

# Holbeach Food Enterprise Zone (FEZ), Lincolnshire

## Surface Water Drainage Strategy

On behalf of **South Holland District Council**



Project Ref: 38615/4001 | Rev: - | Date: October 2017



## Document Control Sheet




**Project Name:** Holbeach Food Enterprise Zone (FEZ), Lincolnshire

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**Report Title:** Surface Water Drainage Strategy

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Revision	Date	Description	Prepared	Reviewed	Approved

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## Introduction

This Surface Water Drainage Assessment has been prepared by Peter Brett Associates LLP (PBA), on behalf of our Client South Holland District Council, to outline the options for surface water drainage and the inclusion of Sustainable Drainage Systems (SuDS) as part of a Local Development Order for a proposed Food Enterprise Zone (FEZ) to the west of Holbeach in Lincolnshire.

This report should be read in conjunction with the Flood Risk Mitigation Strategy report ref. 38615/4001.

This report sets out the latest national, regional and local guidance in relation to surface water drainage and an indication of the types of SuDS that would be suitable at the site, given the geology and hydrogeology in the area.

The proposal is for a new FEZ; a centre of excellence for research and development in the field of food and agriculture.

The concept is for a central hub accessed off the A151 to the east, with discrete zones across the site covering a range of specialisms.

The strategy report has been prepared in accordance with the relevant national, regional and local planning policy and statutory authority guidance as follows:

- National policy regarding flood risk as contained within the **National Planning Policy Framework (NPPF)** (March 2012) and the **Planning Practice Guidance (PPG) 'Flood risk and coastal change'** (updated April 2015);
- The **DEFRA 'Non-statutory technical standards for sustainable drainage systems'**, (March 2015) and the **Local Authority SuDS Officer Organisation (LASOO) Best Practice Guidance** (September 2015);
- The Environment Agency '**Flood risk assessments: climate change allowances**', (February 2016);
- The **South Holland Local Plan** (adopted July 2006) with particular reference to **Policy SG9 'Sustainable Urban Drainage Systems (SuDS)'**.

# 1 Site Setting

## 1.1 Site Description and Topography

- 1.1.1 The site is approximately 16ha in area and consists of primarily agricultural land and a distillery farm on the western flank of the town of Holbeach in Lincolnshire (site centre OS grid reference 534,735m E, 325,745m N).
- 1.1.2 LiDAR obtained for the site indicates that levels range from 3.68m AOD and 3.48m AOD in the south/south-east to 2.94m AOD in the site centre and 2.75m AOD along the south-eastern boundary (see Figure 001 in **Appendix A**).

## 1.2 Site Geology and Hydrogeology

- 1.2.1 An initial overview of the site geology has been made by using the online British Geological Society (BGS) 'Geology of Britain Viewer'. This advises that the Holbeach area geology is a bedrock of 'West Walton Formation - Mudstone and Siltstone', with superficial deposits of 'Tidal Flat Deposits - Clay and Silt'.
- 1.2.2 The Cranfield University 'Soilscapes' resource indicates the land is 'Loamy and clayey' and described as 'Loamy and clayey soils of coastal flats with naturally high groundwater'.

## 1.3 Existing Drainage and Watercourses

- 1.3.1 The Lincolnshire area is relatively flat and as such the majority of the area drains to a network of watercourses.
- 1.3.2 Riparian watercourses are present along the boundaries of the site, which drain to an Internal Drainage Board channel 'P09 'Distillery Channel' in the north-eastern corner of the site and the P16 'Gander Ground' drain, which is located approximately 90m to the south of the site (see plan in **Appendix B**).
- 1.3.3 An online search on the DigDat portal has confirmed that there are no Anglian Water public sewers within or in the immediate vicinity of the site.
- 1.3.4 The majority of the site is open agricultural or 'greenfield' land. A distillery farm is located in the north-eastern part of the site which consists of buildings and hard standing. This area equates to approximately 1ha.
- 1.3.5 The existing runoff rates for the distillery farm area have been calculated using the Modified Rational Method and the greenfield runoff rates for the remainder of the site have been calculated using the IH124 method based on the EA/DEFRA 'Rainfall runoff management for developments Rev E' (see **Appendix C**) and are shown in **Table 1.1**.

Table 1.1: Existing runoff rates

Annual Probability Rainfall Event	Brownfield Runoff Rate 1.0 ha (l/s)	Greenfield Runoff Rate 15.0 ha (l/s)
1 in 1 year	89.6	18.3
1 in 2 year/Qbar	115.6	21.5
1 in 30 year	216.8	49.4
1 in 100 year	287.7	67.7

## 2 Planning Policy

### 2.1 National Planning Policy

2.1.1 The '**National Planning Policy Framework**' ('NPPF') was issued by Communities and Local Government in March 2012 as part of the Government's reforms of the planning system of England and Wales to make it less complex and more accessible, to protect the environment and to promote sustainable growth. This was supplemented in March 2014 with the accompanying '**Planning Practice Guidance to the National Planning Policy Framework**' (PPG). The PPG was subsequently updated in April 2015.

2.1.2 The NPPF and PPG recognise that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface runoff from development sites, and recommends that priority be given to the use of Sustainable Drainage Systems (SuDS) in new development.

2.1.3 The PPG states that:

*"Generally the aim should be to discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:*

- 1. into the ground (infiltration)*
- 2. to a surface water body*
- 3. to a surface water sewer, highway drain or another drainage system*
- 4. to a combined sewer."*

2.1.4 The above drainage hierarchy is consistent with that outlined within the Building Regulations Requirement H.

2.1.5 The DEFRA '**Non-statutory technical standards for sustainable drainage systems**', released in March 2015, outlines the requirements for surface water runoff and volume control and surface water drainage design. The DEFRA standards are supported by Best Practice guidance prepared by the Local Authority SuDS Officer Organisation (LASOO). The LASOO includes Lincolnshire County Council who are the Lead Local Flood Authority for the area within which the site is located.

2.1.6 The **Environment Agency (EA)** '**Flood risk assessments – climate change allowances**' guidance, released in February 2016 outlines the contingency allowances for changes in peak river flow for fluvial flood risk and peak rainfall intensity for surface water drainage. This supersedes the climate change allowances within the '*Climate change allowances for planners*' guidance (September 2013).

### 2.2 Local Planning Policy

2.2.1 Local planning policy in relation to surface water drainage is contained within the **South Holland Local Plan** (adopted July 2006) **Policy SG9 'Sustainable Urban Drainage Systems (SuDS)'** as follows:

*"Development generating surface water run-off, likely to result in increased flood risk, will be permitted provided that:*

- 1) The development's surface water management system accords with sustainable development principles and has been designed as part of the development layout; and,*

2) *The system will effectively control and adequately mitigate or attenuate any adverse effects from surface water run-off on people, habitats of acknowledged importance and property; and*

3) *Developers can ensure long term maintenance of the drainage systems, where necessary through planning obligations.*

*Where this is not possible the developer will be required to implement an alternative method of surface water disposal that is to the Council's satisfaction."*

2.2.2 It is understood that this Plan will eventually be replaced by the **South East Lincolnshire Local Plan**, which is being produced jointly between Boston Borough Council, South Holland District Council and Lincolnshire County Council.

## 2.3 EA Climate Change Guidance

2.3.1 In considering flood risk to the site, it is necessary to fully consider the potential impacts of climate change for the lifetime of the development within the mitigation measures. This is detailed in the EA 'Flood risk assessments – climate change allowances' guidance, released in February 2016.

2.3.2 **Table 2.1** shows the current climate change allowances for peak rainfall intensity, taken from the above EA guidance.

**Table 2.1: Climate change allowances for peak rainfall intensity**

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total anticipated change for 2060 to 2115
Upper End	+10%	+20%	+40%
Central	+5%	+10%	+20%

2.3.3 Given that the development will include uses for engineering, development and research, the proposed buildings are considered to have a potentially lower development life than equivalent residential development and therefore consideration up to the +40% allowance for climate change value is conservative.



## 3 Proposed Surface Water Drainage Strategy

### 3.1 Discharge Destination

3.1.1 As outlined in **Section 2.1**, the PPG outlines a hierarchy for surface water disposal with infiltration drainage being the preferred option followed by discharge to a surface water body and then to a sewer.

3.1.2 The hierarchy above is considered in order below:

#### ***Discharge into the ground***

3.1.3 As outlined in **Section 3.2**, the site is underlain by Tidal Flat Deposits (clays and silts) over the West Walton Formation (Mudstone and Siltstone). These strata are considered to be relatively impermeable and therefore infiltration drainage is unlikely to be feasible at the site, however intrusive site investigations would be undertaken to confirm ground conditions, groundwater levels and infiltration rates.

#### ***Discharge to a surface water body***

3.1.4 A series of riparian watercourses border the site which drain into IDB drains and it is likely that the site currently drains to these watercourses when saturated.

3.1.5 It is therefore considered that this method of surface water disposal is likely to be the most appropriate at the site.

### 3.2 Proposed SuDS Strategy

3.2.1 The proposed surface water drainage strategy incorporates source control features within each 'zone' such as lined permeable paving which outfalls to conveyance swales at the sides of the access road running towards the centre of the site or to attenuation ponds.

3.2.2 The swales also take runoff from the access roads and also outfall into the attenuation ponds. The ponds will provide biodiversity benefits through the incorporation of a depth of permanent water. The proposed runoff rate from the site to the surrounding IDB/riparian watercourse network is controlled from the second attenuation pond through via a flow control device.

3.2.3 The proposed SuDs features are shown on **PBA drawing 38615/4001/001** (see **Appendix D**). These features have been modelled as a cascade in MicroDrainage Source Control (v. 2016.1) (see schedule and results in **Appendix D**).

3.2.4 Any proposed drainage features will not impact on the existing culverts/connectivity of the surrounding IDB and riparian watercourse networks.

### 3.3 Design Criteria

3.3.1 DEFRA Technical Standard S3 states that:

*“S3 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.”*

3.3.2 South Holland IDB have confirmed that they would allow 1.4 l/s/ha to drain into the watercourse from any proposed impermeable areas at the site (see correspondence in **Appendix B**).

- 3.3.3 Based on an assumed impermeable area of 6.1ha, the allowable final discharge rate to the IDB watercourse is taken as 8.6 l/s to ensure that there is no detriment to the IDB network's capacity to accept and convey flows through the area.

#### Runoff Volume Calculations

- 3.3.4 DEFRA Technical Standards S4 and S6 state that:

*“S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.”*

*“S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.”*

- 3.3.5 The additional volume of runoff produced by development on the site will be managed through the use of SuDS and a restricted discharge in accordance with Standard S2 and S6 above and IDB requirements.

#### Residual Risks & Exceedance Flows and Runoff in Excess of Design Criteria

- 3.3.6 DEFRA Technical Standards S7-S9 state that:

*“S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.*

*S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity sub-station) within the development.*

*S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of the 1 in 100 year rainfall event are managed in exceedance routes that minimises the risks to people and property.”*

- 3.3.7 **Section 2.3** outlines the current climate change allowances for peak rainfall intensity, taken from the EA 'Flood risk assessments – climate change allowances' guidance released in February 2016.

- 3.3.8 A cascade has been created within MicroDrainage Source Control showing the flow of surface water runoff through SuDS features with a final controlled discharge to the IDB/riparian watercourse network. The results confirm that there is no flooding up to the 1 in 100 (1.0%) annual probability +20% allowance for climate change rainfall event. These features are shown on **PBA drawing 38615/4001/001** (see **Appendix D**).

- 3.3.9 It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible. It is practicable to minimise the risk by careful design of the layout of the development such that internal flooding is avoided. Areas of hard standing can be laid to fall away from buildings with flows directed to areas where damage and disruption to buildings, assets and operations will be minimized.

## Water Quality

3.3.10 The new SuDS Manual (Ciria C753, November 2015) introduced a slightly different approach compared to the previous version for the water quality management of surface water. The Manual describes risks posed by the surface water runoff to the receiving environment as a function of:

- The pollution hazard at a particular site (i.e. the pollution **source**).
- The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels (i.e the pollutant **pathway**).
- The sensitivity of the receiving environment (the environmental **receptor**).

3.3.11 Through the use of different SuDS features, pollutants can be effectively removed from surface water as it passes through a ‘treatment train’. The MicroDrainage cascade includes lined permeable paving within the development parcels to treat runoff from the hard standing and car parking areas with further treatment as runoff is conveyed via swales and attenuation ponds before it is discharged to the receiving IBD/riparian watercourses.

3.3.12 **Table 3.2** shows how different SuDS features contribute to the key pillars of water quantity, water quality, amenity and biodiversity.

**Table 4.2: SuDS Manual Table 7.1 ‘SuDS component delivery of design criteria’**

Component type	Description	Collection mechanism	Design criteria					Further information (Chapter ref)	
			Water quantity (Chapter 3)			Water quality (Chapter 4)	Amenity (Chapter 5)		Biodiversity (Chapter 6)
			Peak runoff rate	Small events (interceptions)	Large events				
Rainwater harvesting systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●	11	
Green roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	12	
Infiltration systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	●	●	●	●	●	13	
Proprietary treatment systems	Subsurface structures designed to provide treatment of runoff	P				●		14	
Filter strips	Grass strips that promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	15	
Filter drains	Shallow stone-filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	16	
Swales	Vegetated channels (sometimes planted) used to convey and treat runoff	L	●	●	●	●	●	17	
Bioretention systems	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	P	●	●	●	●	●	18	
Trees	Trees within soil-filled tree pits, tree planters or structural soils used to collect, store and treat runoff	P	●	●		●	●	19	
Pervious pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	●	●	●	●	○	20	
Attenuation storage tanks	Large, below-ground voided spaces used to temporarily store runoff before infiltration, controlled release or use	P	●					21	
Detention basins	Vegetated depressions that store and treat runoff	P	●	●		●	●	22	
Ponds and wetlands	Permanent pools of water used to facilitate treatment of runoff – runoff can also be stored in an attenuation zone above the pool	P	●			●	●	23	

**Key**  
 P – Point, L – Lateral, S – Surface, ● – Likely valuable contribution to delivery of design criterion, ○ – Some potential contribution to delivery of design criterion, if specifically included in the design

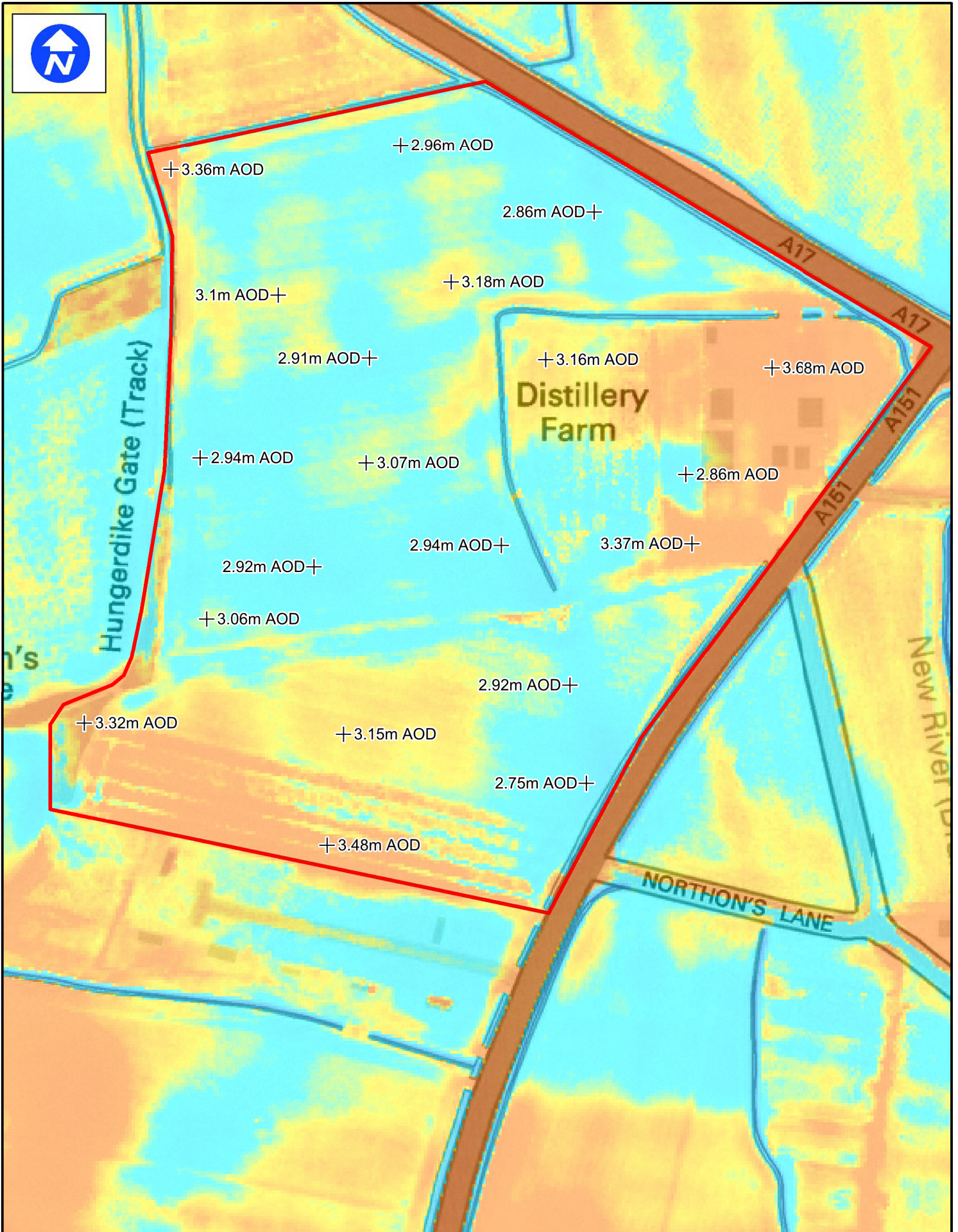
## 4 Conclusions

- 4.1.1 This Surface Water Drainage Assessment has been prepared by Peter Brett Associates LLP (PBA), on behalf our Client South Holland District Council, to outline the options for surface water drainage and the inclusion of Sustainable Drainage Systems (SuDS) as part of a Local Development Order for a Food Enterprise Zone (FEZ) to the west of Holbeach in Lincolnshire.
- 4.1.2 The preferred method of surface water disposal for any development is infiltration in accordance with the National Planning Policy Framework (NPPF) Planning Practice Guidance (PPG) SuDS hierarchy. Based on the available geological information, it is considered that the use of infiltration drainage at the site will not be feasible.
- 4.1.3 The next preferred option in the SuDS hierarchy is to discharge to a watercourse. The site is surrounded by a network of riparian and Internal Drainage Board (IDB) watercourses, and it is considered that this is the most appropriate option for surface water disposal.
- 4.1.4 A surface water drainage strategy has been developed based on the use of different SuDS measures including lined permeable paving, swales and attenuation ponds which will provide water quality, amenity and biodiversity benefits.
- 4.1.5 The surface water drainage strategy proposed complies with the DEFRA 'Non-statutory technical standards' and local planning policy and will be refined further through the development of the masterplan.

## Appendix A Topographical Information

PBA Figure 001 – LiDAR Spot Levels





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Client  
**South Holland District Council**

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**38615**  
**Holbeach Food Enterprise Zone (FEZ), Lincolnshire**

LIDAR Spot Levels

Date: November 2016

Scale: NTS

Drawn By: CV Checked By: EE

Rev: -

Figure Number

**Figure 001**

## **Appendix B South Holland IDB Information**

IDB Network Plan



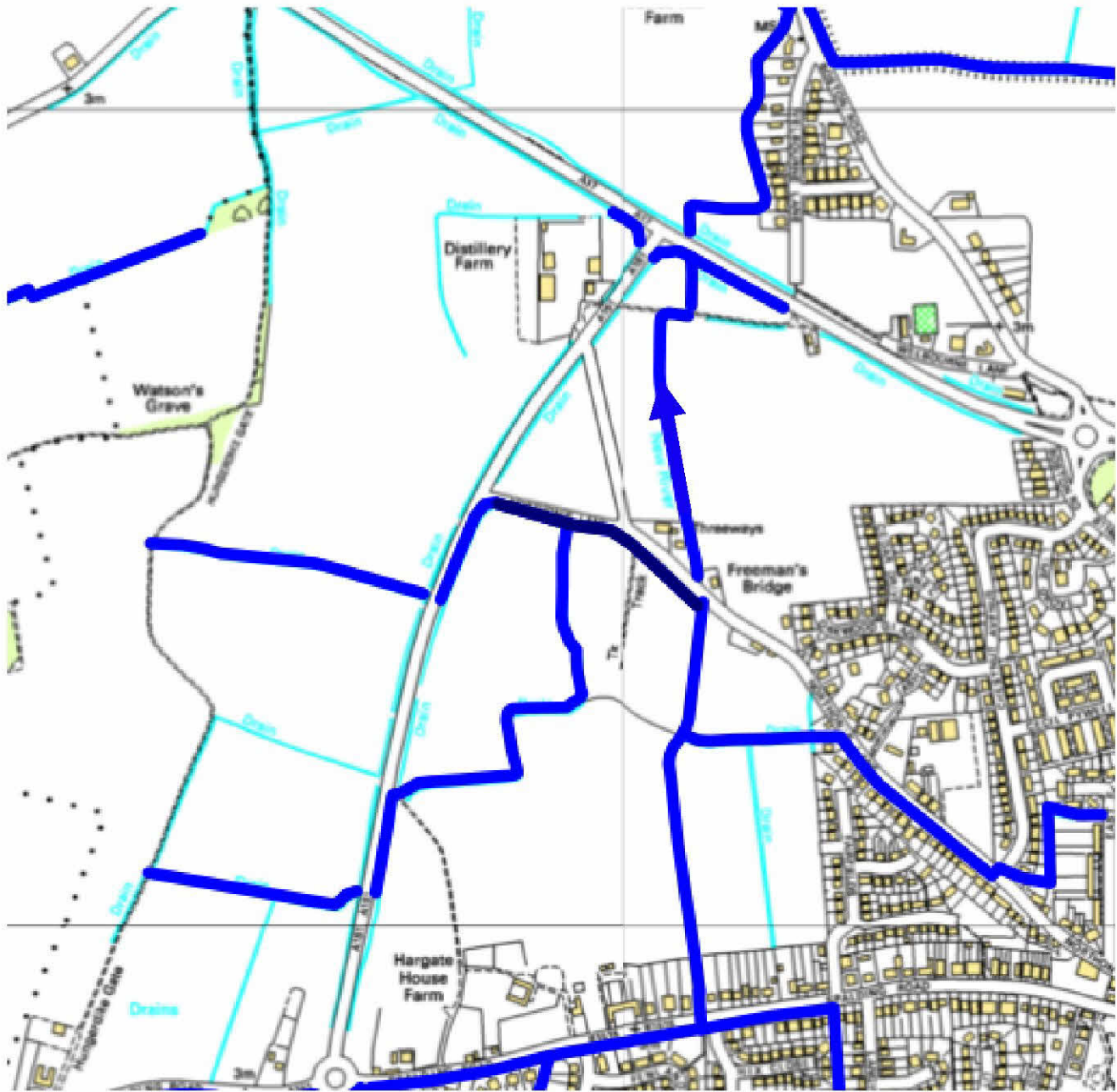
Watercourses maintained or owned by South Holland IDB



Private/Riparian maintained/owned watercourses.

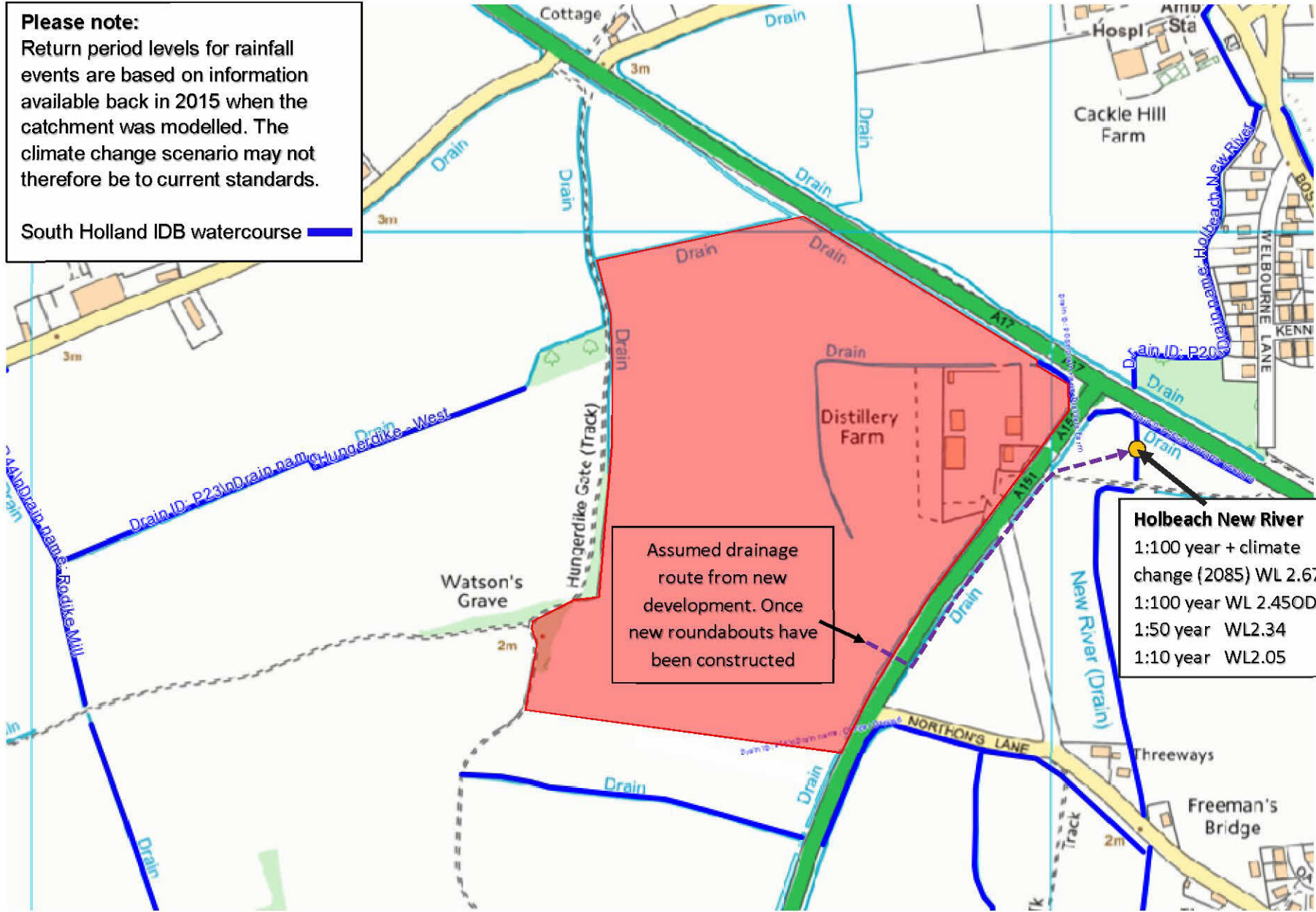






**Please note:**  
 Return period levels for rainfall events are based on information available back in 2015 when the catchment was modelled. The climate change scenario may not therefore be to current standards.

South Holland IDB watercourse



Assumed drainage route from new development. Once new roundabouts have been constructed

**Holbeach New River**  
 1:100 year + climate change (2085) WL 2.67ODN  
 1:100 year WL 2.45ODN  
 1:50 year WL 2.34  
 1:10 year WL 2.05



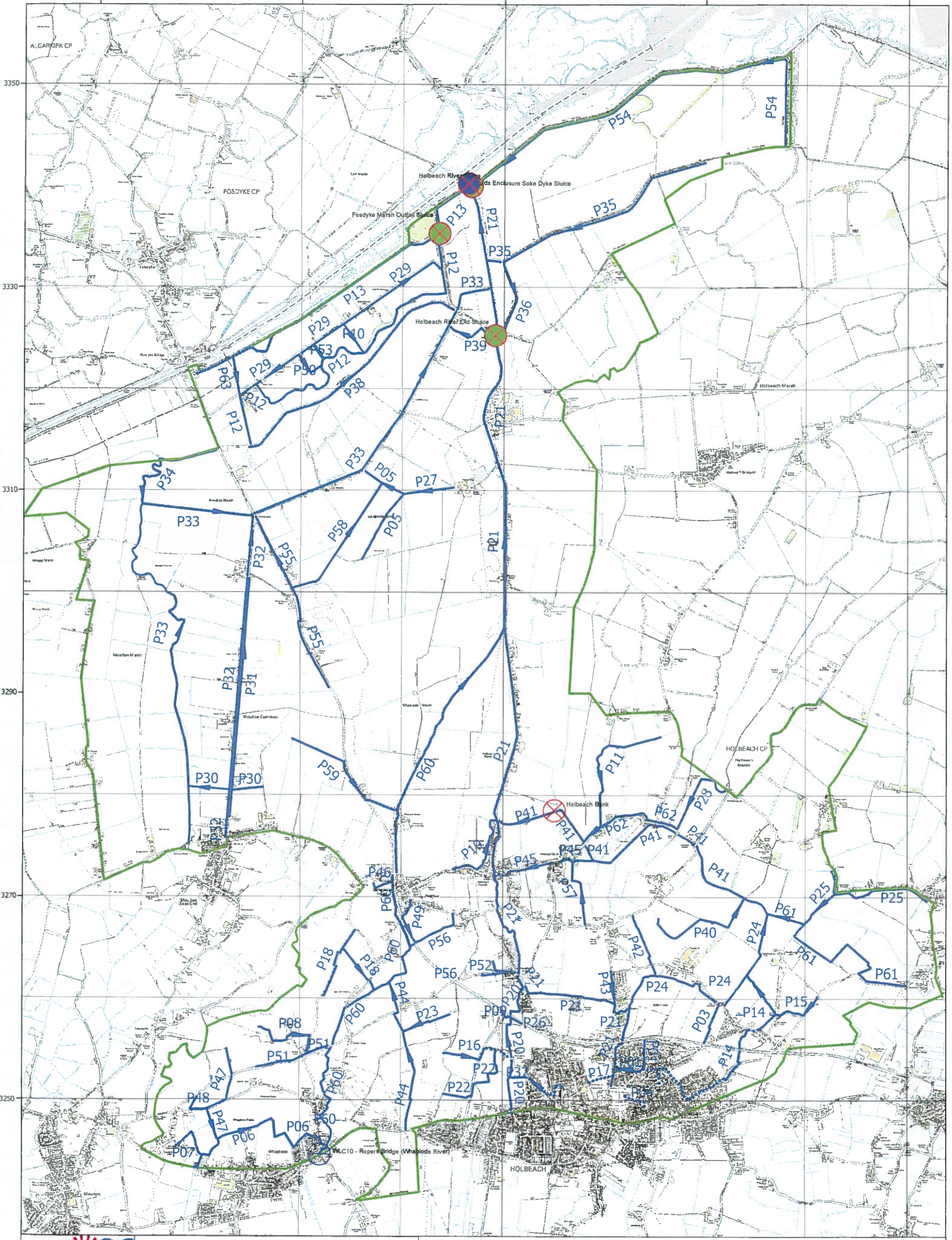
5310

5330

5350

5370

5390



**South Holland IDB**  
**Catchment P - Holbeach River**

Upload date:  
 Feb 2011

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**Key:**

-  - Catchment P Boundary
-  - IDB Ordinary Watercourse
-  - Pumping Station
-  - Water level control
-  - Tidal Sluice
-  - Inland Sluice



# South Holland I.D.B. (March 2008)

DRAIN ID	DRAIN NAME	OWNED BY SHIDB	HIGH PRIORITY	TOTAL LENGTH (m)	* SOW LENGTH (m)	HIGH PRIORITY A LENGTH (m)	HIGH PRIORITY B LENGTH (m)
<b>P: HOLBEACH RIVER CATCHMENT</b>							
P01	BATTLEFIELDS	<input type="checkbox"/>	<input checked="" type="checkbox"/>	580	580	580	0
P02	BATTLEFIELDS OLD PIPELINE	<input type="checkbox"/>	<input type="checkbox"/>	625	625	0	0
P03	BATTLEFIELDS NORTHERN	<input type="checkbox"/>	<input type="checkbox"/>	440	0	0	0
P04	CEMETARY	<input type="checkbox"/>	<input checked="" type="checkbox"/>	390	240	0	0
P05	CHAPEL	<input type="checkbox"/>	<input type="checkbox"/>	1,250	0	0	0
P06	CROWN	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1,905	1,500	1,905	0
P07	CROWN BRANCH	<input type="checkbox"/>	<input checked="" type="checkbox"/>	580	0	440	0
P08	DAISY HALL	<input type="checkbox"/>	<input type="checkbox"/>	805	0	0	0
P09	DISTILLERY FARM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	80	0	0	0
P10	DRAIN NO 15	<input checked="" type="checkbox"/>	<input type="checkbox"/>	350	0	0	0
P11	FLINT HOUSE	<input type="checkbox"/>	<input type="checkbox"/>	1,325	0	0	0
P12	FOSDYKE MARSH MAIN	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4,150	0	0	0
P13	FOSDYKE MARSH SOKE DYKE	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3,550	0	0	0
P14	FOXES LOW	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2,515	2,000	2,515	0
P15	FOXES LOW BRANCH	<input type="checkbox"/>	<input type="checkbox"/>	570	0	0	0
P16	GANDER GROUND	<input type="checkbox"/>	<input type="checkbox"/>	615	0	0	0
P17	GAS HOUSE	<input type="checkbox"/>	<input checked="" type="checkbox"/>	240	240	240	0
P18	GODDAMS LANE	<input type="checkbox"/>	<input type="checkbox"/>	1,285	0	0	0
P19	HOLBEACH CLOUGH	<input type="checkbox"/>	<input checked="" type="checkbox"/>	870	870	870	0
P20	HOLBEACH NEW RIVER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1,380	1,380	1,380	0
P21	HOLBEACH RIVER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	10,350	3,000	10,350	0
P22	HUNGERDYKE - EAST	<input type="checkbox"/>	<input type="checkbox"/>	1,210	0	0	0
P23	HUNGERDIKE - WEST	<input type="checkbox"/>	<input type="checkbox"/>	495	0	0	0
P24	HURN SOUTH	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2,310	0	665	0
P25	HURN BANK DRAIN AND BRANCH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1,770	0	0	0
P26	LOW LANE	<input type="checkbox"/>	<input type="checkbox"/>	180	0	0	0
P27	MAJORS	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1,375	200	875	0
P28	MARSH LEVEL	<input type="checkbox"/>	<input type="checkbox"/>	1,015	0	0	0
P29	MIDDLE MARSH ROAD	<input checked="" type="checkbox"/>	<input type="checkbox"/>	2,235	0	0	0
P30	MOULTON COMMON CONNECTION	<input type="checkbox"/>	<input type="checkbox"/>	735	0	0	0
P31	MOULTON COMMON - EAST	<input type="checkbox"/>	<input type="checkbox"/>	2,560	0	0	0
P32	MOULTON COMMON - WEST	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3,175	500	3,175	0
P33	MOULTON RIVER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	8,375	0	3,445	0
P34	MOULTON RIVER BRANCH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1,295	0	0	0

\* SOW = Strategic Ordinary Watercourse



# South Holland I.D.B. (March 2008)

DRAIN ID	DRAIN NAME	OWNED BY SHIDB	HIGH PRIORITY	TOTAL LENGTH (m)	* SOW LENGTH (m)	HIGH PRIORITY A LENGTH (m)	HIGH PRIORITY B LENGTH (m)
<b>P: HOLBEACH RIVER CATCHMENT</b>							
P35	NEW SEA BANK	<input type="checkbox"/>	<input type="checkbox"/>	2,550	0	0	0
P36	NEW SEA BANK OLD OUTFALL ROUTE	<input type="checkbox"/>	<input type="checkbox"/>	820	0	0	0
P37	NORTHONS LANE	<input type="checkbox"/>	<input checked="" type="checkbox"/>	700	0	160	0
P38	OLD SEA BANK SOKE DYKE	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2,630	500	2,630	0
P39	OLD SLUICE	<input type="checkbox"/>	<input type="checkbox"/>	590	0	0	0
P40	OUNDL VICARAGE	<input type="checkbox"/>	<input type="checkbox"/>	1,250	0	0	0
P41	PEARTREE	<input type="checkbox"/>	<input checked="" type="checkbox"/>	3,530	0	3,530	0
P42	PENNY HILL	<input type="checkbox"/>	<input type="checkbox"/>	640	0	0	0
P43	PENNY HILL ROAD	<input type="checkbox"/>	<input checked="" type="checkbox"/>	325	325	325	0
P44	RODIKE MILL	<input type="checkbox"/>	<input type="checkbox"/>	1,550	0	0	0
P45	ROMAN BANK	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1,020	1,020	1,020	0
P46	SARACENS HEAD	<input type="checkbox"/>	<input type="checkbox"/>	200	0	0	0
P47	SAVAGES LOW	<input type="checkbox"/>	<input type="checkbox"/>	1,100	0	0	0
P48	SAVAGES LOW BRANCH	<input type="checkbox"/>	<input type="checkbox"/>	345	0	0	0
P49	SCARLET GATE	<input type="checkbox"/>	<input type="checkbox"/>	460	0	0	0
P50	SECOND DROVE	<input checked="" type="checkbox"/>	<input type="checkbox"/>	380	0	0	0
P51	SPALDING GATE	<input type="checkbox"/>	<input type="checkbox"/>	755	0	0	0
P52	STOCKWELL GATE	<input type="checkbox"/>	<input type="checkbox"/>	525	0	0	0
P53	THIRD DROVE	<input checked="" type="checkbox"/>	<input type="checkbox"/>	360	0	0	0
P54	WARDS SOKE DYKE	<input type="checkbox"/>	<input type="checkbox"/>	4,340	0	0	0
P55	WASHWAY ROAD A17	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1,860	1,000	1,160	0
P56	WASHWAY ROAD - SARACENS HEAD	<input type="checkbox"/>	<input type="checkbox"/>	595	0	0	0
P57	WASHWAY MILL	<input type="checkbox"/>	<input type="checkbox"/>	730	0	0	0
P58	WHAPLODE LODGE	<input type="checkbox"/>	<input type="checkbox"/>	1,410	0	0	0
P59	WHAPLODE & MOULTON MARSH	<input type="checkbox"/>	<input type="checkbox"/>	1,345	0	0	0
P60	WHAPLODE RIVER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6,150	2,000	6,150	0
P61	WOODHOUSE	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2,185	0	295	0
P62	OLD PEARTREE	<input type="checkbox"/>	<input type="checkbox"/>	1,100	0	0	0
P63	FOSDYKE MARSH SOKE DYKE CONNECTION	<input type="checkbox"/>	<input type="checkbox"/>	380	0	0	0
P64	FIELD MEADOWS PIPELINE	<input type="checkbox"/>	<input type="checkbox"/>	195	0	0	0
<b>Total Length for Holbeach River Catchment (km)</b>				<b>100.61</b>	<b>15.98</b>	<b>41.71</b>	<b>0.00</b>

\* SOW = Strategic Ordinary Watercourse

## **Appendix C Existing Runoff Rates**

Brownfield Runoff Rates

Greenfield Runoff Rates



Holbech FEZ  
Surface Water Drainage  
Existing Surface Water Rates

JOB No: 38615/4001		SHEET: 1 of 1
DATE: 11.01.2017	BY: EE	CHECKED:

### Calculation based on 'Modified Rational Method', HR Wallingford.

Assumes that water travels across the site at 1m/s from the furthest point to the connection with the existing network

#### Data

M5-60min                      20 mm                      Q=2.78CiA  
r                                      0.40

#### Calculation - 1 in 1 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M1-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.0	15	0.65	13.00	0.62	8.06	32.2	89.6
<b>Total</b>								<b>89.6 l/s</b>
Total								89.6 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

<u>D   Z1</u>	<u>M5   Z2 for 1 in 1yr</u>
5   0.40	5   0.620
10   0.55	10   0.610
15   0.65	15   0.620

#### Calculation - 1 in 2 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M1-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.0	15	0.65	13.00	0.80	10.40	41.6	115.6
<b>Total</b>								<b>115.6 l/s</b>
Total								115.6 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

<u>D   Z1</u>	<u>M5   Z2 for 1 in 2yr</u>
5   0.40	5   0.790
10   0.55	10   0.790
15   0.65	15   0.800

#### Calculation - 1 in 30 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M1-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.0	15	0.65	13.00	1.50	19.50	78.0	216.8
<b>Total</b>								<b>216.8 l/s</b>
Total								216.8 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

<u>D   Z1</u>	<u>M5   Z2 for 1 in 30yr</u>
5   0.40	5   1.450
10   0.55	10   1.490
15   0.65	15   1.500

#### Calculation - 1 in 100 Year

Catchment Area	Impermeable Area ha	Duration (D) min	Z1	M5-Dmin mm	Z2	M100-Dmin mm	i mm/hr	Impermeable Runoff l/s
1	1.0	15	0.65	13.00	1.99	25.87	103.5	287.7
<b>Total</b>								<b>287.7 l/s</b>
Total								287.7 l/s/ha

Note: Duration relates to time of concentration for the catchment including allowance for time of entry

<u>D   Z1</u>	<u>M5   Z2 for 1 in 100yr</u>
5   0.40	5   1.790
10   0.55	10   1.910
15   0.65	15   1.990



Holbeach FEZ  
Surface Water Drainage Strategy  
Calculation of Greenfield Discharge Rate

JOB No: 38615/4001		SHEET: 1 of 1
DATE: 13.01.16	BY: EE	CHECKED:

Calculation based on 'Rainfall runoff management for developments' - Report SC030219, October 2013, Defra / Environmental Agency

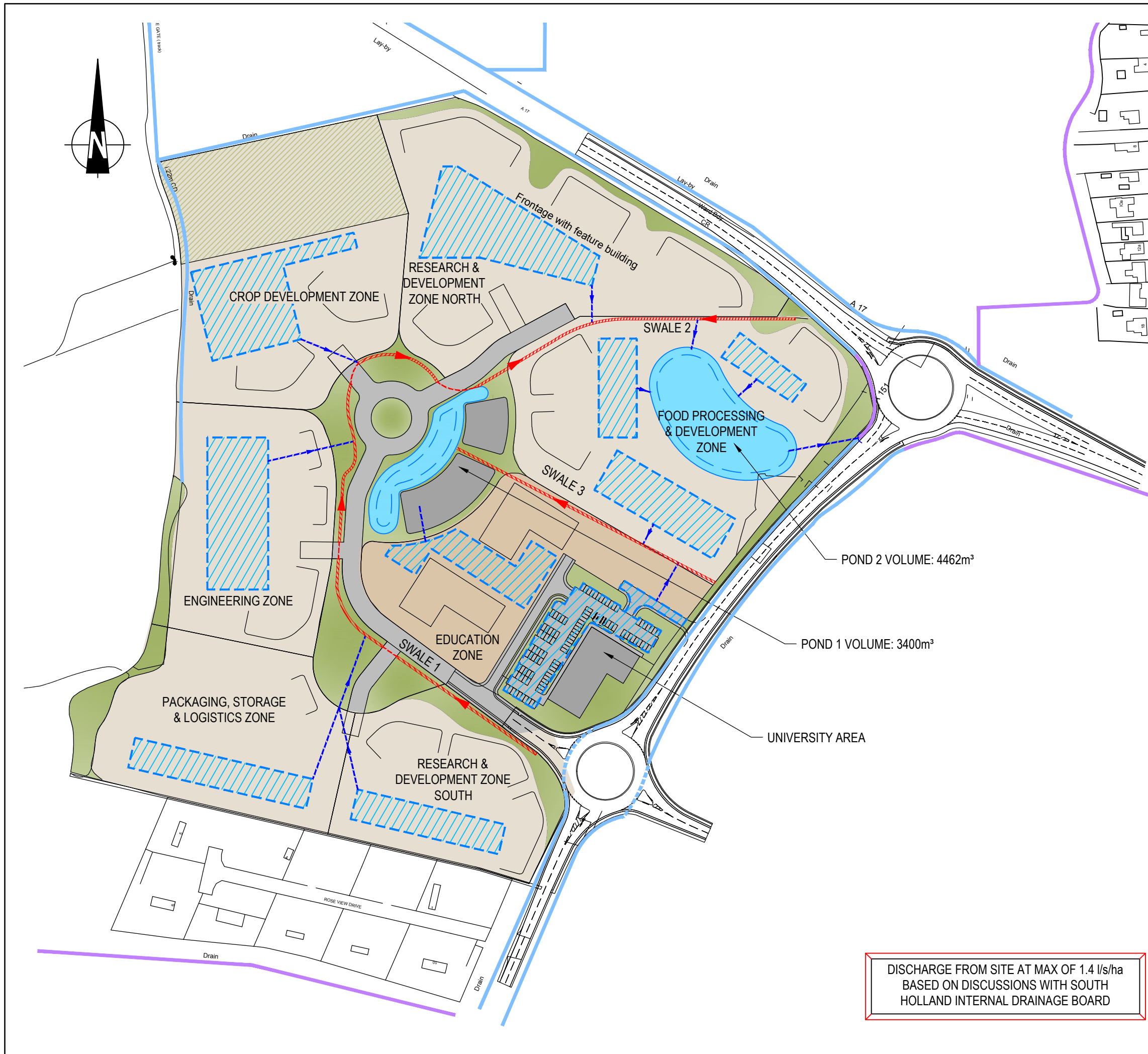
	Site	
R	6	Hydrological region
S	3	SOIL type
Catchment	<200	ha
$A_{(site)}$	1.00	ha Size of catchment (excluding large open parkland that is to remain)
SAAR or AAR	570	mm
SPR	0.3	For SOIL type 3
$A_{(50)}$	50	ha Use 50ha for sites less than 50ha
$Q_{BAR(50)}$	71.7	l/s Catchment mean annual peak flow for $A_{(50)}$ (50ha site)
$Q_{BAR}$	1.4	l/s
$Q_{BAR(site)}/A_{(site)}$	1.4	l/s/ha Mean annual peak flow per unit area (If less than 1 use 1 l/s/ha)
$Q_{throttle}$	5.0	l/s Based on minimum limit of discharge - refer to Page xvi, para 17
$Q_{throttle}/A_{(site)}$	5.0	l/s/ha
$Q_{throttle}/3.5A_{(site)}$	1.4	l/s/ha
$Q_{BAR}/A$	1.4	l/s/ha Use greater value of $Q_{BAR(site)}/A_{(site)}$ and $Q_{throttle}/A_{(site)}$
$GC_1$	0.9	Value taken from Line 11.1
$GC_{30}$	2.3	Value taken from Figure 1.2
$GC_{100}$	3.2	Value taken from Figure 1.2
$Q_{1yr}$	<b>1.2</b>	l/s/ha
$Q_{30yr}$	<b>3.3</b>	l/s/ha
$Q_{100yr}$	<b>4.5</b>	l/s/ha
<i>Total <math>Q_{1yr}</math></i>	<i>18.3</i>	<i>l/s</i>
<i>Total <math>Q_{bar}</math></i>	<i>21.5</i>	<i>l/s</i>
<i>Total <math>Q_{30yr}</math></i>	<i>49.4</i>	<i>l/s</i>
<i>Total <math>Q_{100yr}</math></i>	<i>67.7</i>	<i>l/s</i>








## **Appendix D      Drainage Strategy Information**

Drawing 38615/4001/001

MicroDrainage Source Control Cascade Schedule and Results



**KEY:**

-  PROPOSED SWALE
-  LINED PERMEABLE PAVING
-  ATTENUATION POND
-  IDB DRAIN
-  RIPARIAN WATERCOURSE

**NOTES:**

1. ALL DIMENSIONS ARE IN m UNLESS STATED OTHERWISE.
2. PROPOSED LAYOUT HAS BEEN PROVIDED BY ROBERT DOUGHTY CONSULTANCY, DRAWING NUMBER: 1202-1-MP02, DATED DECEMBER 2015.
3. DRAWING IS FOR PLANNING PURPOSES ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION.
4. FINAL LOCATION & ATTENUATION FEATURES TO BE REFINED AS MASTERPLAN IS DEVELOPED & IN LIAISON WITH SOUTH HOLLAND INTERNAL DRAINAGE BOARD ON RUNOFF RATES FROM SITE.

Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.  
 UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status  
**FOR INFORMATION**

**HOLBEACH FOOD ENTERPRISE ZONE (FEZ)**  
**PROPOSED SURFACE WATER DRAINAGE STRATEGY**




Date of 1st Issue	Designed	Drawn
23.01.2017	EE	jfds
A3 Scale	Checked	Approved
1:2500	EE	RF
Drawing Number	Revision	
<b>38615/4001/001</b>	-	



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DISCHARGE FROM SITE AT MAX OF 1.4 l/s/ha  
 BASED ON DISCUSSIONS WITH SOUTH  
 HOLLAND INTERNAL DRAINAGE BOARD

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Caversham Bridge House Waterman Place Reading RG1 8DN	38615 Holbeach FEZ	
Date 17/01/2017 11:54 File Holbeach FEZ Cascade_02...	Designed by eedney Checked by	
XP Solutions	Source Control 2016.1	

Cascade Summary of Results for Holbeach FEZ Research Development Zone  
South\_021216.srcx

**Upstream Structures**                      **Outflow To**                      **Overflow To**

(None) Holbeach FEZ Swale 1\_021216.srcx                      (None)

Half Drain Time : 184 minutes.


<b>Storm Event</b>	<b>Max Level (m)</b>	<b>Max Depth (m)</b>	<b>Max Infiltration (l/s)</b>	<b>Max Control (l/s)</b>	<b>Max Σ Outflow (l/s)</b>	<b>Max Volume (m³)</b>	<b>Status</b>
15 min Summer	0.245	0.245	0.0	9.2	9.2	113.5	O K
30 min Summer	0.291	0.291	0.0	10.3	10.3	149.0	O K
60 min Summer	0.331	0.331	0.0	11.1	11.1	180.0	O K
120 min Summer	0.355	0.355	0.0	11.5	11.5	199.0	O K
180 min Summer	0.359	0.359	0.0	11.6	11.6	202.1	O K
240 min Summer	0.359	0.359	0.0	11.6	11.6	201.8	O K
360 min Summer	0.352	0.352	0.0	11.5	11.5	196.5	O K
480 min Summer	0.343	0.343	0.0	11.3	11.3	189.4	O K
600 min Summer	0.333	0.333	0.0	11.1	11.1	181.4	O K
720 min Summer	0.322	0.322	0.0	10.9	10.9	173.2	O K
960 min Summer	0.302	0.302	0.0	10.5	10.5	157.4	O K
1440 min Summer	0.267	0.267	0.0	9.7	9.7	129.9	O K
2160 min Summer	0.227	0.227	0.0	8.8	8.8	99.0	O K
2880 min Summer	0.199	0.199	0.0	8.1	8.1	76.8	O K
4320 min Summer	0.160	0.160	0.0	6.9	6.9	49.7	O K
5760 min Summer	0.137	0.137	0.0	6.0	6.0	36.6	O K
7200 min Summer	0.123	0.123	0.0	5.2	5.2	29.7	O K

<b>Storm Event</b>	<b>Rain (mm/hr)</b>	<b>Flooded Volume (m³)</b>	<b>Discharge Volume (m³)</b>	<b>Time-Peak (mins)</b>
15 min Summer	130.597	0.0	119.1	18
30 min Summer	85.825	0.0	160.6	33
60 min Summer	53.779	0.0	204.5	62
120 min Summer	32.595	0.0	250.4	120
180 min Summer	24.012	0.0	277.8	150
240 min Summer	19.224	0.0	297.1	180
360 min Summer	13.954	0.0	324.1	248
480 min Summer	11.125	0.0	344.8	316
600 min Summer	9.325	0.0	361.4	386
720 min Summer	8.069	0.0	375.2	454
960 min Summer	6.417	0.0	397.6	588
1440 min Summer	4.640	0.0	430.2	848
2160 min Summer	3.350	0.0	463.7	1212
2880 min Summer	2.656	0.0	487.7	1584
4320 min Summer	1.912	0.0	521.1	2288
5760 min Summer	1.513	0.0	543.9	2992
7200 min Summer	1.261	0.0	560.7	3680

Cascade Summary of Results for Holbeach FEZ Research Development Zone  
South\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.113	0.113	0.0	4.5	4.5	24.9	O K
10080 min Summer	0.105	0.105	0.0	4.0	4.0	21.4	O K
15 min Winter	0.265	0.265	0.0	9.7	9.7	129.0	O K
30 min Winter	0.317	0.317	0.0	10.8	10.8	169.3	O K
60 min Winter	0.363	0.363	0.0	11.7	11.7	204.8	O K
120 min Winter	0.393	0.393	0.0	12.2	12.2	228.3	O K
180 min Winter	0.397	0.397	0.0	12.3	12.3	231.6	O K
240 min Winter	0.395	0.395	0.0	12.3	12.3	229.9	O K
360 min Winter	0.384	0.384	0.0	12.1	12.1	221.4	O K
480 min Winter	0.370	0.370	0.0	11.8	11.8	210.4	O K
600 min Winter	0.354	0.354	0.0	11.5	11.5	198.4	O K
720 min Winter	0.339	0.339	0.0	11.2	11.2	186.2	O K
960 min Winter	0.309	0.309	0.0	10.6	10.6	163.2	O K
1440 min Winter	0.260	0.260	0.0	9.6	9.6	124.9	O K
2160 min Winter	0.208	0.208	0.0	8.3	8.3	84.3	O K
2880 min Winter	0.173	0.173	0.0	7.3	7.3	58.4	O K
4320 min Winter	0.134	0.134	0.0	5.8	5.8	34.8	O K
5760 min Winter	0.115	0.115	0.0	4.6	4.6	25.7	O K
7200 min Winter	0.102	0.102	0.0	3.9	3.9	20.4	O K
8640 min Winter	0.093	0.093	0.0	3.3	3.3	17.0	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	573.6	4408
10080 min Summer	0.957	0.0	583.6	5144
15 min Winter	130.597	0.0	135.0	18
30 min Winter	85.825	0.0	181.5	32
60 min Winter	53.779	0.0	230.6	60
120 min Winter	32.595	0.0	282.1	116
180 min Winter	24.012	0.0	312.8	168
240 min Winter	19.224	0.0	334.5	190
360 min Winter	13.954	0.0	364.8	268
480 min Winter	11.125	0.0	388.1	342
600 min Winter	9.325	0.0	406.7	416
720 min Winter	8.069	0.0	422.3	488
960 min Winter	6.417	0.0	447.5	626
1440 min Winter	4.640	0.0	484.4	894
2160 min Winter	3.350	0.0	522.3	1256
2880 min Winter	2.656	0.0	549.6	1612
4320 min Winter	1.912	0.0	588.0	2252
5760 min Winter	1.513	0.0	614.7	2992
7200 min Winter	1.261	0.0	634.6	3680
8640 min Winter	1.086	0.0	650.0	4408

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Cascade Summary of Results for Holbeach FEZ Research Development Zone  
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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	0.086	0.086	0.0	2.9	2.9	14.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	0.957	0.0	662.3	5144

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Cascade Rainfall Details for Holbeach FEZ Research Development Zone  
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Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.540

**Time (mins) Area**  
**From: To: (ha)**

0 4 0.540

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Cascade Model Details for Holbeach FEZ Research Development Zone  
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Storage is Online Cover Level (m) 0.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	26.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	722.2	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000

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XP Solutions	Source Control 2016.1	

Cascade Summary of Results for Holbeach FEZ Packaging Storage  
Zone\_021216.srcx

**Upstream                      Outflow To                      Overflow To**  
**Structures**

(None) Holbeach FEZ Swale 1\_021216.srcx                      (None)

Half Drain Time : 242 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.267	0.267	0.0	9.7	9.7	150.2	O K
30 min Summer	0.320	0.320	0.0	10.8	10.8	197.7	O K
60 min Summer	0.367	0.367	0.0	11.8	11.8	240.6	O K
120 min Summer	0.401	0.401	0.0	12.4	12.4	270.8	O K
180 min Summer	0.408	0.408	0.0	12.5	12.5	277.2	O K
240 min Summer	0.409	0.409	0.0	12.5	12.5	277.9	O K
360 min Summer	0.404	0.404	0.0	12.4	12.4	273.4	O K
480 min Summer	0.396	0.396	0.0	12.3	12.3	266.8	O K
600 min Summer	0.387	0.387	0.0	12.1	12.1	258.6	O K
720 min Summer	0.378	0.378	0.0	11.9	11.9	249.8	O K
960 min Summer	0.358	0.358	0.0	11.6	11.6	231.8	O K
1440 min Summer	0.321	0.321	0.0	10.9	10.9	198.9	O K
2160 min Summer	0.277	0.277	0.0	9.9	9.9	159.1	O K
2880 min Summer	0.243	0.243	0.0	9.2	9.2	129.0	O K
4320 min Summer	0.197	0.197	0.0	8.0	8.0	87.5	O K
5760 min Summer	0.167	0.167	0.0	7.1	7.1	62.4	O K
7200 min Summer	0.145	0.145	0.0	6.4	6.4	47.6	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	156.3	18
30 min Summer	85.825	0.0	210.1	33
60 min Summer	53.779	0.0	267.0	62
120 min Summer	32.595	0.0	326.5	120
180 min Summer	24.012	0.0	362.1	168
240 min Summer	19.224	0.0	387.2	196
360 min Summer	13.954	0.0	422.3	258
480 min Summer	11.125	0.0	449.2	328
600 min Summer	9.325	0.0	470.8	396
720 min Summer	8.069	0.0	488.8	464
960 min Summer	6.417	0.0	518.1	600
1440 min Summer	4.640	0.0	560.7	866
2160 min Summer	3.350	0.0	604.6	1252
2880 min Summer	2.656	0.0	636.2	1616
4320 min Summer	1.912	0.0	680.6	2332
5760 min Summer	1.513	0.0	711.4	3048
7200 min Summer	1.261	0.0	734.3	3744



Cascade Summary of Results for Holbeach FEZ Packaging Storage  
Zone\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.133	0.133	0.0	5.7	5.7	39.7	O K
10080 min Summer	0.123	0.123	0.0	5.2	5.2	34.1	O K
15 min Winter	0.289	0.289	0.0	10.2	10.2	170.4	O K
30 min Winter	0.349	0.349	0.0	11.4	11.4	224.0	O K
60 min Winter	0.403	0.403	0.0	12.4	12.4	273.0	O K
120 min Winter	0.444	0.444	0.0	13.1	13.1	309.5	O K
180 min Winter	0.454	0.454	0.0	13.3	13.3	318.9	O K
240 min Winter	0.453	0.453	0.0	13.3	13.3	317.9	O K
360 min Winter	0.445	0.445	0.0	13.1	13.1	310.6	O K
480 min Winter	0.434	0.434	0.0	12.9	12.9	300.4	O K
600 min Winter	0.420	0.420	0.0	12.7	12.7	288.0	O K
720 min Winter	0.405	0.405	0.0	12.4	12.4	274.7	O K
960 min Winter	0.376	0.376	0.0	11.9	11.9	248.3	O K
1440 min Winter	0.324	0.324	0.0	10.9	10.9	201.3	O K
2160 min Winter	0.263	0.263	0.0	9.6	9.6	147.1	O K
2880 min Winter	0.221	0.221	0.0	8.6	8.6	108.5	O K
4320 min Winter	0.166	0.166	0.0	7.1	7.1	61.8	O K
5760 min Winter	0.136	0.136	0.0	6.0	6.0	41.9	O K
7200 min Winter	0.121	0.121	0.0	5.0	5.0	32.9	O K
8640 min Winter	0.110	0.110	0.0	4.3	4.3	27.1	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	752.0	4416
10080 min Summer	0.957	0.0	766.1	5144
15 min Winter	130.597	0.0	176.9	18
30 min Winter	85.825	0.0	237.1	32
60 min Winter	53.779	0.0	300.8	62
120 min Winter	32.595	0.0	367.6	118
180 min Winter	24.012	0.0	407.4	172
240 min Winter	19.224	0.0	435.6	222
360 min Winter	13.954	0.0	475.0	276
480 min Winter	11.125	0.0	505.3	352
600 min Winter	9.325	0.0	529.5	428
720 min Winter	8.069	0.0	549.8	504
960 min Winter	6.417	0.0	582.7	646
1440 min Winter	4.640	0.0	630.8	922
2160 min Winter	3.350	0.0	680.6	1300
2880 min Winter	2.656	0.0	716.5	1672
4320 min Winter	1.912	0.0	767.4	2376
5760 min Winter	1.513	0.0	803.0	3008
7200 min Winter	1.261	0.0	829.9	3744
8640 min Winter	1.086	0.0	851.0	4416

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Cascade Summary of Results for Holbeach FEZ Packaging Storage  
Zone\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	0.101	0.101	0.0	3.8	3.8	23.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	0.957	0.0	868.0	5144

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Cascade Rainfall Details for Holbeach FEZ Packaging Storage  
Zone\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.700

Time (mins)		Area
From:	To:	(ha)
0	4	0.700

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Cascade Model Details for Holbeach FEZ Packaging Storage Zone\_021216.srcx


Storage is Online Cover Level (m) 0.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	30.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	833.3	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.450

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000

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Cascade Summary of Results for Holbeach FEZ Engineering Zone\_021216.srcx

**Upstream Structures**                      **Outflow To**                      **Overflow To**

(None) Holbeach FEZ Swale 1\_021216.srcx                      (None)

Half Drain Time : 252 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.232	0.232	0.0	8.9	8.9	138.5	O K
30 min Summer	0.275	0.275	0.0	9.9	9.9	183.6	O K
60 min Summer	0.314	0.314	0.0	10.7	10.7	224.7	O K
120 min Summer	0.342	0.342	0.0	11.3	11.3	254.5	O K
180 min Summer	0.349	0.349	0.0	11.4	11.4	261.5	O K
240 min Summer	0.350	0.350	0.0	11.4	11.4	262.6	O K
360 min Summer	0.347	0.347	0.0	11.4	11.4	259.3	O K
480 min Summer	0.342	0.342	0.0	11.3	11.3	253.8	O K
600 min Summer	0.335	0.335	0.0	11.1	11.1	246.7	O K
720 min Summer	0.327	0.327	0.0	11.0	11.0	238.8	O K
960 min Summer	0.312	0.312	0.0	10.7	10.7	222.5	O K
1440 min Summer	0.283	0.283	0.0	10.1	10.1	191.8	O K
2160 min Summer	0.247	0.247	0.0	9.3	9.3	154.0	O K
2880 min Summer	0.219	0.219	0.0	8.6	8.6	125.2	O K
4320 min Summer	0.181	0.181	0.0	7.5	7.5	85.9	O K
5760 min Summer	0.154	0.154	0.0	6.7	6.7	62.5	O K
7200 min Summer	0.138	0.138	0.0	6.1	6.1	49.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	144.0	18
30 min Summer	85.825	0.0	194.7	33
60 min Summer	53.779	0.0	248.3	62
120 min Summer	32.595	0.0	304.3	120
180 min Summer	24.012	0.0	337.8	172
240 min Summer	19.224	0.0	361.4	198
360 min Summer	13.954	0.0	394.3	260
480 min Summer	11.125	0.0	419.5	328
600 min Summer	9.325	0.0	439.7	398
720 min Summer	8.069	0.0	456.5	464
960 min Summer	6.417	0.0	483.8	604
1440 min Summer	4.640	0.0	523.3	866
2160 min Summer	3.350	0.0	563.7	1252
2880 min Summer	2.656	0.0	592.5	1616
4320 min Summer	1.912	0.0	632.3	2332
5760 min Summer	1.513	0.0	659.3	3008
7200 min Summer	1.261	0.0	678.9	3744

Cascade Summary of Results for Holbeach FEZ Engineering Zone\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.126	0.126	0.0	5.3	5.3	41.8	O K
10080 min Summer	0.117	0.117	0.0	4.8	4.8	36.1	O K
15 min Winter	0.250	0.250	0.0	9.3	9.3	157.6	O K
30 min Winter	0.298	0.298	0.0	10.4	10.4	208.4	O K
60 min Winter	0.343	0.343	0.0	11.3	11.3	255.3	O K
120 min Winter	0.377	0.377	0.0	11.9	11.9	290.9	O K
180 min Winter	0.387	0.387	0.0	12.1	12.1	300.9	O K
240 min Winter	0.386	0.386	0.0	12.1	12.1	300.8	O K
360 min Winter	0.381	0.381	0.0	12.0	12.0	294.6	O K
480 min Winter	0.372	0.372	0.0	11.8	11.8	285.8	O K
600 min Winter	0.362	0.362	0.0	11.7	11.7	274.8	O K
720 min Winter	0.350	0.350	0.0	11.4	11.4	262.9	O K
960 min Winter	0.327	0.327	0.0	11.0	11.0	238.6	O K
1440 min Winter	0.285	0.285	0.0	10.1	10.1	194.5	O K
2160 min Winter	0.236	0.236	0.0	9.0	9.0	142.8	O K
2880 min Winter	0.201	0.201	0.0	8.1	8.1	105.6	O K
4320 min Winter	0.153	0.153	0.0	6.7	6.7	61.8	O K
5760 min Winter	0.130	0.130	0.0	5.6	5.6	44.3	O K
7200 min Winter	0.116	0.116	0.0	4.7	4.7	35.1	O K
8640 min Winter	0.105	0.105	0.0	4.1	4.1	29.0	O K
10080 min Winter	0.097	0.097	0.0	3.6	3.6	24.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	693.6	4416
10080 min Summer	0.957	0.0	704.9	5144
15 min Winter	130.597	0.0	163.4	18
30 min Winter	85.825	0.0	220.2	32
60 min Winter	53.779	0.0	280.2	62
120 min Winter	32.595	0.0	343.0	118
180 min Winter	24.012	0.0	380.6	174
240 min Winter	19.224	0.0	407.1	224
360 min Winter	13.954	0.0	444.0	278
480 min Winter	11.125	0.0	472.4	354
600 min Winter	9.325	0.0	495.1	430
720 min Winter	8.069	0.0	514.1	506
960 min Winter	6.417	0.0	544.7	648
1440 min Winter	4.640	0.0	589.4	924
2160 min Winter	3.350	0.0	635.3	1316
2880 min Winter	2.656	0.0	668.2	1672
4320 min Winter	1.912	0.0	714.2	2340
5760 min Winter	1.513	0.0	745.9	3048
7200 min Winter	1.261	0.0	769.3	3744
8640 min Winter	1.086	0.0	787.2	4416
10080 min Winter	0.957	0.0	801.2	5144

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Cascade Rainfall Details for Holbeach FEZ Engineering Zone\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.660

Time (mins)		Area
From:	To:	(ha)
0	4	0.660

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Cascade Model Details for Holbeach FEZ Engineering Zone\_021216.srcx

Storage is Online Cover Level (m) 0.550


Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	35.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	972.2	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000



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Cascade Summary of Results for Holbeach FEZ Crop Development  
Zone\_021216.srcx


**Upstream                      Outflow To                      Overflow To**  
**Structures**

(None) Holbeach FEZ Swale 1\_021216.srcx                      (None)

Half Drain Time : 394 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.219	0.219	0.0	8.6	8.6	207.9	O K
30 min Summer	0.260	0.260	0.0	9.6	9.6	278.5	O K
60 min Summer	0.299	0.299	0.0	10.4	10.4	346.7	O K
120 min Summer	0.333	0.333	0.0	11.1	11.1	405.3	O K
180 min Summer	0.346	0.346	0.0	11.4	11.4	428.8	O K
240 min Summer	0.351	0.351	0.0	11.5	11.5	437.5	O K
360 min Summer	0.352	0.352	0.0	11.5	11.5	437.7	O K
480 min Summer	0.350	0.350	0.0	11.4	11.4	435.7	O K
600 min Summer	0.348	0.348	0.0	11.4	11.4	431.6	O K
720 min Summer	0.345	0.345	0.0	11.3	11.3	425.8	O K
960 min Summer	0.336	0.336	0.0	11.2	11.2	411.1	O K
1440 min Summer	0.317	0.317	0.0	10.8	10.8	377.8	O K
2160 min Summer	0.289	0.289	0.0	10.2	10.2	328.9	O K
2880 min Summer	0.265	0.265	0.0	9.7	9.7	286.6	O K
4320 min Summer	0.226	0.226	0.0	8.8	8.8	220.0	O K
5760 min Summer	0.199	0.199	0.0	8.1	8.1	172.3	O K
7200 min Summer	0.178	0.178	0.0	7.5	7.5	137.6	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	213.2	19
30 min Summer	85.825	0.0	289.1	33
60 min Summer	53.779	0.0	369.6	62
120 min Summer	32.595	0.0	453.6	122
180 min Summer	24.012	0.0	503.7	182
240 min Summer	19.224	0.0	539.0	240
360 min Summer	13.954	0.0	588.3	308
480 min Summer	11.125	0.0	626.0	370
600 min Summer	9.325	0.0	656.1	432
720 min Summer	8.069	0.0	681.2	500
960 min Summer	6.417	0.0	721.8	636
1440 min Summer	4.640	0.0	780.4	910
2160 min Summer	3.350	0.0	840.3	1316
2880 min Summer	2.656	0.0	882.7	1700
4320 min Summer	1.912	0.0	940.8	2460
5760 min Summer	1.513	0.0	979.7	3168
7200 min Summer	1.261	0.0	1007.3	3888

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Cascade Summary of Results for Holbeach FEZ Crop Development  
Zone\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.161	0.161	0.0	6.9	6.9	112.6	O K
10080 min Summer	0.148	0.148	0.0	6.5	6.5	94.7	O K
15 min Winter	0.236	0.236	0.0	9.0	9.0	236.6	O K
30 min Winter	0.282	0.282	0.0	10.0	10.0	316.2	O K
60 min Winter	0.326	0.326	0.0	11.0	11.0	393.5	O K
120 min Winter	0.365	0.365	0.0	11.7	11.7	460.8	O K
180 min Winter	0.381	0.381	0.0	12.0	12.0	489.3	O K
240 min Winter	0.388	0.388	0.0	12.1	12.1	501.4	O K
360 min Winter	0.389	0.389	0.0	12.2	12.2	503.0	O K
480 min Winter	0.386	0.386	0.0	12.1	12.1	496.8	O K
600 min Winter	0.382	0.382	0.0	12.0	12.0	490.4	O K
720 min Winter	0.377	0.377	0.0	11.9	11.9	481.3	O K
960 min Winter	0.364	0.364	0.0	11.7	11.7	458.9	O K
1440 min Winter	0.335	0.335	0.0	11.1	11.1	409.0	O K
2160 min Winter	0.295	0.295	0.0	10.3	10.3	338.7	O K
2880 min Winter	0.261	0.261	0.0	9.6	9.6	279.5	O K
4320 min Winter	0.210	0.210	0.0	8.4	8.4	191.6	O K
5760 min Winter	0.176	0.176	0.0	7.4	7.4	134.0	O K
7200 min Winter	0.150	0.150	0.0	6.6	6.6	98.3	O K
8640 min Winter	0.135	0.135	0.0	5.9	5.9	79.4	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	1027.8	4584
10080 min Summer	0.957	0.0	1043.0	5248
15 min Winter	130.597	0.0	242.2	18
30 min Winter	85.825	0.0	327.3	33
60 min Winter	53.779	0.0	417.5	62
120 min Winter	32.595	0.0	511.7	120
180 min Winter	24.012	0.0	567.9	178
240 min Winter	19.224	0.0	607.6	234
360 min Winter	13.954	0.0	662.9	340
480 min Winter	11.125	0.0	705.3	386
600 min Winter	9.325	0.0	739.2	460
720 min Winter	8.069	0.0	767.5	538
960 min Winter	6.417	0.0	813.3	692
1440 min Winter	4.640	0.0	879.6	982
2160 min Winter	3.350	0.0	947.8	1404
2880 min Winter	2.656	0.0	996.2	1792
4320 min Winter	1.912	0.0	1063.7	2548
5760 min Winter	1.513	0.0	1109.6	3232
7200 min Winter	1.261	0.0	1143.1	3896
8640 min Winter	1.086	0.0	1168.3	4576

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Cascade Summary of Results for Holbeach FEZ Crop Development  
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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	0.124	0.124	0.0	5.2	5.2	67.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	0.957	0.0	1187.8	5248

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Cascade Rainfall Details for Holbeach FEZ Crop Development Zone\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.990

Time (mins)		Area
From:	To:	(ha)
0	4	0.990

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Cascade Model Details for Holbeach FEZ Crop Development Zone\_021216.srcx


Storage is Online Cover Level (m) 0.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	58.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	1611.1	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000

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Cascade Summary of Results for Holbeach FEZ Swale 1\_021216.srcx

Upstream Structures	Outflow To	Overflow To
Holbeach FEZ Research Development Zone_South_021216.srcx	Holbeach FEZ Pond 1_021216.srcx	(None)
Holbeach FEZ Packaging Storage Zone_021216.srcx		
Holbeach FEZ Engineering Zone_021216.srcx		
Holbeach FEZ Crop Development Zone_021216.srcx		

Half Drain Time : 40 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ (l/s)	Max Outflow Volume (m³)	Status
15 min Summer	0.332	0.332	0.0	33.3	33.3	57.6	O K
30 min Summer	0.381	0.381	0.0	36.5	36.5	80.4	O K
60 min Summer	0.428	0.428	0.0	39.3	39.3	106.9	O K
120 min Summer	0.471	0.471	0.0	41.7	41.7	135.3	O K
180 min Summer	0.493	0.493	0.0	42.9	42.9	151.0	O K
240 min Summer	0.506	0.506	0.0	43.6	43.6	160.5	O K
360 min Summer	0.518	0.518	0.0	44.2	44.2	169.4	O K
480 min Summer	0.520	0.520	0.0	44.3	44.3	171.0	O K
600 min Summer	0.514	0.514	0.0	44.1	44.1	166.6	O K
720 min Summer	0.508	0.508	0.0	43.7	43.7	162.0	O K
960 min Summer	0.495	0.495	0.0	43.0	43.0	152.2	O K
1440 min Summer	0.467	0.467	0.0	41.5	41.5	132.7	O K
2160 min Summer	0.426	0.426	0.0	39.2	39.2	106.1	O K
2880 min Summer	0.389	0.389	0.0	37.0	37.0	84.4	O K
4320 min Summer	0.327	0.327	0.0	32.9	32.9	55.6	O K
5760 min Summer	0.281	0.281	0.0	29.6	29.6	38.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	681.6	80
30 min Summer	85.825	0.0	918.9	113
60 min Summer	53.779	0.0	1170.0	154
120 min Summer	32.595	0.0	1432.6	212
180 min Summer	24.012	0.0	1589.3	256
240 min Summer	19.224	0.0	1700.1	300
360 min Summer	13.954	0.0	1854.6	378
480 min Summer	11.125	0.0	1973.1	480
600 min Summer	9.325	0.0	2067.9	548
720 min Summer	8.069	0.0	2147.1	604
960 min Summer	6.417	0.0	2275.3	722
1440 min Summer	4.640	0.0	2461.6	966
2160 min Summer	3.350	0.0	2653.2	1332
2880 min Summer	2.656	0.0	2790.2	1696
4320 min Summer	1.912	0.0	2981.3	2380
5760 min Summer	1.513	0.0	3112.1	3064

Cascade Summary of Results for Holbeach FEZ Swale 1\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	0.251	0.251	0.0	26.8	26.8	29.5	O K
8640 min Summer	0.233	0.233	0.0	24.0	24.0	24.6	O K
10080 min Summer	0.218	0.218	0.0	21.9	21.9	21.2	O K
15 min Winter	0.352	0.352	0.0	34.6	34.6	66.3	O K
30 min Winter	0.405	0.405	0.0	37.9	37.9	93.3	O K
60 min Winter	0.455	0.455	0.0	40.9	40.9	124.5	O K
120 min Winter	0.502	0.502	0.0	43.4	43.4	157.9	O K
180 min Winter	0.527	0.527	0.0	44.7	44.7	176.4	O K
240 min Winter	0.541	0.541	0.0	45.4	45.4	187.6	O K
360 min Winter	0.552	0.552	0.0	46.0	46.0	198.8	FLOOD
480 min Winter	0.554	0.554	0.0	46.1	46.1	202.4	FLOOD
600 min Winter	0.552	0.552	0.0	46.0	46.0	199.0	FLOOD
720 min Winter	0.545	0.545	0.0	45.6	45.6	191.2	O K
960 min Winter	0.526	0.526	0.0	44.6	44.6	175.8	O K
1440 min Winter	0.484	0.484	0.0	42.4	42.4	144.3	O K
2160 min Winter	0.420	0.420	0.0	38.8	38.8	102.3	O K
2880 min Winter	0.365	0.365	0.0	35.4	35.4	72.4	O K
4320 min Winter	0.283	0.283	0.0	29.7	29.7	39.0	O K
5760 min Winter	0.240	0.240	0.0	25.2	25.2	26.5	O K
7200 min Winter	0.216	0.216	0.0	21.6	21.6	20.7	O K
8640 min Winter	0.198	0.198	0.0	18.9	18.9	16.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.261	0.0	3208.2	3744
8640 min Summer	1.086	0.0	3281.5	4464
10080 min Summer	0.957	0.0	3338.8	5152
15 min Winter	130.597	0.0	772.3	89
30 min Winter	85.825	0.0	1038.1	125
60 min Winter	53.779	0.0	1319.5	170
120 min Winter	32.595	0.0	1613.9	228
180 min Winter	24.012	0.0	1789.7	276
240 min Winter	19.224	0.0	1914.0	318
360 min Winter	13.954	1.9	2087.5	400
480 min Winter	11.125	4.0	2220.6	484
600 min Winter	9.325	2.1	2327.2	582
720 min Winter	8.069	0.0	2416.4	652
960 min Winter	6.417	0.0	2560.8	764
1440 min Winter	4.640	0.0	2771.3	1024
2160 min Winter	3.350	0.0	2988.5	1400
2880 min Winter	2.656	0.0	3144.7	1748
4320 min Winter	1.912	0.0	3364.6	2396
5760 min Winter	1.513	0.0	3517.2	3056
7200 min Winter	1.261	0.0	3630.9	3752
8640 min Winter	1.086	0.0	3719.2	4496


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Cascade Summary of Results for Holbeach FEZ Swale 1\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	0.183	0.183	0.0	16.7	16.7	14.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	0.957	0.0	3789.5	5208



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Cascade Rainfall Details for Holbeach FEZ Swale 1\_021216.srcx


Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.200

**Time (mins) Area**  
**From: To: (ha)**

0 4 0.200

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Cascade Model Details for Holbeach FEZ Swale 1\_021216.srcx


Storage is Online Cover Level (m) 0.550

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	210.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.2		

Orifice Outflow Control

Diameter (m) 0.180 Discharge Coefficient 0.600 Invert Level (m) 0.000

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Cascade Summary of Results for Holbeach FEZ Processing and Development Zone  
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**Upstream Structures**                      **Outflow To**                      **Overflow To**

(None) Holbeach FEZ Swale 3\_021216.srcx                      (None)

Half Drain Time : 261 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.226	0.226	0.0	8.8	8.8	149.3	O K
30 min Summer	0.269	0.269	0.0	9.8	9.8	198.3	O K
60 min Summer	0.309	0.309	0.0	10.6	10.6	243.7	O K
120 min Summer	0.339	0.339	0.0	11.2	11.2	277.9	O K
180 min Summer	0.347	0.347	0.0	11.4	11.4	287.5	O K
240 min Summer	0.349	0.349	0.0	11.4	11.4	289.0	O K
360 min Summer	0.346	0.346	0.0	11.4	11.4	286.4	O K
480 min Summer	0.342	0.342	0.0	11.3	11.3	281.8	O K
600 min Summer	0.336	0.336	0.0	11.2	11.2	275.3	O K
720 min Summer	0.330	0.330	0.0	11.0	11.0	267.7	O K
960 min Summer	0.316	0.316	0.0	10.8	10.8	251.7	O K
1440 min Summer	0.288	0.288	0.0	10.2	10.2	220.2	O K
2160 min Summer	0.253	0.253	0.0	9.4	9.4	180.5	O K
2880 min Summer	0.226	0.226	0.0	8.8	8.8	149.3	O K
4320 min Summer	0.187	0.187	0.0	7.7	7.7	105.3	O K
5760 min Summer	0.161	0.161	0.0	7.0	7.0	78.0	O K
7200 min Summer	0.143	0.143	0.0	6.4	6.4	61.2	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	154.7	18
30 min Summer	85.825	0.0	209.3	33
60 min Summer	53.779	0.0	266.9	62
120 min Summer	32.595	0.0	327.2	122
180 min Summer	24.012	0.0	363.2	180
240 min Summer	19.224	0.0	388.6	206
360 min Summer	13.954	0.0	424.0	268
480 min Summer	11.125	0.0	451.1	334
600 min Summer	9.325	0.0	472.8	404
720 min Summer	8.069	0.0	490.9	470
960 min Summer	6.417	0.0	520.2	608
1440 min Summer	4.640	0.0	562.6	878
2160 min Summer	3.350	0.0	606.1	1256
2880 min Summer	2.656	0.0	637.0	1640
4320 min Summer	1.912	0.0	679.8	2336
5760 min Summer	1.513	0.0	708.7	3056
7200 min Summer	1.261	0.0	729.6	3744

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Cascade Summary of Results for Holbeach FEZ Processing and Development Zone  
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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.131	0.131	0.0	5.6	5.6	51.4	O K
10080 min Summer	0.122	0.122	0.0	5.1	5.1	44.5	O K
15 min Winter	0.244	0.244	0.0	9.2	9.2	169.9	O K
30 min Winter	0.292	0.292	0.0	10.3	10.3	225.1	O K
60 min Winter	0.338	0.338	0.0	11.2	11.2	276.7	O K
120 min Winter	0.373	0.373	0.0	11.9	11.9	317.3	O K
180 min Winter	0.385	0.385	0.0	12.1	12.1	330.2	O K
240 min Winter	0.386	0.386	0.0	12.1	12.1	331.9	O K
360 min Winter	0.381	0.381	0.0	12.0	12.0	325.9	O K
480 min Winter	0.374	0.374	0.0	11.9	11.9	318.4	O K
600 min Winter	0.365	0.365	0.0	11.7	11.7	308.1	O K
720 min Winter	0.355	0.355	0.0	11.5	11.5	296.6	O K
960 min Winter	0.334	0.334	0.0	11.1	11.1	272.4	O K
1440 min Winter	0.294	0.294	0.0	10.3	10.3	226.9	O K
2160 min Winter	0.246	0.246	0.0	9.2	9.2	171.8	O K
2880 min Winter	0.210	0.210	0.0	8.3	8.3	130.9	O K
4320 min Winter	0.162	0.162	0.0	7.0	7.0	79.1	O K
5760 min Winter	0.136	0.136	0.0	5.9	5.9	55.4	O K
7200 min Winter	0.121	0.121	0.0	5.0	5.0	43.8	O K
8640 min Winter	0.110	0.110	0.0	4.3	4.3	36.1	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	745.4	4416
10080 min Summer	0.957	0.0	757.4	5152
15 min Winter	130.597	0.0	175.6	18
30 min Winter	85.825	0.0	236.7	33
60 min Winter	53.779	0.0	301.3	62
120 min Winter	32.595	0.0	368.8	118
180 min Winter	24.012	0.0	409.2	174
240 min Winter	19.224	0.0	437.7	228
360 min Winter	13.954	0.0	477.5	282
480 min Winter	11.125	0.0	508.0	360
600 min Winter	9.325	0.0	532.4	436
720 min Winter	8.069	0.0	552.8	512
960 min Winter	6.417	0.0	585.8	656
1440 min Winter	4.640	0.0	633.8	938
2160 min Winter	3.350	0.0	683.1	1324
2880 min Winter	2.656	0.0	718.4	1700
4320 min Winter	1.912	0.0	767.8	2380
5760 min Winter	1.513	0.0	801.8	3056
7200 min Winter	1.261	0.0	826.8	3752
8640 min Winter	1.086	0.0	846.0	4496

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Cascade Summary of Results for Holbeach FEZ Processing and Development Zone  
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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.101	0.101	0.0	3.8	3.8	30.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.957	0.0	861.1	5240

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Cascade Rainfall Details for Holbeach FEZ Processing and Development Zone  
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Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.710

**Time (mins) Area**  
**From: To: (ha)**

0 4 0.710

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Cascade Model Details for Holbeach FEZ Processing and Development Zone  
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Storage is Online Cover Level (m) 0.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	40.0
Membrane Percolation (mm/hr)	1000	Length (m)	95.0
Max Percolation (l/s)	1055.6	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000

Cascade Summary of Results for Holbeach FEZ Education Zone\_021216.srcx

**Upstream Structures**                      **Outflow To**                      **Overflow To**

(None) Holbeach FEZ Swale 3\_021216.srcx                      (None)

Half Drain Time : 164 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.224	0.224	0.0	8.7	8.7	97.9	O K
30 min Summer	0.276	0.276	0.0	9.9	9.9	127.5	O K
60 min Summer	0.319	0.319	0.0	10.8	10.8	152.7	O K
120 min Summer	0.344	0.344	0.0	11.3	11.3	166.6	O K
180 min Summer	0.349	0.349	0.0	11.4	11.4	169.6	O K
240 min Summer	0.348	0.348	0.0	11.4	11.4	169.4	O K
360 min Summer	0.340	0.340	0.0	11.2	11.2	164.5	O K
480 min Summer	0.329	0.329	0.0	11.0	11.0	158.2	O K
600 min Summer	0.317	0.317	0.0	10.8	10.8	151.2	O K
720 min Summer	0.305	0.305	0.0	10.5	10.5	144.1	O K
960 min Summer	0.281	0.281	0.0	10.0	10.0	130.7	O K
1440 min Summer	0.242	0.242	0.0	9.2	9.2	108.1	O K
2160 min Summer	0.200	0.200	0.0	8.1	8.1	84.0	O K
2880 min Summer	0.172	0.172	0.0	7.3	7.3	67.5	O K
4320 min Summer	0.138	0.138	0.0	6.1	6.1	48.2	O K
5760 min Summer	0.121	0.121	0.0	5.0	5.0	38.2	O K
7200 min Summer	0.109	0.109	0.0	4.3	4.3	31.4	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	102.9	18
30 min Summer	85.825	0.0	138.3	33
60 min Summer	53.779	0.0	175.7	62
120 min Summer	32.595	0.0	214.8	112
180 min Summer	24.012	0.0	238.2	140
240 min Summer	19.224	0.0	254.7	172
360 min Summer	13.954	0.0	277.8	242
480 min Summer	11.125	0.0	295.5	310
600 min Summer	9.325	0.0	309.7	378
720 min Summer	8.069	0.0	321.5	444
960 min Summer	6.417	0.0	340.8	578
1440 min Summer	4.640	0.0	368.8	834
2160 min Summer	3.350	0.0	397.8	1192
2880 min Summer	2.656	0.0	418.6	1556
4320 min Summer	1.912	0.0	447.9	2252
5760 min Summer	1.513	0.0	468.3	2992
7200 min Summer	1.261	0.0	483.4	3680



Cascade Summary of Results for Holbeach FEZ Education Zone\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.101	0.101	0.0	3.8	3.8	26.8	O K
10080 min Summer	0.094	0.094	0.0	3.4	3.4	23.3	O K
15 min Winter	0.247	0.247	0.0	9.3	9.3	111.0	O K
30 min Winter	0.306	0.306	0.0	10.6	10.6	144.7	O K
60 min Winter	0.356	0.356	0.0	11.5	11.5	173.7	O K
120 min Winter	0.386	0.386	0.0	12.1	12.1	191.0	O K
180 min Winter	0.388	0.388	0.0	12.1	12.1	192.5	O K
240 min Winter	0.386	0.386	0.0	12.1	12.1	191.3	O K
360 min Winter	0.372	0.372	0.0	11.8	11.8	182.9	O K
480 min Winter	0.354	0.354	0.0	11.5	11.5	172.7	O K
600 min Winter	0.335	0.335	0.0	11.1	11.1	162.0	O K
720 min Winter	0.317	0.317	0.0	10.8	10.8	151.5	O K
960 min Winter	0.284	0.284	0.0	10.1	10.1	132.2	O K
1440 min Winter	0.231	0.231	0.0	8.9	8.9	101.7	O K
2160 min Winter	0.179	0.179	0.0	7.5	7.5	71.4	O K
2880 min Winter	0.147	0.147	0.0	6.5	6.5	53.1	O K
4320 min Winter	0.119	0.119	0.0	4.9	4.9	37.0	O K
5760 min Winter	0.103	0.103	0.0	3.9	3.9	27.9	O K
7200 min Winter	0.093	0.093	0.0	3.3	3.3	22.5	O K
8640 min Winter	0.085	0.085	0.0	2.9	2.9	18.9	O K
10080 min Winter	0.079	0.079	0.0	2.5	2.5	16.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	495.2	4416
10080 min Summer	0.957	0.0	504.7	5144
15 min Winter	130.597	0.0	116.5	18
30 min Winter	85.825	0.0	156.1	32
60 min Winter	53.779	0.0	197.9	60
120 min Winter	32.595	0.0	241.8	116
180 min Winter	24.012	0.0	268.0	146
240 min Winter	19.224	0.0	286.5	184
360 min Winter	13.954	0.0	312.4	260
480 min Winter	11.125	0.0	332.3	334
600 min Winter	9.325	0.0	348.3	406
720 min Winter	8.069	0.0	361.6	476
960 min Winter	6.417	0.0	383.3	614
1440 min Winter	4.640	0.0	414.9	868
2160 min Winter	3.350	0.0	447.7	1236
2880 min Winter	2.656	0.0	471.4	1584
4320 min Winter	1.912	0.0	504.9	2292
5760 min Winter	1.513	0.0	528.5	3000
7200 min Winter	1.261	0.0	546.3	3744
8640 min Winter	1.086	0.0	560.3	4416
10080 min Winter	0.957	0.0	571.6	5144

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Caversham Bridge House Waterman Place Reading RG1 8DN	38615 Holbeach FEZ	
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XP Solutions	Source Control 2016.1	


Cascade Rainfall Details for Holbeach FEZ Education Zone\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.460

Time (mins)		Area
From:	To:	(ha)
0	4	0.460

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XP Solutions	Source Control 2016.1	

Cascade Model Details for Holbeach FEZ Education Zone\_021216.srcx


Storage is Online Cover Level (m) 0.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	35.0
Membrane Percolation (mm/hr)	1000	Length (m)	55.0
Max Percolation (l/s)	534.7	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000

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Cascade Summary of Results for Holbeach FEZ University Area\_021216.srcx


**Upstream Structures**                      **Outflow To**                      **Overflow To**

(None) Holbeach FEZ Swale 3\_021216.srcx                      (None)

Half Drain Time : 195 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.198	0.198	0.0	8.0	8.0	98.5	O K
30 min Summer	0.231	0.231	0.0	8.9	8.9	131.2	O K
60 min Summer	0.260	0.260	0.0	9.6	9.6	160.2	O K
120 min Summer	0.279	0.279	0.0	10.0	10.0	179.2	O K
180 min Summer	0.283	0.283	0.0	10.1	10.1	183.0	O K
240 min Summer	0.283	0.283	0.0	10.1	10.1	183.5	O K
360 min Summer	0.280	0.280	0.0	10.0	10.0	180.0	O K
480 min Summer	0.274	0.274	0.0	9.9	9.9	174.6	O K
600 min Summer	0.268	0.268	0.0	9.7	9.7	168.2	O K
720 min Summer	0.261	0.261	0.0	9.6	9.6	161.3	O K
960 min Summer	0.247	0.247	0.0	9.3	9.3	147.5	O K
1440 min Summer	0.223	0.223	0.0	8.7	8.7	122.8	O K
2160 min Summer	0.194	0.194	0.0	7.9	7.9	94.5	O K
2880 min Summer	0.172	0.172	0.0	7.3	7.3	74.5	O K
4320 min Summer	0.142	0.142	0.0	6.3	6.3	50.8	O K
5760 min Summer	0.126	0.126	0.0	5.3	5.3	39.5	O K
7200 min Summer	0.114	0.114	0.0	4.6	4.6	32.3	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	103.2	18
30 min Summer	85.825	0.0	140.8	33
60 min Summer	53.779	0.0	180.5	62
120 min Summer	32.595	0.0	222.0	120
180 min Summer	24.012	0.0	246.8	154
240 min Summer	19.224	0.0	264.2	184
360 min Summer	13.954	0.0	288.5	250
480 min Summer	11.125	0.0	307.0	318
600 min Summer	9.325	0.0	321.8	386
720 min Summer	8.069	0.0	334.1	456
960 min Summer	6.417	0.0	354.0	588
1440 min Summer	4.640	0.0	382.5	850
2160 min Summer	3.350	0.0	411.5	1212
2880 min Summer	2.656	0.0	431.7	1584
4320 min Summer	1.912	0.0	459.1	2252
5760 min Summer	1.513	0.0	476.9	2992
7200 min Summer	1.261	0.0	489.2	3680

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Cascade Summary of Results for Holbeach FEZ University Area\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.105	0.105	0.0	4.0	4.0	27.4	O K
10080 min Summer	0.097	0.097	0.0	3.6	3.6	23.7	O K
15 min Winter	0.212	0.212	0.0	8.4	8.4	112.6	O K
30 min Winter	0.249	0.249	0.0	9.3	9.3	149.5	O K
60 min Winter	0.282	0.282	0.0	10.1	10.1	182.7	O K
120 min Winter	0.305	0.305	0.0	10.5	10.5	205.8	O K
180 min Winter	0.310	0.310	0.0	10.6	10.6	210.2	O K
240 min Winter	0.309	0.309	0.0	10.6	10.6	209.1	O K
360 min Winter	0.303	0.303	0.0	10.5	10.5	202.9	O K
480 min Winter	0.294	0.294	0.0	10.3	10.3	194.1	O K
600 min Winter	0.284	0.284	0.0	10.1	10.1	184.0	O K
720 min Winter	0.273	0.273	0.0	9.9	9.9	173.5	O K
960 min Winter	0.253	0.253	0.0	9.4	9.4	153.2	O K
1440 min Winter	0.218	0.218	0.0	8.6	8.6	118.4	O K
2160 min Winter	0.180	0.180	0.0	7.5	7.5	81.1	O K
2880 min Winter	0.152	0.152	0.0	6.7	6.7	58.1	O K
4320 min Winter	0.123	0.123	0.0	5.2	5.2	38.1	O K
5760 min Winter	0.107	0.107	0.0	4.2	4.2	28.5	O K
7200 min Winter	0.096	0.096	0.0	3.5	3.5	22.8	O K
8640 min Winter	0.087	0.087	0.0	3.0	3.0	19.1	O K
10080 min Winter	0.081	0.081	0.0	2.6	2.6	16.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	497.9	4408
10080 min Summer	0.957	0.0	504.1	5144
15 min Winter	130.597	0.0	117.6	18
30 min Winter	85.825	0.0	159.7	32
60 min Winter	53.779	0.0	204.2	60
120 min Winter	32.595	0.0	250.8	118
180 min Winter	24.012	0.0	278.5	170
240 min Winter	19.224	0.0	298.1	192
360 min Winter	13.954	0.0	325.4	270
480 min Winter	11.125	0.0	346.3	344
600 min Winter	9.325	0.0	362.9	418
720 min Winter	8.069	0.0	376.8	492
960 min Winter	6.417	0.0	399.2	628
1440 min Winter	4.640	0.0	431.7	894
2160 min Winter	3.350	0.0	464.6	1256
2880 min Winter	2.656	0.0	488.0	1612
4320 min Winter	1.912	0.0	520.0	2292
5760 min Winter	1.513	0.0	541.3	3000
7200 min Winter	1.261	0.0	556.5	3744
8640 min Winter	1.086	0.0	567.6	4416
10080 min Winter	0.957	0.0	575.9	5136

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Cascade Rainfall Details for Holbeach FEZ University Area\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.490

Time (mins)		Area
From:	To:	(ha)
0	4	0.490

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Cascade Model Details for Holbeach FEZ University Area\_021216.srcx


Storage is Online Cover Level (m) 0.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	33.4
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	927.8	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000

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Cascade Summary of Results for Holbeach FEZ Swale 3\_021216.srcx

<b>Upstream Structures</b>	<b>Outflow To</b>	<b>Overflow To</b>
Holbeach FEZ Processing and Development Zone_B_021216.srcx Holbeach FEZ Education Zone_021216.srcx Holbeach FEZ University Area_021216.srcx	Holbeach FEZ Pond 1_021216.srcx	(None)

Half Drain Time : 14 minutes.

<b>Storm Event</b>	<b>Max Level (m)</b>	<b>Max Depth (m)</b>	<b>Max Infiltration (l/s)</b>	<b>Max Control (l/s)</b>	<b>Max E (l/s)</b>	<b>Max Outflow Volume (m³)</b>	<b>Status</b>
15 min Summer	0.225	0.225	0.0	22.9	22.9	20.3	O K
30 min Summer	0.246	0.246	0.0	26.0	26.0	25.1	O K
60 min Summer	0.267	0.267	0.0	28.5	28.5	30.6	O K
120 min Summer	0.291	0.291	0.0	30.3	30.3	37.4	O K
180 min Summer	0.301	0.301	0.0	31.0	31.0	40.7	O K
240 min Summer	0.305	0.305	0.0	31.3	31.3	42.1	O K
360 min Summer	0.303	0.303	0.0	31.2	31.2	41.6	O K
480 min Summer	0.299	0.299	0.0	30.9	30.9	40.3	O K
600 min Summer	0.295	0.295	0.0	30.6	30.6	38.8	O K
720 min Summer	0.290	0.290	0.0	30.2	30.2	37.2	O K
960 min Summer	0.279	0.279	0.0	29.4	29.4	33.9	O K
1440 min Summer	0.258	0.258	0.0	27.7	27.7	28.2	O K
2160 min Summer	0.241	0.241	0.0	25.3	25.3	23.9	O K
2880 min Summer	0.227	0.227	0.0	23.2	23.2	20.7	O K
4320 min Summer	0.206	0.206	0.0	20.1	20.1	16.4	O K
5760 min Summer	0.187	0.187	0.0	17.3	17.3	13.0	O K


<b>Storm Event</b>	<b>Rain (mm/hr)</b>	<b>Flooded Volume (m³)</b>	<b>Discharge Volume (m³)</b>	<b>Time-Peak (mins)</b>
15 min Summer	130.597	0.0	360.8	72
30 min Summer	85.825	0.0	488.3	87
60 min Summer	53.779	0.0	623.1	116
120 min Summer	32.595	0.0	764.0	168
180 min Summer	24.012	0.0	848.1	214
240 min Summer	19.224	0.0	907.5	260
360 min Summer	13.954	0.0	990.2	334
480 min Summer	11.125	0.0	1053.6	396
600 min Summer	9.325	0.0	1104.3	456
720 min Summer	8.069	0.0	1146.6	518
960 min Summer	6.417	0.0	1214.9	642
1440 min Summer	4.640	0.0	1314.0	884
2160 min Summer	3.350	0.0	1415.3	1244
2880 min Summer	2.656	0.0	1487.3	1600
4320 min Summer	1.912	0.0	1586.8	2296
5760 min Summer	1.513	0.0	1653.9	3024



Cascade Summary of Results for Holbeach FEZ Swale 3\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	0.173	0.173	0.0	15.2	15.2	10.9	O K
8640 min Summer	0.160	0.160	0.0	13.4	13.4	9.1	O K
10080 min Summer	0.150	0.150	0.0	12.1	12.1	7.9	O K
15 min Winter	0.234	0.234	0.0	24.2	24.2	22.2	O K
30 min Winter	0.256	0.256	0.0	27.5	27.5	27.5	O K
60 min Winter	0.283	0.283	0.0	29.7	29.7	35.1	O K
120 min Winter	0.309	0.309	0.0	31.7	31.7	43.5	O K
180 min Winter	0.321	0.321	0.0	32.5	32.5	47.7	O K
240 min Winter	0.326	0.326	0.0	32.8	32.8	49.5	O K
360 min Winter	0.325	0.325	0.0	32.8	32.8	49.3	O K
480 min Winter	0.319	0.319	0.0	32.3	32.3	47.0	O K
600 min Winter	0.312	0.312	0.0	31.8	31.8	44.5	O K
720 min Winter	0.304	0.304	0.0	31.3	31.3	41.9	O K
960 min Winter	0.287	0.287	0.0	30.0	30.0	36.5	O K
1440 min Winter	0.257	0.257	0.0	27.6	27.6	27.7	O K
2160 min Winter	0.233	0.233	0.0	24.1	24.1	22.1	O K
2880 min Winter	0.215	0.215	0.0	21.5	21.5	18.2	O K
4320 min Winter	0.185	0.185	0.0	17.1	17.1	12.8	O K
5760 min Winter	0.164	0.164	0.0	14.0	14.0	9.7	O K
7200 min Winter	0.148	0.148	0.0	11.8	11.8	7.6	O K
8640 min Winter	0.135	0.135	0.0	10.2	10.2	6.2	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.261	0.0	1702.3	3736
8640 min Summer	1.086	0.0	1738.5	4440
10080 min Summer	0.957	0.0	1766.1	5168
15 min Winter	130.597	0.0	409.6	75
30 min Winter	85.825	0.0	552.4	90
60 min Winter	53.779	0.0	703.4	128
120 min Winter	32.595	0.0	861.4	180
180 min Winter	24.012	0.0	955.7	226
240 min Winter	19.224	0.0	1022.4	270
360 min Winter	13.954	0.0	1115.3	358
480 min Winter	11.125	0.0	1186.6	426
600 min Winter	9.325	0.0	1243.6	488
720 min Winter	8.069	0.0	1291.2	554
960 min Winter	6.417	0.0	1368.3	688
1440 min Winter	4.640	0.0	1480.4	924
2160 min Winter	3.350	0.0	1595.4	1300
2880 min Winter	2.656	0.0	1677.8	1652
4320 min Winter	1.912	0.0	1792.8	2340
5760 min Winter	1.513	0.0	1871.6	3024
7200 min Winter	1.261	0.0	1929.6	3784
8640 min Winter	1.086	0.0	1973.9	4416

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XP Solutions	Source Control 2016.1	

Cascade Summary of Results for Holbeach FEZ Swale 3\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	0.123	0.123	0.0	9.0	9.0	5.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	0.957	0.0	2008.6	5160

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Cascade Rainfall Details for Holbeach FEZ Swale 3\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins)		Area
From:	To:	(ha)
0	4	0.000

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Cascade Model Details for Holbeach FEZ Swale 3\_021216.srcx


Storage is Online Cover Level (m) 0.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	160.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Orifice Outflow Control

Diameter (m) 0.180 Discharge Coefficient 0.600 Invert Level (m) 0.000


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Cascade Summary of Results for Holbeach FEZ Pond 1\_021216.srcx

Upstream Structures	Outflow To	Overflow To
Holbeach FEZ Swale 1_021216.srcx	Holbeach FEZ Swale 2_021216.srcx	(None)
Holbeach FEZ Research Development Zone South_021216.srcx		
Holbeach FEZ Packaging Storage Zone_021216.srcx		
Holbeach FEZ Engineering Zone_021216.srcx		
Holbeach FEZ Crop Development Zone_021216.srcx		
Holbeach FEZ Swale 3_021216.srcx		
Holbeach FEZ Processing and Development Zone B_021216.srcx		
Holbeach FEZ Education Zone_021216.srcx		
Holbeach FEZ University Area_021216.srcx		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	0.158	0.158	12.5	813.9	O K
30 min Summer	0.206	0.206	14.7	1066.0	O K
60 min Summer	0.261	0.261	15.0	1357.8	O K
120 min Summer	0.321	0.321	15.0	1676.7	O K
180 min Summer	0.357	0.357	15.0	1872.1	O K
240 min Summer	0.383	0.383	15.0	2011.7	O K
360 min Summer	0.420	0.420	15.0	2207.5	O K
480 min Summer	0.447	0.447	15.0	2357.2	O K
600 min Summer	0.469	0.469	15.0	2475.9	O K
720 min Summer	0.487	0.487	15.0	2573.6	O K
960 min Summer	0.514	0.514	15.0	2724.4	O K
1440 min Summer	0.547	0.547	15.0	2905.2	O K
2160 min Summer	0.560	0.560	15.0	2979.0	O K
2880 min Summer	0.550	0.550	15.0	2920.0	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	130.597	0.0	684.0	408
30 min Summer	85.825	0.0	943.1	482
60 min Summer	53.779	0.0	1583.0	580
120 min Summer	32.595	0.0	1921.0	690
180 min Summer	24.012	0.0	2094.8	762
240 min Summer	19.224	0.0	2194.7	820
360 min Summer	13.954	0.0	2279.6	918
480 min Summer	11.125	0.0	2278.9	1006
600 min Summer	9.325	0.0	2233.5	1088
720 min Summer	8.069	0.0	2181.6	1168
960 min Summer	6.417	0.0	2079.7	1318
1440 min Summer	4.640	0.0	1923.6	1612
2160 min Summer	3.350	0.0	3848.2	2180
2880 min Summer	2.656	0.0	3900.2	2556

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XP Solutions	Source Control 2016.1	

Cascade Summary of Results for Holbeach FEZ Pond 1\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
4320 min Summer	0.523	0.523	15.0	2774.9	O K
5760 min Summer	0.491	0.491	15.0	2598.1	O K
7200 min Summer	0.456	0.456	15.0	2405.2	O K
8640 min Summer	0.421	0.421	15.0	2215.9	O K
10080 min Summer	0.388	0.388	15.0	2035.1	O K
15 min Winter	0.176	0.176	14.0	907.1	O K
30 min Winter	0.232	0.232	14.9	1203.1	O K
60 min Winter	0.295	0.295	15.0	1538.2	O K
120 min Winter	0.363	0.363	15.0	1904.1	O K
180 min Winter	0.405	0.405	15.0	2128.3	O K
240 min Winter	0.435	0.435	15.0	2288.8	O K
360 min Winter	0.476	0.476	15.0	2515.5	O K
480 min Winter	0.508	0.508	15.0	2690.3	O K
600 min Winter	0.532	0.532	15.0	2821.9	O K
720 min Winter	0.551	0.551	15.0	2927.2	O K
960 min Winter	0.580	0.580	15.0	3087.3	O K
1440 min Winter	0.616	0.616	15.0	3288.2	O K
2160 min Winter	0.636	0.636	15.0	3399.4	O K
2880 min Winter	0.626	0.626	15.0	3342.1	O K
4320 min Winter	0.587	0.587	15.0	3129.1	O K
5760 min Winter	0.542	0.542	15.0	2878.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
4320 min Summer	1.912	0.0	3580.8	3260
5760 min Summer	1.513	0.0	4869.1	4000
7200 min Summer	1.261	0.0	5005.2	4744
8640 min Summer	1.086	0.0	5095.6	5496
10080 min Summer	0.957	0.0	5131.7	6240
15 min Winter	130.597	0.0	790.3	427
30 min Winter	85.825	0.0	1044.4	523
60 min Winter	53.779	0.0	1783.0	628
120 min Winter	32.595	0.0	2128.1	744
180 min Winter	24.012	0.0	2278.0	822
240 min Winter	19.224	0.0	2334.7	882
360 min Winter	13.954	0.0	2309.9	986
480 min Winter	11.125	0.0	2242.5	1078
600 min Winter	9.325	0.0	2193.1	1152
720 min Winter	8.069	0.0	2153.3	1224
960 min Winter	6.417	0.0	2087.4	1366
1440 min Winter	4.640	0.0	1981.2	1652
2160 min Winter	3.350	0.0	4212.2	2176
2880 min Winter	2.656	0.0	4147.4	2736
4320 min Winter	1.912	0.0	3728.1	3424
5760 min Winter	1.513	0.0	5503.0	4280


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Cascade Summary of Results for Holbeach FEZ Pond 1\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
7200 min Winter	0.488	0.488	15.0	2579.2	O K
8640 min Winter	0.431	0.431	15.0	2269.9	O K
10080 min Winter	0.379	0.379	15.0	1988.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
7200 min Winter	1.261	0.0	5664.1	5128
8640 min Winter	1.086	0.0	5778.8	5896
10080 min Winter	0.957	0.0	5841.1	6640



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Cascade Rainfall Details for Holbeach FEZ Pond 1\_021216.srcx


Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.200

**Time (mins) Area**  
**From: To: (ha)**

0 4 0.200

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Cascade Model Details for Holbeach FEZ Pond 1\_021216.srcx

Storage is Online Cover Level (m) 0.650

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	5100.0	0.650	5605.6

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0179-1500-0650-1500
Design Head (m)	0.650
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	179
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.650	15.0
Flush-Flo™	0.276	15.0
Kick-Flo®	0.503	13.3
Mean Flow over Head Range	-	12.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.3	1.200	20.1	3.000	31.1	7.000	46.7
0.200	14.7	1.400	21.6	3.500	33.5	7.500	48.3
0.300	14.9	1.600	23.0	4.000	35.8	8.000	49.9
0.400	14.5	1.800	24.4	4.500	37.9	8.500	51.5
0.500	13.4	2.000	25.6	5.000	39.9	9.000	53.0
0.600	14.4	2.200	26.8	5.500	41.7	9.500	54.5
0.800	16.5	2.400	28.0	6.000	43.5		
1.000	18.4	2.600	29.1	6.500	45.3		

Cascade Summary of Results for Holbeach FEZ Research Development Zone  
North\_021216.srcx

**Upstream Structures**                      **Outflow To**                      **Overflow To**

(None) Holbeach FEZ Swale 2\_021216.srcx                      (None)

Half Drain Time : 405 minutes.


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.216	0.216	0.0	8.5	8.5	209.4	O K
30 min Summer	0.256	0.256	0.0	9.5	9.5	280.8	O K
60 min Summer	0.294	0.294	0.0	10.3	10.3	350.0	O K
120 min Summer	0.328	0.328	0.0	11.0	11.0	409.7	O K
180 min Summer	0.341	0.341	0.0	11.3	11.3	434.0	O K
240 min Summer	0.346	0.346	0.0	11.4	11.4	443.3	O K
360 min Summer	0.347	0.347	0.0	11.4	11.4	443.9	O K
480 min Summer	0.346	0.346	0.0	11.4	11.4	442.2	O K
600 min Summer	0.343	0.343	0.0	11.3	11.3	438.3	O K
720 min Summer	0.340	0.340	0.0	11.2	11.2	432.7	O K
960 min Summer	0.332	0.332	0.0	11.1	11.1	418.4	O K
1440 min Summer	0.314	0.314	0.0	10.7	10.7	385.4	O K
2160 min Summer	0.287	0.287	0.0	10.2	10.2	336.7	O K
2880 min Summer	0.263	0.263	0.0	9.6	9.6	294.1	O K
4320 min Summer	0.226	0.226	0.0	8.8	8.8	226.8	O K
5760 min Summer	0.199	0.199	0.0	8.1	8.1	178.2	O K
7200 min Summer	0.178	0.178	0.0	7.5	7.5	142.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	214.6	19
30 min Summer	85.825	0.0	291.3	33
60 min Summer	53.779	0.0	372.6	62
120 min Summer	32.595	0.0	457.4	122
180 min Summer	24.012	0.0	508.0	182
240 min Summer	19.224	0.0	543.7	240
360 min Summer	13.954	0.0	593.4	310
480 min Summer	11.125	0.0	631.5	372
600 min Summer	9.325	0.0	661.8	434
720 min Summer	8.069	0.0	687.2	502
960 min Summer	6.417	0.0	728.1	638
1440 min Summer	4.640	0.0	787.2	910
2160 min Summer	3.350	0.0	847.5	1316
2880 min Summer	2.656	0.0	890.0	1700
4320 min Summer	1.912	0.0	948.3	2460
5760 min Summer	1.513	0.0	987.2	3168
7200 min Summer	1.261	0.0	1014.7	3888

Cascade Summary of Results for Holbeach FEZ Research Development Zone  
North\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
8640 min Summer	0.161	0.161	0.0	7.0	7.0	117.2	O K
10080 min Summer	0.148	0.148	0.0	6.5	6.5	98.6	O K
15 min Winter	0.232	0.232	0.0	8.9	8.9	238.4	O K
30 min Winter	0.277	0.277	0.0	10.0	10.0	318.9	O K
60 min Winter	0.321	0.321	0.0	10.9	10.9	397.3	O K
120 min Winter	0.359	0.359	0.0	11.6	11.6	465.8	O K
180 min Winter	0.375	0.375	0.0	11.9	11.9	495.2	O K
240 min Winter	0.382	0.382	0.0	12.0	12.0	507.9	O K
360 min Winter	0.384	0.384	0.0	12.1	12.1	510.4	O K
480 min Winter	0.380	0.380	0.0	12.0	12.0	504.3	O K
600 min Winter	0.377	0.377	0.0	11.9	11.9	498.2	O K
720 min Winter	0.372	0.372	0.0	11.8	11.8	489.5	O K
960 min Winter	0.360	0.360	0.0	11.6	11.6	467.6	O K
1440 min Winter	0.332	0.332	0.0	11.1	11.1	418.1	O K
2160 min Winter	0.293	0.293	0.0	10.3	10.3	347.7	O K
2880 min Winter	0.260	0.260	0.0	9.6	9.6	288.0	O K
4320 min Winter	0.210	0.210	0.0	8.4	8.4	198.7	O K
5760 min Winter	0.176	0.176	0.0	7.4	7.4	139.8	O K
7200 min Winter	0.151	0.151	0.0	6.6	6.6	102.8	O K
8640 min Winter	0.136	0.136	0.0	5.9	5.9	82.9	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
8640 min Summer	1.086	0.0	1034.9	4584
10080 min Summer	0.957	0.0	1049.9	5248
15 min Winter	130.597	0.0	243.9	19
30 min Winter	85.825	0.0	329.8	33
60 min Winter	53.779	0.0	421.0	62
120 min Winter	32.595	0.0	516.1	120
180 min Winter	24.012	0.0	572.9	178
240 min Winter	19.224	0.0	612.9	234
360 min Winter	13.954	0.0	668.8	340
480 min Winter	11.125	0.0	711.6	388
600 min Winter	9.325	0.0	745.8	464
720 min Winter	8.069	0.0	774.3	540
960 min Winter	6.417	0.0	820.5	692
1440 min Winter	4.640	0.0	887.3	984
2160 min Winter	3.350	0.0	956.0	1404
2880 min Winter	2.656	0.0	1004.8	1812
4320 min Winter	1.912	0.0	1072.5	2552
5760 min Winter	1.513	0.0	1118.5	3240
7200 min Winter	1.261	0.0	1151.8	3896
8640 min Winter	1.086	0.0	1176.9	4584

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Cascade Summary of Results for Holbeach FEZ Research Development Zone  
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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	0.125	0.125	0.0	5.3	5.3	70.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	0.957	0.0	1196.2	5336

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Cascade Rainfall Details for Holbeach FEZ Research Development Zone  
North\_021216.srcx


Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.000

**Time (mins) Area**  
**From: To: (ha)**

0 4 1.000

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Cascade Model Details for Holbeach FEZ Research Development Zone  
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Storage is Online Cover Level (m) 0.550


Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	60.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	1666.7	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000



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Cascade Summary of Results for Holbeach FEZ Swale 2\_021216.srcx

Upstream Structures	Outflow To	Overflow To
Holbeach FEZ Research Development Zone North_021216.srcx Holbeach FEZ Pond 1_021216.srcx Holbeach FEZ Swale 1_021216.srcx	Holbeach FEZ Pond 2_021216.srcx	(None)
Holbeach FEZ Research Development Zone South_021216.srcx Holbeach FEZ Packaging Storage Zone_021216.srcx Holbeach FEZ Engineering Zone_021216.srcx Holbeach FEZ Crop Development Zone_021216.srcx Holbeach FEZ Swale 3_021216.srcx		
Holbeach FEZ Processing and Development Zone B_021216.srcx Holbeach FEZ Education Zone_021216.srcx Holbeach FEZ University Area_021216.srcx		

Half Drain Time : 14 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max $\Sigma$ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
15 min Summer	0.251	0.251	0.0	26.8	26.8	26.4	O K
30 min Summer	0.265	0.265	0.0	28.3	28.3	29.8	O K
60 min Summer	0.268	0.268	0.0	28.5	28.5	30.5	O K
120 min Summer	0.259	0.259	0.0	27.8	27.8	28.1	O K
180 min Summer	0.249	0.249	0.0	26.5	26.5	25.8	O K
240 min Summer	0.242	0.242	0.0	25.4	25.4	24.0	O K
360 min Summer	0.250	0.250	0.0	26.6	26.6	26.1	O K
480 min Summer	0.255	0.255	0.0	27.3	27.3	27.1	O K
600 min Summer	0.255	0.255	0.0	27.4	27.4	27.3	O K
720 min Summer	0.257	0.257	0.0	27.6	27.6	27.7	O K
960 min Summer	0.264	0.264	0.0	28.2	28.2	29.6	O K
1440 min Summer	0.266	0.266	0.0	28.4	28.4	29.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
15 min Summer	130.597	0.0	933.2	15
30 min Summer	85.825	0.0	1279.3	23
60 min Summer	53.779	0.0	2015.1	40
120 min Summer	32.595	0.0	2450.0	74
180 min Summer	24.012	0.0	2681.3	106
240 min Summer	19.224	0.0	2821.7	140
360 min Summer	13.954	0.0	2960.9	362
480 min Summer	11.125	0.0	3001.0	458
600 min Summer	9.325	0.0	2989.8	488
720 min Summer	8.069	0.0	2967.1	506
960 min Summer	6.417	0.0	2912.7	600
1440 min Summer	4.640	0.0	2825.8	836

Cascade Summary of Results for Holbeach FEZ Swale 2\_021216.srcx


Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
2160 min Summer	0.257	0.257	0.0	27.6	27.6	27.6	O K
2880 min Summer	0.251	0.251	0.0	26.7	26.7	26.2	O K
4320 min Summer	0.242	0.242	0.0	25.4	25.4	24.0	O K
5760 min Summer	0.235	0.235	0.0	24.4	24.4	22.5	O K
7200 min Summer	0.230	0.230	0.0	23.7	23.7	21.4	O K
8640 min Summer	0.226	0.226	0.0	23.1	23.1	20.5	O K
10080 min Summer	0.223	0.223	0.0	22.6	22.6	19.7	O K
15 min Winter	0.266	0.266	0.0	28.4	28.4	30.0	O K
30 min Winter	0.279	0.279	0.0	29.4	29.4	33.6	O K
60 min Winter	0.278	0.278	0.0	29.3	29.3	33.4	O K
120 min Winter	0.262	0.262	0.0	28.0	28.0	29.0	O K
180 min Winter	0.249	0.249	0.0	26.5	26.5	25.8	O K
240 min Winter	0.246	0.246	0.0	26.0	26.0	25.1	O K
360 min Winter	0.259	0.259	0.0	27.8	27.8	28.3	O K
480 min Winter	0.266	0.266	0.0	28.4	28.4	30.1	O K
600 min Winter	0.272	0.272	0.0	28.9	28.9	31.7	O K
720 min Winter	0.277	0.277	0.0	29.3	29.3	33.1	O K
960 min Winter	0.279	0.279	0.0	29.4	29.4	33.5	O K
1440 min Winter	0.269	0.269	0.0	28.6	28.6	30.9	O K
2160 min Winter	0.255	0.255	0.0	27.3	27.3	27.1	O K
2880 min Winter	0.247	0.247	0.0	26.1	26.1	25.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
2160 min Summer	3.350	0.0	4829.2	1168
2880 min Summer	2.656	0.0	4929.8	1556
4320 min Summer	1.912	0.0	4673.4	2288
5760 min Summer	1.513	0.0	6019.4	3000
7200 min Summer	1.261	0.0	6189.8	3752
8640 min Summer	1.086	0.0	6306.1	4496
10080 min Summer	0.957	0.0	6361.9	5224
15 min Winter	130.597	0.0	1072.9	15
30 min Winter	85.825	0.0	1423.4	25
60 min Winter	53.779	0.0	2270.4	44
120 min Winter	32.595	0.0	2723.8	80
180 min Winter	24.012	0.0	2937.4	114
240 min Winter	19.224	0.0	3037.4	354
360 min Winter	13.954	0.0	3073.8	352
480 min Winter	11.125	0.0	3055.7	452
600 min Winter	9.325	0.0	3045.8	446
720 min Winter	8.069	0.0	3039.1	504
960 min Winter	6.417	0.0	3027.1	626
1440 min Winter	4.640	0.0	2999.3	880
2160 min Winter	3.350	0.0	5316.1	1248
2880 min Winter	2.656	0.0	5303.2	1616

Cascade Summary of Results for Holbeach FEZ Swale 2\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
4320 min Winter	0.236	0.236	0.0	24.6	24.6	22.7	O K
5760 min Winter	0.229	0.229	0.0	23.5	23.5	21.0	O K
7200 min Winter	0.223	0.223	0.0	22.6	22.6	19.8	O K
8640 min Winter	0.218	0.218	0.0	21.8	21.8	18.7	O K
10080 min Winter	0.213	0.213	0.0	21.1	21.1	17.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
4320 min Winter	1.912	0.0	4963.5	2332
5760 min Winter	1.513	0.0	6804.2	3032
7200 min Winter	1.261	0.0	7006.3	3744
8640 min Winter	1.086	0.0	7152.4	4472
10080 min Winter	0.957	0.0	7239.2	5256

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Cascade Rainfall Details for Holbeach FEZ Swale 2\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.150

Time (mins)		Area
From:	To:	(ha)
0	4	0.150

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Cascade Model Details for Holbeach FEZ Swale 2\_021216.srcx

Storage is Online Cover Level (m) 0.500

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	120.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	500.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0		

Orifice Outflow Control

Diameter (m) 0.180 Discharge Coefficient 0.600 Invert Level (m) 0.000

Cascade Summary of Results for Holbeach FEZ Processing and Development Zone  
A\_021216.srcx


Upstream Structures                      Outflow To                      Overflow To

(None) Holbeach FEZ Pond 2\_021216.srcx                      (None)

Half Drain Time : 125 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.229	0.229	0.0	8.8	8.8	80.4	O K
30 min Summer	0.281	0.281	0.0	10.0	10.0	103.9	O K
60 min Summer	0.322	0.322	0.0	10.9	10.9	122.6	O K
120 min Summer	0.342	0.342	0.0	11.3	11.3	131.6	O K
180 min Summer	0.346	0.346	0.0	11.4	11.4	133.2	O K
240 min Summer	0.343	0.343	0.0	11.3	11.3	132.1	O K
360 min Summer	0.331	0.331	0.0	11.1	11.1	126.2	O K
480 min Summer	0.316	0.316	0.0	10.8	10.8	119.6	O K
600 min Summer	0.301	0.301	0.0	10.5	10.5	112.7	O K
720 min Summer	0.286	0.286	0.0	10.1	10.1	106.2	O K
960 min Summer	0.259	0.259	0.0	9.5	9.5	94.3	O K
1440 min Summer	0.218	0.218	0.0	8.6	8.6	75.7	O K
2160 min Summer	0.177	0.177	0.0	7.4	7.4	57.2	O K
2880 min Summer	0.151	0.151	0.0	6.6	6.6	45.4	O K
4320 min Summer	0.124	0.124	0.0	5.2	5.2	33.5	O K
5760 min Summer	0.109	0.109	0.0	4.3	4.3	26.4	O K
7200 min Summer	0.099	0.099	0.0	3.7	3.7	21.8	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	85.5	18
30 min Summer	85.825	0.0	114.7	32
60 min Summer	53.779	0.0	145.6	60
120 min Summer	32.595	0.0	177.9	100
180 min Summer	24.012	0.0	197.2	132
240 min Summer	19.224	0.0	210.9	166
360 min Summer	13.954	0.0	230.0	234
480 min Summer	11.125	0.0	244.6	302
600 min Summer	9.325	0.0	256.4	368
720 min Summer	8.069	0.0	266.2	434
960 min Summer	6.417	0.0	282.1	562
1440 min Summer	4.640	0.0	305.4	810
2160 min Summer	3.350	0.0	329.4	1168
2880 min Summer	2.656	0.0	346.8	1528
4320 min Summer	1.912	0.0	371.3	2248
5760 min Summer	1.513	0.0	388.4	2944
7200 min Summer	1.261	0.0	401.2	3680

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Cascade Summary of Results for Holbeach FEZ Processing and Development Zone  
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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.091	0.091	0.0	3.2	3.2	18.5	O K
10080 min Summer	0.085	0.085	0.0	2.9	2.9	16.1	O K
15 min Winter	0.253	0.253	0.0	9.4	9.4	91.2	O K
30 min Winter	0.312	0.312	0.0	10.7	10.7	118.0	O K
60 min Winter	0.360	0.360	0.0	11.6	11.6	139.7	O K
120 min Winter	0.383	0.383	0.0	12.0	12.0	149.9	O K
180 min Winter	0.384	0.384	0.0	12.1	12.1	150.5	O K
240 min Winter	0.379	0.379	0.0	12.0	12.0	147.8	O K
360 min Winter	0.357	0.357	0.0	11.6	11.6	138.1	O K
480 min Winter	0.334	0.334	0.0	11.1	11.1	127.8	O K
600 min Winter	0.311	0.311	0.0	10.7	10.7	117.7	O K
720 min Winter	0.290	0.290	0.0	10.2	10.2	108.2	O K
960 min Winter	0.254	0.254	0.0	9.4	9.4	91.8	O K
1440 min Winter	0.200	0.200	0.0	8.1	8.1	67.7	O K
2160 min Winter	0.152	0.152	0.0	6.7	6.7	46.1	O K
2880 min Winter	0.130	0.130	0.0	5.6	5.6	36.0	O K
4320 min Winter	0.106	0.106	0.0	4.1	4.1	25.2	O K
5760 min Winter	0.092	0.092	0.0	3.3	3.3	19.1	O K
7200 min Winter	0.083	0.083	0.0	2.7	2.7	15.5	O K
8640 min Winter	0.075	0.075	0.0	2.4	2.4	12.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.086	0.0	411.2	4408
10080 min Summer	0.957	0.0	419.2	5144
15 min Winter	130.597	0.0	96.7	18
30 min Winter	85.825	0.0	129.4	32
60 min Winter	53.779	0.0	164.0	60
120 min Winter	32.595	0.0	200.2	112
180 min Winter	24.012	0.0	221.9	140
240 min Winter	19.224	0.0	237.2	178
360 min Winter	13.954	0.0	258.6	254
480 min Winter	11.125	0.0	275.1	324
600 min Winter	9.325	0.0	288.3	394
720 min Winter	8.069	0.0	299.3	462
960 min Winter	6.417	0.0	317.2	596
1440 min Winter	4.640	0.0	343.5	840
2160 min Winter	3.350	0.0	370.7	1192
2880 min Winter	2.656	0.0	390.4	1552
4320 min Winter	1.912	0.0	418.4	2288
5760 min Winter	1.513	0.0	438.1	2992
7200 min Winter	1.261	0.0	453.0	3744
8640 min Winter	1.086	0.0	464.9	4416


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Cascade Summary of Results for Holbeach FEZ Processing and Development Zone  
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Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m <sup>3</sup> )	Status
10080 min Winter	0.069	0.069	0.0	2.1	2.1	10.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
10080 min Winter	0.957	0.0	474.5	5144



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Cascade Rainfall Details for Holbeach FEZ Processing and Development Zone  
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Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.380

Time (mins)		Area
From:	To:	(ha)
0	4	0.380

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Cascade Model Details for Holbeach FEZ Processing and Development Zone  
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Storage is Online Cover Level (m) 0.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	30.0
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	416.7	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Cap Volume Depth (m)	0.400

Orifice Outflow Control

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 0.000


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Cascade Summary of Results for Holbeach FEZ Pond 2\_021216.srcx

Upstream Structures	Outflow To	Overflow To
Holbeach FEZ Processing and Development Zone A_021216.srcx	(None)	(None)
Holbeach FEZ Swale 2_021216.srcx		
Holbeach FEZ Research Development Zone North_021216.srcx		
Holbeach FEZ Pond 1_021216.srcx		
Holbeach FEZ Swale 1_021216.srcx		
Holbeach FEZ Research Development Zone South_021216.srcx		
Holbeach FEZ Packaging Storage Zone_021216.srcx		
Holbeach FEZ Engineering Zone_021216.srcx		
Holbeach FEZ Crop Development Zone_021216.srcx		
Holbeach FEZ Swale 3_021216.srcx		
Holbeach FEZ Processing and Development Zone B_021216.srcx		
Holbeach FEZ Education Zone_021216.srcx		
Holbeach FEZ University Area_021216.srcx		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.125	0.125	6.7	668.5	O K
30 min Summer	0.172	0.172	8.4	920.6	O K
60 min Summer	0.224	0.224	8.6	1209.0	O K
120 min Summer	0.280	0.280	8.6	1515.9	O K
180 min Summer	0.314	0.314	8.6	1701.8	O K
240 min Summer	0.338	0.338	8.6	1834.4	O K
360 min Summer	0.370	0.370	8.6	2012.7	O K
480 min Summer	0.385	0.385	8.6	2097.2	O K
600 min Summer	0.390	0.390	8.6	2127.2	O K
720 min Summer	0.393	0.393	8.6	2143.1	O K
960 min Summer	0.396	0.396	8.6	2160.4	O K
1440 min Summer	0.404	0.404	8.6	2203.2	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	427.3	1069
30 min Summer	85.825	0.0	546.3	1276
60 min Summer	53.779	0.0	1315.9	1688
120 min Summer	32.595	0.0	1335.1	2164
180 min Summer	24.012	0.0	1331.7	2470
240 min Summer	19.224	0.0	1323.8	2698
360 min Summer	13.954	0.0	1303.7	2880
480 min Summer	11.125	0.0	1281.6	2880
600 min Summer	9.325	0.0	1258.4	2880
720 min Summer	8.069	0.0	1235.1	2880
960 min Summer	6.417	0.0	1188.1	2880
1440 min Summer	4.640	0.0	1094.7	2880

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Cascade Summary of Results for Holbeach FEZ Pond 2\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
2160 min Summer	0.558	0.558	8.6	3079.1	O K
2880 min Summer	0.593	0.593	8.6	3278.4	O K
4320 min Summer	0.594	0.594	8.6	3289.2	O K
5760 min Summer	0.666	0.666	8.6	3701.8	O K
7200 min Summer	0.686	0.686	8.6	3821.6	O K
8640 min Summer	0.692	0.692	8.6	3857.2	O K
10080 min Summer	0.681	0.681	8.6	3789.2	O K
15 min Winter	0.142	0.142	7.7	761.7	O K
30 min Winter	0.197	0.197	8.5	1056.8	O K
60 min Winter	0.256	0.256	8.6	1382.9	O K
120 min Winter	0.319	0.319	8.6	1729.8	O K
180 min Winter	0.357	0.357	8.6	1939.4	O K
240 min Winter	0.380	0.380	8.6	2070.3	O K
360 min Winter	0.396	0.396	8.6	2159.6	O K
480 min Winter	0.401	0.401	8.6	2188.8	O K
600 min Winter	0.407	0.407	8.6	2222.8	O K
720 min Winter	0.413	0.413	8.6	2256.8	O K
960 min Winter	0.424	0.424	8.6	2319.0	O K
1440 min Winter	0.442	0.442	8.6	2419.7	O K
2160 min Winter	0.642	0.642	8.6	3565.1	O K
2880 min Winter	0.664	0.664	8.6	3694.0	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
2160 min Summer	3.350	0.0	2313.9	5284
2880 min Summer	2.656	0.0	2189.4	5760
4320 min Summer	1.912	0.0	1961.0	5760
5760 min Summer	1.513	0.0	4428.5	7296
7200 min Summer	1.261	0.0	4194.2	7952
8640 min Summer	1.086	0.0	3971.1	8704
10080 min Summer	0.957	0.0	3754.5	9312
15 min Winter	130.597	0.0	491.0	1101
30 min Winter	85.825	0.0	568.1	1440
60 min Winter	53.779	0.0	1338.2	1942
120 min Winter	32.595	0.0	1346.6	2490
180 min Winter	24.012	0.0	1341.4	2840
240 min Winter	19.224	0.0	1333.3	2880
360 min Winter	13.954	0.0	1313.2	2880
480 min Winter	11.125	0.0	1291.0	2880
600 min Winter	9.325	0.0	1267.6	2880
720 min Winter	8.069	0.0	1243.9	2880
960 min Winter	6.417	0.0	1197.5	2880
1440 min Winter	4.640	0.0	1109.8	2880
2160 min Winter	3.350	0.0	2324.3	5756
2880 min Winter	2.656	0.0	2213.0	5760

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Cascade Summary of Results for Holbeach FEZ Pond 2\_021216.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m <sup>3</sup> )	Status
4320 min Winter	0.648	0.648	8.6	3601.5	O K
5760 min Winter	0.748	0.748	8.6	4184.6	O K
7200 min Winter	0.771	0.771	8.6	4322.5	O K
8640 min Winter	0.789	0.789	8.6	4428.5	O K
10080 min Winter	0.788	0.788	8.6	4420.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m <sup>3</sup> )	Discharge Volume (m <sup>3</sup> )	Time-Peak (mins)
4320 min Winter	1.912	0.0	2010.8	5760
5760 min Winter	1.513	0.0	4562.5	7840
7200 min Winter	1.261	0.0	4420.3	8440
8640 min Winter	1.086	0.0	4257.1	9008
10080 min Winter	0.957	0.0	4061.0	9752

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Cascade Rainfall Details for Holbeach FEZ Pond 2\_021216.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.200

Time (mins)		Area
From:	To:	(ha)
0	4	0.200

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Cascade Model Details for Holbeach FEZ Pond 2\_021216.srcx

Storage is Online Cover Level (m) 0.800

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	5300.0	0.800	5937.5

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0139-8600-0800-8600
Design Head (m)	0.800
Design Flow (l/s)	8.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	139
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	8.6
Flush-Flo™	0.254	8.6
Kick-Flo®	0.562	7.3
Mean Flow over Head Range	-	7.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	10.4	3.000	16.1	7.000	24.1
0.200	8.5	1.400	11.2	3.500	17.3	7.500	24.9
0.300	8.6	1.600	11.9	4.000	18.4	8.000	25.7
0.400	8.3	1.800	12.6	4.500	19.5	8.500	26.4
0.500	7.9	2.000	13.2	5.000	20.5	9.000	27.2
0.600	7.5	2.200	13.9	5.500	21.5	9.500	27.9
0.800	8.6	2.400	14.4	6.000	22.4		
1.000	9.5	2.600	15.0	6.500	23.3		