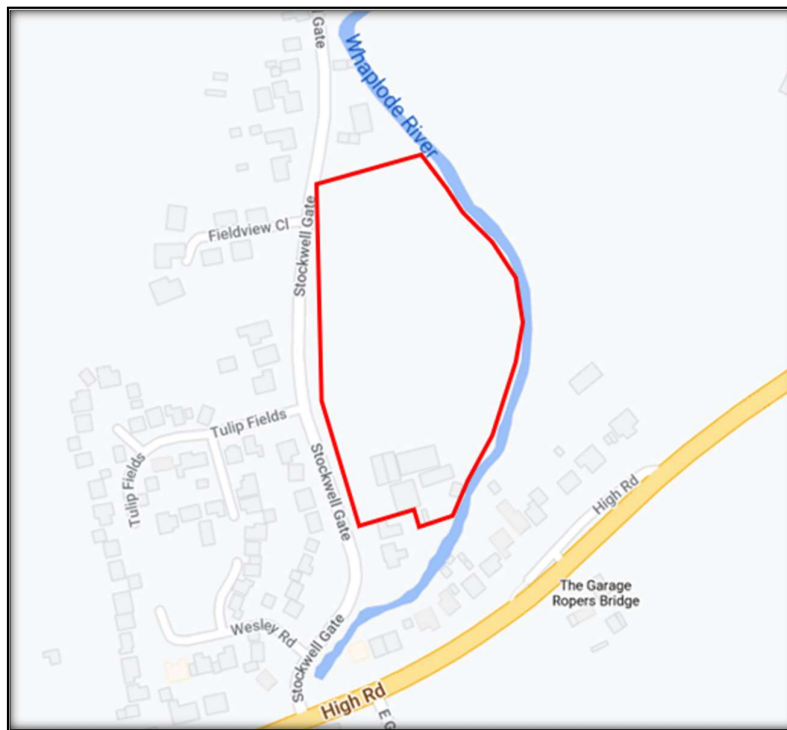
PROPOSED RESIDENTIAL DEVELOPMENT

LAND EAST OF STOCKWELL GATE,

WHAPLODE, SPALDING, LINCOLNSHIRE

PROJECT NO: SW 22-150

DOCUMENT REF: SW 22-150-CAL-C-01



FOR MR J. WELCH
C/O ANDREW M WRIGHT LTD.

Contents

Greenfield Run-off Calculations	3
HydroBrake Flow Control Details	5
Network Details & FEH Rainfall Data Hydraulic Model Output.....	8
Network Details & FEH Rainfall Data Hydraulic Model Output.....	18
FEH Rainfall Data Hydraulic Model Output With a 1:30 Year Surcharged Outfall....	28
FEH Rainfall Data Hydraulic Model Output With a 1:100 Year Surcharged Outfall..	31

Revision	Date	Description		
-	August 2022	First Issue	Prepared	M. Pett
			Approved	A.Wilson CEng MStructE

Greenfield Run-off Calculations

[Print](#)[Close Report](#)

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Marcus Pett

Site name: SW 22-150

Site location: Stockwell Gate

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

Site Details

Latitude: 52.80308° N

Longitude: 0.02493° W

Reference: 1826277427

Date: May 23 2022 10:11

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1.867

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics Default Edited

SOIL type: 2 2

HOST class: N/A N/A

SPR/SPRHOST: 0.3 0.3

Hydrological characteristics Default Edited

SAAR (mm): 566 566

Hydrological region: 5 5

Growth curve factor 1 year: 0.87 0.87

Growth curve factor 30 years: 2.45 2.45

Growth curve factor 100 years: 3.56 3.56

Growth curve factor 200 years: 4.21 4.21

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates Default Edited

Q_{BAR} (l/s): 2.65 2.65

1 in 1 year (l/s): 2.31 2.31

1 in 30 years (l/s): 6.5 6.5

1 in 100 year (l/s): 9.45 9.45

1 in 200 years (l/s): 11.17 11.17

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

HydroBrake Flow Control Details

Technical Specification

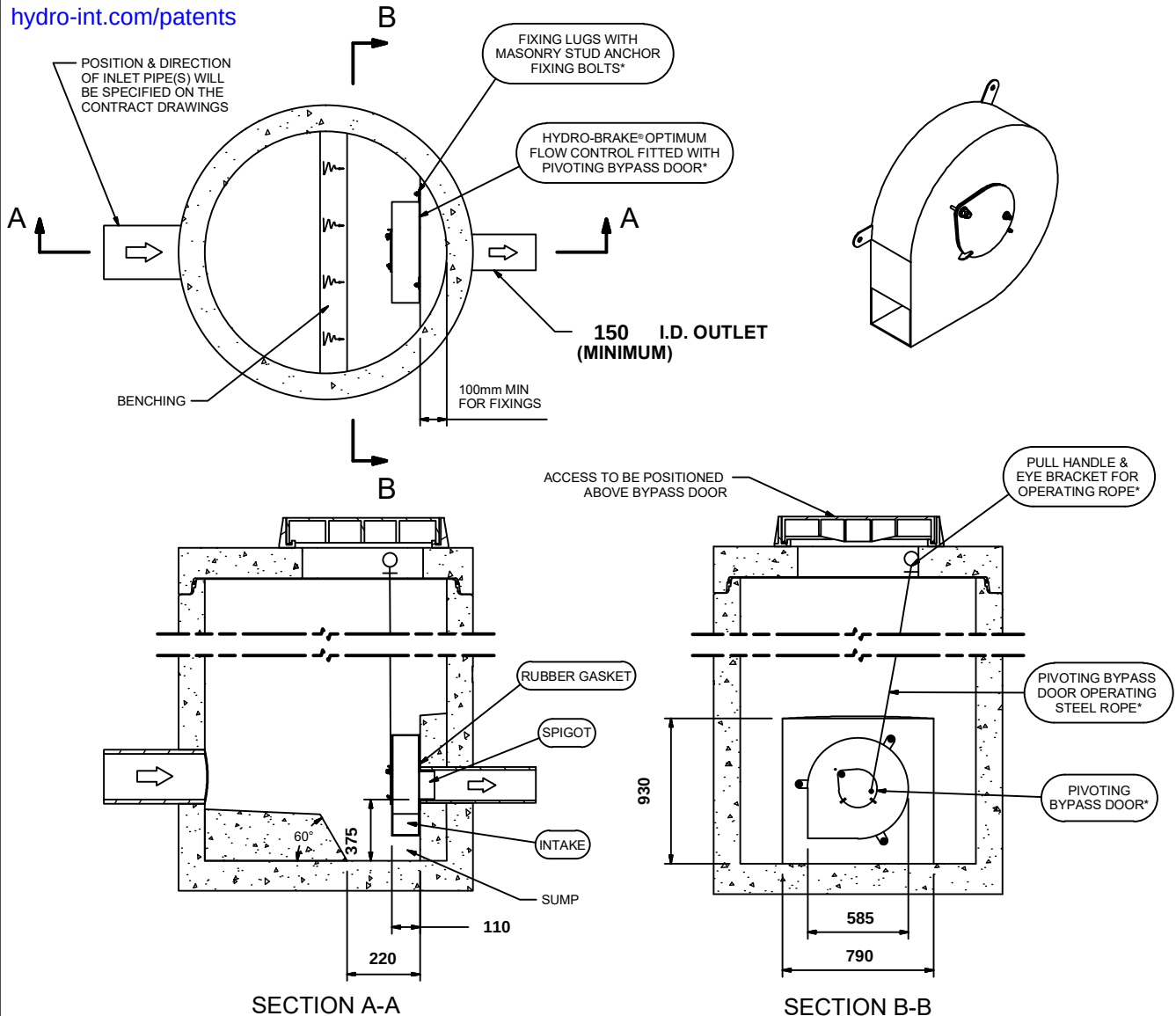
Control Point	Head (m)	Flow (l/s)
Primary Design	1.360	5.000
Flush-Flo™	0.405	4.991
Kick-Flo®	0.835	3.990
Mean Flow		4.381

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 159 kg



hydro-int.com/patents



IMPORTANT: ○ LIMIT OF HYDRO INTERNATIONAL SUPPLY
 THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
 FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
 ALL CIVIL AND INSTALLATION WORK BY OTHERS
 * WHERE SUPPLIED
 HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE



The head/flow characteristics of this SHE-0100-5000-1360-5000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
 International®

DATE 05/08/2022 10:11

SITE Stockwell Gate

DESIGNER Marcus Pett

REF SW 22-150

SHE-0100-5000-1360-5000

Hydro-Brake® Optimum

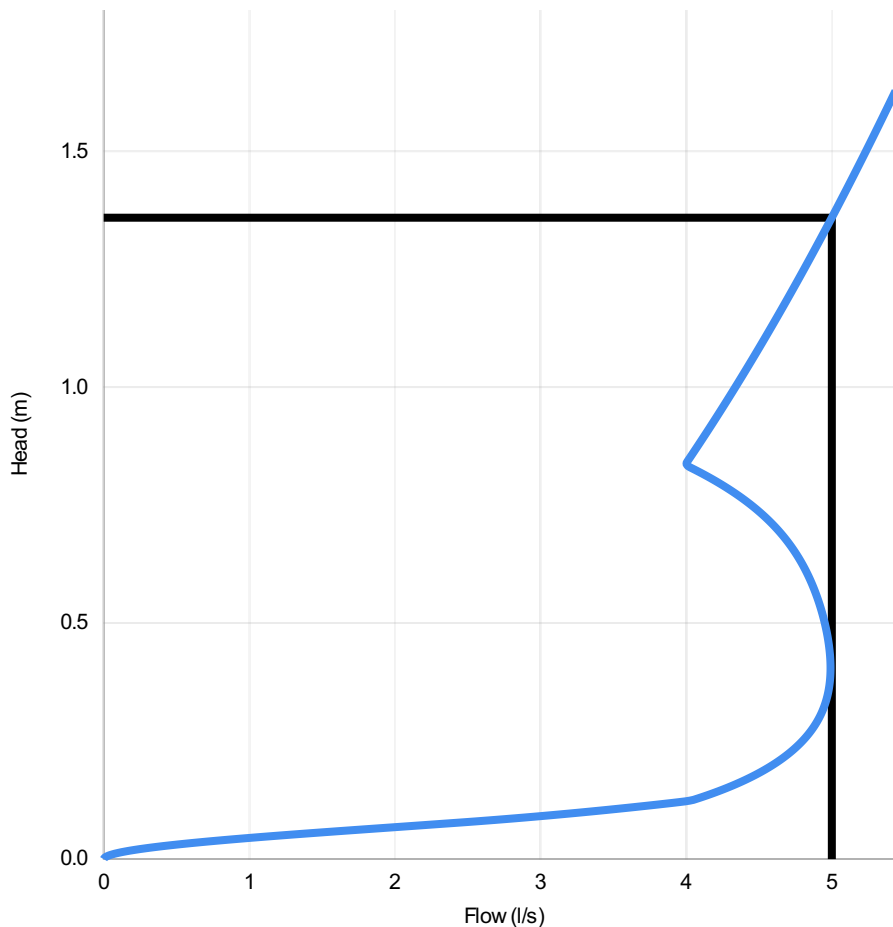
Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.360	5.000
Flush-Flo	0.405	4.991
Kick-Flo®	0.835	3.990
Mean Flow		4.381



PT/329/0412

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.047	1.078
0.094	3.097
0.141	4.193
0.188	4.529
0.234	4.745
0.281	4.878
0.328	4.953
0.375	4.986
0.422	4.990
0.469	4.972
0.516	4.939
0.563	4.890
0.610	4.824
0.657	4.735
0.703	4.613
0.750	4.448
0.797	4.226
0.844	4.010
0.891	4.111
0.938	4.210
0.985	4.305
1.032	4.399
1.079	4.490
1.126	4.580
1.172	4.667
1.219	4.752
1.266	4.836
1.313	4.919
1.360	4.999

DESIGN ADVICE



The head/flow characteristics of this SHE-0100-5000-1360-5000 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International

DATE 05/08/2022 10:11

Site Stockwell Gate

DESIGNER Marcus Pett

Ref SW 22-150

SHE-0100-5000-1360-5000

Hydro-Brake Optimum®

Network Details & FEH Rainfall Data Hydraulic Model Output

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.900
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S01	0.021	5.00	3.295	1200	533209.791	324661.087	1.150
S02	0.092	5.00	3.360	1350	533229.637	324662.037	1.485
S03			3.085	1350	533271.271	324663.805	1.340
S04	0.012	5.00	3.200	1350	533274.922	324667.204	1.475
HW01			3.500	1200	533311.464	324668.679	1.990
S10	0.056	5.00	3.350	1200	533252.164	324735.440	1.205
S11	0.060	5.00	3.350	1200	533245.579	324726.661	1.255
S12	0.047	5.00	3.250	1200	533255.888	324702.451	1.260
S13			3.170	1200	533262.220	324678.661	1.280
SW100	0.042	5.00	3.350	1200	533206.552	324728.230	0.805
SW101			3.350	1200	533211.002	324671.240	1.140
S20	0.144	5.00	3.460	1200	533242.076	324614.151	1.305
TANK		5.00	3.300	1350	533275.120	324659.833	1.550
BASIN		5.00	3.300	1200	533278.699	324661.693	0.650

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.002	S01	S02	19.869	0.600	2.145	2.025	0.120	165.6	225	6.45	50.0
1.003	S02	S03	41.672	0.600	1.875	1.745	0.130	320.6	375	7.14	47.4
1.004	S03	S04	4.988	0.600	1.745	1.725	0.020	249.4	375	7.21	47.2
1.005	S04	HW01	36.572	0.600	1.725	1.510	0.215	170.1	225	7.82	45.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.002	1.013	40.3	8.5	0.925	1.110	0.063	0.0	70	0.806
1.003	1.006	111.1	38.4	1.110	0.965	0.299	0.0	152	0.917
1.004	1.142	126.2	59.1	0.965	1.100	0.462	0.0	181	1.125
1.005	0.999	39.7	58.1	1.250	1.765	0.474	0.0	225	1.018

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
3.000	S10	S11	12.210	0.600	2.145	2.095	0.050	244.2	300	5.20	50.0
3.001	S11	S12	26.580	0.600	2.095	1.990	0.105	253.1	300	5.65	50.0
3.002	S12	S13	25.260	0.600	1.990	1.890	0.100	252.6	300	6.08	50.0
3.003	S13	S03	17.396	0.600	1.890	1.820	0.070	248.5	300	6.37	50.0
1.000	SW100	SW101	57.163	0.600	2.545	2.210	0.335	170.6	225	5.95	50.0
1.001	SW101	S01	10.225	0.600	2.210	2.145	0.065	157.3	225	6.12	50.0
2.000	S20	S02	49.475	0.600	2.155	1.950	0.205	241.3	300	5.82	50.0
4.000	TANK	S04	7.374	0.600	1.750	1.725	0.025	294.9	375	5.12	50.0
5.000	BASIN	S04	6.681	0.600	2.650	2.425	0.225	29.7	300	5.04	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
3.000	1.001	70.8	7.6	0.905	0.955	0.056	0.0	66	0.659
3.001	0.983	69.5	15.7	0.955	0.960	0.116	0.0	96	0.798
3.002	0.984	69.6	22.1	0.960	0.980	0.163	0.0	116	0.876
3.003	0.993	70.2	22.1	0.980	0.965	0.163	0.0	115	0.881
1.000	0.998	39.7	5.7	0.580	0.915	0.042	0.0	58	0.713
1.001	1.040	41.3	5.7	0.915	0.925	0.042	0.0	56	0.731
2.000	1.007	71.2	19.5	1.005	1.110	0.144	0.0	107	0.862
4.000	1.050	115.9	0.0	1.175	1.100	0.000	0.0	0	0.000
5.000	2.895	204.7	0.0	0.350	0.475	0.000	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.002	19.869	165.6	225	Circular	3.295	2.145	0.925	3.360	2.025	1.110
1.003	41.672	320.6	375	Circular	3.360	1.875	1.110	3.085	1.745	0.965
1.004	4.988	249.4	375	Circular	3.085	1.745	0.965	3.200	1.725	1.100
1.005	36.572	170.1	225	Circular	3.200	1.725	1.250	3.500	1.510	1.765
3.000	12.210	244.2	300	Circular	3.350	2.145	0.905	3.350	2.095	0.955
3.001	26.580	253.1	300	Circular	3.350	2.095	0.955	3.250	1.990	0.960

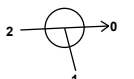
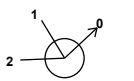
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.002	S01	1200	Manhole	Adoptable	S02	1350	Manhole	Adoptable
1.003	S02	1350	Manhole	Adoptable	S03	1350	Manhole	Adoptable
1.004	S03	1350	Manhole	Adoptable	S04	1350	Manhole	Adoptable
1.005	S04	1350	Manhole	Adoptable	HW01	1200	Manhole	Adoptable
3.000	S10	1200	Manhole	Adoptable	S11	1200	Manhole	Adoptable
3.001	S11	1200	Manhole	Adoptable	S12	1200	Manhole	Adoptable

Pipeline Schedule

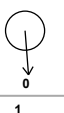
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
3.002	25.260	252.6	300	Circular	3.250	1.990	0.960	3.170	1.890	0.980
3.003	17.396	248.5	300	Circular	3.170	1.890	0.980	3.085	1.820	0.965
1.000	57.163	170.6	225	Circular	3.350	2.545	0.580	3.350	2.210	0.915
1.001	10.225	157.3	225	Circular	3.350	2.210	0.915	3.295	2.145	0.925
2.000	49.475	241.3	300	Circular	3.460	2.155	1.005	3.360	1.950	1.110
4.000	7.374	294.9	375	Circular	3.300	1.750	1.175	3.200	1.725	1.100
5.000	6.681	29.7	300	Circular	3.300	2.650	0.350	3.200	2.425	0.475

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
3.002	S12	1200	Manhole	Adoptable	S13	1200	Manhole	Adoptable
3.003	S13	1200	Manhole	Adoptable	S03	1350	Manhole	Adoptable
1.000	SW100	1200	Manhole	Adoptable	SW101	1200	Manhole	Adoptable
1.001	SW101	1200	Manhole	Adoptable	S01	1200	Manhole	Adoptable
2.000	S20	1200	Manhole	Adoptable	S02	1350	Manhole	Adoptable
4.000	TANK	1350	Manhole	Adoptable	S04	1350	Manhole	Adoptable
5.000	BASIN	1200	Manhole	Adoptable	S04	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
S01	533209.791	324661.087	3.295	1.150	1200		1	1.001	2.145	225
							0	1.002	2.145	225
S02	533229.637	324662.037	3.360	1.485	1350		1	2.000	1.950	300
							2	1.002	2.025	225
							0	1.003	1.875	375
S03	533271.271	324663.805	3.085	1.340	1350		1	3.003	1.820	300
							2	1.003	1.745	375
							0	1.004	1.745	375
S04	533274.922	324667.204	3.200	1.475	1350		1	5.000	2.425	300
							2	4.000	1.725	375
							3	1.004	1.725	375
							0	1.005	1.725	225
HW01	533311.464	324668.679	3.500	1.990	1200		1	1.005	1.510	225
S10	533252.164	324735.440	3.350	1.205	1200		0	3.000	2.145	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
S11	533245.579	324726.661	3.350	1.255	1200		1	3.000	2.095	300
							0	3.001	2.095	300
S12	533255.888	324702.451	3.250	1.260	1200		1	3.001	1.990	300
							0	3.002	1.990	300
S13	533262.220	324678.661	3.170	1.280	1200		1	3.002	1.890	300
							0	3.003	1.890	300
SW100	533206.552	324728.230	3.350	0.805	1200					
							0	1.000	2.545	225
SW101	533211.002	324671.240	3.350	1.140	1200		1	1.000	2.210	225
							0	1.001	2.210	225
S20	533242.076	324614.151	3.460	1.305	1200					
							0	2.000	2.155	300
TANK	533275.120	324659.833	3.300	1.550	1350					
							0	4.000	1.750	375
BASIN	533278.699	324661.693	3.300	0.650	1200					
							0	5.000	2.650	300

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m ³ /ha)	0.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	960	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	10	0
10	0	10	0
30	0	10	0
100	40	10	0

Node S04 Online Hydro-Brake® Control

Flap Valve	✓	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.725	Product Number	CTL-SHE-0100-5000-1360-5000
Design Depth (m)	1.360	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node TANK Offline Orifice Control

Flap Valve	x	Invert Level (m)	1.750	Discharge Coefficient	0.600
Loop to Node	S04	Diameter (m)	0.376		

Node BASIN Offline Orifice Control

Flap Valve	x	Invert Level (m)	2.650	Discharge Coefficient	0.600
Loop to Node	S04	Diameter (m)	0.301		

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.750
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	630.0	0.0	0.400	630.0	0.0	0.401	0.0	0.0

Node BASIN Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.650
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	248

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	687.0	0.0	0.650	1103.0	0.0

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 93.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	11	2.221	0.076	9.4	0.0858	0.0000	OK
15 minute winter	S02	11	2.041	0.166	44.6	0.2378	0.0000	OK
15 minute winter	S03	11	1.981	0.236	69.1	0.3377	0.0000	OK
15 minute winter	S04	11	1.938	0.213	71.1	0.3045	0.0000	OK
15 minute summer	HW01	1	1.510	0.000	4.6	0.0000	0.0000	OK
15 minute winter	S10	10	2.218	0.073	8.7	0.0829	0.0000	OK
15 minute winter	S11	10	2.199	0.104	18.0	0.1176	0.0000	OK
15 minute winter	S12	11	2.119	0.129	24.9	0.1461	0.0000	OK
15 minute winter	S13	11	2.024	0.134	24.9	0.1513	0.0000	OK
15 minute winter	SW100	10	2.607	0.062	6.6	0.0700	0.0000	OK
15 minute winter	SW101	11	2.272	0.062	6.4	0.0702	0.0000	OK
15 minute winter	S20	11	2.270	0.115	22.5	0.1306	0.0000	OK
360 minute winter	TANK	264	1.854	0.104	9.7	62.6734	0.0000	OK
15 minute summer	BASIN	1	2.650	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.002	S02	9.3	0.812	0.230	0.2269	
15 minute winter	S02	1.003	S03	44.5	0.745	0.400	2.5034	
15 minute winter	S03	1.004	S04	69.6	1.072	0.551	0.3430	
15 minute winter	S04	Hydro-Brake®	HW01	4.7				33.4
15 minute winter	S10	3.000	S11	8.6	0.493	0.121	0.2135	
15 minute winter	S11	3.001	S12	17.6	0.701	0.253	0.6685	
15 minute winter	S12	3.002	S13	24.9	0.843	0.357	0.7498	
15 minute winter	S13	3.003	S03	24.6	0.761	0.350	0.5990	
15 minute winter	SW100	1.000	SW101	6.4	0.746	0.162	0.5034	
15 minute winter	SW101	1.001	S01	6.3	0.613	0.153	0.1055	
15 minute winter	S20	2.000	S02	21.8	0.889	0.306	1.2133	
360 minute winter	TANK	4.000	S04	-4.3	-0.272	-0.037	0.2158	
360 minute winter	TANK	Orifice	S04	1.6				-9.5
15 minute summer	BASIN	5.000	S04	0.0	0.000	0.000	0.0000	
15 minute summer	BASIN	Orifice	S04	0.0				0.0

Results for 10 year +10% A Critical Storm Duration. Lowest mass balance: 93.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	10	2.259	0.114	20.0	0.1287	0.0000	OK
15 minute winter	S02	11	2.197	0.322	97.4	0.4609	0.0000	OK
15 minute winter	S03	11	2.109	0.364	143.2	0.5213	0.0000	OK
15 minute winter	S04	11	2.018	0.293	146.9	0.4187	0.0000	SURCHARGED
15 minute summer	HW01	1	1.510	0.000	4.9	0.0000	0.0000	OK
15 minute winter	S10	10	2.273	0.128	18.5	0.1448	0.0000	OK
15 minute winter	S11	10	2.262	0.167	38.0	0.1891	0.0000	OK
15 minute winter	S12	11	2.211	0.221	52.7	0.2495	0.0000	OK
15 minute winter	S13	11	2.150	0.260	51.2	0.2945	0.0000	OK
15 minute winter	SW100	10	2.637	0.092	13.9	0.1038	0.0000	OK
15 minute winter	SW101	11	2.307	0.097	13.6	0.1101	0.0000	OK
15 minute winter	S20	10	2.336	0.181	47.7	0.2042	0.0000	OK
240 minute winter	TANK	232	1.963	0.213	26.8	127.8965	0.0000	OK
15 minute summer	BASIN	1	2.650	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.002	S02	20.1	0.896	0.500	0.5227	
15 minute winter	S02	1.003	S03	92.8	0.878	0.835	4.3784	
15 minute winter	S03	1.004	S04	143.8	1.439	1.139	0.5029	
15 minute winter	S04	Hydro-Brake®	HW01	4.9				71.3
15 minute winter	S10	3.000	S11	18.1	0.533	0.256	0.4213	
15 minute winter	S11	3.001	S12	37.1	0.794	0.534	1.2734	
15 minute winter	S12	3.002	S13	51.2	0.922	0.736	1.5214	
15 minute winter	S13	3.003	S03	50.5	0.778	0.720	1.1706	
15 minute winter	SW100	1.000	SW101	13.6	0.883	0.342	0.8944	
15 minute winter	SW101	1.001	S01	13.5	0.743	0.327	0.1864	
15 minute winter	S20	2.000	S02	47.7	1.001	0.670	2.5724	
240 minute winter	TANK	4.000	S04	-14.1	-0.429	-0.122	0.5152	
240 minute winter	TANK	Orifice	S04	6.2				-44.5
15 minute summer	BASIN	5.000	S04	0.0	0.000	0.000	0.0000	
15 minute summer	BASIN	Orifice	S04	0.0				0.0

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 93.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	11	2.427	0.282	27.5	0.3193	0.0000	SURCHARGED
15 minute winter	S02	11	2.376	0.501	122.2	0.7166	0.0000	SURCHARGED
15 minute winter	S03	11	2.188	0.443	186.3	0.6340	0.0000	SURCHARGED
360 minute winter	S04	344	2.081	0.356	32.7	0.5088	0.0000	SURCHARGED
15 minute summer	HW01	1	1.510	0.000	5.0	0.0000	0.0000	OK
15 minute winter	S10	11	2.484	0.339	25.4	0.3836	0.0000	SURCHARGED
15 minute winter	S11	11	2.482	0.387	49.8	0.4373	0.0000	SURCHARGED
15 minute winter	S12	11	2.409	0.419	68.0	0.4738	0.0000	SURCHARGED
15 minute winter	S13	11	2.284	0.394	68.2	0.4455	0.0000	SURCHARGED
15 minute winter	SW100	10	2.655	0.110	19.1	0.1240	0.0000	OK
15 minute winter	SW101	12	2.444	0.234	19.2	0.2652	0.0000	SURCHARGED
15 minute winter	S20	11	2.537	0.382	65.3	0.4323	0.0000	SURCHARGED
360 minute winter	TANK	344	2.079	0.329	27.9	197.2335	0.0000	OK
15 minute summer	BASIN	1	2.650	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.002	S02	29.8	0.917	0.739	0.7902	
15 minute winter	S02	1.003	S03	118.4	1.074	1.066	4.5963	
15 minute winter	S03	1.004	S04	185.2	1.682	1.468	0.5311	
360 minute winter	S04	Hydro-Brake®	HW01	5.0				276.0
15 minute winter	S10	3.000	S11	24.2	0.538	0.342	0.8598	
15 minute winter	S11	3.001	S12	47.9	0.808	0.689	1.8717	
15 minute winter	S12	3.002	S13	68.2	0.969	0.981	1.7788	
15 minute winter	S13	3.003	S03	67.9	0.964	0.967	1.2250	
15 minute winter	SW100	1.000	SW101	19.2	0.936	0.485	1.6631	
15 minute winter	SW101	1.001	S01	21.6	0.761	0.521	0.4067	
15 minute winter	S20	2.000	S02	61.8	1.017	0.868	3.4840	
360 minute winter	TANK	4.000	S04	-15.4	-0.337	-0.133	0.7757	
360 minute winter	TANK	Orifice	S04	9.0				-61.9
15 minute summer	BASIN	5.000	S04	0.0	0.000	0.000	0.0000	
15 minute summer	BASIN	Orifice	S04	0.0				0.0

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 93.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	10	3.246	1.101	42.3	1.2453	0.0000	FLOOD RISK
15 minute winter	S02	10	3.104	1.229	205.8	1.7593	0.0000	FLOOD RISK
600 minute winter	S03	570	2.989	1.244	44.1	1.7806	0.0000	FLOOD RISK
480 minute winter	S04	456	3.042	1.317	65.0	1.8847	0.0000	FLOOD RISK
15 minute summer	HW01	1	1.510	0.000	5.0	0.0000	0.0000	OK
15 minute winter	S10	10	3.350	1.205	48.4	1.3629	2.4718	FLOOD
15 minute winter	S11	10	3.342	1.247	85.0	1.4107	0.0000	FLOOD RISK
15 minute winter	S12	10	3.187	1.197	116.7	1.3540	0.0000	FLOOD RISK
120 minute winter	S13	76	3.000	1.110	47.1	1.2549	0.0000	FLOOD RISK
15 minute winter	SW100	10	3.350	0.805	36.3	0.9105	1.9710	FLOOD
15 minute winter	SW101	10	3.266	1.056	39.5	1.1939	0.0000	FLOOD RISK
15 minute winter	S20	9	3.460	1.305	124.4	1.4760	4.4102	FLOOD
360 minute winter	TANK	360	2.998	1.248	58.8	241.4846	0.0000	SURCHARGED
480 minute winter	BASIN	464	2.929	0.279	48.4	217.1171	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.002	S02	47.6	1.197	1.182	0.7902	
15 minute winter	S02	1.003	S03	206.0	1.868	1.854	4.5963	
600 minute winter	S03	1.004	S04	43.9	0.564	0.348	0.5502	
480 minute winter	S04	Hydro-Brake®	HW01	5.0				376.5
15 minute winter	S10	3.000	S11	40.1	0.570	0.567	0.8598	
15 minute winter	S11	3.001	S12	83.2	1.182	1.197	1.8717	
15 minute winter	S12	3.002	S13	117.1	1.663	1.683	1.7788	
120 minute winter	S13	3.003	S03	46.3	0.778	0.660	1.2250	
15 minute winter	SW100	1.000	SW101	26.7	0.969	0.673	2.2734	
15 minute winter	SW101	1.001	S01	31.9	0.803	0.772	0.4067	
15 minute winter	S20	2.000	S02	106.1	1.507	1.490	3.4840	
360 minute winter	TANK	4.000	S04	-37.0	-0.361	-0.319	0.8133	
360 minute winter	TANK	Orifice	S04	12.1				-126.5
480 minute winter	BASIN	5.000	S04	-27.4	0.606	-0.134	0.4634	
480 minute winter	BASIN	Orifice	S04	14.4				-39.8

Network Details & FEH Rainfall Data Hydraulic Model Output

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.900
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SW100	0.042	5.00	3.350	1200	533206.552	324728.230	0.805
SW101			3.350	1200	533211.002	324671.240	1.140
S01	0.021	5.00	3.295	1200	533209.791	324661.087	1.150
S20	0.144	5.00	3.460	1200	533242.076	324614.151	1.305
S02	0.092	5.00	3.360	1350	533229.637	324662.037	1.485
S10	0.056	5.00	3.350	1200	533252.164	324735.440	1.205
S11	0.060	5.00	3.350	1200	533245.579	324726.661	1.255
S12	0.047	5.00	3.250	1200	533255.888	324702.451	1.260
S13			3.170	1200	533262.220	324678.661	1.280
S03			3.085	1350	533271.271	324663.805	1.340
TANK		5.00	3.300	1350	533275.120	324659.833	1.550
BASIN		5.00	3.300	1200	533278.699	324661.693	0.650
S04	0.012	5.00	3.200	1350	533274.922	324667.204	1.475
HW01			3.500	1200	533311.464	324668.679	1.990

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW100	SW101	57.163	0.600	2.545	2.210	0.335	170.6	225	5.95	50.0
1.001	SW101	S01	10.225	0.600	2.210	2.145	0.065	157.3	225	6.12	50.0
1.002	S01	S02	19.869	0.600	2.145	2.025	0.120	165.6	225	6.45	50.0
2.000	S20	S02	49.475	0.600	2.155	1.950	0.205	241.3	300	5.82	50.0
1.003	S02	S03	41.672	0.600	1.875	1.745	0.130	320.6	375	7.14	50.0
3.000	S10	S11	12.210	0.600	2.145	2.095	0.050	244.2	300	5.20	50.0
3.001	S11	S12	26.580	0.600	2.095	1.990	0.105	253.1	300	5.65	50.0
3.002	S12	S13	25.260	0.600	1.990	1.890	0.100	252.6	300	6.08	50.0
3.003	S13	S03	17.396	0.600	1.890	1.820	0.070	248.5	300	6.37	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.998	39.7	5.7	0.580	0.915	0.042	0.0	58	0.713
1.001	1.040	41.3	5.7	0.915	0.925	0.042	0.0	56	0.731
1.002	1.013	40.3	8.5	0.925	1.110	0.063	0.0	70	0.806
2.000	1.007	71.2	19.5	1.005	1.110	0.144	0.0	107	0.862
1.003	1.006	111.1	40.5	1.110	0.965	0.299	0.0	156	0.930
3.000	1.001	70.8	7.6	0.905	0.955	0.056	0.0	66	0.659
3.001	0.983	69.5	15.7	0.955	0.960	0.116	0.0	96	0.798
3.002	0.984	69.6	22.1	0.960	0.980	0.163	0.0	116	0.876
3.003	0.993	70.2	22.1	0.980	0.965	0.163	0.0	115	0.881

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.004	S03	S04	4.988	0.600	1.745	1.725	0.020	249.4	375	7.21	50.0
4.000	TANK	S04	7.374	0.600	1.750	1.725	0.025	294.9	375	5.12	50.0
5.000	BASIN	S04	6.681	0.600	2.650	2.425	0.225	29.7	300	5.04	50.0
1.005	S04	HW01	36.572	0.600	1.725	1.510	0.215	170.1	225	7.82	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.004	1.142	126.2	62.6	0.965	1.100	0.462	0.0	186	1.140
4.000	1.050	115.9	0.0	1.175	1.100	0.000	0.0	0	0.000
5.000	2.895	204.7	0.0	0.350	0.475	0.000	0.0	0	0.000
1.005	0.999	39.7	64.2	1.250	1.765	0.474	0.0	225	1.018

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	57.163	170.6	225	Circular	3.350	2.545	0.580	3.350	2.210	0.915
1.001	10.225	157.3	225	Circular	3.350	2.210	0.915	3.295	2.145	0.925
1.002	19.869	165.6	225	Circular	3.295	2.145	0.925	3.360	2.025	1.110
2.000	49.475	241.3	300	Circular	3.460	2.155	1.005	3.360	1.950	1.110
1.003	41.672	320.6	375	Circular	3.360	1.875	1.110	3.085	1.745	0.965
3.000	12.210	244.2	300	Circular	3.350	2.145	0.905	3.350	2.095	0.955
3.001	26.580	253.1	300	Circular	3.350	2.095	0.955	3.250	1.990	0.960
3.002	25.260	252.6	300	Circular	3.250	1.990	0.960	3.170	1.890	0.980
3.003	17.396	248.5	300	Circular	3.170	1.890	0.980	3.085	1.820	0.965
1.004	4.988	249.4	375	Circular	3.085	1.745	0.965	3.200	1.725	1.100
4.000	7.374	294.9	375	Circular	3.300	1.750	1.175	3.200	1.725	1.100
5.000	6.681	29.7	300	Circular	3.300	2.650	0.350	3.200	2.425	0.475
1.005	36.572	170.1	225	Circular	3.200	1.725	1.250	3.500	1.510	1.765

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW100	1200	Manhole	Adoptable	SW101	1200	Manhole	Adoptable
1.001	SW101	1200	Manhole	Adoptable	S01	1200	Manhole	Adoptable
1.002	S01	1200	Manhole	Adoptable	S02	1350	Manhole	Adoptable
2.000	S20	1200	Manhole	Adoptable	S02	1350	Manhole	Adoptable
1.003	S02	1350	Manhole	Adoptable	S03	1350	Manhole	Adoptable
3.000	S10	1200	Manhole	Adoptable	S11	1200	Manhole	Adoptable
3.001	S11	1200	Manhole	Adoptable	S12	1200	Manhole	Adoptable
3.002	S12	1200	Manhole	Adoptable	S13	1200	Manhole	Adoptable
3.003	S13	1200	Manhole	Adoptable	S03	1350	Manhole	Adoptable
1.004	S03	1350	Manhole	Adoptable	S04	1350	Manhole	Adoptable
4.000	TANK	1350	Manhole	Adoptable	S04	1350	Manhole	Adoptable
5.000	BASIN	1200	Manhole	Adoptable	S04	1350	Manhole	Adoptable
1.005	S04	1350	Manhole	Adoptable	HW01	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW100	533206.552	324728.230	3.350	0.805	1200	 0	1.000 2.545 225		
SW101	533211.002	324671.240	3.350	1.140	1200	 1 0	1.000 2.210 225 1.001 2.210 225		
S01	533209.791	324661.087	3.295	1.150	1200	 1 0	1.001 2.145 225 1.002 2.145 225		
S20	533242.076	324614.151	3.460	1.305	1200	 0	2.000 2.155 300		
S02	533229.637	324662.037	3.360	1.485	1350	 1 2 0	2.000 1.950 300 1.002 2.025 225 1.003 1.875 375		
S10	533252.164	324735.440	3.350	1.205	1200	 0	3.000 2.145 300		
S11	533245.579	324726.661	3.350	1.255	1200	 1 0	3.000 2.095 300 3.001 2.095 300		
S12	533255.888	324702.451	3.250	1.260	1200	 1 0	3.001 1.990 300 3.002 1.990 300		
S13	533262.220	324678.661	3.170	1.280	1200	 1 0	3.002 1.890 300 3.003 1.890 300		
S03	533271.271	324663.805	3.085	1.340	1350	 1 2 0	3.003 1.820 300 1.003 1.745 375 1.004 1.745 375		
TANK	533275.120	324659.833	3.300	1.550	1350	 0	4.000 1.750 375		
BASIN	533278.699	324661.693	3.300	0.650	1200	 0	5.000 2.650 300		
S04	533274.922	324667.204	3.200	1.475	1350	 1 2 3 0	5.000 2.425 300 4.000 1.725 375 1.004 1.725 375 1.005 1.725 225		

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
HW01	533311.464	324668.679	3.500	1.990	1200	1	1.005	1.510	225


Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	960
Ratio-R	0.400	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	10	0
10	0	10	0
30	0	10	0
100	40	10	0

Node S04 Online Hydro-Brake® Control

Flap Valve	✓	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.725	Product Number	CTL-SHE-0100-5000-1360-5000
Design Depth (m)	1.360	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node TANK Offline Orifice Control

Flap Valve	x	Invert Level (m)	1.750	Discharge Coefficient	0.600
Loop to Node	S04	Diameter (m)	0.376		

Node BASIN Offline Orifice Control

Flap Valve	x	Invert Level (m)	2.650	Discharge Coefficient	0.600
Loop to Node	S04	Diameter (m)	0.301		

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.750
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	680

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	630.0	0.0	0.400	630.0	0.0	0.401	0.0	0.0

Node BASIN Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.650
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	687.0	0.0	0.650	1103.0	0.0

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 96.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW100	10	2.615	0.070	8.4	0.0793	0.0000	OK
15 minute winter	SW101	11	2.281	0.071	8.2	0.0808	0.0000	OK
15 minute winter	S01	11	2.232	0.087	12.1	0.0986	0.0000	OK
15 minute winter	S20	11	2.288	0.133	28.9	0.1505	0.0000	OK
15 minute winter	S02	11	2.077	0.202	57.4	0.2891	0.0000	OK
15 minute winter	S10	10	2.232	0.087	11.2	0.0983	0.0000	OK
15 minute winter	S11	10	2.215	0.120	23.0	0.1362	0.0000	OK
15 minute winter	S12	11	2.140	0.150	32.0	0.1700	0.0000	OK
15 minute winter	S13	11	2.052	0.162	31.9	0.1832	0.0000	OK
15 minute winter	S03	11	2.017	0.272	88.5	0.3886	0.0000	OK
240 minute winter	TANK	192	1.860	0.110	14.7	65.7929	0.0000	OK
15 minute summer	BASIN	1	2.650	0.000	0.0	0.0000	0.0000	OK
15 minute summer	S04	11	1.962	0.237	87.1	0.3398	0.0000	SURCHARGED
15 minute summer	HW01	1	1.510	0.000	4.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW100	1.000	SW101	8.2	0.789	0.206	0.6048	
15 minute winter	SW101	1.001	S01	8.1	0.648	0.196	0.1279	
15 minute winter	S01	1.002	S02	11.9	0.868	0.296	0.2734	
15 minute winter	S20	2.000	S02	28.0	0.953	0.394	1.4557	
15 minute winter	S02	1.003	S03	57.1	0.780	0.514	3.0413	
15 minute winter	S10	3.000	S11	11.0	0.512	0.156	0.2645	
15 minute winter	S11	3.001	S12	22.6	0.738	0.325	0.8147	
15 minute winter	S12	3.002	S13	31.9	0.879	0.458	0.9358	
15 minute winter	S13	3.003	S03	31.4	0.782	0.448	0.7628	
15 minute winter	S03	1.004	S04	89.5	1.175	0.709	0.3947	
240 minute winter	TANK	4.000	S04	-6.5	-0.359	-0.056	0.2297	
240 minute winter	TANK	Orifice	S04	1.4				-10.9
15 minute summer	BASIN	5.000	S04	0.0	0.000	0.000	0.0000	
15 minute summer	BASIN	Orifice	S04	0.0				0.0
15 minute summer	S04	Hydro-Brake®	HW01	4.8				38.3

Results for 10 year +10% A Critical Storm Duration. Lowest mass balance: 96.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW100	10	2.632	0.087	12.6	0.0984	0.0000	OK
15 minute winter	SW101	11	2.301	0.091	12.3	0.1034	0.0000	OK
15 minute winter	S01	11	2.255	0.110	18.1	0.1242	0.0000	OK
15 minute winter	S20	10	2.326	0.171	43.2	0.1936	0.0000	OK
15 minute winter	S02	11	2.163	0.288	87.6	0.4117	0.0000	OK
15 minute winter	S10	10	2.263	0.118	16.8	0.1332	0.0000	OK
15 minute winter	S11	10	2.251	0.156	34.5	0.1763	0.0000	OK
15 minute winter	S12	11	2.191	0.201	47.8	0.2268	0.0000	OK
15 minute winter	S13	11	2.122	0.232	47.1	0.2626	0.0000	OK
15 minute winter	S03	11	2.087	0.342	130.9	0.4887	0.0000	OK
240 minute winter	TANK	224	1.921	0.171	21.9	102.5593	0.0000	OK
15 minute summer	BASIN	1	2.650	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S04	11	2.005	0.280	134.2	0.4012	0.0000	SURCHARGED
15 minute summer	HW01	1	1.510	0.000	4.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW100	1.000	SW101	12.3	0.866	0.310	0.8282	
15 minute winter	SW101	1.001	S01	12.2	0.713	0.296	0.1757	
15 minute winter	S01	1.002	S02	18.2	0.923	0.452	0.4440	
15 minute winter	S20	2.000	S02	43.0	0.988	0.604	2.2880	
15 minute winter	S02	1.003	S03	84.6	0.856	0.761	4.0866	
15 minute winter	S10	3.000	S11	16.5	0.530	0.233	0.3822	
15 minute winter	S11	3.001	S12	33.7	0.788	0.484	1.1512	
15 minute winter	S12	3.002	S13	47.1	0.919	0.677	1.3710	
15 minute winter	S13	3.003	S03	46.3	0.778	0.660	1.0842	
15 minute winter	S03	1.004	S04	131.4	1.382	1.041	0.4833	
240 minute winter	TANK	4.000	S04	-11.0	-0.408	-0.095	0.3971	
240 minute winter	TANK	Orifice	S04	2.2				-26.7
15 minute summer	BASIN	5.000	S04	0.0	0.000	0.000	0.0000	
15 minute summer	BASIN	Orifice	S04	0.0				0.0
15 minute winter	S04	Hydro-Brake®	HW01	4.9				64.4

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 96.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW100	10	2.644	0.099	16.0	0.1122	0.0000	OK
15 minute winter	SW101	12	2.317	0.107	15.6	0.1214	0.0000	OK
15 minute winter	S01	11	2.312	0.167	22.4	0.1885	0.0000	OK
15 minute winter	S20	11	2.357	0.202	54.8	0.2281	0.0000	OK
15 minute winter	S02	11	2.268	0.393	111.7	0.5618	0.0000	SURCHARGED
15 minute winter	S10	11	2.297	0.152	21.3	0.1722	0.0000	OK
15 minute winter	S11	11	2.292	0.197	43.5	0.2232	0.0000	OK
15 minute winter	S12	11	2.267	0.277	59.9	0.3130	0.0000	OK
15 minute winter	S13	11	2.198	0.308	55.6	0.3485	0.0000	SURCHARGED
15 minute winter	S03	11	2.138	0.393	158.4	0.5623	0.0000	SURCHARGED
240 minute winter	TANK	232	1.980	0.230	28.7	137.9814	0.0000	OK
15 minute summer	BASIN	1	2.650	0.000	0.0	0.0000	0.0000	OK
15 minute winter	S04	10	2.033	0.308	162.9	0.4404	0.0000	SURCHARGED
15 minute summer	HW01	1	1.510	0.000	4.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW100	1.000	SW101	15.6	0.908	0.394	0.9996	
15 minute winter	SW101	1.001	S01	15.0	0.741	0.363	0.2561	
15 minute winter	S01	1.002	S02	23.8	0.891	0.591	0.7084	
15 minute winter	S20	2.000	S02	54.7	0.999	0.769	2.9877	
15 minute winter	S02	1.003	S03	103.0	0.934	0.927	4.5963	
15 minute winter	S10	3.000	S11	20.8	0.534	0.293	0.5191	
15 minute winter	S11	3.001	S12	42.1	0.808	0.605	1.5560	
15 minute winter	S12	3.002	S13	55.6	0.932	0.800	1.7475	
15 minute winter	S13	3.003	S03	55.9	0.801	0.796	1.2250	
15 minute winter	S03	1.004	S04	158.6	1.516	1.257	0.5165	
240 minute winter	TANK	4.000	S04	-15.3	-0.435	-0.132	0.5610	
240 minute winter	TANK	Orifice	S04	1.3				-42.1
15 minute summer	BASIN	5.000	S04	0.0	0.000	0.000	0.0000	
15 minute summer	BASIN	Orifice	S04	0.0				0.0
15 minute winter	S04	Hydro-Brake®	HW01	4.9				82.0

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 96.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW100	11	3.254	0.709	29.0	0.8017	0.0000	FLOOD RISK
15 minute winter	SW101	11	3.089	0.879	26.2	0.9944	0.0000	FLOOD RISK
15 minute winter	S01	11	3.053	0.908	40.7	1.0274	0.0000	FLOOD RISK
15 minute winter	S20	11	3.331	1.176	99.5	1.3298	0.0000	FLOOD RISK
15 minute winter	S02	11	2.916	1.041	191.8	1.4894	0.0000	SURCHARGED
15 minute winter	S10	11	3.142	0.997	38.7	1.1276	0.0000	FLOOD RISK
15 minute winter	S11	11	3.121	1.026	76.1	1.1608	0.0000	FLOOD RISK
15 minute winter	S12	11	2.965	0.975	105.8	1.1024	0.0000	FLOOD RISK
240 minute winter	S13	180	2.722	0.832	21.2	0.9408	0.0000	SURCHARGED
240 minute winter	S03	180	2.732	0.987	58.9	1.4119	0.0000	SURCHARGED
240 minute winter	TANK	180	2.726	0.976	54.5	241.0953	0.0000	SURCHARGED
480 minute winter	BASIN	456	2.698	0.048	13.8	33.8058	0.0000	OK
480 minute winter	S04	328	2.715	0.990	34.2	1.4162	0.0000	SURCHARGED
15 minute summer	HW01	1	1.510	0.000	5.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW100	1.000	SW101	26.2	0.983	0.660	2.2734	
15 minute winter	SW101	1.001	S01	32.5	0.818	0.787	0.4067	
15 minute winter	S01	1.002	S02	44.1	1.109	1.095	0.7902	
15 minute winter	S20	2.000	S02	96.1	1.365	1.350	3.4840	
15 minute winter	S02	1.003	S03	191.8	1.739	1.725	4.5963	
15 minute winter	S10	3.000	S11	36.3	0.541	0.513	0.8598	
15 minute winter	S11	3.001	S12	75.2	1.068	1.082	1.8717	
15 minute winter	S12	3.002	S13	105.7	1.502	1.519	1.7788	
240 minute winter	S13	3.003	S03	20.8	0.731	0.296	1.2250	
240 minute winter	S03	1.004	S04	58.0	0.813	0.460	0.5502	
240 minute winter	TANK	4.000	S04	-32.1	-0.496	-0.277	0.8133	
240 minute winter	TANK	Orifice	S04	27.2				-85.8
480 minute winter	BASIN	5.000	S04	-7.1	0.603	-0.035	0.2572	
480 minute winter	BASIN	Orifice	S04	1.3				1.7
480 minute winter	S04	Hydro-Brake®	HW01	5.0				365.5

FEH Rainfall Data Hydraulic Model Output With a 1:30 Year Surcharged Outfall

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m ³ /ha)	0.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	0	10	0

Node HW01 Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m ²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		
Applies to All storms					

Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	0.590	1440	0.590

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 83.12%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	S01	690	2.613	0.468	2.0	0.5295	0.0000	SURCHARGED
960 minute winter	S02	690	2.613	0.738	9.4	1.0555	0.0000	SURCHARGED
960 minute winter	S03	690	2.616	0.871	20.7	1.2458	0.0000	SURCHARGED
960 minute winter	S04	690	2.611	0.886	36.9	1.2685	0.0000	SURCHARGED
15 minute summer	HW01	1	2.100	0.590	0.0	0.0000	0.0000	OK
960 minute winter	S10	690	2.613	0.468	2.4	0.5290	0.0000	SURCHARGED
960 minute winter	S11	690	2.613	0.518	3.7	0.5856	0.0000	SURCHARGED
960 minute winter	S12	690	2.613	0.623	5.2	0.7042	0.0000	SURCHARGED
960 minute winter	S13	690	2.613	0.723	5.2	0.8175	0.0000	SURCHARGED
15 minute winter	SW100	10	2.655	0.110	19.1	0.1239	0.0000	OK
960 minute winter	SW101	690	2.613	0.403	1.9	0.4559	0.0000	SURCHARGED
960 minute winter	S20	690	2.613	0.458	4.5	0.5181	0.0000	SURCHARGED
600 minute winter	TANK	465	2.628	0.878	43.2	240.9550	0.0000	SURCHARGED
480 minute winter	BASIN	472	2.652	0.002	0.7	1.2720	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	S01	1.002	S02	2.0	0.528	0.050	0.7902	
960 minute winter	S02	1.003	S03	15.1	0.311	0.136	4.5963	
960 minute winter	S03	1.004	S04	21.1	0.341	0.167	0.5502	
960 minute winter	S04	Hydro-Brake®	HW01	5.0				129.0
960 minute winter	S10	3.000	S11	-2.4	0.328	-0.033	0.8598	
960 minute winter	S11	3.001	S12	3.7	0.471	0.053	1.8717	
960 minute winter	S12	3.002	S13	5.2	0.550	0.075	1.7788	
960 minute winter	S13	3.003	S03	5.6	0.478	0.080	1.2250	
15 minute winter	SW100	1.000	SW101	19.3	0.936	0.486	1.6644	
960 minute winter	SW101	1.001	S01	-1.6	0.406	-0.039	0.4067	
960 minute winter	S20	2.000	S02	4.5	0.571	0.063	3.4840	
600 minute winter	TANK	4.000	S04	-13.7	-0.215	-0.119	0.8133	
600 minute winter	TANK	Orifice	S04	15.9				-157.3
480 minute winter	BASIN	5.000	S04	-0.7	-5.093	-0.003	0.0662	
480 minute winter	BASIN	Orifice	S04	0.0				0.4

FEH Rainfall Data Hydraulic Model Output With a 1:100 Year Surcharged Outfall

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m ³ /ha)	0.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	10	0

Node HW01 Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m ²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		
Applies to All storms					

Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	1.120	1440	1.120

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 91.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S01	10	3.247	1.102	42.3	1.2460	0.0000	FLOOD RISK
15 minute winter	S02	10	3.106	1.231	205.5	1.7614	0.0000	FLOOD RISK
480 minute winter	S03	456	3.064	1.319	52.8	1.8875	0.0000	FLOOD RISK
480 minute winter	S04	464	3.108	1.383	71.9	1.9784	0.0000	FLOOD RISK
15 minute summer	HW01	1	2.630	1.120	0.0	0.0000	0.0000	OK
15 minute winter	S10	10	3.350	1.205	48.4	1.3629	2.4925	FLOOD
15 minute winter	S11	10	3.342	1.247	85.1	1.4107	0.0000	FLOOD RISK
15 minute winter	S12	10	3.188	1.198	116.5	1.3548	0.0000	FLOOD RISK
120 minute winter	S13	74	3.032	1.142	46.3	1.2920	0.0000	FLOOD RISK
15 minute winter	SW100	10	3.350	0.805	36.3	0.9105	1.9794	FLOOD
15 minute winter	SW101	10	3.267	1.057	40.0	1.1949	0.0000	FLOOD RISK
15 minute winter	S20	9	3.460	1.305	124.4	1.4760	4.4355	FLOOD
480 minute winter	TANK	480	3.049	1.299	48.5	241.5586	0.0000	FLOOD RISK
600 minute winter	BASIN	570	2.980	0.330	45.1	261.6615	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S01	1.002	S02	47.6	1.198	1.182	0.7902	
15 minute winter	S02	1.003	S03	205.8	1.866	1.851	4.5963	
480 minute winter	S03	1.004	S04	71.5	0.649	0.567	0.5502	
480 minute winter	S04	Hydro-Brake®	HW01	4.9				133.9
15 minute winter	S10	3.000	S11	40.1	0.569	0.566	0.8598	
15 minute winter	S11	3.001	S12	83.1	1.180	1.196	1.8717	
15 minute winter	S12	3.002	S13	116.9	1.660	1.680	1.7788	
120 minute winter	S13	3.003	S03	45.5	0.751	0.648	1.2250	
15 minute winter	SW100	1.000	SW101	26.7	0.969	0.672	2.2734	
15 minute winter	SW101	1.001	S01	31.9	0.802	0.772	0.4067	
15 minute winter	S20	2.000	S02	106.1	1.506	1.489	3.4840	
480 minute winter	TANK	4.000	S04	-36.1	-0.334	-0.311	0.8133	
480 minute winter	TANK	Orifice	S04	26.4				-93.5
600 minute winter	BASIN	5.000	S04	-25.1	-0.523	-0.123	0.4705	
600 minute winter	BASIN	Orifice	S04	19.8				-67.6