Preliminary Drainage Strategy

Project:

Plant Based Protein Extraction Facility, Rangell Gate, Spalding, Lincolnshire

Client:

Naylor Farms

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Introduction

Jackson consulting engineers have been appointed by Naylor Farms, to undertake a drainage strategy, forming part of the supporting evidence of the planning submission for the proposed plant based protein extraction facility, to land south of Low Gate (B1165), Spalding, near PE12 6FA. The following document is to assist the planners and Lead Local Flood Authority (LLFA) in demonstrating that the development is acceptable in terms of sustainable drainage strategy and flood risk as a result of the development.

Existing Site

The site lies to the south of Low Road and West of Rangell Gate. An aerial location plan is shown in figure 1, please note that the red line is indicative and does not indicate the planning boundary.



Figure 1 - Site Location

Site Topography

A site survey has been carried out by MD Surveys, drawing number Rangell 01, which can be found in appendix A. The total site area is 2.86 hectares.

The development sits just south of Low Road (B1165) and to the west of Rangell Gate. The current site is accessed through a private road, off Low Road. There is a single dwelling near the entrance of the site, and the current site has two farm buildings. The field is currently used for crops.

The overall field, other than near the access onto the field and the existing dwelling, is bounded by ditches. The ditch to the western boundary is off the edge of the A16, and presumably serves as the drainage for that road. From the topographical survey levels, the ditch to the north boundary falls from west to east, with the eastern boundary having a very subtle fall heading south. The southern ditch falls east to west, towards the A16, although the A16 ditch was not surveyed, it appears that ditch is deeper than the field ditches. The ditch to the field is typically 0.7-0.9m deep. During a site walkover it was noted that the ditches contained well established reeds, and it was difficult to locate any culvert locations. One culvert location was noted to the southern ditch at the vehicle access point. The ditch at the southern boundary is outside of the application site, but it is owned by the same landowner and would currently serve the development site.

The applicant is still in the process of establishing the ditch ownership and connectivity. At present it is assumed that all ditches bounding the field (north, east, and south) are owned by the landowner serving the field and the ditches to the east and part of the north also serve the existing highway. It is assumed that the ditch to the west is outside of the site's boundary, serving the A16 and is owned and maintained by LCC, and the site walkover demonstrated that the fields ditches connect into this via. and open connection. It is reasonable to assume that the LCC ditch will have overall connectivity into either the main river or into the IDB ditches, and this has been tentatively confirmed by LCC.

The proposed site is to be accessed from the existing entrance off Low Road, with a proposed access to the field being created directly to the south of this, over an existing ditch. The levels along the edge of Low Road at the existing junction, is approximately 3.33m AOD. The existing access falls away from Low Road, and at the edge of the existing hardstanding, nearest the proposed access, the levels are around 3.15m AOD, although it is expected there will be some redevelopment of these levels. The existing field levels typically range from 2.70m and 3.10m AOD.

Ground Conditions

A phase 1 or 2 ground investigation report is not available for this site currently, and the findings of this section are based on publicly available information. A full ground investigation will be undertaken prior to detailed design and assessed by the appointed engineer.

The bedrock geology of the site is described as 'Oxford Clay Formation'. This generally indicates that deeper infiltration devices are not viable for the site to understand the full viability of infiltration.

The superficial deposits are described as 'Tidal Flat Deposits', consisting of clays and silts. This type of strata can offer some limited infiltration but is generally restricted by the underlying clay. Additionally, the soaked CBR's of the silty clay are likely to be poor and not allow the use of items such as unlined porous paving.

There is limited borehole information in close proximity of the site. Any ground water levels will need to be assessed at detailed design stage.

Both British Geological Survey definitions can be found respectively in figures 2 and 3 below.

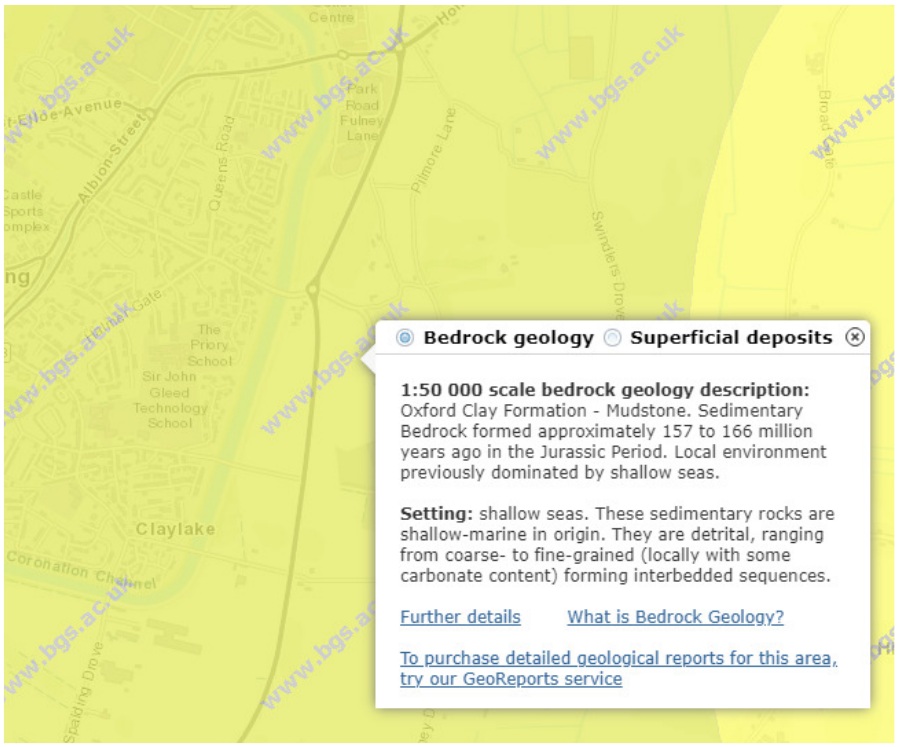


Figure 2 - BGS Bedrock Geology

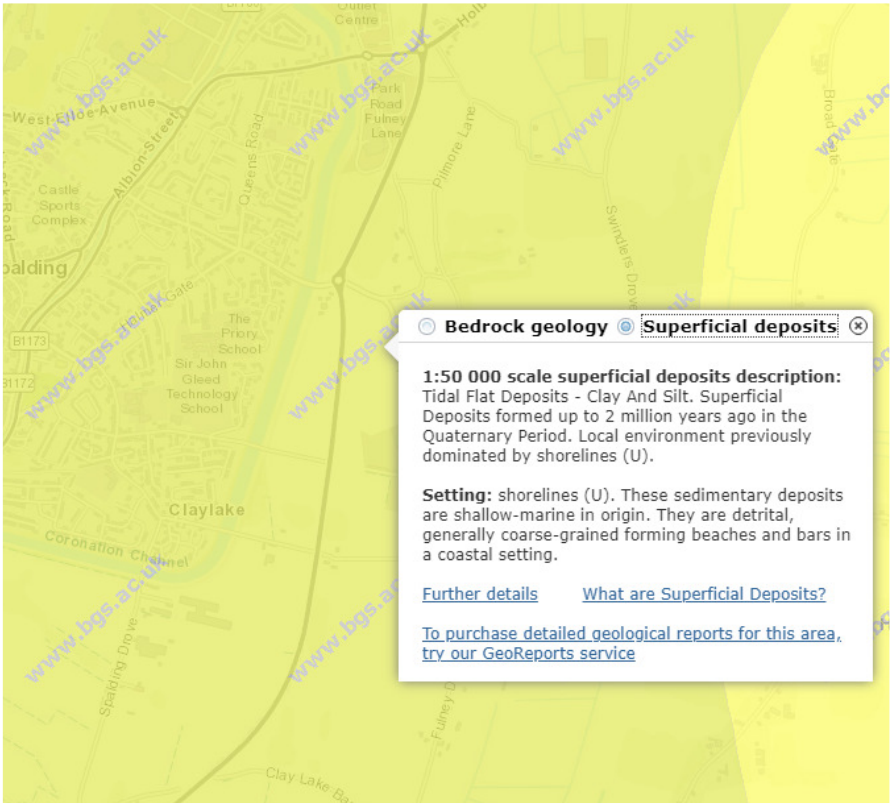


Figure 3 - BGS Superficial Deposits

Surrounding Drainage

The existing drainage for the site and adopted roads have already been described earlier in this document. No surface water sewers have been identified in close proximity of the site.

Overall, the development sits within South Holland Internal Drainage Boards district, specifically into Wisemans Catchment. The figure below shows the local assets in relation to the site. DRN193P1804 and 5 lie almost due east of the existing southern ditch within the landowners field. No evidence has been seen of a direct connection into this IDB ditch, and as the field ditch then proceeds to fall to the west it is unlikely that the site connects into the IDB ditch at this location. Local to the A16, it is unclear where the A16 ditch flows into an IDB ditch, although it is assumed it does. There is an existing IDB drain to the west of the A16 (south of the development) – DRN193P3402 which appears to connect into the A16 ditch which then flows east. It is unlikely that the drainage will have any direct connections into the Coronation Channel, but this needs to be established.

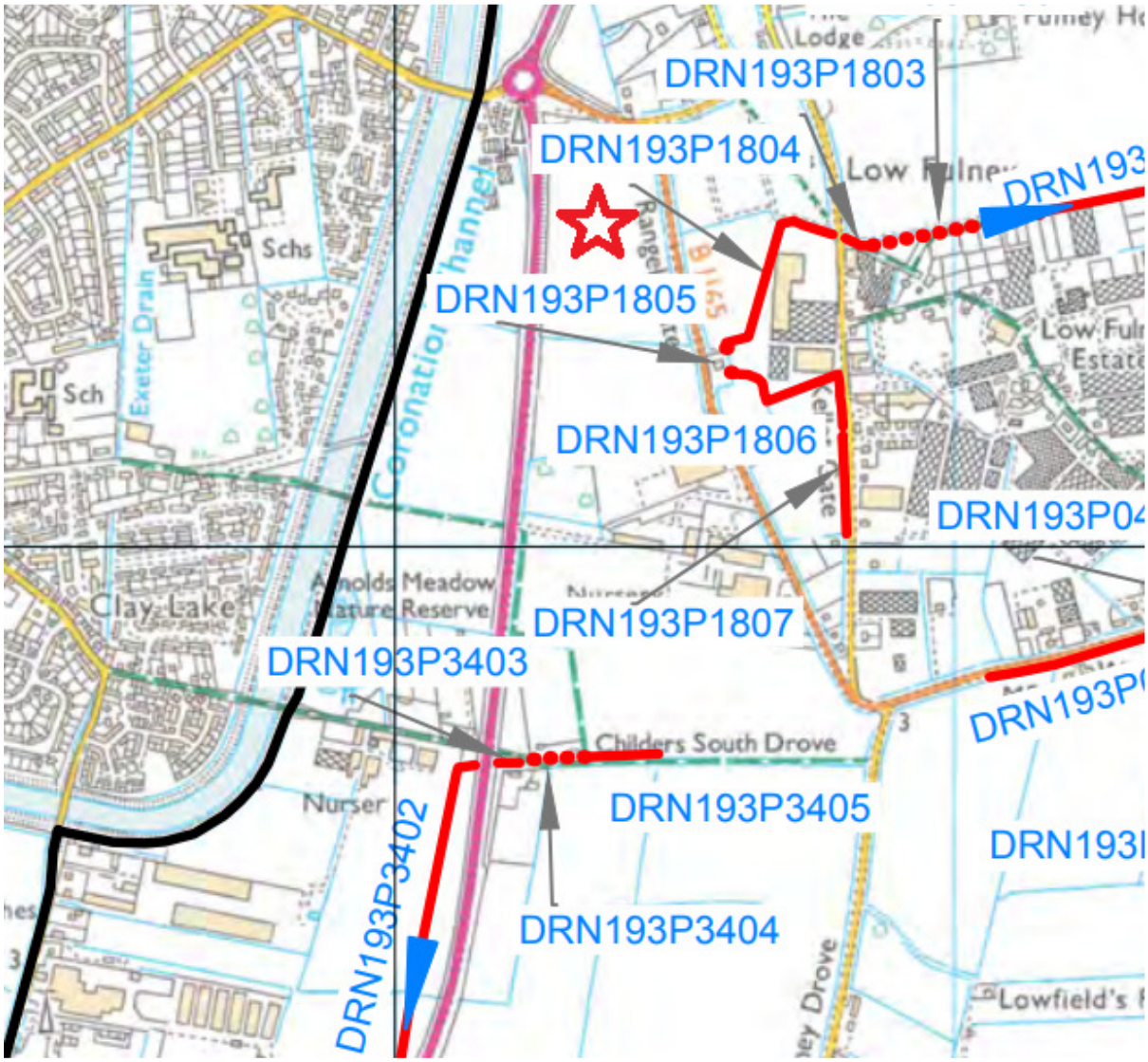


Figure 4 - IDB Assets Local to Site

In summary, the site and general area is served by land drainage, being a mixture of private and LCC ditches before ultimately discharging into IDB drainage, although this will need to be fully determined at detailed design stage. The site will benefit from natural riparian rights, but any increase to greenfield discharge needs to be established with the LLFA and IDB. Improvements to the field ditches can readily be made as they are owned by the landowner.

The final discharge rates will need to be agreed with LCC/LLFA and SHIDB/WLMA, and a development contribution will need to be made for any discharge.

Surface Water Flood Risk

The existing flood risk for the site has been assessed by a different consultant and can be found within report: ECL0563/P&R. The FRA has recommendations for the finished floor levels and construction and should be fully referenced to develop the detailed drainage strategy.

The FRA should be fully referred to, but the general consensus is that there is no recommended minimum FFL as the building will be built with refuse points and flood resilient construction. Given the limited depth to the existing ditch it is proposed that the floors are to be raised a minimum of 300mm above existing levels to ensure that a surface water gravity solution is feasible, this is not a recommendation for flood risk, just for ease of constructing drainage elements.

Development Proposals

The development consists of the demolition of existing buildings and construction of a new plant based protein extraction facility and ancillary office space together with landscaping, SuDS features, car park and associated infrastructure

Drainage Strategy

The following section provides narrative on the principles behind the drainage strategy and has been carried out in general accordance with Lincolnshire County Council's "Sustainable Drainage Design and Evaluation Guide" (SDDEG), and "CIRIA's C753 – the SUDS Manual", where appropriate.

Surface Water Drainage

For new developments there is a requirement to apply sustainable drainage principles (SuDS) to the disposal of surface water from the site where practicable. As required by Building Regulations and Defra's "Non-statutory Technical Standards for Sustainable Drainage Systems" (NTS), surface water must discharge to the following, listed in priority.

1. To ground – in an adequate soakaway or some other adequate infiltration system.
2. To a watercourse.
3. To a surface water sewer, highway drain or other drainage system.
4. To a combined sewer.

Infiltration

Due to the field currently baring crops, only very basic infiltration testing has been undertaken to establish the general viability of infiltration. It is expected at detailed design, once the growing season has passed, the

Two different sets of testing was undertaken, the first test was to establish the viability of a drainage field for foul water – carried out in general accordance with building regulations and the second test to establish surface water drainage soakaway rates in general accordance with BRE365.

Foul Infiltration

The foul test, although undertaken in general accordance with building regulations, had a slightly different pit size, in this case being 400mm deep rather than 300mm deep. The recordings were still taken between 25 and 75% - when the water depth was between 300mm and 100mm depth. The top of test pit was taken at 500mm below ground levels. Due to access to the field, the testing was only undertaken once, and the purpose is to demonstrate overall viability of infiltration. As the total depth of water was 400mm rather than 300mm the equation is modified to represent a 200mm drop of water. The equation used for this exercise is;

V_p = Time/200

A summary of the results and infiltration rates are shown in the table below.

Trial Pit	Time taken to drop between 75% and 25%, seconds (minutes)	Time/200 = V_p
1	1140 (19)	5.7
2	3240 (54)	16.2
3	9480 (158)	47.4
4	1080 (18)	5.4
5	1320 (22)	6.6

For infiltration to a drainage field to be viable then the VP rate should fall between 12 and 100. Although several of these results were below 12, it is likely that over the subsequent 2 tests at each hole location, this result would slow down. Additionally, test location 3 had a slow V_p rate, although given that all other test locations had a good rate of drop, it would be unreasonable to use the slowest rate for the entire area.

It should be noted that these infiltration rates are preliminary, and a full set of testing is required to establish the design rates and determine if all other ground conditions are suitable.

Surface Water Infiltration

Two tests were undertaken for surface water disposal, in general accordance with BRE 365. Both pits were 1.5m long x 0.6m wide x 0.9m deep, each were filled with 0.9m of water and the time taken to drop 25% and 75% were recorded. Again, due to access to the feild, the tests were only undertaken once for each pit. A summary of the results is shown in the table below.

Test Location	Time taken to drop between 75% and 25%, seconds minutes	f
1	257	9.4×10^{-6} m/s
2	350	6.9×10^{-6} m.s

The infiltration rates show that the site has some infiltration potential, although the infiltration rates are slow, and are only likely to be slower for the 2nd and 3rd tests.

It should be noted that these infiltration rates are preliminary and a full set of testing is required to establish the design rates and determine if all other ground conditions are suitable.

Infiltration Summary

Subject to other factors stated in the foul drainage proposals section, there is potential that foul drainage can be discharge via. a drainage field, although the final design will be subject to complete testing, available space and most importantly, approval from the EA.

The BRE 365 testing returned slower infiltration rates, and although the ground does infiltrate, as the results are slow it is likely that the entire site cannot be catered for through infiltration and will be subject to further testing. Parts of the storage features a likely to be unlined once they are out of there permeant water levels and these areas could partly infiltrate subject to full results becoming available and depth of the water table.

Watercourse

As previously described, the site benefits from land drainage to the perimeter of the field, which currently serves the existing field and adopted highway. This ditch then connects into an assumed LCC ditch running alongside the A16, before assuming to connect into an IDB drain.

A connection into a watercourse is the most likely definitive connection, although the overall connection into the IDB system needs to be proven through detailed design, and rates will need to be agreed by LCC/LLFA and the IDB. Similar with the foul drainage discharge, the watercourse has potential to receive the treated water, subject to agreement with the IDB, LCC/LLFA and the EA.

Surface Water Sewer

There are no identified surface water sewers in the vicinity of the site. As a watercourse connection is viable, then there is no need for a surface water sewer to be considered.

Run-off Rates

Existing Drainage Arrangements

As the site is greenfield it has no current surface water drainage. The natural topography of the site directs surface runoff into the existing watercourses to the north, east and south of the site and will either flow directly overland or laterally within the strata layers, certainly as the underlying strata, would be considered as being very slow draining to impermeable once saturated.

Existing greenfield run-off

The greenfield run-off for the site is summarised in figure 5, with a full copy of the report provided in appendix B.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	1.12	1.12
1 in 1 year (l/s):	0.97	0.97
1 in 30 years (l/s):	2.75	2.75
1 in 100 year (l/s):	3.99	3.99
1 in 200 years (l/s):	4.72	4.72

Figure 5 - Existing Greenfield Runoff Rates

The Q_{BAR} greenfield run-off for the site is calculated at 1.1 l/s, and ideally the proposed discharge from the site should be restricted as close as practical to this rate.

A discharge rate of 1.1 l/s is likely to be susceptible to blockage, and subject to discussion with the IDB and LCC, a higher discharge rate may be considered.

The HR Wallingford Greenfield runoff rate estimation for sites is an industry standard way to determine the greenfield run-off. The above calculation uses the IH124 method to determine the runoff.

Proposed Run-off

The greenfield run-off from the site should, as far as reasonably practical, not exceed the greenfield runoff rate for the Q_{BAR} event, which in this instance is 1.1 l/s. Therefore, the proposed discharge from the site will have a maximum runoff of 1.1 l/s, for all storms up to and including the 1 in 100 year + 40% climate change event, although this will be subject to further negotiation with LCC/IDB for a higher allowable discharge to lower the risk of device blockage. The post development run-off values are summarised in the table below. These figures represent the non-surcharged event. The full calculations can be found in appendix C.

Storm	Critical Flow
1 Year	1.1 l/s
2 Year	1.1 l/s
30 Year	1.1 l/s
100 Year	1.1 l/s
100 Year + 40% CC	1.1 l/s

Drainage Proposals

The ethos for the drainage design is to try and mimic natural drainage as far as possible, and to ensure that as a result of the development, flood risk offsite is not increased. The following section demonstrates how this will be achieved and outline the general drainage strategy.

The proposed drainage strategy can be found in appendix D.

Infiltration

The site is somewhat unique in its layout, in the fact that large areas of open space is being provided. These spaces feature tree planting, meadows and a pond. As a result of this, there is an opportunity to offer infiltration areas over large areas such as infiltration blankets, with any planting in these areas being specified to allow for periods of saturated ground. This option is subject to further infiltration testing and therefore is not being fully explored at this stage, although the proposed drainage layout could be easily modified to accommodate infiltration. Notes on this potential can be found on the preliminary drainage strategy. The use of infiltration will be dependent on the foul drainage solution as infiltration features for surface water shall not be located in these areas.

Watercourses

Although the final connectivity of the ditches is not known, it is reasonable to assume that the existing ditch on the site connects into an LCC ditch which then connects into the IDB network. Subject to final

agreed run-off rates, and ruling out infiltration, it is proposed that the sites surface water drainage will connect into the existing field drain.

One of the main constraints of the site is the limited fall between the proposed/existing levels and invert level of the ditch, this is exacerbated by the scale of the development. The drainage proposals put forward bear these site constraints in mind.

The north of the site is occupied by staff carparking space. It is proposed that this area will flow overland into perimeter swales which then flow into the attenuation pond.

The main concrete access way serving the facility will discharge to a perimeter swale. As the site is very flat, and the outfall depth shallow, it is proposed that the swale will be designed as a wet swale, which reduces the need for a longitudinal fall. The runoff from the accessway will be a simple overland flow towards the swale along it's length. The swale will provide source control, water quality improvements, conveyance and amenity value – as the bed of the swale will be wet, there will be planting opportunities. This swale will connect into the attenuation pond.

The roof water will enter a piped network before discharging into the swales. It is proposed that the water flow through a rainwater harvesting tank before discharging into the pond so that the water can be reused. The final size of the rainwater harvesting tank will be determined at the detailed design stage once the water demand is known.

All of the site's surface water will ultimately discharge into the attenuation pond, which will have a flow restriction before discharging into the fields ditch. The current proposal is for the pond to have a wet bed to provide amenity value for the site. This will create a permanent water level, and the water level will rise during storm events, helping to cycle the water. As the final discharge is low, it is recommended at detailed design stage that a filter system will be put in place at the outfall.

The site has been designed to incorporate source control as far as reasonably practical, and it is our opinion that SUDS has been fully considered for this type of development, meeting all of the appropriate standards. All of the water from these sources will pass through at least two treatment devices.

The site utilises a Hydrobrake, which has a provisional opening size of 55mm to control the discharge to greenfield run-off rates. The surface water will pass through devices such as reeds within the swale, filter strips and the pond, and therefore the risk of blockage is low as debris will be filtered before entering the Hydrobrake. Although suitable filtration is offered throughout the design, it is recommended that the incoming pipe to the Hydrobrake is further filtered such as a stone surround. If the Hydrobrake was to become blocked, or a higher storm period encountered then there would be more flooding than currently modelled. A provisional flood route is shown on the proposed drainage plans, but to summarise, flood water would flow towards the attenuation basin, utilise the freeboard, then overtop into the existing watercourse, away from any buildings.

The system has been designed so that there is no above ground flooding for the 1 in 30-year event and all flooding up to and including the 1 in 100 year + 40% climate change event is contained within the site. The calculations demonstrate that the 1 in 30-year storm event is stored below ground. For the 1 in 100-year + 40% climate change event, there is some minor flooding – a total of approximately 12m^3 located in soft landscaping – this would easily dissipate into the surrounding area, or within the private, unmodelled drainage pipes. A 3D schematic of the drainage model is shown in figure 6.

The proposed drainage layout is shown on JCE drawing 077-JCE-00-SI-DR-C-3000, which can be found in appendix D and a 3D schematic of the drainage model shown in figure 7.

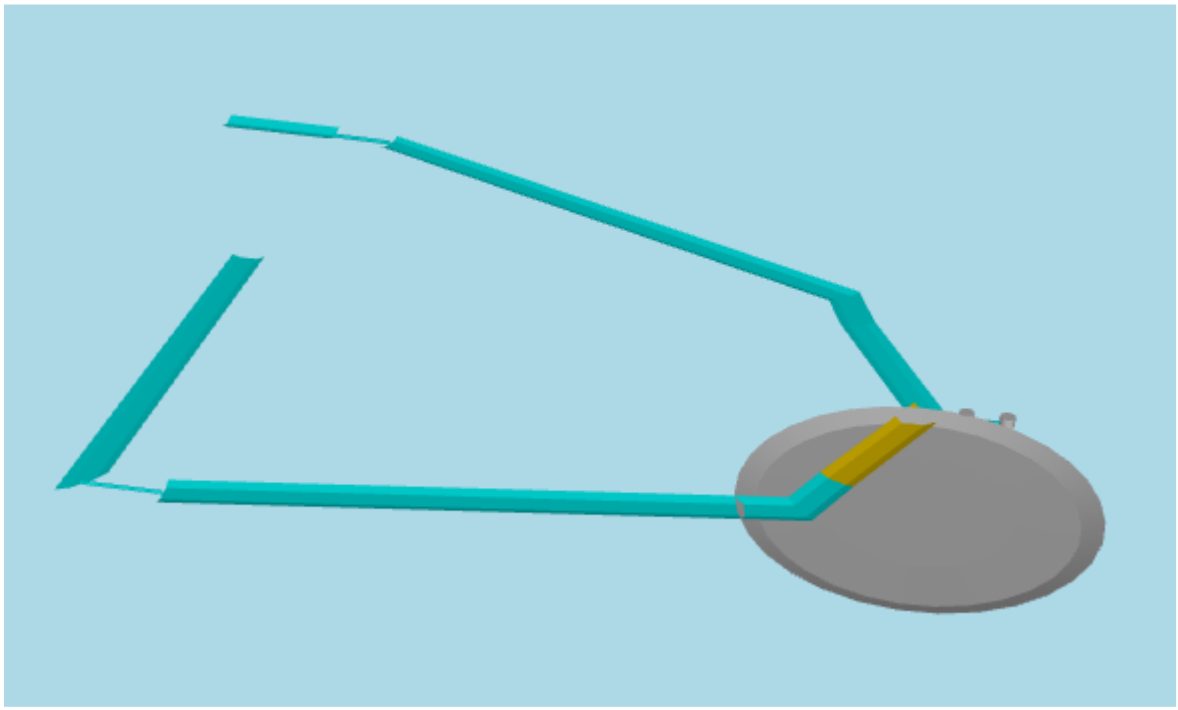


Figure 6 - 3D View of Drainage Model

Surcharged Outfall

During storm events, it is unknown if the water in the existing watercourse network will surcharge the outfall device, which needs to be considered. As this cannot be determined, the model has included a second set of calculations, 0145-CAL-3010, found in appendix E, to consider a surcharged event. As the water levels are not known a surcharge depth of 0.5m has been assumed. A flap valve is to be fitted downstream of the Hydrobrake to ensure offsite water does not enter the site.

The maximum water level in this event is 2.615m AOD, and this represents the worst case, highest pond level scenario. This gives an approximate water depth in the basin of 0.56m.

Exceedance Flows

There is always the possibility that a device can become temporarily blocked or fail, resulting in the system flooding. Additionally, the site has been designed up to and including storms of 1 in 100 year + 40% climate change, any storms greater than this will cause above ground flooding. The proposed flood routing in storms of exceedance or device failure can be found on the drainage drawing. The top of bank for the pond is set at 2.800m AOD, which is slightly lower than surrounding levels. The modelled water level in the pond during the critical 1 in 100 year + 40% storm event is 2.588m AOD, therefore more than 200mm of free board is being provided.

Half Drain Times

As the discharge rate from site is so slow, the half drain down times will be higher for higher intensity storms. To ensure the proposals are still suitable it is common to ensure a subsequent 1 in 10 year

storm can be stored within the attenuation pond, 24 hours after the 1 in 100 year + 40% climate change event.

As seen in the figure below, the maximum water volume for the 1 in 10 year event within the pond is 281m^3. The graphical representation below shows approximately the level of water in the pond.

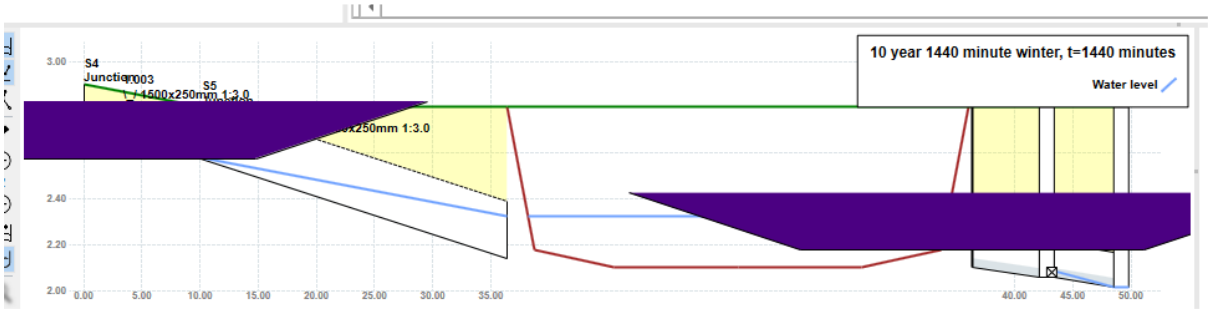


Figure 7 - Water levels for the Critical 1 in 10 year Storm

For the 1 in 100 year + 40% climate change event, at the peak the pond still has 200mm available as for storage. The 200mm of storage creates approximately 346m^3 of spare capacity, and therefore natural the pond will store the 1 in 10 year storm straight away. The figure below shows the ponds volume after 24 hours, and this would take the ponds spare capacity at that time as roughly 423m^3.

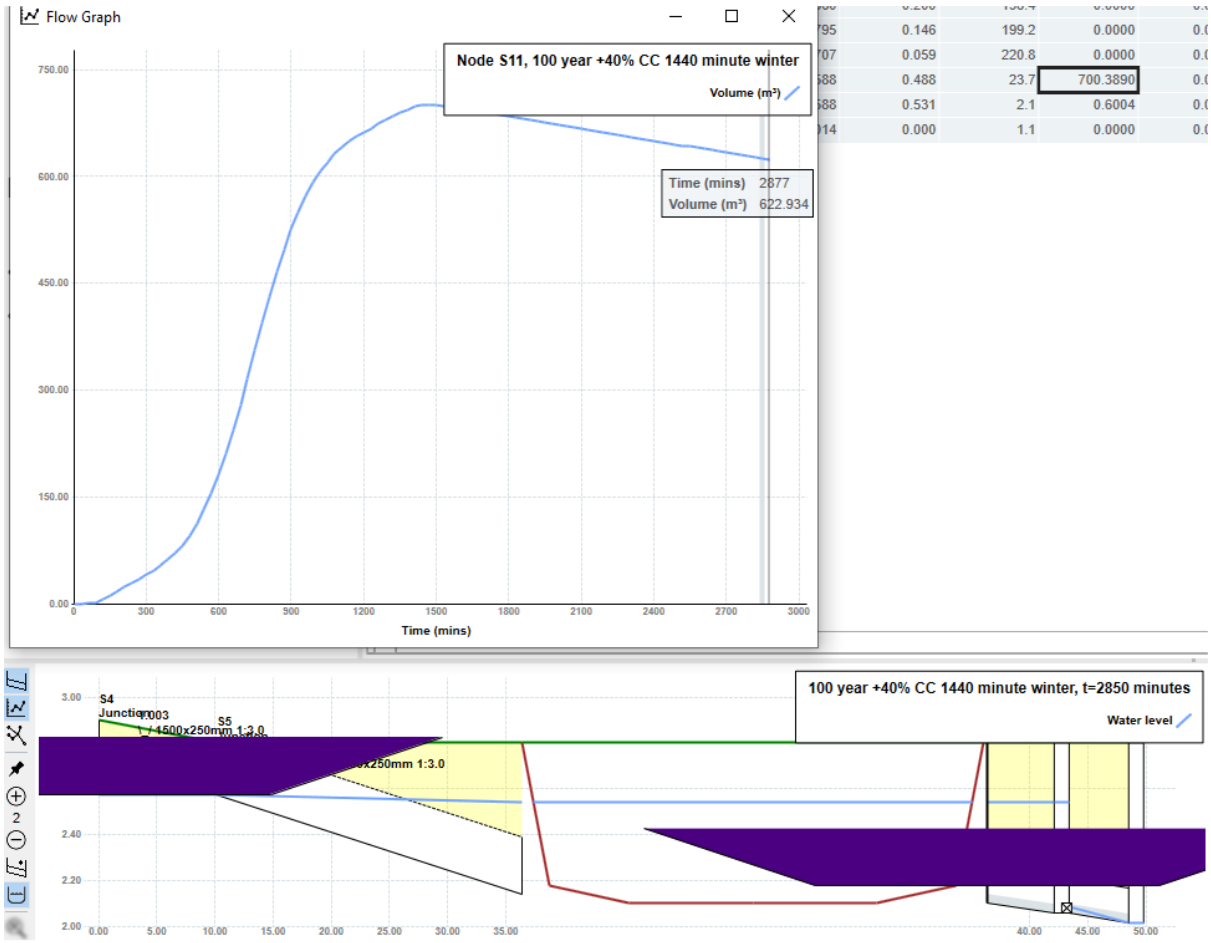


Figure 8 - Water Levels 24 Hours After a 1 in 100 Year + 40% CC Event

A brief check on the 1 in 30 year storm shows that the required capacity for that event is 363m^3, and the proposed pond size will almost be able to fully store a 1 in 30 year storm if it occurred directly after a 1 in 100 year + 40% climate change event.

To summarise, although the half drain down times exceed 24 hours, the excess storage in the system means that the system will be able to store a subsequent 1 in 30 year storm event, 24 hours after the 1 in 100 year + 40% climate change event has passed.

Water Quality

The methods of surface water disposal mentioned above have included provisions for water quality. In accordance with CIRIA C753, the pollution hazard features for the drainage areas are:

- Other roofs - Low
- Non-residential parking - Low
- Commercial yard and delivery areas - Medium

To remove the pollution risks, CIRA have developed 'Pollution hazard indices' and the 'mitigation indices' that the SuDS components provide, further details of these are found in figures 8 and 9 below. This simple approach is considered suitable for this type of development.

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Figure 9 - Pollution hazard indices for different land use classifications

	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Figure 10 - Indicative SuDS mitigation indices for discharging to a surface water

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ pollution hazard index
(for each contaminant type) (for each contaminant type)

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required where:

$$\textit{Total SuDS mitigation index} = \textit{mitigation index}_1 + 0.5\ (\textit{mitigation index}_2)$$

Where:

$$\textit{Mitigation index}_n = \textit{mitigation index for component } n$$

Provided the total SuDS mitigation index exceeds the pollution hazard indices, then sufficient water quality will be provided.

For the calculations below the hazards are represented by;

Total suspended solids = Red

Metals = Blue

Hydrocarbons = Green

The figures are presented to show the actual achieved in the right-hand side column. The right-hand side's total must be higher than the left-hand side.

Roof areas

The roof water enters the below ground pipework directly, before passing into a swale, before ultimately discharging into the attenuation pond. The mitigation for this area is:

0.3 0.8 0.05 = Swale 0.5 0.6 0.6 + ½ Detention Basin 0.7 0.7 0.5 – Total 0.85 0.95 0.85

The mitigation provided by the swale and detention pond creates enough water quality improvement for this aspect of the development.

Non-residential parking

The non-residential parking will pass overland into the swale before discharging into the detention basin. The mitigation for this area is:

0.5 0.4 0.4 = Swale 0.5 0.6 0.6 + ½ Detention Basin 0.7 0.7 0.5 – Total 0.85 0.95 0.85

The mitigation provided by the swale and detention pond creates enough water quality improvement for this aspect of the development.

Commercial Yard and Delivery Areas

The commercial yard and delivery area will drain into a swale, before discharging into the detention pond. The mitigation for this area is:

0.7 0.6 0.7 = Swale 0.5 0.6 0.6 + ½ Detention Basin 0.7 0.7 0.5 – Total 0.85 0.95 0.85

The mitigation provided by the swale and detention pond creates enough water quality improvement for this aspect of the development.

All the methods above provide enough water quality in accordance with CIRIA's C753 document or a suitable compared to the existing drainage arrangements. Further evidence will need to be provided at detailed design stage. In some instances the water will also pass over a filter drain which will improve the water quality further.

Flood Risk off-site

As the flow from site will be restricted to greenfield runoff rates, the flood risk offsite has not been increased as a result of the development.

Management/Maintenance

It is crucial that the elements mentioned in the drainage elements and water quality are maintained to a sufficient standard to ensure that the devices can still function as designed. Generally, the maintenance requirements are either from CIRIA 753, or manufacturer guidance. It is currently assumed that the building's management will maintain the SUDS devices.

The devices outlined below are preliminary only and subject to detailed design.

Filter Strip

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 reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Hydrobrake Maintenance

Maintenance

Normally, little maintenance is required as there are no moving parts within the Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size. The Flow Control (where applicable) is fitted with a pivoting bypass door, which allows the manhole chamber to be drained down should blockage occur. The smaller conical units, below the minimum recommended size, are also supplied with rodding facilities or vortex suppressor pipes as standard.

Following installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber. After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. If problems are experienced, please do not hesitate to contact the company so that an investigation may be made.

All Flow Control units are typically manufactured from grade 304 Stainless Steel, and if required they can also be manufactured in grade 316 Stainless Steel. Both materials have an estimated life span in excess of the design life of drainage systems.

Detention Pond

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices, eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

Foul Proposals

Unlike surface water drainage, the preference for foul water disposal is to connect into a sewer, and only where this is not a viable option should other means of drainage be considered.

Connection to a Sewer

Extracts of the Anglian Water asset maps are shown in the figures below, with the full asset maps being provided in appendix F. The first figure shows a foul connection, reference 0801, in Low Road to the east of the entrance of the site. The length of this connection would be approximately 430m, and it would have to go through a busy roundabout and over a bridge. As a result of this, this connection point is not deemed suitable.

The second figure shows an existing riser main to the south of the site, with the majority of the line of riser main being within the landowners land. This connects into an existing pumping station in Matmore Gate. The length of connection to this point would be approximately 1.17km, and although this is significantly further than the other closest sewer, it would be easier to construct, although a limiting factor would be, similar to the first connection point, crossing the river and A16, and therefor this connection point is also not deemed suitable.

The length of these connections are demonstrated on drawing 0145-JCE-00-SI-DR-C-3010, found in appendix G.



Figure 11 - Foul Connection into Low Road

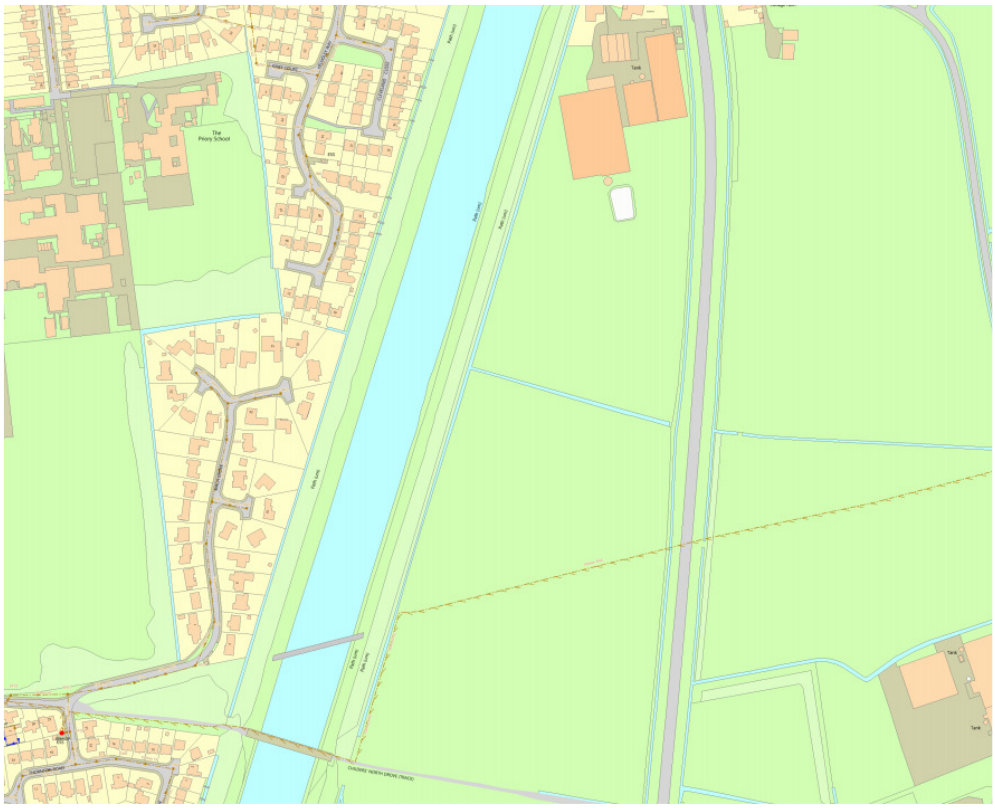


Figure 12 - Foul Connection into Matmore Gate

One of the criteria for a reasonable connection is the length of the connection. The EA consider a connection be made to the public sewer if the distance of the closest sewer falls within the following condition.

> *Divide the maximum volume in cubic metres that you want to discharge from those other premises by 0.75 (1 cubic metre is 1000 litres). Multiply the result by 30 metres. This will give you a result in metres.*

Although the final foul discharge from the site needs to be determined at detailed design stage, the preliminary daily volume of discharge is expected to be around 40m^3, with the majority of this coming off of the produce. With the EA's formula, this gives a distance of approximately 1600m ((40m3/0.75)*30), with both connections falling within this distance.

The EA states '*If there is a good reason why you cannot connect to the public foul sewer (for example, if there is a river or a railway line in the way) then you must apply for a permit. You must provide evidence to justify this when you apply*'. In this sites case, either connection will need to cross the A16 or a river, with the southern connection having to cross through ditches and the northern connection having to pass through a roundabout. These constraints of the site would make the connection into the existing foul sewer unreasonable and alternative methods of foul drainage is to be considered.

To rule out a connection into the existing public sewer, an application form will need to be completed at detailed design, and the EA will determine if the reason for not connecting into a public foul sewer is acceptable.

Anglian Water may have a preferred connection point, but ultimately, as the discharge is for foul water, it is expected that AW would need to make capacity available. The final details of any connection to the existing foul sewer, if required, will be agreed through a section 106 application at detailed design stage.

Connection to a Watercourse

The preferred foul connection from the site is to treat the water through a foul treatment plant and then discharge into the watercourse.

The approximate daily discharge is fairly significant, and an appropriate unit will need to be specified, in this case the proposal is a Kingspan Klargester BioFicent Commercial Sewage Treatment Plant – 67H, although at detail design, the manufacturer will need to confirm that the foul water entering the device can be sufficiently treated and the appropriate size specified. The EA may even deem that the water leaving the produce does not need treating, and in that instance the wastewater treatment plant will be much smaller, only required to account for the welfare facilities.

As the parameters fall outside of the EA's standard advice, a permit will need to be submitted, and there is a possibility that the connection to the existing sewer will still be preferred. The IDB and LCC will also need to agree to the discharge, and although they will probably take the EA's acceptance if a permit is issued, they still may be concerned over the amount of water entering from the system. A discharge of 40m^3 a day equates to an average discharge rate of 0.5l/s, and the IDB will likely require a development contribution.

Connection to a Drainage Field

The last option is to dispose of the foul water back to ground via. a drainage field. The earlier calculations show that generally the VP rates are good, but as each location was tested once it is likely that the VP rates will be slower. It is proposed that a preliminary VP rate of 30 is used at this stage, but it is critical that if this method is used, that full testing is undertaken at detailed design stage.

The floor area required for the drainage field is taken from building regulations, with the equation

$$A_t = p \times V_p \times 0.25$$

Where;

A_t = the floor area of the drainage field in m^2

p = the number of people served by the tank

V_p = the percolation value in seconds/mm.

The factor of 0.25 generally relates to a septic tank and the British Standard makes reference to this figure being reduced to 0.20, although this will need to be determined at detailed design stage. The p value refers to number of people served and unfortunately the discharge from the produce do not relate to this. The standard figure of 150 litres per person per day is used in building regulations and using this figure against the approximate discharge of 40m^3 gives a population equivalent of 270 persons. Using the conservative value of 0.25 and a VP of 30 gives a floor area of approximately 2000m^2. It would be proposed that the discharge form the wastewater treatment plant is pumped to avoid seasonal waterlogged ground.

Given the amount of water being discharged into the ground, a permit will need to be applied for with the EA, and this, similar to the watercourse connections is still dependent on if they will waive the requirement to discharge into the existing sewers.

In summary, there is a viable foul drainage option, although the EA will need to be formally consulted to determine which option is used.

Conclusion

- The above drainage strategy demonstrates that the site can be drained through the use of a Sustainable Drainage System at an appropriate level for the development, and although the final method has not been decided, viable options have been provided.
- The flow offsite will be restricted to a maximum of 1.1 l/s.
- Calculations have been included to assess a surcharged outfall.
- Maximum water depth in the basin is less than 0.5m.
- Less that 12m^3 of flooding is currently anticipated for the 1 in 100 year + 40% climate change event.
- Existing greenfield offsite flow from the undeveloped site is reduced for all storms above the Q_{BAR} event.
- The proposed scheme does not increase the risk of flooding either on or off site as a result of the development.
- A full maintenance strategy will be developed at the detailed design stage.
- A preliminary drainage layout can be found on JCE's Preliminary Drainage Strategy drawing: 0145-JCE-00-SI-DR-C-3000.
- The EA will be consulting regarding the foul drainage options and what they will be willing to accept. From a construction and cost perspective the order of preference for foul drainage is;
    - Wastewater treatment plant discharging into a local watercourse
    - Wastewater treatment plant discharging into a drainage field
    - Pumped connection into one of the two existing foul sewers – subject to AW approval.

Jackson Consulting Engineers is a trading name of Ben Jackson Consulting Ltd - Brunel House, Centre Park, 340 Firecrest Court, Warrington, WA1 1RG, reg no. 11709531

Appendices

Appendix A – Existing Topographical Survey

526250 E
526300 E
526350 E
526400 E
526450 E
526500 E
526550 E
322800 N
322750 N
322700 N
322650 N
322600 N
322550 N
322500 N
322450 N
322400 N
322350 N

Low Road
B1165
A16
Track
Mixed Hardcore
Scrub
Building
Tank
Building
Arable
Arable
Arable
Arable
Arable
Rangell Gate
B1165
A16
B1165
A16
450m
450m
450m

North.
(Indicative)

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Job Title : Site survey - Land to east of A16 at Rangell Gate - Spalding - Lincs

Client : Naylor - Project 1 - J Kirk

Drawn : MDS Date : 22nd March 2021

Drawing number: Rangell 01 Scale 1:500 on A0 sheet

THE DEPICTION OF A WALL, FENCE OR HEDGE DOES NOT NECESSARILY REPRESENT A LEGAL BOUNDARY. IT IS THE CLIENTS RESPONSIBILITY TO CONFIRM LEGAL BOUNDARIES WITH THE VENDOR / CONTRACTOR

Survey information is as result of measurement to existing features and does not imply legal ownership of boundaries or land divisions. Where boundary alignment lines are added to the survey drawing and are taken from legal documents or other information supplied they are done so within the constraints of drawing quality and scale. They are provided on the basis of opinion and do not imply legal contract.

Drainage information is as a result of surface inspection only, no chambers have been accessed. Manhole and pipe diameters should be checked before design and construction

This plan should only be used for its original purpose. No responsibility will be accepted if this plan if supplied to any party other than the original client.

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

DO NOT SCALE FROM THIS DRAWING

All trees marked as "indicative" have approximate heights and spreads
Trees marked with a "T" or "TAG" have been measured on site and should be referenced in conjunction with the Tree Survey Report carried out for SHDC by others

The data used for the computation of horizontal & vertical control for this survey was recorded using survey grade GPS receivers and corrected data from Trimble VRS Services using Geoid model OSTN15 with OSGM 15 .
Station establishment was carried out in accordance with best practice guidelines issued by The Survey Association.

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Appendix B – Greenfield Runoff

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Ben Jackson
Site name:	Low Fulney
Site location:	Spalding

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:	52.78613° N
Longitude:	0.12778° W
Reference:	149178055
Date:	Aug 27 2021 23:01

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.83

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):	559	559
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 ≤ 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):	1.12	1.12
1 in 1 year (l/s):	0.97	0.97
1 in 30 years (l/s):	2.75	2.75
1 in 100 year (l/s):	3.99	3.99
1 in 200 years (l/s):	4.72	4.72

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.

Appendix C – Proposed Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	1.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Inverts
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
Swale 1	0.262	5.00	2.900		0.250
H5			2.900		0.258
H6	0.253	5.00	2.900		0.315
Swale 2			2.900		0.324
Swale 3			2.800		0.225
Swale 4	0.037	5.00	3.500		0.400
H8			3.100		0.387
H9	0.285	5.00	3.000		0.340
Swale 5			2.900		0.251
Swale 6			2.800		0.152
H12			2.800		0.700
Hydrobrake			2.800	1500	0.743
H13			2.800	1200	0.786

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	Swale 1	H5	75.167	0.600	2.650	2.642	0.008	10000.0	1500	9.72	1.0
1.001	H5	H6	12.750	0.600	2.642	2.585	0.057	225.0	225	9.97	1.0
1.002	H6	Swale 2	94.303	0.600	2.585	2.576	0.009	10000.0	1500	15.89	1.0
1.003	Swale 2	Swale 3	10.142	0.600	2.576	2.575	0.001	10000.0	1500	16.53	1.0
1.004	Swale 3	H12	26.228	0.600	2.575	2.138	0.437	60.0	1500	16.65	1.0
1.005	H12	Hydrobrake	6.401	0.600	2.100	2.057	0.043	150.0	150	16.78	1.0
1.006	Hydrobrake	H13	6.400	0.600	2.057	2.014	0.043	150.0	150	16.92	1.0
2.000	Swale 4	H8	23.198	0.600	3.100	2.713	0.387	60.0	500	5.10	1.0
2.001	H8	H9	12.030	0.600	2.713	2.660	0.053	225.0	225	5.33	1.0

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	0.265	149.2	0.7	0.000	0.008	0.262	0.0	12	0.040
1.001	0.867	34.5	0.7	0.033	0.090	0.262	0.0	22	0.347
1.002	0.265	149.2	1.4	0.065	0.074	0.515	0.0	17	0.051
1.003	0.265	149.2	1.4	0.074	-0.025	0.515	0.0	17	0.051
1.004	3.557	2000.7	1.4	-0.025	0.412	0.515	0.0	3	0.244
1.005	0.818	14.5	2.3	0.550	0.593	0.837	0.0	40	0.597
1.006	0.818	14.5	2.3	0.593	0.636	0.837	0.0	40	0.597
2.000	4.042	2748.7	0.1	0.000	-0.013	0.037	0.0	1	0.102
2.001	0.867	34.5	0.1	0.162	0.115	0.037	0.0	9	0.188

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Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.002	H9	Swale 5	107.383	0.600	2.660	2.649	0.011	10000.0	1500	12.07	1.0
2.003	Swale 5	Swale 6	9.903	0.600	2.649	2.648	0.001	10000.0	1500	12.70	1.0
2.004	Swale 6	H12	28.334	0.600	2.648	2.176	0.472	60.0	1500	12.83	1.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.002	0.265	149.2	0.9	0.090	0.001	0.322	0.0	13	0.042
2.003	0.265	149.2	0.9	0.001	-0.098	0.322	0.0	13	0.042
2.004	3.557	2000.7	0.9	-0.098	0.374	0.322	0.0	2	0.188

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	75.167	10000.0	1500	Swale Wet	2.900	2.650	0.000	2.900	2.642	0.008
1.001	12.750	225.0	225	Circular	2.900	2.642	0.033	2.900	2.585	0.090
1.002	94.303	10000.0	1500	Swale Wet	2.900	2.585	0.065	2.900	2.576	0.074
1.003	10.142	10000.0	1500	Swale Wet	2.900	2.576	0.074	2.800	2.575	-0.025
1.004	26.228	60.0	1500	Swale Wet	2.800	2.575	-0.025	2.800	2.138	0.412
1.005	6.401	150.0	150	Circular	2.800	2.100	0.550	2.800	2.057	0.593
1.006	6.400	150.0	150	Circular	2.800	2.057	0.593	2.800	2.014	0.636
2.000	23.198	60.0	500	Swale Con	3.500	3.100	0.000	3.100	2.713	-0.013
2.001	12.030	225.0	225	Circular	3.100	2.713	0.162	3.000	2.660	0.115
2.002	107.383	10000.0	1500	Swale Wet	3.000	2.660	0.090	2.900	2.649	0.001
2.003	9.903	10000.0	1500	Swale Wet	2.900	2.649	0.001	2.800	2.648	-0.098
2.004	28.334	60.0	1500	Swale Wet	2.800	2.648	-0.098	2.800	2.176	0.374

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Swale 1		Junction		H5		Junction	
1.001	H5		Junction		H6		Junction	
1.002	H6		Junction		Swale 2		Junction	
1.003	Swale 2		Junction		Swale 3		Junction	
1.004	Swale 3		Junction		H12		Junction	
1.005	H12		Junction		Hydrobrake	1500	Manhole	Adoptable
1.006	Hydrobrake	1500	Manhole	Adoptable	H13	1200	Manhole	Adoptable
2.000	Swale 4		Junction		H8		Junction	
2.001	H8		Junction		H9		Junction	
2.002	H9		Junction		Swale 5		Junction	
2.003	Swale 5		Junction		Swale 6		Junction	
2.004	Swale 6		Junction		H12		Junction	

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
Swale 1	2.900	0.250			0	1.000	2.650	1500

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Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
H5	2.900	0.258		1	1.000	2.642	1500
				0	1.001	2.642	225
H6	2.900	0.315		1	1.001	2.585	225
				0	1.002	2.585	1500
Swale 2	2.900	0.324		1	1.002	2.576	1500
				0	1.003	2.576	1500
Swale 3	2.800	0.225		1	1.003	2.575	1500
				0	1.004	2.575	1500
Swale 4	3.500	0.400					
				0	2.000	3.100	500
H8	3.100	0.387		1	2.000	2.713	500
				0	2.001	2.713	225
H9	3.000	0.340		1	2.001	2.660	225
				0	2.002	2.660	1500
Swale 5	2.900	0.251		1	2.002	2.649	1500
				0	2.003	2.649	1500
Swale 6	2.800	0.152		1	2.003	2.648	1500
				0	2.004	2.648	1500
H12	2.800	0.700		1	2.004	2.176	1500
				2	1.004	2.138	1500
				0	1.005	2.100	150
Hydrobrake	2.800	0.743	1500	1	1.005	2.057	150
				0	1.006	2.057	150
H13	2.800	0.786	1200	1	1.006	2.014	150

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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)	1440
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 %)
1	0	0	0
2	0	0	0
10	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node Hydrobrake Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	2.057	Product Number	CTL-SHE-0055-1100-0600-1100
Design Depth (m)	0.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.1	Min Node Diameter (mm)	1200

Node H12 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	515.0	0.0	0.075	1390.0	0.0	0.700	1790.0	0.0

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Results for 1 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	23	2.743	0.093	28.4	0.0000	0.0000	OK
30 minute winter	H5	23	2.742	0.100	21.1	0.0000	0.0000	OK
15 minute winter	H6	12	2.676	0.091	41.0	0.0000	0.0000	OK
15 minute winter	Swale 2	14	2.622	0.046	36.5	0.0000	0.0000	OK
30 minute winter	Swale 3	22	2.598	0.023	34.4	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.114	0.014	5.2	0.0000	0.0000	OK
15 minute winter	H8	11	2.769	0.056	5.1	0.0000	0.0000	OK
15 minute winter	H9	12	2.755	0.095	44.5	0.0000	0.0000	OK
15 minute winter	Swale 5	14	2.694	0.045	36.1	0.0000	0.0000	OK
15 minute winter	Swale 6	14	2.671	0.023	33.5	0.0000	0.0000	OK
1440 minute winter	H12	1380	2.229	0.129	6.5	147.8020	0.0000	OK
1440 minute winter	Hydrobrake	1380	2.229	0.172	2.8	0.3040	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	21.1	0.194	0.142	12.9761	
30 minute winter	H5	1.001	H6	14.6	0.965	0.422	0.1994	
15 minute winter	H6	1.002	Swale 2	36.5	0.315	0.245	11.0927	
15 minute winter	Swale 2	1.003	Swale 3	34.7	0.620	0.233	0.5720	
30 minute winter	Swale 3	1.004	H12	34.2	0.929	0.017	0.9669	
15 minute winter	Swale 4	2.000	H8	5.1	0.288	0.002	0.5262	
15 minute winter	H8	2.001	H9	4.8	0.427	0.139	0.1411	
15 minute winter	H9	2.002	Swale 5	36.1	0.314	0.242	12.6645	
15 minute winter	Swale 5	2.003	Swale 6	33.5	0.612	0.224	0.5455	
15 minute winter	Swale 6	2.004	H12	33.2	0.917	0.017	1.0243	
1440 minute winter	H12	1.005	Hydrobrake	2.8	0.314	0.197	0.1080	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				165.2

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Results for 2 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.761	0.111	36.5	0.0000	0.0000	OK
30 minute winter	H5	23	2.760	0.118	27.0	0.0000	0.0000	OK
15 minute winter	H6	12	2.692	0.107	55.3	0.0000	0.0000	OK
15 minute winter	Swale 2	14	2.630	0.054	50.0	0.0000	0.0000	OK
15 minute winter	Swale 3	14	2.604	0.029	48.4	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.117	0.017	6.7	0.0000	0.0000	OK
15 minute winter	H8	11	2.777	0.064	6.6	0.0000	0.0000	OK
15 minute winter	H9	12	2.769	0.109	57.6	0.0000	0.0000	OK
15 minute winter	Swale 5	13	2.702	0.053	49.4	0.0000	0.0000	OK
15 minute winter	Swale 6	14	2.676	0.028	45.8	0.0000	0.0000	OK
1440 minute winter	H12	1410	2.255	0.155	7.6	184.1792	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1410	2.254	0.197	2.7	0.3487	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	27.0	0.197	0.181	15.8534	
30 minute winter	H5	1.001	H6	19.8	1.065	0.574	0.2445	
15 minute winter	H6	1.002	Swale 2	50.0	0.361	0.335	13.2781	
15 minute winter	Swale 2	1.003	Swale 3	48.4	0.717	0.324	0.6886	
15 minute winter	Swale 3	1.004	H12	48.4	1.058	0.024	1.1991	
15 minute winter	Swale 4	2.000	H8	6.6	0.304	0.002	0.6228	
15 minute winter	H8	2.001	H9	6.3	0.453	0.181	0.1698	
15 minute winter	H9	2.002	Swale 5	49.4	0.359	0.331	15.0974	
15 minute winter	Swale 5	2.003	Swale 6	45.8	0.705	0.307	0.6481	
15 minute winter	Swale 6	2.004	H12	46.0	1.039	0.023	1.2551	
1440 minute winter	H12	1.005	Hydrobrake	2.7	0.333	0.190	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				168.2

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Results for 10 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.796	0.146	54.5	0.0000	0.0000	OK
30 minute winter	H5	22	2.796	0.154	40.6	0.0000	0.0000	OK
15 minute winter	H6	12	2.720	0.135	85.5	0.0000	0.0000	OK
15 minute winter	Swale 2	13	2.645	0.069	80.5	0.0000	0.0000	OK
15 minute winter	Swale 3	13	2.613	0.038	79.3	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.121	0.021	10.1	0.0000	0.0000	OK
15 minute winter	H8	12	2.797	0.084	10.0	0.0000	0.0000	OK
15 minute winter	H9	11	2.795	0.135	86.2	0.0000	0.0000	OK
15 minute winter	Swale 5	13	2.715	0.066	77.7	0.0000	0.0000	OK
15 minute winter	Swale 6	13	2.685	0.037	74.6	0.0000	0.0000	OK
1440 minute winter	H12	1440	2.321	0.221	10.8	281.0041	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1440	2.321	0.264	1.8	0.4657	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	40.6	0.200	0.272	21.9339	
30 minute winter	H5	1.001	H6	33.1	1.297	0.958	0.3302	
15 minute winter	H6	1.002	Swale 2	80.5	0.444	0.540	17.4345	
15 minute winter	Swale 2	1.003	Swale 3	79.3	0.890	0.531	0.9105	
15 minute winter	Swale 3	1.004	H12	78.5	1.267	0.039	1.6279	
15 minute winter	Swale 4	2.000	H8	10.0	0.335	0.004	0.8652	
15 minute winter	H8	2.001	H9	8.9	0.490	0.259	0.2302	
15 minute winter	H9	2.002	Swale 5	77.7	0.432	0.521	19.6915	
15 minute winter	Swale 5	2.003	Swale 6	74.6	0.870	0.500	0.8555	
15 minute winter	Swale 6	2.004	H12	74.6	1.242	0.037	1.7010	
1440 minute winter	H12	1.005	Hydrobrake	1.8	0.269	0.125	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				171.0

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Results for 30 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.823	0.173	69.5	0.0000	0.0000	OK
30 minute winter	H5	22	2.823	0.181	51.0	0.0000	0.0000	OK
15 minute winter	H6	12	2.738	0.153	109.8	0.0000	0.0000	OK
15 minute winter	Swale 2	13	2.655	0.079	106.2	0.0000	0.0000	OK
15 minute winter	Swale 3	13	2.621	0.046	104.8	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.124	0.024	12.8	0.0000	0.0000	OK
15 minute winter	H8	11	2.817	0.104	12.7	0.0000	0.0000	OK
15 minute winter	H9	11	2.813	0.153	108.2	0.0000	0.0000	OK
15 minute winter	Swale 5	12	2.724	0.075	99.6	0.0000	0.0000	OK
15 minute winter	Swale 6	13	2.691	0.043	96.2	0.0000	0.0000	OK
1440 minute winter	H12	1440	2.376	0.276	13.3	363.0925	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1440	2.375	0.318	2.6	0.5624	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	51.0	0.207	0.342	27.0863	
30 minute winter	H5	1.001	H6	42.8	1.478	1.242	0.3891	
15 minute winter	H6	1.002	Swale 2	106.2	0.500	0.712	20.4228	
15 minute winter	Swale 2	1.003	Swale 3	104.8	1.003	0.703	1.0689	
15 minute winter	Swale 3	1.004	H12	104.7	1.406	0.052	1.9537	
15 minute winter	Swale 4	2.000	H8	12.7	0.342	0.005	1.1391	
15 minute winter	H8	2.001	H9	12.0	0.521	0.349	0.2804	
15 minute winter	H9	2.002	Swale 5	99.6	0.479	0.668	22.8154	
15 minute winter	Swale 5	2.003	Swale 6	96.2	0.970	0.645	0.9898	
15 minute winter	Swale 6	2.004	H12	97.1	1.369	0.049	2.0096	
1440 minute winter	H12	1.005	Hydrobrake	2.6	0.290	0.178	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				169.4

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Results for 100 year Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.864	0.214	91.2	0.0000	0.0000	OK
30 minute winter	H5	22	2.864	0.222	66.6	0.0000	0.0000	OK
15 minute winter	H6	11	2.757	0.172	144.1	0.0000	0.0000	OK
15 minute winter	Swale 2	15	2.691	0.115	142.4	0.0000	0.0000	OK
15 minute winter	Swale 3	12	2.629	0.054	144.4	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.128	0.028	16.6	0.0000	0.0000	OK
15 minute winter	H8	11	2.842	0.129	16.4	0.0000	0.0000	OK
15 minute winter	H9	11	2.834	0.174	139.5	0.0000	0.0000	OK
15 minute winter	Swale 5	12	2.736	0.087	133.2	0.0000	0.0000	OK
15 minute winter	Swale 6	12	2.700	0.052	131.4	0.0000	0.0000	OK
1440 minute winter	H12	1470	2.452	0.352	16.9	480.4705	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1470	2.451	0.394	2.2	0.6970	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	66.6	0.225	0.447	35.3050	
30 minute winter	H5	1.001	H6	53.3	1.625	1.546	0.4456	
15 minute winter	H6	1.002	Swale 2	142.4	0.575	0.954	24.7297	
15 minute winter	Swale 2	1.003	Swale 3	144.4	1.128	0.968	1.5134	
15 minute winter	Swale 3	1.004	H12	137.0	1.555	0.068	2.4392	
15 minute winter	Swale 4	2.000	H8	16.4	0.375	0.006	1.5152	
15 minute winter	H8	2.001	H9	15.8	0.574	0.457	0.3396	
15 minute winter	H9	2.002	Swale 5	133.2	0.548	0.893	26.6852	
15 minute winter	Swale 5	2.003	Swale 6	131.4	1.106	0.881	1.1868	
15 minute winter	Swale 6	2.004	H12	130.0	1.523	0.065	2.4230	
1440 minute winter	H12	1.005	Hydrobrake	2.2	0.307	0.151	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				158.6

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Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.37%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	19	2.900	0.250	127.5	0.0000	5.8733	FLOOD
30 minute winter	H5	19	2.900	0.258	89.2	0.0000	5.7971	FLOOD
15 minute winter	H6	11	2.781	0.196	197.5	0.0000	0.0000	OK
15 minute winter	Swale 2	13	2.726	0.150	201.5	0.0000	0.0000	OK
60 minute summer	Swale 3	35	2.638	0.063	179.1	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.135	0.035	23.3	0.0000	0.0000	OK
15 minute winter	H8	11	2.876	0.163	23.1	0.0000	0.0000	OK
15 minute winter	H9	11	2.860	0.200	198.4	0.0000	0.0000	OK
15 minute winter	Swale 5	13	2.795	0.146	199.2	0.0000	0.0000	OK
15 minute summer	Swale 6	13	2.707	0.059	220.8	0.0000	0.0000	OK
1440 minute winter	H12	1470	2.588	0.488	23.7	700.1133	0.0000	FLOOD RISK
1440 minute winter	Hydrobrake	1470	2.588	0.531	2.1	0.9378	0.0000	FLOOD RISK
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	89.2	0.254	0.598	43.1955	
30 minute winter	H5	1.001	H6	55.1	1.691	1.597	0.4749	
15 minute winter	H6	1.002	Swale 2	201.5	0.631	1.350	32.0351	
15 minute winter	Swale 2	1.003	Swale 3	233.2	1.300	1.563	1.9793	
60 minute summer	Swale 3	1.004	H12	153.1	1.540	0.077	6.2013	
15 minute winter	Swale 4	2.000	H8	23.1	0.433	0.008	2.1023	
15 minute winter	H8	2.001	H9	22.6	0.684	0.655	0.4099	
15 minute winter	H9	2.002	Swale 5	199.2	0.615	1.335	36.1837	
15 minute winter	Swale 5	2.003	Swale 6	221.6	1.280	1.486	1.8803	
15 minute summer	Swale 6	2.004	H12	161.0	1.628	0.080	2.8022	
1440 minute winter	H12	1.005	Hydrobrake	2.1	0.282	0.146	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				167.8

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Appendix D – Proposed Drainage Plan

Conveyance Swale
H8
CL: 3.100
(2.713)
2000
7300
H9
CL: 2.910
(2.660)
3.1m AOD
3.4m AOD
2.713m AOD
3.013m AOD
Path
Tarmac
Tarmac
Ditch
GP
3.0m
Waiting
Parking
Disabled
Path
Gate
Security
Hut
Bikes
H10
CL: 2.900
(2.650)
EV
EV
EV
EV
Potential EV
Disabled
2.4mx120m Visibility Splay
Paving
R
R
R
R
Staff Store
Office
Store
Staff Toilets
Mixed
Hardcore
FFL
3.550
(2.400)
Paving
RE: 3.070
PS6
CL: 3.400
(2.750)
PF4
CL: 3.400
(2.800)
PS1
CL: 3.400
(2.730)
PF5
CL: 3.400
(2.675)
Paving
Fat Training Room
Reception
Email
Kitchen
Staff Toilets
PF2
CL: 3.250
(2.330)
RE: 2.885
Motor Bikes
Motor Bikes
Motor Bikes
PF1
CL: 3.250
(2.650)
Storage Yard
Gravel
Tarmac
Paving
PS7
CL: 3.400
(2.670)
H11
CL: 2.900
(2.370)
RE: 2.890
D Shower
Kitchen
Dining
Staff Welfare
Plant Room
PF3
CL: 3.250
(2.080)
H1
CL: 2.900
(2.650)
Steam
Generators
Storage
Arable
PS2
CL: 3.250
(2.785)
RE: 2.925
Sample
chamber
CL: 3.000
IL in: 1.585
IL out: 1.385
PF6
CL: 3.000
(1.865)
Kingspan BioFicient Commercial
Sewage Treatment Plant
(provisional unit 67H), or similar
- to be approved by the EA.
Foul position locations
for the factory are
unknown, drain point
shown indicatively.
Drum dryer
RE: 2.890
RE: 2.925
FFL
3.400
(3.100)
PS3
CL: 3.250
(2.785)
RE: 2.945
H2
CL: 2.900
(2.650)
H3
CL: 2.900
(2.650)
Wild flower meadow
Tarmac
AP
PS4
CL: 3.250
(2.785)
PS5
CL: 3.400
(2.725)
H4
CL: 2.900
(2.650)
H5
CL: 2.900
(2.650)
H6
CL: 2.900
(2.585)
H7
CL: 2.835
(2.585)
Tarmac
Tarmac
Wild flower meadow
Attenuation Pond
Ditch
Ditch
ANGLE GATE
RAIL
E 526446.035
N 322736.184
El 3.091
E 526311.732
N 322719.732
El 3.228
The wet swale is to have the general dimensions. The edge of the access way is to have a 1m filter strip.
Top of Bank: 2.900
Water Level: 2.650
Bed Level: 2.500
Swale downstream to be 150mm higher than base of the wet swale to ensure water stays trapped.
Swale to discharge into the dry part of the attenuation pond, and dispersed. It is recommended that a gravel bed is installed with randomly placed boulders.
It is recommended that the outfall is protected from blockage through the inclusion of a gravel filter or similar.
Headwall into existing ditch to be installed with a flap valve to stop any surcharged water flowing into the pond.
H12
CL: 2.800
(2.100)
H13
CL: 2.800
(2.014)
Hydrobrake
CL: 2.800
(2.057)
Hydrobrake flow control, restricted to 1.1 l/s, reference - CTL-SHE-0055-1100-0600-1100
The attenuation pond is to have the following dimensions.
Permanent water level: 2.100
End of bench: 2.175
Top of bank: 2.800
At detailed design, the dry bench could be used for full/partial infiltration.
End of the wet swale. An impermeable check dam is to be installed at 150mm depth to retain the water within the wet swale. Swale flowing east is to act as a conveyance swale discharging into the pond.
The wet swale is to have the general dimensions. The edge of the access way is to have a 1m filter strip.
Top of Bank: 2.900
Water Level: 2.650
Bed Level: 2.500
At detailed design, this area of the site could be profiled to all flood water/ infiltration
The wet swale is to have the general dimensions. The edge of the access way is to have a 1m filter strip.
Top of Bank: 2.835

R — Private Surface Rainwater Pipe Loca
AP — ACO Qmax channel, with access poir
Conveyance swale
Swale - wet bed
xxxØ @ 1:xxx — Private Foul Water Sewer
F — Private Foul Below Ground Drainage (Architect to specify type, SVP, SS,
P.F1.1
CL: XX.XXX
(x.xxx)
Private Foul Water PPIC
Cover Level
(invert)
Private Foul or Surface Water Pump (colour denotes water type)
Denotes proposed exceedence flow
Denotes proposed exceedence flow
FFL
22.200
(21.900)
Finished Floor Level
Level Proposed
Approximate Ground Level

Appendix E – Surcharged Outfall Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	1.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Inverts
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
Swale 1	0.262	5.00	2.900		0.250
H5			2.900		0.258
H6	0.253	5.00	2.900		0.315
Swale 2			2.900		0.324
Swale 3			2.800		0.225
Swale 4	0.037	5.00	3.500		0.400
H8			3.100		0.387
H9	0.285	5.00	3.000		0.340
Swale 5			2.900		0.251
Swale 6			2.800		0.152
H12			2.800		0.700
Hydrobrake			2.800	1500	0.743
H13			2.800	1200	0.786

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	Swale 1	H5	75.167	0.600	2.650	2.642	0.008	10000.0	1500	9.72	1.0
1.001	H5	H6	12.750	0.600	2.642	2.585	0.057	225.0	225	9.97	1.0
1.002	H6	Swale 2	94.303	0.600	2.585	2.576	0.009	10000.0	1500	15.89	1.0
1.003	Swale 2	Swale 3	10.142	0.600	2.576	2.575	0.001	10000.0	1500	16.53	1.0
1.004	Swale 3	H12	26.228	0.600	2.575	2.138	0.437	60.0	1500	16.65	1.0
1.005	H12	Hydrobrake	6.401	0.600	2.100	2.057	0.043	150.0	150	16.78	1.0
1.006	Hydrobrake	H13	6.400	0.600	2.057	2.014	0.043	150.0	150	16.92	1.0
2.000	Swale 4	H8	23.198	0.600	3.100	2.713	0.387	60.0	500	5.10	1.0
2.001	H8	H9	12.030	0.600	2.713	2.660	0.053	225.0	225	5.33	1.0

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	0.265	149.2	0.7	0.000	0.008	0.262	0.0	12	0.040
1.001	0.867	34.5	0.7	0.033	0.090	0.262	0.0	22	0.347
1.002	0.265	149.2	1.4	0.065	0.074	0.515	0.0	17	0.051
1.003	0.265	149.2	1.4	0.074	-0.025	0.515	0.0	17	0.051
1.004	3.557	2000.7	1.4	-0.025	0.412	0.515	0.0	3	0.244
1.005	0.818	14.5	2.3	0.550	0.593	0.837	0.0	40	0.597
1.006	0.818	14.5	2.3	0.593	0.636	0.837	0.0	40	0.597
2.000	4.042	2748.7	0.1	0.000	-0.013	0.037	0.0	1	0.102
2.001	0.867	34.5	0.1	0.162	0.115	0.037	0.0	9	0.188

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Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.002	H9	Swale 5	107.383	0.600	2.660	2.649	0.011	10000.0	1500	12.07	1.0
2.003	Swale 5	Swale 6	9.903	0.600	2.649	2.648	0.001	10000.0	1500	12.70	1.0
2.004	Swale 6	H12	28.334	0.600	2.648	2.176	0.472	60.0	1500	12.83	1.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.002	0.265	149.2	0.9	0.090	0.001	0.322	0.0	13	0.042
2.003	0.265	149.2	0.9	0.001	-0.098	0.322	0.0	13	0.042
2.004	3.557	2000.7	0.9	-0.098	0.374	0.322	0.0	2	0.188

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	75.167	10000.0	1500	Swale Wet	2.900	2.650	0.000	2.900	2.642	0.008
1.001	12.750	225.0	225	Circular	2.900	2.642	0.033	2.900	2.585	0.090
1.002	94.303	10000.0	1500	Swale Wet	2.900	2.585	0.065	2.900	2.576	0.074
1.003	10.142	10000.0	1500	Swale Wet	2.900	2.576	0.074	2.800	2.575	-0.025
1.004	26.228	60.0	1500	Swale Wet	2.800	2.575	-0.025	2.800	2.138	0.412
1.005	6.401	150.0	150	Circular	2.800	2.100	0.550	2.800	2.057	0.593
1.006	6.400	150.0	150	Circular	2.800	2.057	0.593	2.800	2.014	0.636
2.000	23.198	60.0	500	Swale Con	3.500	3.100	0.000	3.100	2.713	-0.013
2.001	12.030	225.0	225	Circular	3.100	2.713	0.162	3.000	2.660	0.115
2.002	107.383	10000.0	1500	Swale Wet	3.000	2.660	0.090	2.900	2.649	0.001
2.003	9.903	10000.0	1500	Swale Wet	2.900	2.649	0.001	2.800	2.648	-0.098
2.004	28.334	60.0	1500	Swale Wet	2.800	2.648	-0.098	2.800	2.176	0.374

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Swale 1		Junction		H5		Junction	
1.001	H5		Junction		H6		Junction	
1.002	H6		Junction		Swale 2		Junction	
1.003	Swale 2		Junction		Swale 3		Junction	
1.004	Swale 3		Junction		H12		Junction	
1.005	H12		Junction		Hydrobrake	1500	Manhole	Adoptable
1.006	Hydrobrake	1500	Manhole	Adoptable	H13	1200	Manhole	Adoptable
2.000	Swale 4		Junction		H8		Junction	
2.001	H8		Junction		H9		Junction	
2.002	H9		Junction		Swale 5		Junction	
2.003	Swale 5		Junction		Swale 6		Junction	
2.004	Swale 6		Junction		H12		Junction	

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
Swale 1	2.900	0.250			0	1.000	2.650	1500

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Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
H5	2.900	0.258		1	1.000	2.642	1500
				0	1.001	2.642	225
H6	2.900	0.315		1	1.001	2.585	225
				0	1.002	2.585	1500
Swale 2	2.900	0.324		1	1.002	2.576	1500
				0	1.003	2.576	1500
Swale 3	2.800	0.225		1	1.003	2.575	1500
				0	1.004	2.575	1500
Swale 4	3.500	0.400					
				0	2.000	3.100	500
H8	3.100	0.387		1	2.000	2.713	500
				0	2.001	2.713	225
H9	3.000	0.340		1	2.001	2.660	225
				0	2.002	2.660	1500
Swale 5	2.900	0.251		1	2.002	2.649	1500
				0	2.003	2.649	1500
Swale 6	2.800	0.152		1	2.003	2.648	1500
				0	2.004	2.648	1500
H12	2.800	0.700		1	2.004	2.176	1500
				2	1.004	2.138	1500
				0	1.005	2.100	150
Hydrobrake	2.800	0.743	1500	1	1.005	2.057	150
				0	1.006	2.057	150
H13	2.800	0.786	1200	1	1.006	2.014	150

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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)	1440
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 %)
1	0	0	0
2	0	0	0
10	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node Hydrobrake Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	2.057	Product Number	CTL-SHE-0055-1100-0600-1100
Design Depth (m)	0.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.1	Min Node Diameter (mm)	1200

Node H12 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	2.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	515.0	0.0	0.075	1390.0	0.0	0.700	1790.0	0.0

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Results for 1 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	23	2.743	0.093	28.4	0.0000	0.0000	OK
30 minute winter	H5	23	2.742	0.100	21.1	0.0000	0.0000	OK
15 minute winter	H6	12	2.676	0.091	41.0	0.0000	0.0000	OK
15 minute winter	Swale 2	14	2.622	0.046	36.5	0.0000	0.0000	OK
30 minute winter	Swale 3	22	2.598	0.023	34.4	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.114	0.014	5.2	0.0000	0.0000	OK
15 minute winter	H8	11	2.769	0.056	5.1	0.0000	0.0000	OK
15 minute winter	H9	12	2.755	0.095	44.5	0.0000	0.0000	OK
15 minute winter	Swale 5	14	2.694	0.045	36.1	0.0000	0.0000	OK
15 minute winter	Swale 6	14	2.671	0.023	33.5	0.0000	0.0000	OK
1440 minute winter	H12	1380	2.229	0.129	6.5	147.8020	0.0000	OK
1440 minute winter	Hydrobrake	1380	2.229	0.172	2.8	0.3040	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	21.1	0.194	0.142	12.9761	
30 minute winter	H5	1.001	H6	14.6	0.965	0.422	0.1994	
15 minute winter	H6	1.002	Swale 2	36.5	0.315	0.245	11.0927	
15 minute winter	Swale 2	1.003	Swale 3	34.7	0.620	0.233	0.5720	
30 minute winter	Swale 3	1.004	H12	34.2	0.929	0.017	0.9669	
15 minute winter	Swale 4	2.000	H8	5.1	0.288	0.002	0.5262	
15 minute winter	H8	2.001	H9	4.8	0.427	0.139	0.1411	
15 minute winter	H9	2.002	Swale 5	36.1	0.314	0.242	12.6645	
15 minute winter	Swale 5	2.003	Swale 6	33.5	0.612	0.224	0.5455	
15 minute winter	Swale 6	2.004	H12	33.2	0.917	0.017	1.0243	
1440 minute winter	H12	1.005	Hydrobrake	2.8	0.314	0.197	0.1080	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				165.2

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Results for 2 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.761	0.111	36.5	0.0000	0.0000	OK
30 minute winter	H5	23	2.760	0.118	27.0	0.0000	0.0000	OK
15 minute winter	H6	12	2.692	0.107	55.3	0.0000	0.0000	OK
15 minute winter	Swale 2	14	2.630	0.054	50.0	0.0000	0.0000	OK
15 minute winter	Swale 3	14	2.604	0.029	48.4	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.117	0.017	6.7	0.0000	0.0000	OK
15 minute winter	H8	11	2.777	0.064	6.6	0.0000	0.0000	OK
15 minute winter	H9	12	2.769	0.109	57.6	0.0000	0.0000	OK
15 minute winter	Swale 5	13	2.702	0.053	49.4	0.0000	0.0000	OK
15 minute winter	Swale 6	14	2.676	0.028	45.8	0.0000	0.0000	OK
1440 minute winter	H12	1410	2.255	0.155	7.6	184.1792	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1410	2.254	0.197	2.7	0.3487	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	27.0	0.197	0.181	15.8534	
30 minute winter	H5	1.001	H6	19.8	1.065	0.574	0.2445	
15 minute winter	H6	1.002	Swale 2	50.0	0.361	0.335	13.2781	
15 minute winter	Swale 2	1.003	Swale 3	48.4	0.717	0.324	0.6886	
15 minute winter	Swale 3	1.004	H12	48.4	1.058	0.024	1.1991	
15 minute winter	Swale 4	2.000	H8	6.6	0.304	0.002	0.6228	
15 minute winter	H8	2.001	H9	6.3	0.453	0.181	0.1698	
15 minute winter	H9	2.002	Swale 5	49.4	0.359	0.331	15.0974	
15 minute winter	Swale 5	2.003	Swale 6	45.8	0.705	0.307	0.6481	
15 minute winter	Swale 6	2.004	H12	46.0	1.039	0.023	1.2551	
1440 minute winter	H12	1.005	Hydrobrake	2.7	0.333	0.190	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				168.2

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Results for 10 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.796	0.146	54.5	0.0000	0.0000	OK
30 minute winter	H5	22	2.796	0.154	40.6	0.0000	0.0000	OK
15 minute winter	H6	12	2.720	0.135	85.5	0.0000	0.0000	OK
15 minute winter	Swale 2	13	2.645	0.069	80.5	0.0000	0.0000	OK
15 minute winter	Swale 3	13	2.613	0.038	79.3	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.121	0.021	10.1	0.0000	0.0000	OK
15 minute winter	H8	12	2.797	0.084	10.0	0.0000	0.0000	OK
15 minute winter	H9	11	2.795	0.135	86.2	0.0000	0.0000	OK
15 minute winter	Swale 5	13	2.715	0.066	77.7	0.0000	0.0000	OK
15 minute winter	Swale 6	13	2.685	0.037	74.6	0.0000	0.0000	OK
1440 minute winter	H12	1440	2.321	0.221	10.8	281.0041	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1440	2.321	0.264	1.8	0.4657	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	40.6	0.200	0.272	21.9339	
30 minute winter	H5	1.001	H6	33.1	1.297	0.958	0.3302	
15 minute winter	H6	1.002	Swale 2	80.5	0.444	0.540	17.4345	
15 minute winter	Swale 2	1.003	Swale 3	79.3	0.890	0.531	0.9105	
15 minute winter	Swale 3	1.004	H12	78.5	1.267	0.039	1.6279	
15 minute winter	Swale 4	2.000	H8	10.0	0.335	0.004	0.8652	
15 minute winter	H8	2.001	H9	8.9	0.490	0.259	0.2302	
15 minute winter	H9	2.002	Swale 5	77.7	0.432	0.521	19.6915	
15 minute winter	Swale 5	2.003	Swale 6	74.6	0.870	0.500	0.8555	
15 minute winter	Swale 6	2.004	H12	74.6	1.242	0.037	1.7010	
1440 minute winter	H12	1.005	Hydrobrake	1.8	0.269	0.125	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				171.0

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Results for 30 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.823	0.173	69.5	0.0000	0.0000	OK
30 minute winter	H5	22	2.823	0.181	51.0	0.0000	0.0000	OK
15 minute winter	H6	12	2.738	0.153	109.8	0.0000	0.0000	OK
15 minute winter	Swale 2	13	2.655	0.079	106.2	0.0000	0.0000	OK
15 minute winter	Swale 3	13	2.621	0.046	104.8	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.124	0.024	12.8	0.0000	0.0000	OK
15 minute winter	H8	11	2.817	0.104	12.7	0.0000	0.0000	OK
15 minute winter	H9	11	2.813	0.153	108.2	0.0000	0.0000	OK
15 minute winter	Swale 5	12	2.724	0.075	99.6	0.0000	0.0000	OK
15 minute winter	Swale 6	13	2.691	0.043	96.2	0.0000	0.0000	OK
1440 minute winter	H12	1440	2.376	0.276	13.3	363.0925	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1440	2.375	0.318	2.6	0.5624	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	51.0	0.207	0.342	27.0863	
30 minute winter	H5	1.001	H6	42.8	1.478	1.242	0.3891	
15 minute winter	H6	1.002	Swale 2	106.2	0.500	0.712	20.4228	
15 minute winter	Swale 2	1.003	Swale 3	104.8	1.003	0.703	1.0689	
15 minute winter	Swale 3	1.004	H12	104.7	1.406	0.052	1.9537	
15 minute winter	Swale 4	2.000	H8	12.7	0.342	0.005	1.1391	
15 minute winter	H8	2.001	H9	12.0	0.521	0.349	0.2804	
15 minute winter	H9	2.002	Swale 5	99.6	0.479	0.668	22.8154	
15 minute winter	Swale 5	2.003	Swale 6	96.2	0.970	0.645	0.9898	
15 minute winter	Swale 6	2.004	H12	97.1	1.369	0.049	2.0096	
1440 minute winter	H12	1.005	Hydrobrake	2.6	0.290	0.178	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				169.4

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	22	2.864	0.214	91.2	0.0000	0.0000	OK
30 minute winter	H5	22	2.864	0.222	66.6	0.0000	0.0000	OK
15 minute winter	H6	11	2.757	0.172	144.1	0.0000	0.0000	OK
15 minute winter	Swale 2	15	2.691	0.115	142.4	0.0000	0.0000	OK
15 minute winter	Swale 3	12	2.629	0.054	144.4	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.128	0.028	16.6	0.0000	0.0000	OK
15 minute winter	H8	11	2.842	0.129	16.4	0.0000	0.0000	OK
15 minute winter	H9	11	2.834	0.174	139.5	0.0000	0.0000	OK
15 minute winter	Swale 5	12	2.736	0.087	133.2	0.0000	0.0000	OK
15 minute winter	Swale 6	12	2.700	0.052	131.4	0.0000	0.0000	OK
1440 minute winter	H12	1470	2.452	0.352	16.9	480.4705	0.0000	SURCHARGED
1440 minute winter	Hydrobrake	1470	2.451	0.394	2.2	0.6970	0.0000	SURCHARGED
15 minute summer	H13	1	2.014	0.000	1.1	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)
30 minute winter	Swale 1	1.000	H5	66.6	0.225	0.447	35.3050	
30 minute winter	H5	1.001	H6	53.3	1.625	1.546	0.4456	
15 minute winter	H6	1.002	Swale 2	142.4	0.575	0.954	24.7297	
15 minute winter	Swale 2	1.003	Swale 3	144.4	1.128	0.968	1.5134	
15 minute winter	Swale 3	1.004	H12	137.0	1.555	0.068	2.4392	
15 minute winter	Swale 4	2.000	H8	16.4	0.375	0.006	1.5152	
15 minute winter	H8	2.001	H9	15.8	0.574	0.457	0.3396	
15 minute winter	H9	2.002	Swale 5	133.2	0.548	0.893	26.6852	
15 minute winter	Swale 5	2.003	Swale 6	131.4	1.106	0.881	1.1868	
15 minute winter	Swale 6	2.004	H12	130.0	1.523	0.065	2.4230	
1440 minute winter	H12	1.005	Hydrobrake	2.2	0.307	0.151	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.1				158.6

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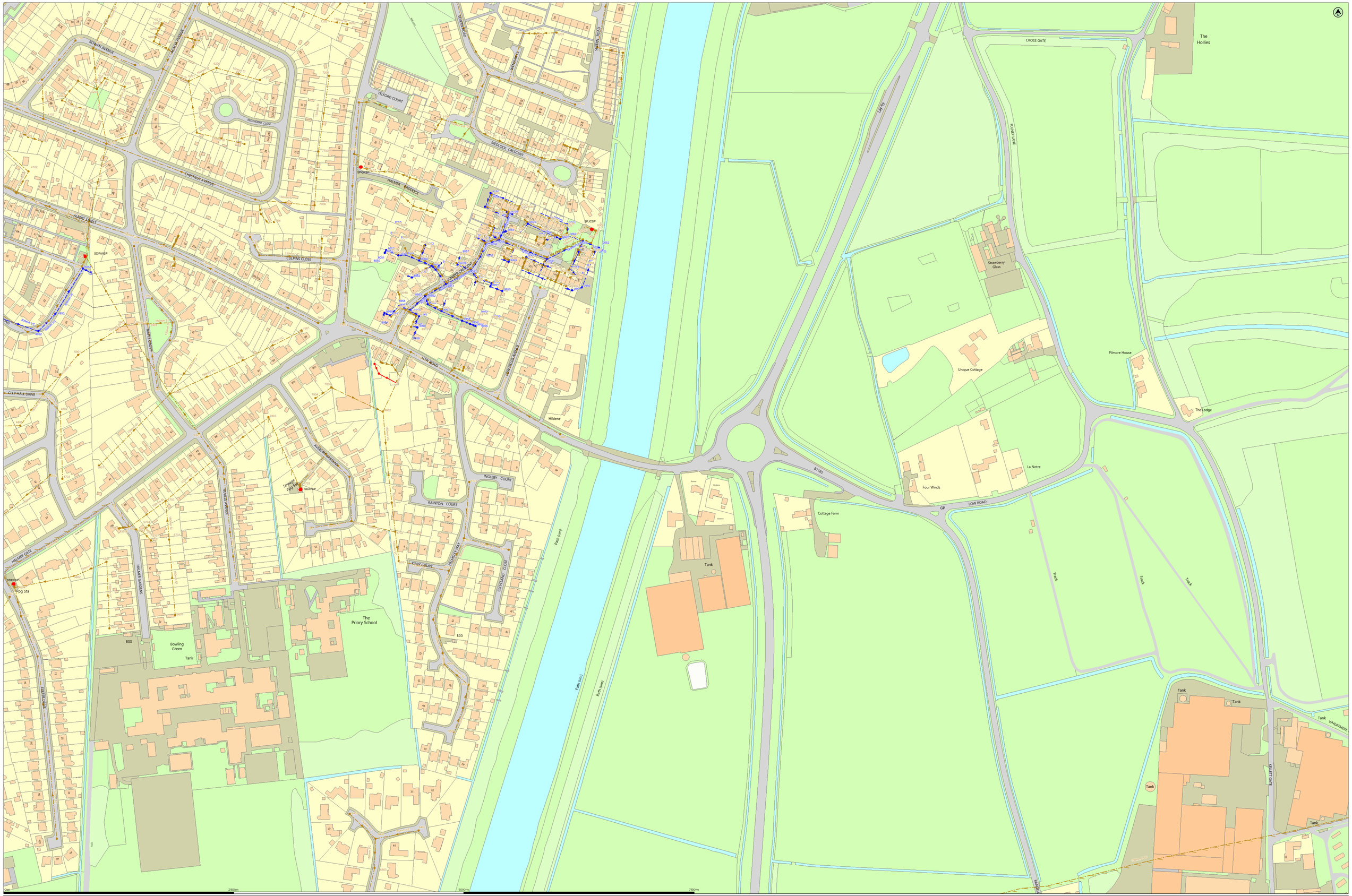
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Swale 1	19	2.900	0.250	127.5	0.0000	5.8723	FLOOD
30 minute winter	H5	19	2.900	0.258	89.2	0.0000	5.7941	FLOOD
15 minute winter	H6	11	2.781	0.196	197.5	0.0000	0.0000	OK
15 minute winter	Swale 2	13	2.726	0.150	201.5	0.0000	0.0000	OK
60 minute summer	Swale 3	35	2.639	0.064	182.0	0.0000	0.0000	OK
15 minute winter	Swale 4	10	3.135	0.035	23.3	0.0000	0.0000	OK
15 minute winter	H8	11	2.876	0.163	23.1	0.0000	0.0000	OK
15 minute winter	H9	11	2.860	0.200	198.4	0.0000	0.0000	OK
15 minute winter	Swale 5	13	2.795	0.146	199.2	0.0000	0.0000	OK
15 minute summer	Swale 6	13	2.707	0.059	220.8	0.0000	0.0000	OK
1440 minute winter	H12	1470	2.616	0.516	23.7	745.9557	0.0000	FLOOD RISK
1440 minute winter	Hydrobrake	1470	2.615	0.558	1.0	0.9865	0.0000	FLOOD RISK
15 minute summer	H13	1	2.514	0.500	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)
30 minute winter	Swale 1	1.000	H5	89.2	0.254	0.598	43.1955	
30 minute winter	H5	1.001	H6	55.1	1.693	1.598	0.4749	
15 minute winter	H6	1.002	Swale 2	201.5	0.631	1.350	32.0351	
15 minute winter	Swale 2	1.003	Swale 3	233.2	1.300	1.563	1.9793	
60 minute summer	Swale 3	1.004	H12	150.4	1.540	0.075	6.3970	
15 minute winter	Swale 4	2.000	H8	23.1	0.433	0.008	2.1023	
15 minute winter	H8	2.001	H9	22.6	0.684	0.655	0.4099	
15 minute winter	H9	2.002	Swale 5	199.2	0.615	1.335	36.1837	
15 minute winter	Swale 5	2.003	Swale 6	221.6	1.280	1.486	1.8803	
15 minute summer	Swale 6	2.004	H12	161.0	1.628	0.080	2.8022	
1440 minute winter	H12	1.005	Hydrobrake	1.0	0.063	0.072	0.1127	
1440 minute winter	Hydrobrake	Hydro-Brake®	H13	1.0				109.0

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Appendix F – Anglian Water Asset Maps



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Date: 18/08/21

Scale: 1:1250

Map Centre: 526156,322824

Data updated: 31/07/21

Our Ref: 628099 - 1

Wastewater Plan A0

This plan is provided by Anglian Water pursuant 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, lateral drains and any pipes not shown on the plan may exist in the area. Accurate information must be obtained by survey 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 2021 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.

Foul Sewer	Outfall*	Sewage Treatment Works	
Surface Sewer			
Combined Sewer			
Final Effluent	Inlet*	Public Pumping Station	
Rising Main*			
Private Sewer*	Manhole*	Decommissioned Pumping Station	
Decommissioned Sewer*			

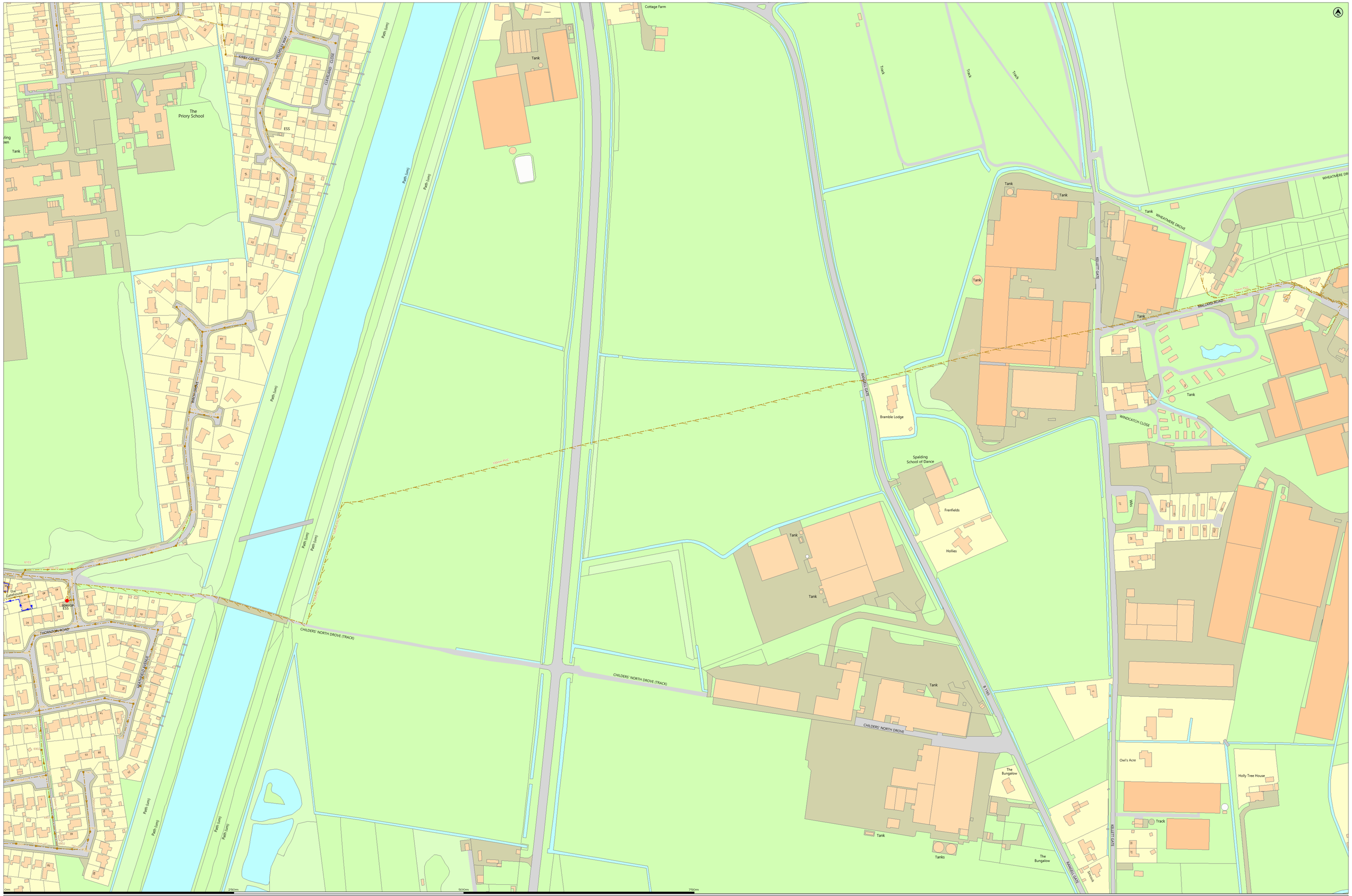
*(Colour denotes effluent type)

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Naylor

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
0001	526015	323032	F	-	-	-
0002	526054	323051	F	-	-	-
0003	526063	323047	F	-	-	-
0004	526069	323060	F	-	-	-
0005	526037	323058	F	-	-	-
0006	526012	323053	F	-	-	-
0007	526066	323038	F	-	-	-
0011	526049	323040	F	-	-	-
0012	526052	323038	F	-	-	-
0015	526003	323050	F	-	-	-
0016	526005	323054	F	-	-	-
0017	526014	323051	F	-	-	-
0018	526027	323011	F	-	-	-
0019	526012	323046	F	-	-	-
0020	526029	323016	F	-	-	-
0021	526025	323005	F	-	-	-
0022	526036	323001	F	-	-	-
0023	526016	323009	F	-	-	-
0024	526010	323023	F	-	-	-
0027	526035	323014	F	-	-	-
0028	526041	323010	F	-	-	-
0029	526044	323013	F	-	-	-
0030	526039	323018	F	-	-	-
0034	526036	323067	F	-	-	-
0040	526030	323054	F	-	-	-
0101	526095	323199	F	-	-	-
0102	526046	323198	F	-	-	-
0103	526051	323129	F	2.76	2.16	0.6
0104	526036	323136	F	2.84	2.1	0.74
0105	526010	323140	F	2.89	1.92	0.97
0106	526006	323125	F	2.85	1.96	0.89
0107	526022	323110	F	2.81	2.12	0.69
0108	526056	323123	F	-	-	-
0109	526056	323118	F	-	-	-
0110	526055	323114	F	-	-	-
0111	526055	323108	F	-	-	-
0112	526055	323101	F	-	-	-
0113	526041	323151	F	-	-	-
0114	526047	323149	F	-	-	-
0115	526035	323153	F	-	-	-
0201	526002	323275	F	-	-	-
0202	526026	323276	F	-	-	-
0203	526070	323260	F	-	-	-
0204	526098	323254	F	-	-	-
049B	525973	323029	F	-	-	-
0801	526030	322839	F	-	-	-
0901	526008	322999	F	-	-	-
4002	525475	323087	F	3.4	0.63	2.77
4101	525439	323102	F	3.45	0.79	2.66
4102	525452	323125	F	3.45	1.07	2.38
4103	525468	323182	F	3.24	1.17	2.07
4104	525467	323158	F	-	-	-
4105	525452	323163	F	-	-	-
4106	525447	323166	F	-	-	-
4205	525467	323225	F	3.255	1.775	1.48
4206	525489	323202	F	-	-	-
4401	525483	322400	F	2.76	1.89	0.87
4402	525474	322495	F	2.65	1.08	1.57
4501	525462	322598	F	2.824	1.234	1.59
4602	525444	322642	F	2.962	0.952	2.01
4603	525432	322663	F	-	-	-
4604	525437	322673	F	-	-	-
4702	525476	322795	F	3.62	2.99	0.63
4703	525489	322791	F	3.653	2.513	1.14
4801	525443	322849	F	-	-	-
4802	525487	322864	F	3.609	2.119	1.49
4803	525468	322883	F	3.609	1.049	2.56
4901	525451	322951	F	3.54	1.29	2.25
4902	525474	322963	F	3.39	0.99	2.4
4903	525493	322996	F	3.26	0.8	2.46
5001	525510	323022	F	3.39	0.28	3.11
5002	525515	323032	F	-	-	-
5004	525567	323044	F	-	-	-
5005	525599	323045	F	3.5	1.28	2.22
5006	525518	323071	F	3.488	0.368	3.12
5100	525543	323188	F	3.274	-	-
5101	525569	323167	F	2.881	0.811	2.07
5102	525537	323155	F	3	0.76	2.24
5103	525509	323194	F	3.342	-	-
5200	525503	323267	F	3.032	1.952	1.08
5201	525506	323223	F	3.223	1.663	1.56
5202	525535	323227	F	3.287	1.777	1.51
5203	525557	323217	F	-	-	-
5204	525526	323215	F	3.271	0.991	2.28
5205	525568	323241	F	2.86	1.69	1.17
5206	525522	323259	F	2.976	1.186	1.79
5207	525588	323266	F	-	-	-
5208	525591	323275	F	-	-	-
5209	525594	323281	F	-	-	-
5210	525596	323285	F	-	-	-
5601	525540	322629	F	-	-	-
5602	525502	322685	F	-	-	-
5701	525537	322701	F	3.33	2.18	1.15
5702	525561	322738	F	3.182	1.632	1.55
5703	525576	322734	F	-	-	-
5704	525583	322740	F	-	-	-
5705	525550	322737	F	-	-	-
5706	525555	322738	F	-	-	-
5707	525585	322724	F	-	-	-
5801	525529	322805	F	3.678	2.926	0.752
5802	525592	322890	F	3.384	1.944	1.44
5901	525506	322926	F	4.159	0.919	3.24
5902	525557	322959	F	3.547	0.497	3.05
5903	525581	322960	F	3.245	1.255	1.99
5904	525586	322987	F	3.334	1.944	1.39
6002	525693	323054	F	3.28	2.57	0.71
6003	525699	323095	F	3.047	1.392	1.655
6006	525611	323030	F	-	-	-
6007	525611	323024	F	-	-	-
6008	525610	323022	F	-	-	-
6100	525635	323167	F	-	-	-
6101	525687	323155	F	3.163	1.863	1.3
6200	525656	323238	F	3.245	1.495	1.75
6201	525626	323223	F	3.109	1.279	1.83
6202	525598	323236	F	3.006	1.126	1.88
6203	525627	323291	F	3.045	1.335	1.71
6204	525602	323259	F	-	-	-
6205	525625	323271	F	-	-	-
6206	525633	323268	F	-	-	-
6207	525633	323265	F	-	-	-
6601	525611	322643	F	-	-	-
6602	525678	322682	F	3.047	2.107	0.94
6701	525605	322725	F	3.23	2.06	1.17
6702	525671	322733	F	3.018	1.858	1.16
6703	525601	322767	F	3.3	1.97	1.33
6704	525665	322791	F	3.082	1.632	1.45
6801	525656	322814	F	3.139	1.579	1.56
6802	525606	322883	F	3.431	0.921	2.51
6803	525637	322840	F	-	-	-
6804	525664	322804	F	3.073	1.723	1.35
6901	525685	322920	F	3.355	1.715	1.64
6902	525605	322941	F	3.382	1.852	1.53
6903	525609	322961	F	3.461	1.601	1.86
7001	525768	323008	F	3.44	2.58	0.86
7002	525798	323028	F	3.35	1.94	1.41
7003	525770	323031	F	-	-	-
7004	525703	323034	F	3.24	2.49	0.75
7005	525771	323052	F	3.34	2.52	0.82
7006	525763	323088	F	3.413	1.603	1.81
7007	525705	323079	F	-	-	-
7008	525719	323070	F	-	-	-
7100	525767	323147	F	3.214	1.764	1.45
7200	525779	323229	F	-	-	-
7201	525704	323224	F	3.234	1.734	1.5
7202	525775	323289	F	3.144	1.944	1.2
7701	525759	322738	F	3.01	1.93	1.08
7703	525747	322785	F	2.92	-0.3	3.22
7801	525775	322818	F	2.9	-0.12	3.02
7802	525754	322846	F	3.02	1.89	1.13
7803	525713	322858	F	3.115	2.065	1.05
7804	525764	322879	F	-	-	0.991
7805	525781	322890	F	-	-	1.48
7901	525749	322952	F	3.587	2.857	0.73
7902	525767	322960	F	3.534	2.184	1.35
7903	525794	322960	F	-	-	-
8001	525802	323073	F	-	-	-
8002	525870	323088	F	-	-	-
8003	525885	323083	F	-	-	-
8009	525864	323036	F	-	-	-
8013	525853	323036	F	-	-	-
8014	525897	323018	F	-	-	-
8015	525891	323024	F	-	-	-
8016	525877	323016	F	-	-	-
8021	525892	323045	F	-	-	-
8024	525876	323031	F	-	-	-
8101	525806	323144	F	-	-	-
8102	525894	323170	F	3.17	1.84	1.33
8103	525841	323195	F	-	-	-
8104	525878	323115	F	-	-	-
8105	525866	323118	F	-	-	-
8106	525851	323124	F	-	-	-
8107	525825	323126	F	-	-	-
8108	525857	323100	F	-	-	-
8201	525811	323200	F	-	-	-
8202	525799	323285	F	-	-	-
8203	525826	323201	F	-	-	-
8303	525828	322368	F	2.5	1.223	1.277
8312	525817	323308	F	-	-	-
8401	525829	322400	F	2.5	1.39	1.11
8402	525876	322409	F	2.432	1.68	0.752
8403	525801	322427	F	2.5	1.612	0.888
8601	525892	322638	F	3.08	1.31	1.77
8701	525855	322702	F	2.78	0.84	1.94
8702	525851	322734	F	2.94	0.63	2.31
8703	525803	322745	F	2.9	0.21	2.69
8704	525801	322793	F	2.81	-	2.81
8801	525843	322795	F	2.998	0.728	2.27
8802	525837	322864	F	2.942	1.002	1.94
8901	525867	322929	F	2.992	1.442	1.55
8902	525862	322975	F	-	-	-
8903	525884	322992	F	-	-	-
8904	525846	322938	F	2.893	1.672	1.221
8911	525873	322968	F	-	-	-
8912	525867	322972	F	-	-	-
8913	525868	322956	F	-	-	-
8916	525888	322982	F	-	-	-
8918	525855	322991	F	-	-	-
8919	525856	322977	F	-	-	-
8920	525846	322967	F	-	-	-
9000	525907	323004	F	-	-	-
9001	525942	323033	F	-	-	-
9002	525948	323048	F	-	-	-
9003	525972	323077	F	-	-	-
9004	525963	323052	F	-	-	-
9005	525933	323020	F	-	-	-
9007	525917	323026	F	-	-	-
9008	525955	323100	F	-	-	-
9009	525986	323087	F	-	-	-
9017	525939	323005	F	-	-	-
9019	525984	323084	F	-	-	-
9020	525967	323084	F	-	-	-
9021	525974	323081	F	-	-	-
9022	525950	323087	F	-	-	-
9023	525941	323010	F	-	-	-
9025	525957	323004	F	-	-	-
9028	525953	323055	F	-	-	-
9029	525955	323059	F	-	-	-
9030	525953	323066	F	-	-	-
9031	525991	323025	F	-	-	-
9032	525993	323030	F	-	-	-
9036	525989	323020	F	-	-	-
9039	525994	323071	F	-	-	-
9045	525969	323032	F	-	-	-
9046	525972	323042	F	-	-	-
9047	525978	323040	F	-	-	-
9048	525943	323051	F	-	-	-
9101	525921	323159	F	3.17	1.64	1.53
9102	525991	323147	F	2.96	1.8	1.16
9103	525964	323158	F	3.04	1.65	1.39
9104	525995	323159	F	3.23	2.03	1.2
9105	525932	323174	F	3.195	1.475	1.72
9106	525901	323182	F	3.12	1.65	1.47
9107	525904	323107	F	-	-	-
9201	525940	323206	F	3.15	1.37	1.78
9202	525974	323224	F	-	-	-
9203	525951	323231	F	-	-	-
9204	525989	323275	F	-	-	-
9205	525925	323281	F	-	-	-
9501	525914	322516	F	2.932	2.082	0.85
9502	525924	322542	F	2.964	1.944	1.02
9503	525930	322567	F	2.994	1.824	1.17
9504	525904	322589	F	2.925	1.665	1.26
9601	525902	322602	F	2.791	1.531	1.26
9602	525909	322691	F	-	-	-
9701	525974	322714	F	2.775	1.515	1.26
9702	525925	322726	F	2.607	1.267	1.34
9703	525931	322788	F	2.754	1.614	1.14
9801	525962	322879	F	3.098	1.958	1.14
9901	525918	322901	F	3.033	1.783	1.25
9902	525983	322932	F	3.037	2.197	0.84
9904	525901	322975	F	-	-	-
9910	525935	322962	F	-	-	-
9914	525922	322967	F	-	-	-
9919	525925	322913	F	-	-	-
9920	525924	322909	F	-	-	-
9921	525915	322911	F	-	-	-
0051	526016	323030	S	-	-	-
0052	526072	323042	S	-	-	-
0053	526054	323049	S	-	-	-
0054	526067	323038	S	-	-	-
0055	526016	323051	S	-	-	-
0057	526041	323019	S	-	-	-
0058	526046	323013	S	-	-	-
0059	526050	323038	S	-	-	-
0060	526012	323024	S	-	-	-
0061	526038	323068	S	-	-	-
0062	526038	323055	S	-	-	-
0063	526030	323052	S	-	-	-
0950	526053	322999	S	-	-	-
0951	526043	322996	S	-	-	-
4952	525463	322952	S	-	-	-
4953	525481	322971	S	-	-	-
5051	525511	323020	S	-	-	-
8052	525839	323037	S	-	-	-
8053	525841	323040	S	-	-	-
8054	525854	323034	S	-	-	-
8055	525862	323035	S	-	-	-
8059	525890	323023	S	-	-	-
8060	525894	323019	S	-	-	-
8061	525877	323015	S	-	-	-
8062	525869	323010	S	-	-	-
8063	525883	323045	S	-	-	-
8064	525877	323028	S	-	-	-
8951	525867	322975	S	-	-	-
8952	525883	322990	S	-	-	-
8955	525839	322971	S	-	-	-
8956	525845	322969	S	-	-	-
8957	525854	322979	S	-	-	-
8960	525875	322955	S	-	-	-
8961	525871	322957	S	-	-	-
8962	525876	322968	S	-	-	-
8963	525869	322973	S	-	-	-
8964	525886	322981	S	-	-	-
9051	525906	323003	S	-	-	-
9052	525933	323018	S	-	-	-
9053	525943	323032	S	-	-	-
9054	525949	323046	S	-	-	-
9055	525964	323051	S	-	-	-
9056	525973	323075	S	-	-	-
9057	525922	323037	S	-	-	-
9058	525975	323080	S	-	-	-
9059	525918	323024	S	-	-	-
9060	525955	323004	S	-	-	-
9061	525939	323009	S	-	-	-
9062	525948	323087	S	-	-	-
9063	525956	323056	S	-	-	-
9064	525971	323060	S	-	-	-
9065	525993	323032	S	-	-	-
9066	525900	323025	S	-	-	-
9067	525939	323054	S	-	-	-
9068	525945	323051	S	-	-	-
9069	525974	323027	S	-	-	-
9070	525995	323068	S	-	-	-
9150	525954	323102	S	-	-	-
9950	525967	322995	S	-	-	-
9951	525954	323000	S	-	-	-
9954	525938	322957	S	-	-	-
9956	525932	322959	S	-	-	-
9957	525901	322973	S	-	-	-
9958	525923	322963	S	-	-	-



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Date: 18/08/21

Scale: 1:1250

Map Centre: 526344,322274

Data updated: 31/07/21

Our Ref: 628100 - 1

Wastewater Plan A0

This plan is provided by Anglian Water pursuant 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 2021 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water assets only. Reproduction or modification 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.

Foul Sewer	Outfall*	Sewage Treatment Works	
Surface Sewer			
Combined Sewer			
Final Effluent	Inlet*	Public Pumping Station	
Rising Main*			
Private Sewer*	Manhole*	Decommissioned Pumping Station	
Decommissioned Sewer*			

*(Colour denotes effluent type)

ben@j-ce.co.uk

Naylor 1

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
6001	525641	322052	F	2.804	-0.824	3.628
6002	525647	322070	F	2.715	-0.285	3
6003	525694	322080	F	2.77	-0.63	3.4
6101	525687	322142	F	3.3	-0.57	3.87
6102	525689	322109	F	2.911	-0.779	3.69
6103	525637	322141	F	3.5	0.847	2.653
6104	525632	322134	F	3.37	0.904	2.466
6602	525678	322682	F	3.047	2.107	0.94
6702	525671	322733	F	3.018	1.858	1.16
6801	525666	321873	F	2.782	0.322	2.46
6802	525671	321839	F	2.511	0.456	2.055
6804	525627	321844	F	2.655	0.9	1.755
6901	525652	321989	F	2.851	-0.029	2.88
6902	525654	321946	F	2.815	0.205	2.61
6903	525659	321918	F	2.803	0.253	2.55
7001	525723	322002	F	2.506	1.226	1.28
7002	525762	322015	F	2.525	1.395	1.13
7003	525768	322035	F	2.507	1.377	1.13
7004	525781	322076	F	2.453	1.078	1.375
7005	525730	322085	F	2.398	0.828	1.57
7101	525746	322153	F	2.5	-0.237	2.737
7701	525759	322738	F	3.01	1.93	1.08
7801	525707	321857	F	2.726	0.906	1.82
7802	525702	321837	F	2.636	0.706	1.93
7901	525754	321996	F	2.59	1.3	1.29
7902	525742	321959	F	2.625	1.435	1.19
7903	525700	321922	F	2.736	1.336	1.4
8101	525800	322168	F	2.5	0.102	2.398
8201	525817	322206	F	2.5	0.354	2.146
8202	525810	322276	F	2.5	0.726	1.774
8301	525815	322313	F	2.5	0.918	1.582
8302	525846	322307	F	2.377	1.48	0.897
8303	525828	322368	F	2.5	1.223	1.277
8401	525829	322400	F	2.5	1.39	1.11
8402	525876	322409	F	2.432	1.68	0.752
8403	525801	322427	F	2.5	1.612	0.888
8601	525892	322638	F	3.08	1.31	1.77
8701	525855	322702	F	2.78	0.84	1.94
8702	525851	322734	F	2.94	0.63	2.31
8703	525803	322745	F	2.9	0.21	2.69
9501	525914	322516	F	2.932	2.082	0.85
9502	525924	322542	F	2.964	1.944	1.02
9503	525930	322567	F	2.994	1.824	1.17
9504	525904	322589	F	2.925	1.665	1.26
9601	525902	322602	F	2.791	1.531	1.26
9602	525909	322691	F	-	-	-
9701	525974	322714	F	2.775	1.515	1.26
9702	525925	322726	F	2.607	1.267	1.34

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

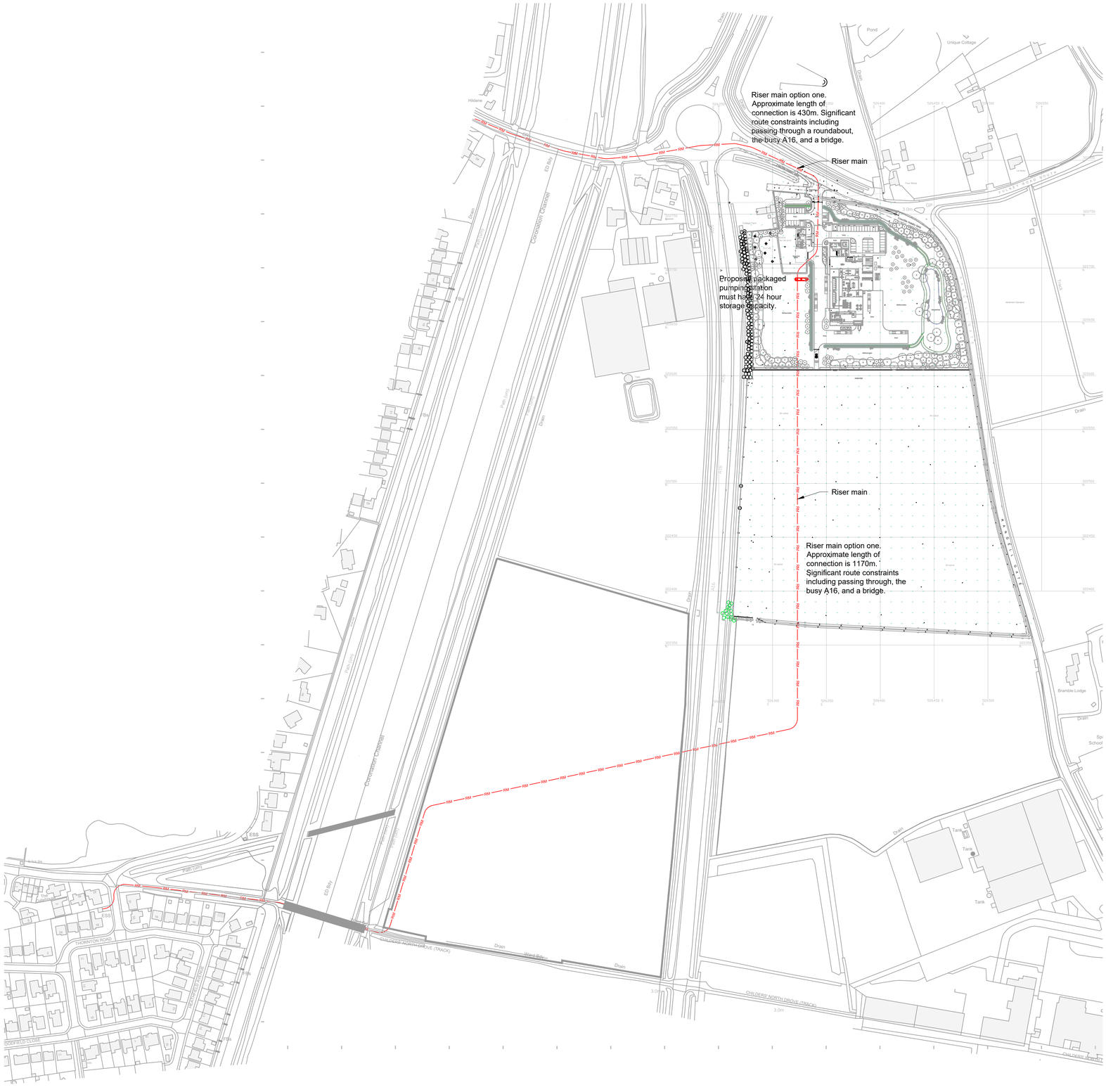
Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix G – Proposed Foul Riser Main



Disclaimer
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Any works carried out without necessary written approvals is at the risk of the developer.
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Drawing must be printed in colour. This text will be red if a coloured drawing.

Notes:

1. All drawings to be read in conjunction with Structural Engineers Drawings.
2. If in doubt - ASK!
3. Any discrepancies are to be reported back to the engineer immediately.
4. All dimensions are in metres unless noted otherwise (pipe diameters are generally shown in milimetres, unless noted otherwise).
5. Drawings marked Preliminary, Information or Tender are for guidance/ approval only, i.e. NOT for Construction.
6. It is likely that existing services will be present within the existing site. Contractor to ensure all necessary precautions have been taken before any excavation takes place.
7. It is the contractors responsibility to locate existing services where they may be affected by proposed works and protect them as necessary and agreed by the utility provider.
8. Drawings to be read in conjunction with all relevant drawings.
9. Setting out to be in accordance with the Architectural plans.
10. All proprietary items to be installed in strict accordance with the manufacturers instructions and recommendations.
11. All works to be carried out in accordance wit the current British Standards, Codes for practice and Building Regulations.
12. Manhole covers are to be D400 in adoptable areas and the main access way, C250 for shared parking areas, B125 for private domestic car parking and A15 for soft landscaped and non-vehicle areas.
13. For private drainage, the pipework does not need concrete pipe protection if the following depths are exceeded:
    13.1. For PVC - 0.9m in vehicular areas or 0.6m in soft landscaping.
    13.2. For clayware or concrete - 1.2m in vehicular areas or 0.6m in soft landscaping.
14. Pipe materials to be the following;
    14.1. Clayware to be Class 120
    14.2. Concrete to be Class M
    14.3. Thermoplastic to have a nominal ring stiffness of SN4.
15. PPIC's deeper than 1.2m are to be fitted with a non-access cover.
16. Unused PPIC connections are to be installed with caps.
17. Excavations near foundations need to be carefully considered. Refer to building regulations, and consult with the structural engineer where appropriate.
18. No work is to be started until all necessary approvals have been obtained.
19. Drainage has been design to store all storms up to and including the 1 in 100 year + 40% climate change within the site.
20. The junctions from RWP's, fin drains, SVP's and similar connections into main runs are to be determined on site, and in accordance with building regulations.
21. All RWP's, SVP's, etc., to be fitted with rodding access.
22. For PPIC's the orientation of the main channel is to generally connect upstream and downstream pipes with stated inverts. Non stated inverts such as RE's, R's and F's to generally connect into side inlets.
23. Drainage generally designed to incorporate a side step in preformed bases down into the main channel invert of of 100mm. Details vary dependant on the preformed base and manufacturer selected.
24. Backdrops might be required to ensure that building drainage above foundations are able to enter the PPIC - refer to details.
25. Unless noted , rain water pipes (R's) and below ground foul drainage pipes (F's) to be 100mmØ . R's to have a minimum fall of 1:100, and F's to have a minimum fall of 1:40, unless a WC is connected when the minimum fall shall be 1:80.
26. All RWP's and below ground foul drainage to be set out from the architectural drawings.
27. Where drainage gradients have been stated, these represent the minimum gradients, and can be steeper - subject to a maximum gradient of 1:10.
28. If the contractor is unsure which manhole/PPIC reference is being used for the actual manhole/PPIC, ask!
29. Cover levels are approximate only and must suit the finished external levels.
30. All tie in levels with existing items are to be confirmed prior to construction.
31. Architect to confirm threshold drain requirements.
32. Unless noted, drainage connections to be invert to invert.
33. RWP positions have currently been assumed and must be confirmed by the architect.
34. Above ground foul drainage has currently been assumed and must be confirmed by the architect.
35. Discharge into the existing ditch must be agreed by LCC/LLFA, IDB and the EA.
36. The EA must be consulted in relation to the foul drainage disposal.

PLANNING
For planning authority approval

Rev	Description	Drn	Ck'd	Date
P01	Drawing generally updated to reflect the revised architectural plan	BJ	JCE	19/08/2

Client:
Naylor Farms

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Tel: 01775 729259
Email: enquiries@j-ce.co.uk
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Project Title:
Proposed Commercial Development,
Land off Low Road, Spalding

Drawing Title:
Proposed Foul Water Disposal,
Connection into Sewer

Drawing Status:
Preliminary

Scale: 1:2000	Paper size: A1	Date: 29/08/2021
Drawn: BJ	Checked: JCE	Approved: JCE

Drawing Number:	Rev
0145-JCE-00-SI-DR-C-3010	P01