Holbeach Food Enterprise Zone (FEZ), Lincolnshire

Surface Water Drainage Strategy

On behalf of **South Holland District Council**

Project Ref: 332511500/4002/002 | Rev: A | Date: June 2023

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For and on behalf of Stantec UK Limited				

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A	16/06/2023	Update to extend the LDO and allow for updated masterplan.	Hugh Leekam	Richard Fisher	Amy Hensler

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Abbreviations

ABI	-	Association of British Insurers
AP	-	Annual Probability
BGS	-	British Geological Survey
CDM	-	Construction (Design and Management)
CIRIA	-	Construction Industry Research and Information Association
DDA	-	Disability Discrimination Act
DEFRA	-	Department for Environment, Food and Rural Affairs
EA	-	Environment Agency
FAS	-	Flood Alleviation Scheme
FEZ	-	Food Enterprise Zone
FRA	-	Flood Risk Assessment
FRAP	-	Flood Risk Activity Permit
FRMP	-	Flood Risk Management Plan
FRMS	-	Flood Risk Mitigation Strategy
GIS	-	Geographic Information System
IDB	-	Internal Drainage Board
LLFA	-	Lead Local Flood Authority
LDO	-	Local Development Order
M. AOD	-	Metres Above Ordnance Datum (Newlyn)
NPPF	-	National Planning Policy Framework
PFRA	-	Preliminary Flood Risk Assessment
PPG	-	Planning Practice Guidance
RoSWF	-	Risk of Surface Water Flooding
SuDS	-	Sustainable Drainage Systems
SFRA	-	Strategic Flood Risk Assessment
SHDC	-	South Holland District Council

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1 Introduction

1.1 Scope of Report

1.1.1 This 'Surface Water Drainage Strategy' Report (Rev A) has been prepared by Stantec, on behalf our Client South Holland District Council (SHDC), to outline the options for surface water drainage and the inclusion of Sustainable Drainage Systems (SuDS) to support the extension of a Local Development Order (LDO) for the 'Food Enterprise Zone' (FEZ), on land to the west of Holbeach, Lincolnshire, Spalding, PE12 7PY (site centre OS grid reference 534,730m E, 325,750m N).

1.1.2 The LDO is being implemented and built out, and this update to the original 'Surface Water Drainage Strategy report (2017), has been produced to extend the life of the LDO beyond the original 5-year period.

1.1.3 This Surface Water Drainage Strategy (SWDS) will cover the same area, as that covered by the original LDO and the supporting FRMS document, previously provided in 2017.

1.1.4 The report should be read in conjunction with the Flood Risk Mitigation Strategy report ref. **332511500/4001/002**.

1.1.5 This report sets out the latest national, regional and local guidance in relation to surface water drainage (**Section 2**) and an indication of the types of SuDS that would be suitable at the site, given the geology and hydrogeology in the area (**Section 4**).

1.2 Existing Site and Proposed Development

1.2.1 The existing 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. The site is surrounding by neighbouring agricultural fields, with the centre of Holbeach town located 1.2km south-east of the site.

1.2.2 The site lies within the administrative boundary of South Holland District Council (SHDC).

1.2.3 There are several ordinary watercourses and IDB drainage channels, that border the site boundary and surround the site area. These drainage channels are managed by the **South Holland Internal Drainage Board** (SHIDB).

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

1.2.5 The south-eastern part of the site was recently the subject of an outline planning application by the University of Lincoln for a 'proposed centre of excellence in agri food' and associated works (SHBC planning reference H09-0771-16, approved November 2016). This forms part of the wider FEZ and it is anticipated the wider site will utilise the proposed main access via a roundabout off the A151 (the application also included for a new roundabout at the junction of the A17 and A151 (the Peppermint Junction). See further details on the proposed development within in the **Holbeach Flood Mitigation Strategy Report (2023) - 332511500/4001/002**.

1.2.6 The Surface Water Drainage Strategy sets out an amended approach to the original report due to the method of delivery of the plots over the site. The original strategy was focussed on a site-wide strategy with two large ponds providing the main attenuation function. As the FEZ development has progressed in piecemeal applications, the strategy has been revised to instead identify the attenuation requirements on a plot-by-plot basis and provide recommendations in what form such measures can be provided.

1.3 Sources of Information

1.3.1 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)** (February 2019) and the **Planning Practice Guidance (PPG) 'Flood risk and coastal change'** (updated August 2022);
- 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 gov.uk/guidance **'Flood risk assessments: climate change allowances'**, (May 2022);
- The **EA** Northern Area Tidal Hazard Mapping Study' and **Flood Mapping & Hydraulic Wash Model** (EA reference - CCN/ 2023/ 303845, April 2023) including modelled breach hazard mapping and tidal flood data;
- **The South East Lincolnshire (2011-2036) Local Plan** (adopted in March 2019), with particular reference to drainage design policy's – **Policy 2:** – **'Development Management'**, **Policy 3:** – **'Design of New Development'** and **Policy 4: – 'Approach to Flood Risk';**
- **The South East Lincolnshire Strategic Flood Risk Assessment,** (SFRA) released in March 2017;
- **South Holland District Council 'Update of Strategic Flood Risk Assessment'** (SFRA) dated February 2017;
- **Anglian Water** online mapping.

2 Planning Policy Context

2.1 National Policy and Guidance

2.1.1 National policy in relation to flood risk is contained within the **National Planning Policy Framework (NPPF),** updated July 2021, issued by the Department for Levelling Up, Housing and Communities, with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change'.

2.1.2 The latest version of the associated **Planning Practice Guidance (PPG)** 'Flood Risk and Coastal Change' section was updated August 2022.

2.1.3 The NPPF and PPG demonstrate a flood risk management approach for the lifespan of the proposed development considering the effects of climate change. The document sets the framework to minimise vulnerability, provide resilience to the impacts of climate change, and to fully consider the potential impacts of climate change for the lifetime of the development within the mitigation measures.

2.1.4 The guidance on the application of climate change allowances in FRAs is linked via the PPG and was most recently updated in May 2022. The guidance provides contingency allowances for the potential increases in peak river flow, peak rainfall intensity and sea level rise which are considered accordingly subject to the site conditions.

2.1.5 The NPPF and PPG place emphasis on the need to fully consider – and design for – the impacts of climate change as set out in the 'Flood risk assessments: climate change allowances' planning guidance accessible at the following link:

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

2.1.6 This guidance provides contingency allowances for potential increases due to climate change in peak river flow, sea level rise and rainfall intensity. These allowances are key for designing appropriate mitigation into the development to consider the flood risks over the lifetime of the development (peak river flow and/or sea level rise), and for the management of surface water over the site (peak rainfall intensity).

2.1.7 The EA climate change allowances guidance was updated in May 2022 to include a GIS based 'peak rainfall allowances' map showing the anticipated changes in rainfall intensity based on river management catchment. The anticipated changes in peak rainfall intensity in small catchments (less than 5km2), or urbanised drainage catchments are summarised in **Table 2-1**: Climate Change – Peak Rainfall Intensity Allowances.

Table 2-1: Climate Change – Peak Rainfall Intensity Allowances

Welland Management Catchment	**Total potential change anticipated** (2070s epoch – i.e. 2061 to 2125)	
	Central	***Upper End***
3.3% (1 in 30-year) rainfall	*25%*	*35%*
1.0% (1 in 100-year) rainfall	*25%*	***40%***

2.1.8 As the development proposals are considered as having a design life of 100 years, a 40% climate change allowance will be assessed within the surface water drainage strategy discussed in **Section 4**.

2.2 Local Policy and Guidance

The South East Lincolnshire Local Plan (2011-2036)

2.2.1 Local planning policy is contained within **The South East Lincolnshire (2011-2036) Local Plan** (adopted in March 2019), with particular reference to drainage design policy's – **Policy 2: – '*Development Management*'**, **Policy 3**: **– '*Design of New Development*'** and **Policy 4:** – ***'Approach to Flood Risk'***, which state:

Policy 2: Development Management

''Proposals requiring planning permission for development will be permitted provided that sustainable development considerations are met, specifically in relation to:

1) sustainable drainage and flood risk;

The primary purpose of 'sustainable drainage systems' (SuDS) is to minimise the impact of urban development on the water environment, reduce flood risk and provide habitats for wildlife. Opportunities for incorporating a range of SuDS in all new development must be taken wherever possible.

There are many different SuDS features available to suit the constraints of a site which could come in the form of green roofs or by providing new wildlife habitats such as ponds, wetlands and swales. Hard-engineered elements are often used in high-density, commercial and industrial developments, including permeable paving, canals, treatment channels, attenuation storage and soakaways.

However, the discharge of surface water to soakaways or other infiltration devices must be considered first before alternative methods are investigated. SuDS should be designed into the landscape of all new development and should be included as part of a wider approach across South East Lincolnshire to improve water quality and provide flood mitigation. Maintenance will also be required, appropriate to the type of development and location proposed.''

Policy 3: Design of New Development

''All development will create distinctive places through the use of high quality and inclusive design. Development proposals will demonstrate how the following issues, where they are relevant to the proposal, will be secured:

1) the mitigation of flood risk through flood-resistant and flood-resilient design and sustainable drainage systems (SuDS);

A development will make buildings and places more resilient to flooding by, for example, raising the floor level, and adapting the internal materials, electrical South East Lincolnshire Local Plan 2011-36 circuits and plumbing to cope better with any flood event.

These issues may be successfully incorporated in buildings that follow traditional or contemporary design in accordance with Building Regulations. In addition, owing to flood risk new activities may need to be deterred in certain areas based on their intrinsic hazard from water. The hazard may result from a combination of the activity type, its duration and the potential for failure of flood-control measures.''

Policy 4: Approach to Flood Risk

''Development proposed within an area at risk of flooding (Flood Zones 2 and 3 of the Environment Agency's flood map or at risk during a breach or overtopping scenario as shown on the flood hazard and depths maps in the Strategic Flood Risk Assessment) will be permitted, where:

2) *It can be demonstrated that essential infrastructure in FZ3a & FZ3b, highly vulnerable development in FZ2 and more vulnerable development in FZ3 provide wider sustainability benefits to the community that outweigh flood risk.*
3) *The application is supported with a site-specific flood risk assessment, covering risk from all sources of flooding including the impacts of climate change and which: a. demonstrate that the vulnerability of the proposed use is compatible with the flood zone;*
4) *identify the relevant predicted flood risk (breach/overtopping) level, and mitigation measures that demonstrate how the development will be made safe and that occupants will be protected from flooding from any source;*
5) *propose appropriate flood resistance and resilience measures (following the guidance outlined in the Strategic Flood Risk Assessment), maximising the use of passive resistance measures (measures that do not require human intervention to be deployed), to ensure the development maintains an appropriate level of safety for its lifetime;*
6) *include appropriate flood warning and evacuation procedures where necessary (referring to the County's evacuation routes plan), which have been undertaken in consultation with the authority's emergency planning staff;*
7) *incorporates the use of Sustainable Drainage Systems (SuDS) (unless it is demonstrated that this is not technically feasible) and confirms how these will be maintained/managed for the lifetime of development (surface water connections to the public sewerage network will only be permitted in exceptional circumstances where it is demonstrated that there are no feasible alternatives);*
8) *demonstrates that the proposal will not increase risk elsewhere and that opportunities through layout, form of development and green infrastructure have been considered as a way of providing flood betterment and reducing flood risk overall; g. demonstrates that adequate foul water treatment and disposal already exists or can be provided in time to serve the development;*
9) *ensures suitable access is safeguarded for the maintenance of water resources, drainage and flood risk management infrastructure.*

Mitigation may also be incorporated in SuDS which are likely to be required irrespective of the flood risk. All major developments will be expected to incorporate Sustainable Drainage Systems (SuDs) as standard. SuDS can vary substantially in terms of what is required, from rain water harvesting to water retention and treatment (e.g. through reed beds).

Some SuDS may be an adequate response to surface water flood issues. Surface water connections to the public sewerage network should only be made in exceptional circumstances where it can be shown where there are no feasible alternatives.''

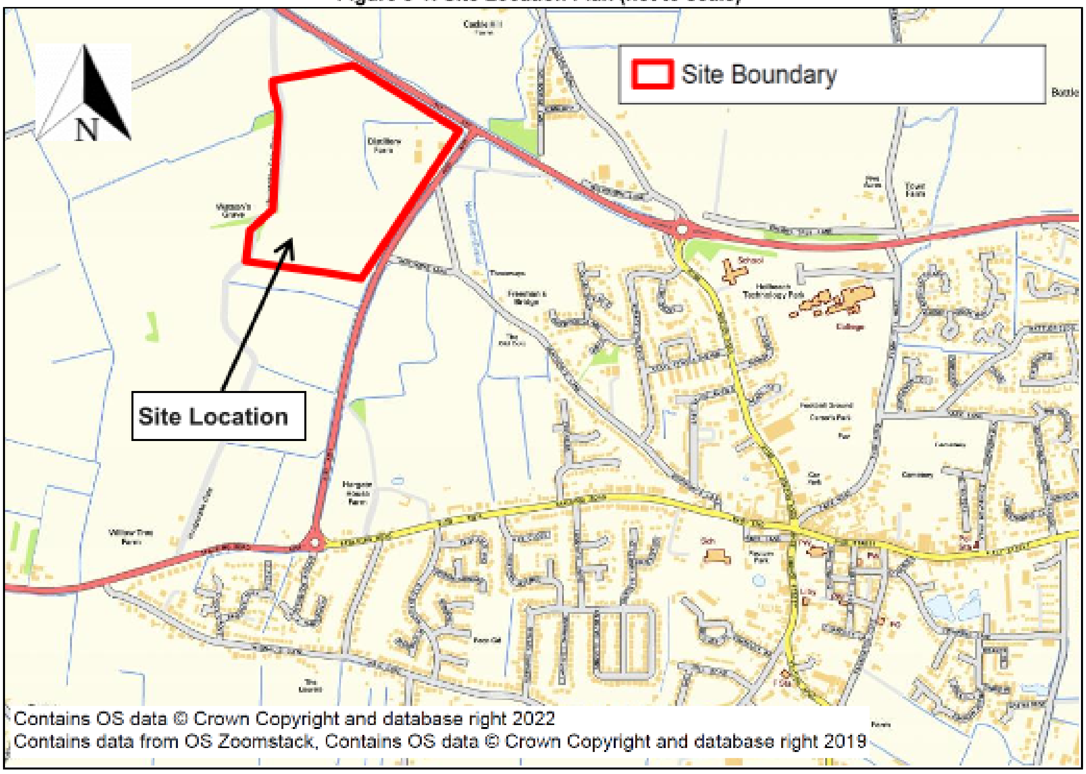
3 Site Setting

3.1 Site Description

3.1.1 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).

3.1.2 Holbeach lies within the administrative boundary of South Holland District Council (SHDC).

Figure 3-1: Site Location Plan (not to scale)



3.1.3 The site is bordered to the east by the A151 and the A17 Washway Road to the north, by the Hungerdike Gate to the west and agricultural land to the immediate south.

3.1.4 There are several ordinary watercourses and drainage channels, that border the site boundary and surround the site area.

3.2 Topography

3.2.1 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 **Appendix A**).

3.3 Geology and Hydrogeology

3.3.1 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'.

3.3.2 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'.

3.4 Existing Drainage Arrangements and Hydrological Setting

3.4.1 The Lincolnshire area is relatively flat and as such the majority of the area drains to a network of watercourses.

3.4.2 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** .

3.4.3 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.

3.4.4 The areas within the south-east of the site are approved and in the process of being built out, the area for consideration is 11.5ha.

3.4.5 The majority of the site – equating to 10.5 ha - 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 and equates to approximately 1ha.

3.4.6 Using the above site areas, the existing runoff rates for the distillery farm area have been calculated using Modified Rational Method with FEH rainfall profile data for brownfield runoff rates and the greenfield runoff rates have been calculated using FEH 2008 Statistical Method QMED Equation – shown in **Table 3-1** (see **Appendix C**).

Table 3-1: Existing Runoff Rates

Annual Probability Rainfall Event	Brownfield Runoff Rate 1.0 ha (l/s)	Greenfield Runoff Rate 10.5 ha (l/s)
1 in 1 year	87.3	8.6
1 in 2 year/Q_{BAR}	119.2	9.9
1 in 30 year	294.8	25.3
1 in 100 year	399.3	35.3

4 Surface Water Drainage Strategy

4.1 SuDS Drainage Hierarchy

4.1.1 To ensure that surface water flows can be safely managed on site, a Surface Water Drainage Strategy should be produced in accordance with local, regional and national planning policy concerning flood risk and surface water drainage.

4.1.2 As of April 2015, the Lead Local Flood Authority (LLFA) has become the statutory consultee for surface water management on planning applications for 'major development'. As the LLFA, Lincolnshire County Council (LCC) is therefore responsible for the approval of surface water drainage systems within such development, and the South Holland Drainage Board also play a key role as the local IDB, as the IDB channels will potentially serve as the receiving watercourses for runoff from the area (and therefore require IDB approval of the proposed runoff rates).

4.1.3 The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface runoff from development sites. The NPPF recommends that priority is given to the use of Sustainable Drainage Systems (SuDS) in new development, this being complementary to the control of development within the floodplain.

4.1.4 As the intention of SuDS is to mimic the natural drainage regime of the undeveloped site, the NPPF PPG states the following (consistent with the Building Regulations H3 hierarchy):

> ***...the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:***
>
> ***- into the ground (infiltration),***
>
> ***- to a surface water body,***
>
> ***- to a surface water sewer, highway drain or another drainage system,***
>
> ***- to a combined sewer***

4.2 Discharge Destination

4.2.1 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.

4.2.2 The hierarchy above is considered in order below:

Discharge into the ground

4.2.3 As outlined in **Section 3.3**, 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

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

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

4.3 Types of SuDS Measures

4.3.1 The policy requirement is for surface water runoff to be limited to a rate agreed with the IDB, with associated on-site attenuation required to temporarily retain the water in a rainfall event.

4.3.2 There are many forms for this on-site attenuation, and any strategy is likely to incorporate a range of measures that are integrated into a water network across the site, but it is recommended that emphasis is placed on the incorporation of surface features as these provide an amenity benefit, less long-term maintenance concerns, and can further promote the ecological enhancement credentials of the development through incorporation into any wider ecological enhancement strategy.

- Given the scale of the site, the most efficient approach is a holistic strategy utilising one – or a number of - large scale attenuation features in the form of **ponds or basins** which would serve a number of the individual plots – see example in provided in Figure 4.1. The inclusion of the ponds within the drainage strategy will also help with reducing construction costs, as less additional SuDS storage devices are needed within the design.

  It is noted that the current layout identifies a series of central ponds, but it is understood that these are intended to provide an amenity role rather than any integration into the surface water drainage strategy. It may be beneficial to review this as such areas could serve a dual purpose and reduce the on-site attenuation demands at a plot level, but at this stage they have been omitted from further consideration.

Figure 4-1: Example of Open Attenuation Pond with Planted Edges and Permanent Water

- **Swales** are a very useful drainage feature which can provide (i) significant biodiversity enhancements to a site, (ii) a significant route of conveyance – replacing the need for extensive below-ground pipework – as well as attenuation, and (iii) they can be designed in a variety of forms to suit the site constraints and aspirations. For example, 'dry swales' can be provided to utilise additional capacity within a filter medium along the base of the channel, otherwise 'wet swales' can be designed with check dams to retain a shallow depth of water at the base to encourage wetland planting and associated biodiversity (see **Figure 4-2** for examples of swales).

Figure 4-2: Examples of swales for drainage and biodiversity

- **Permeable pavements** also provide a level of surface water quality treatment as sediments are filtered out on the pavement surface and other pollutants are filtered out and degraded in the underlying sub-base.

4.3.3 In general, a minimum allowance of approximately 15% of a proposed development parcel area is recommended to allow for a strategic attenuation measures (potentially greater if permeable paving is preferred over above-ground soft engineered features), which would potentially be further supplemented by local measures to increase the storage provision and provide a conveyance function.

4.4 Proposed SuDS Strategy

4.4.1 The proposed surface water drainage strategy would be to incorporate source control features within each plot, such as lined permeable paving or surface attenuation features as discussed in **Section 4.3**, which provide on-site temporary storage of surface water prior to outfalls towards the surrounding IDB (potentially via the system of swales within the site).

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

4.5 Design Criteria

4.5.1 DEFRA Technical Standard S3 states that:

"***S2** 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.*"

4.5.2 Liaison has been undertaken with SHIDB throughout the design and approval process of the FEZ. As part of the original Surface Water Drainage Strategy (2017) SHIDB agreed a discharge rate for the whole site based on **1.4 l/ha** peak discharge to drain into the surrounding IDB watercourse channels (see correspondence in **Appendix B**). SHIDB has also advised in more recent correspondence dated June 2023 that they would want to see the discharge rate limited to a Q_{BAR} equivalent, preferably with a consolidated strategy for the whole site that could be considered under one consent (see correspondence in **Appendix B**).

4.5.3 While the above is reasonable for the delivery of a single overarching strategy for the FEZ site, the revised approach whereby individual plots have progressed in isolation means that achieving QBAR for each is not achievable as it is below the minimum allowable rate that discharge control devises can be designed to in order to minimise the risk of blockage. (typically 5l/s is referenced, although emerging new devices are understood to be able to achieve 2l/s). The implications of this are discussed in the 'Runoff Rate Assessment' below.

Runoff Rate Assessment

4.5.4 The impermeable area for each plot has been calculated for Q_{BAR} equivalent and is less than 1 l/s. This is considered to be too low to achieve without compromising the risk of blockage to the flow device. The storage estimates have therefore been assessed based on a rate of 2 l/s and a higher rate of 5 l/s.

4.5.5 The IDB set out fee arrangements, in the form of 'Surface Water Development Contribution (SWDC) rates, that would apply where a higher discharge rate is proposed, and as individual plots come forward it will be necessary to determine the achievable discharge rate in each case and liaise with SHIDB to ascertain (a) if the discharge rate is agreeable, and (ii) the resulting charge for the proposed flow – see **Figure 4.3**.

Figure 4-3: Extract of SHIDB Development Control Banding/Run-Off Charges 2023/24

Banding	Impermeable area, A, discharging (ha)		Surface Water Development Contribution rate (£/m²)
	Is greater than (>)	and is less than or equal to (≤)	
1	0	5	£15.14
2	5	10	£12.66
3	10	15	£10.88
4	15	20	£9.11
5	20	25	£7.32
6	25	n/a	£4.84

Table 2: Impermeable Area Bandings

Banding	Equivalent run-off rate (litres/second/hectare)		SWDC rate (as % of full contribution rate)
	Is greater than (>)	and is less than or equal to (≤)	
1	0	1.4	3
	Is greater than (>)	and is less than (<)	
2	1.4	5	10
	Is greater than or equal to (≥)	and is less than (<)	
3	5	10	15
4	10	15	20
5	15	20	25

4.5.6 The undeveloped plots over the site have been assessed individually. For each plot, the proposed impermeable area has been taken as 80% of the developable area, which includes a 10% allowance for urban creep in accordance with the CIRIA SuDS Manual (2015).

4.5.7 The greenfield runoff rates and on-site storage attenuation required for potential discharge rate scenarios of 2l/s and 5l/s for each proposed sub-catchment, based on the emerging and current typically assumed values for the 'minimum feasible runoff rate without causing risk of blockage' are shown in **Table 4-1**.

4.5.8 It is noted that the planning application for the University of Lincoln Centre of Excellence site on the southern part of the FEZ was approved under planning reference H09-0771-16, and the SHODB agreed a discharge rate of 5l/s based on the minimum flow control feasible to avoid the risk of blockage criteria discussed above.

Table 4-1: Proposed Discharge Rates and On-site Storage Requirements Comparison

Plot	Total Plot Area (ha)	80% Impermeable Area (ha)	Q_{BAR} GRR Rate l/s	Q100 year GRR Rate l/s	Approx. on-site storage requirements (m³) At a Proposed Discharge Rate of 2l/s	Approx. on-site storage requirements (m³) At a Proposed Discharge Rate of 5l/s
1	0.52	0.41	0.37	1.4	**520**	**440**
2	0.33	0.26	0.24	0.9	**310**	**250**
3	0.36	0.29	0.26	1.0	**340**	**280**
4	0.30	0.24	0.22	0.8	**280**	**230**
5	0.42	0.33	0.30	1.1	**410**	**340**
6	0.95	0.76	0.68	2.5	**1,020**	**910**
7	0.53	0.43	0.38	1.4	**540**	**460**
8	0.93	0.75	0.67	2.5	**1000**	**890**
9	0.20	0.16	0.14	0.5	**170**	**130**
10	1.35	1.10	0.97	3.6	**1,500**	**1360**
11	0.49	0.39	0.36	1.3	**490**	**420**
12	0.59	0.47	0.43	1.6	**610**	**530**
13	0.44	0.35	0.32	1.2	**430**	**370**

Runoff Volume Calculations

4.5.9 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.*"

4.5.10 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.

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

4.6.1 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.*"

4.6.2 **Section 2.1** 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 and updated in May 2022.

4.6.3 Control of the flow of surface water runoff through on-site attenuation is considered on a plot-by-plot basis, through SuDS storage features (ponds, permeable paving, swales), with a final controlled discharge to the IDB/riparian watercourse network.

4.6.4 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.

4.7 Water Quality

4.7.1 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).

4.7.2 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.

4.7.3 **Table 4-2** 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: Water quantity (Chapter 3): Peak runoff rate	Design criteria: Water quantity (Chapter 3): Runoff volumes: Small events (Interceptions)	Design criteria: Water quantity (Chapter 3): Runoff volumes: Large events	Design criteria: Water quality (Chapter 4)	Design criteria: Amenity (Chapter 5)	Design criteria: Biodiversity (Chapter 6)	Further information (Chapter ref)
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

5 Conclusions

5.1.1 This Surface Water Drainage Assessment has been prepared by Stantec, 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 the extension to the Local Development Order for a Food Enterprise Zone (FEZ) to the west of Holbeach in Lincolnshire.

5.1.2 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.

5.1.3 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.

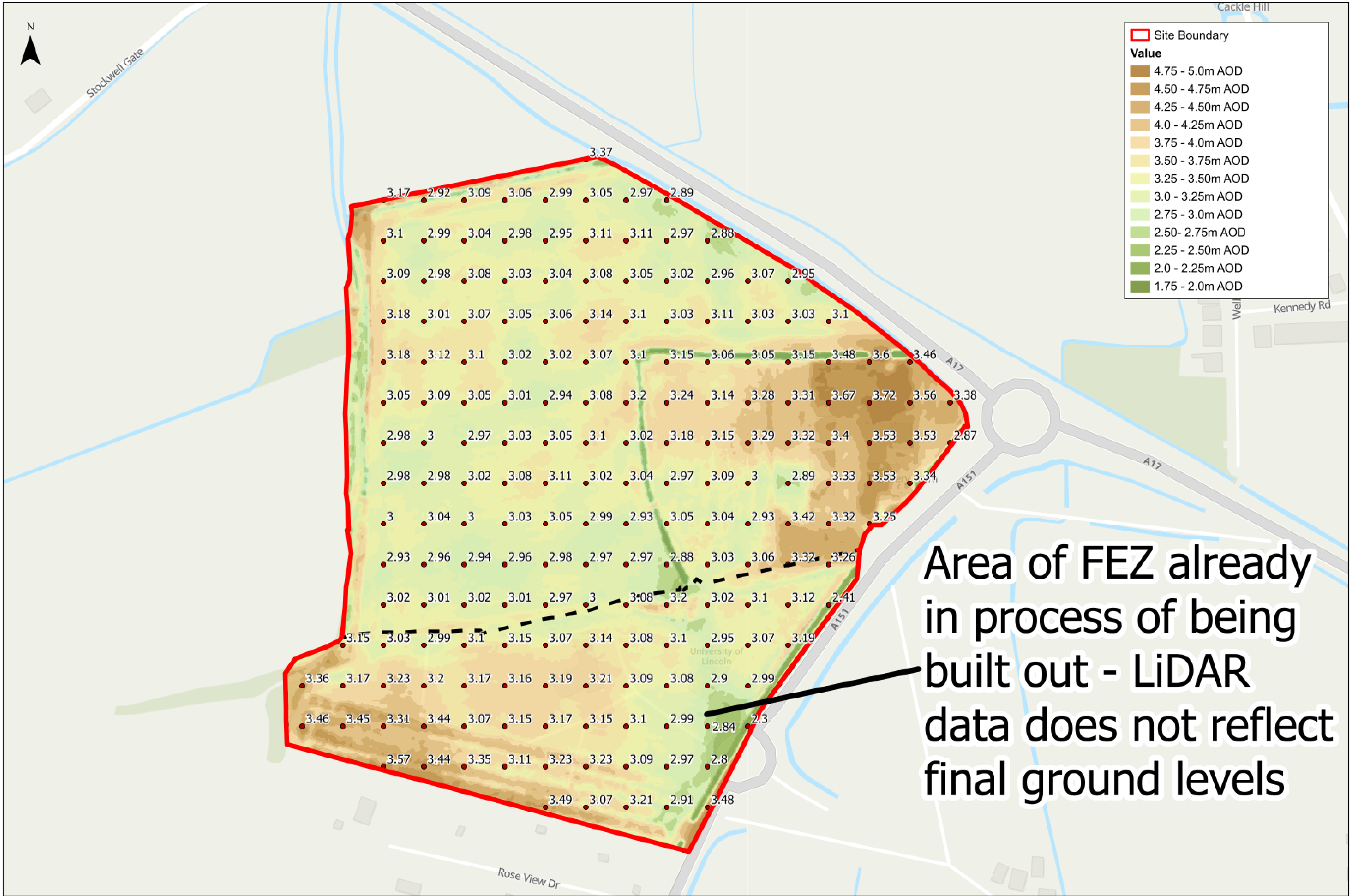
5.1.4 The Surface Water Drainage Strategy sets out a different approach to the original report due to the approach to delivery of plots over the site. The original strategy was focussed on a site-wide strategy with two large ponds providing the main attenuation function. As the FEZ development has instead progressed in piecemeal applications, the strategy has been revised to instead identify the attenuation requirements on a plot-by-plot basis and provide recommendations in what form such measures can be provided.

5.1.5 As individual plots come forward it will be necessary to determine the achievable discharge rate in each case and apply to SHIDB to obtain consent for a discharge to the adjacent channel. The on-site attenuation requirement will be dependent on discharge rates agreed with SHIDB, and due to plot sizes it is likely this will be based on the achievable discharge rate that minimises the risk of blockage to flow control devices. As such, Surface Water Development Contribution (SWDC) rates will be applied by the IDB as part of the consenting application process accordingly.

5.1.6 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

- Figure 001 – LiDAR Spot Levels
- Topographical Survey - Axis Survey Drawings AS2020/6 and AS2020/7 (August 2016)
0/7 (August 2016)



Stantec

Client: South Holland District Council

HOLBEACH FOOD ENTERPRISE ZONE (FEZ) LINCOLNSHIRE

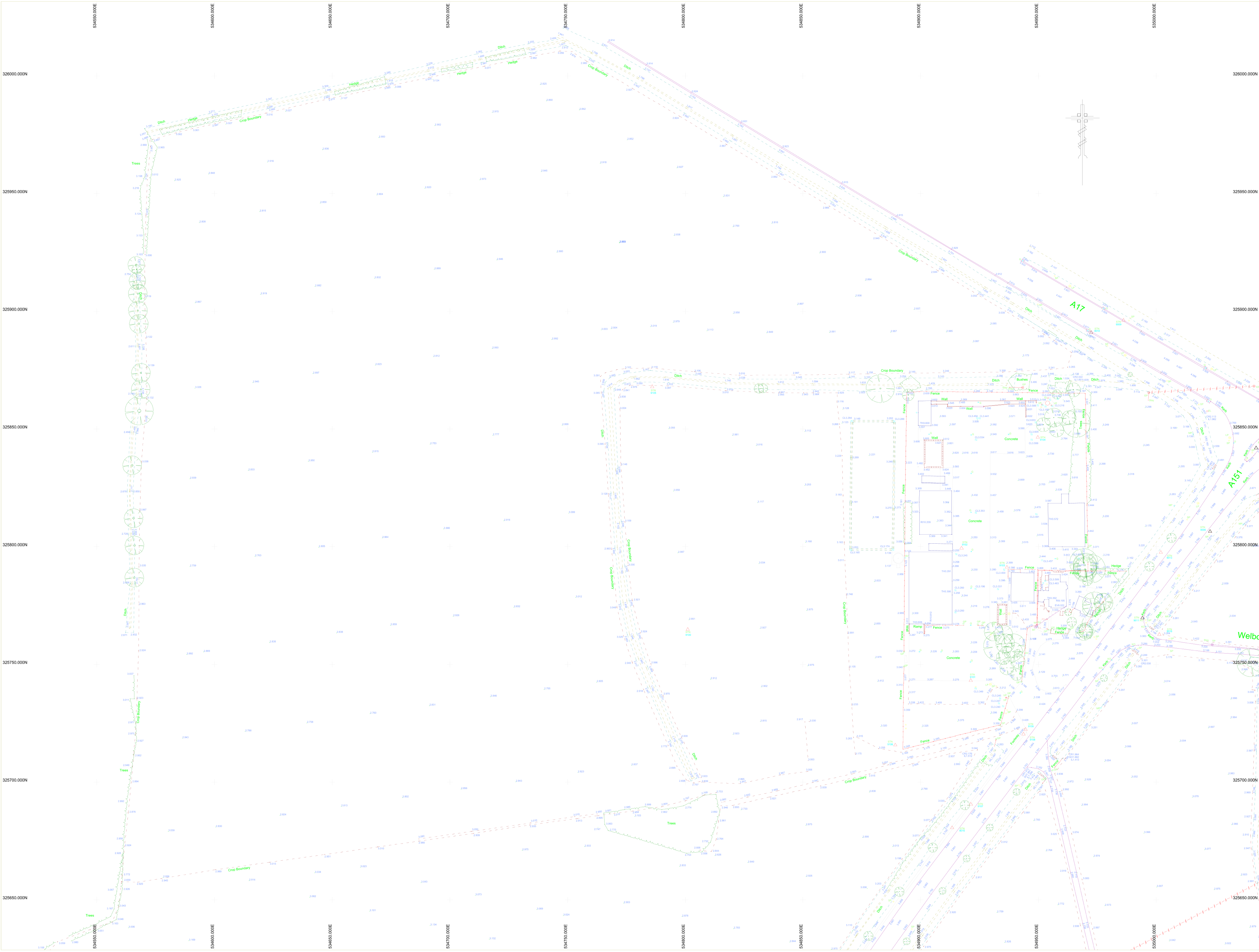
Topography - Detailed

0 125 250 m

Contains OS data © Crown Copyright and database right 2022
Contains data from OS Zoomstack, Contains OS data © Crown Copyright and database right 2019

1:2,500 @ A3	Date: 15/06/2023
Drawn: HL	Checked: RF
Figure: 003a	Rev: A

Document Path: C:\Users\hleekam\Documents\ArcGIS\Projects\HOLBEACH 2\HOLBEACH 2.aprx



KEY:

- BUILDING
- FENCE
- HEDGE
- CHANNEL
- WALL
- BANK EDGE
- STORM DRAINAGE
- FOUL DRAINAGE
- CHANGE OF SURFACE
- OVERHEAD ELECTRIC
- OVERHEAD TELEPHONE
- TREE
- BOREHOLE
- MANHOLE
- CONTROL STATION

B	BOLLARD	RE	ROD EYE
BIN	BIN	RI	RIDGE
BT	BRITISH TELECOM	SP	SIGN POST
CR	PIPE CROWN	STAY	STAY
CTV	CABLE TELEVISION	SV	STOP VALVE
EA	EARTH	TBM	BENCH MARK
EL	ELECTRIC BOX	TH	THRESHOLD
EP	ELECTRIC POLE	TL	TRAFFIC LIGHT
EV	EAVES	TP	TELEGRAPH POLE
FH	FIRE HYDRANT	TS	TRAFFIC SIGNAL
G	GULLY	VC	VENT COLUMN
GA	GAS VALVE	VP	VENT PIPE
IC	INSPECTION CHAMBER	WL	WATER LEVEL
IL	INVERT LEVEL	WM	WATER METER
KO	KERB OFFLET	WT	WALL TOP
LH	LAMP HOLE		
LP	LAMP POST		
MP	MARKER POST		
PB	POST BOX		

NOTES:

1. Survey plotted to OS National Grid.
2. All levels related to OS Datum.
3. GPS/GLONASS ETRS89 observations transformed to OSGB36 using OSTN02 Transformation.
4. ETRS89 ellipsoid heights converted to heights above mean sea level using National Geoid Model OSGM02.

Initial Survey Date: 4 FEB2015

CONTROL STATIONS

Stn:	Eastings:	Northings:	Height:

Rev:	Amendments:	Date:

Client: **ROBERT DOUGHTY CONSULTANCY**

Project Title: **LAND WEST OF HOLBEACH LINCOLNSHIRE**

Drawing Title: **OGL SURVEY**

Scale: 1:500
Date: 12 AUG 2016
Drawing No: AS2020/6
Rev: A0
C.A.D. Title: RDCHOLBEACHTOTAL
Drawn By: D.J.SMITH

AXIS SURVEYS LTD.
CHARTERED LAND SURVEYORS
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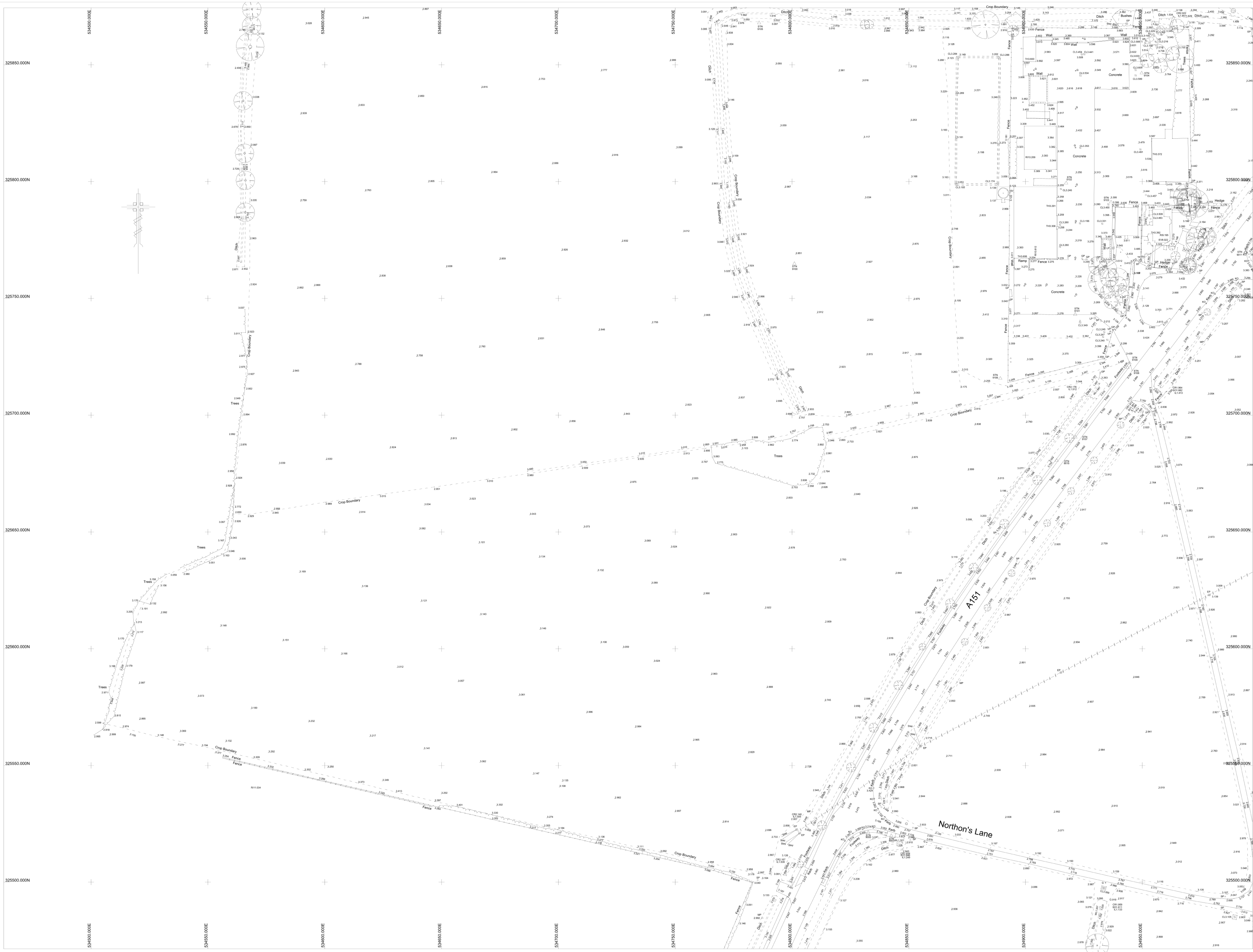
TEL (01507) 606397
FAX (01507) 354050
www.axissurveys.co.uk
office@axissurveys.co.uk



KEY:

- BUILDING
- FENCE
- HEDGE
- CHANNEL
- WALL
- BANK EDGE
- STORM DRAINAGE
- FOUL DRAINAGE
- CHANGE OF SURFACE
- OVERHEAD ELECTRIC
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- TREE
- BOREHOLE
- MANHOLE
- CONTROL STATION

B	BOLLARD	RE	ROD EYE
BIN	BIN	RI	RIDGE
BT	BRITISH TELECOM	SP	SIGN POST
CR	PIPE CROWN	STAY	STAY
CTV	CABLE TELEVISION	SV	STOP VALVE
EA	EARTH	TBM	BENCH MARK
EL	ELECTRIC BOX	TH	THRESHOLD
EP	ELECTRIC POLE	TL	TRAFFIC LIGHT
EV	EAVES	TP	TELEGRAPH POLE
FH	FIRE HYDRANT	TS	TRAFFIC SIGNAL
G	GULLY	VC	VENT COLUMN
GA	GAS VALVE	VP	VENT PIPE
IC	INSPECTION CHAMBER	WL	WATER LEVEL
IL	INVERT LEVEL	WM	WATER METER
KO	KERB OFFLET	WT	WALL TOP
LH	LAMP HOLE		
LP	LAMP POST		
MP	MARKER POST		
PB	POST BOX		

NOTES:

1. Survey plotted to OS National Grid.
2. All levels related to OS Datum.
3. GPS/GLONASS ETRS89 observations transformed to OSGB36 using OSTN02 Transformation.
4. ETRS89 ellipsoid heights converted to heights above mean sea level using National Geoid Model OSGM02.

Initial Survey Date: 5 FEB 2015

CONTROL STATIONS

Stn:	Eastings:	Northings:	Height:

Rev:	Amendments:	Date:

Client:
ROBERT DOUGHTY CONSULTANCY

Project Title:
LAND WEST OF HOLBEACH LINCOLNSHIRE

Drawing Title:
OGL SURVEY

Scale: 1:500
Date: 13 AUG 2016
Drawing No: AS2020/7
Rev: A0
C.A.D. Title: RDCHOLBEACHTOTAL
Drawn By: D.J.SMITH

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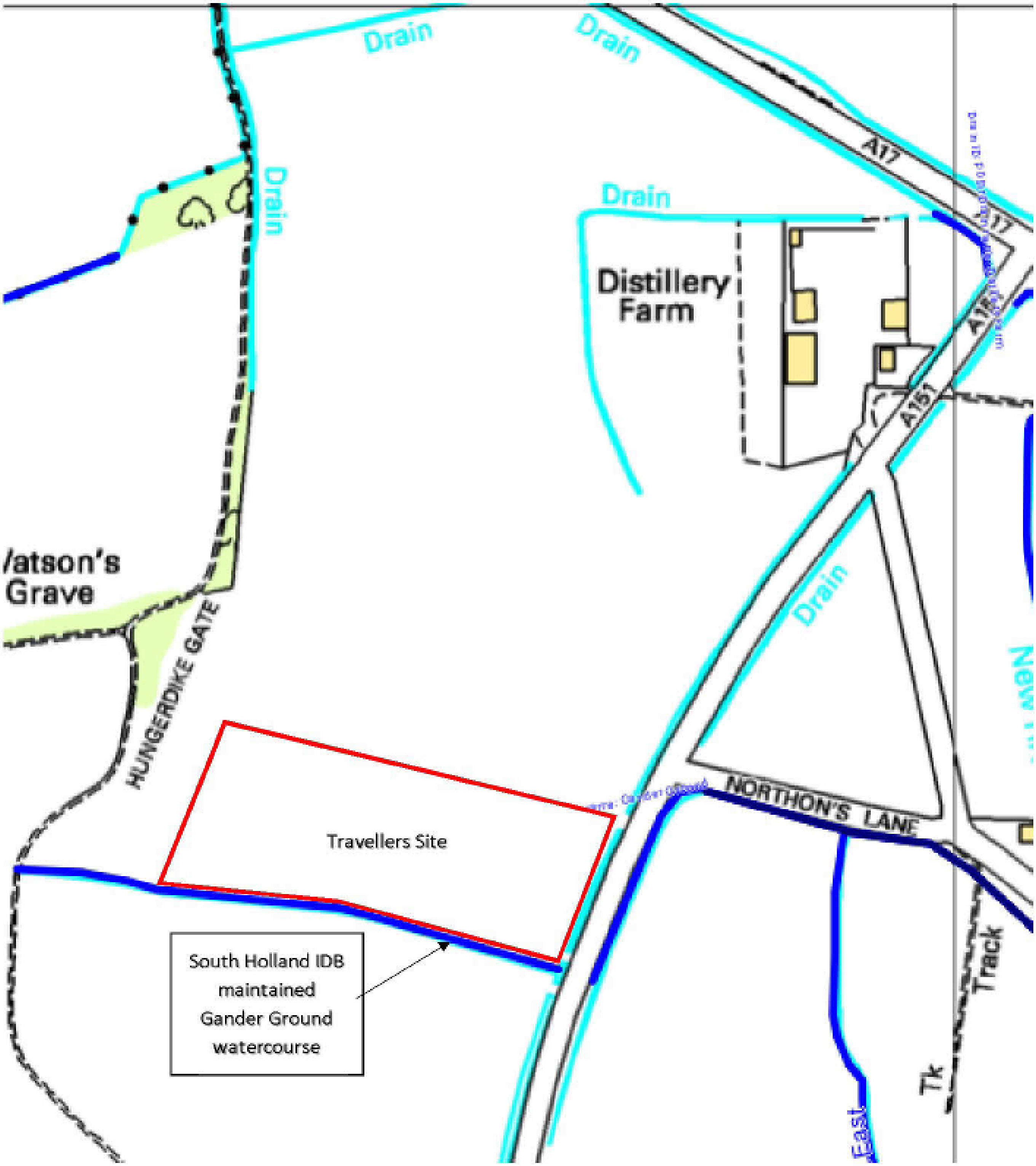
office@axissurveys.co.uk

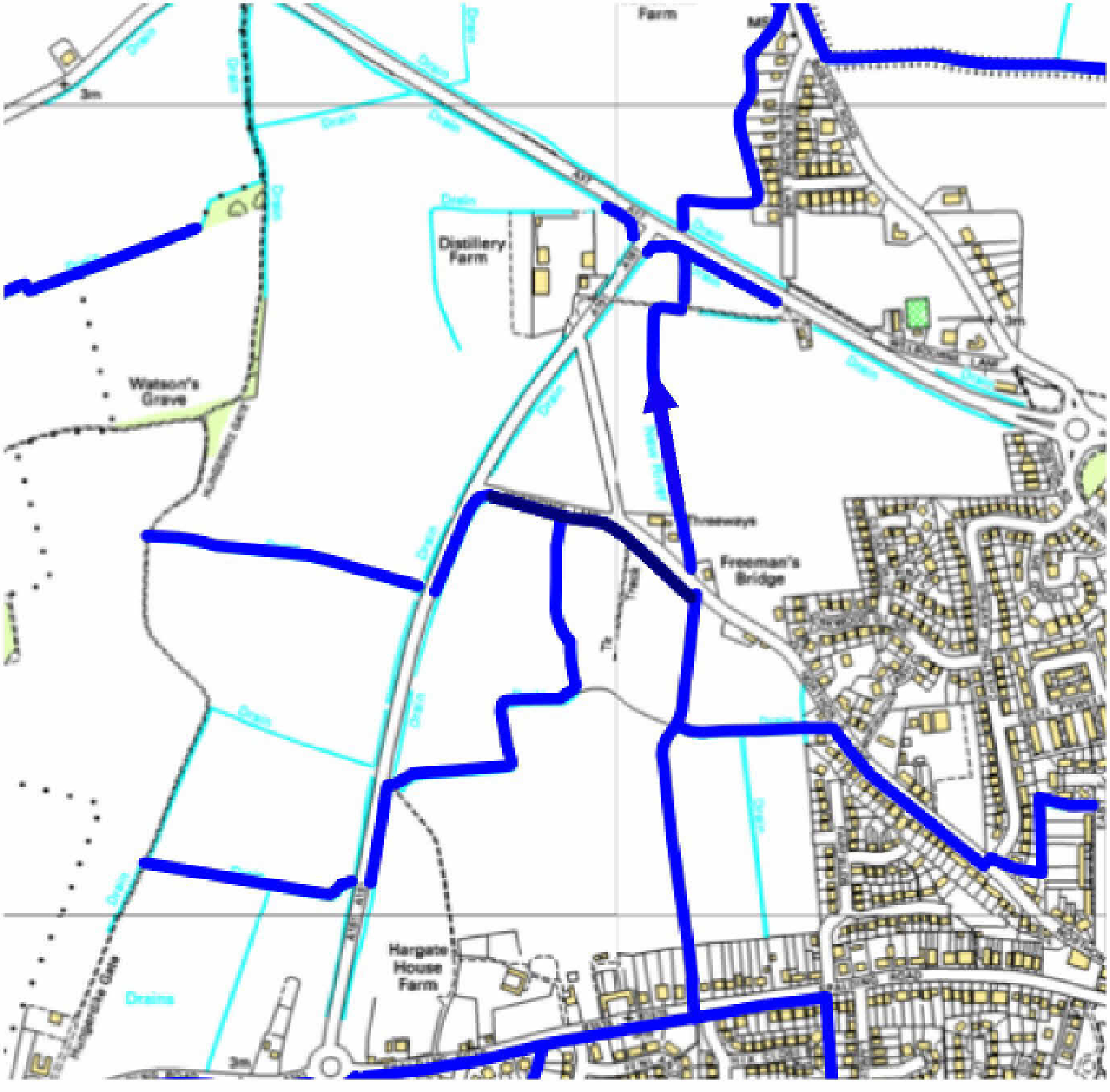
Appendix B South Holland IDB Information

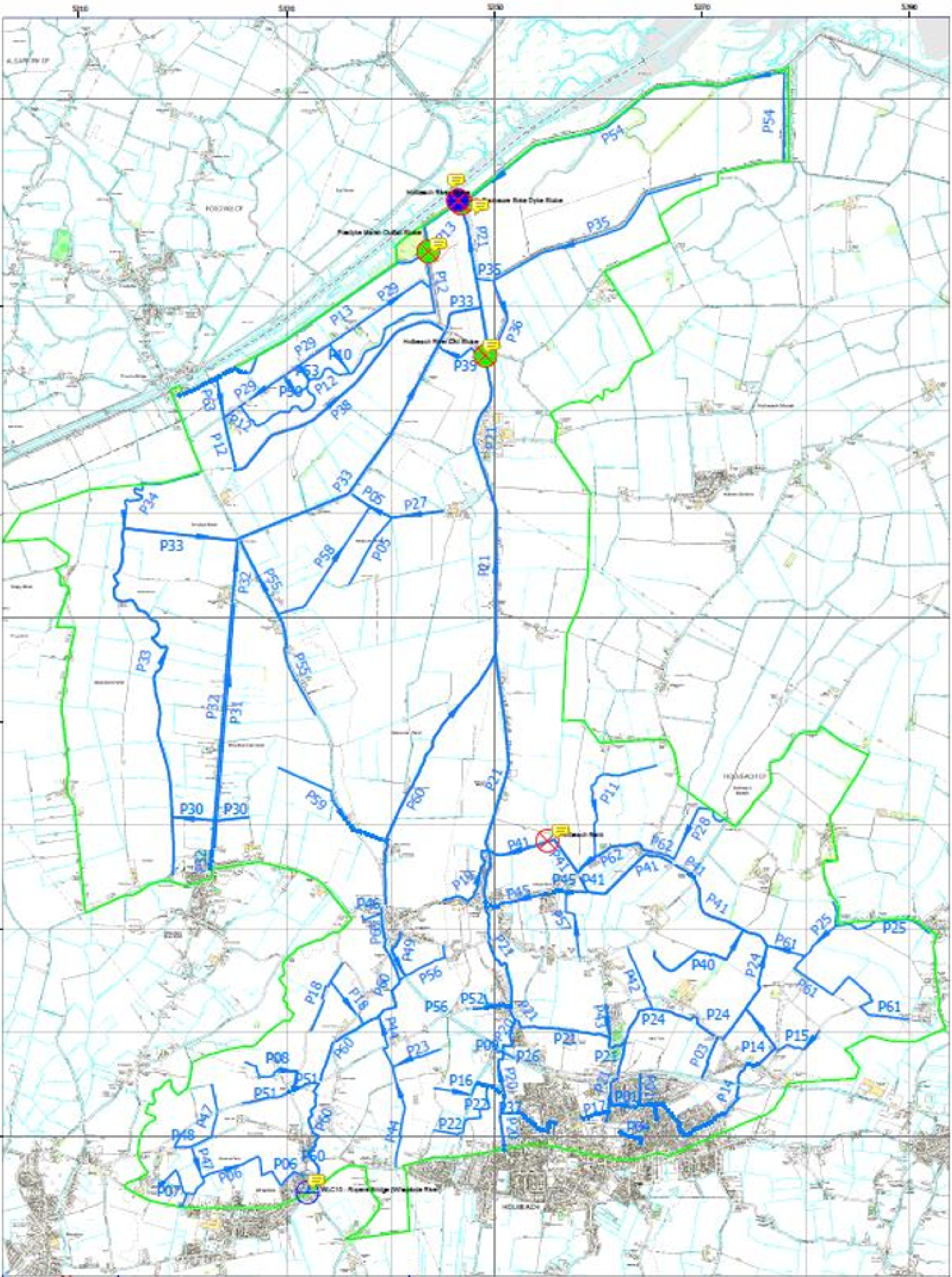
- IDB Network Plan
- IDB Email Correspondence dated 2nd June 2023 (Confirming Discharge Rate)



Watercourses maintained or owned by South Holland IDB

Private/Riparian maintained/owned watercourses.


Farm
Distillery Farm
Watson's Grave
Threeways
Freeman's Bridge
Hargate House Farm
Drain
Drains
3m



South Holland IDB
Catchment P - Holbeach River

Upload date:
Feb 2011

Key:

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

0 1 2 km

N

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)
P: HOLBEACH RIVER CATCHMENT							
P01	BATTLEFIELDS	☐	☑	580	580	580	0
P02	BATTLEFIELDS OLD PIPELINE	☐	☐	625	625	0	0
P03	BATTLEFIELDS NORTHERN	☐	☐	440	0	0	0
P04	CEMETARY	☐	☑	390	240	0	0
P05	CHAPEL	☐	☐	1,250	0	0	0
P06	CROWN	☐	☑	1,905	1,500	1,905	0
P07	CROWN BRANCH	☐	☑	580	0	440	0
P08	DAISY HALL	☐	☐	805	0	0	0
P09	DISTILLERY FARM	☑	☐	80	0	0	0
P10	DRAIN NO 15	☑	☐	350	0	0	0
P11	FLINT HOUSE	☐	☐	1,325	0	0	0
P12	FOSDYKE MARSH MAIN	☑	☐	4,150	0	0	0
P13	FOSDYKE MARSH SOKE DYKE	☑	☐	3,550	0	0	0
P14	FOXES LOW	☐	☑	2,515	2,000	2,515	0
P15	FOXES LOW BRANCH	☐	☐	570	0	0	0
P16	GANDER GROUND	☐	☐	615	0	0	0
P17	GAS HOUSE	☐	☑	240	240	240	0
P18	GODDAMS LANE	☐	☐	1,285	0	0	0
P19	HOLBEACH CLOUGH	☐	☑	870	870	870	0
P20	HOLBEACH NEW RIVER	☑	☑	1,380	1,380	1,380	0
P21	HOLBEACH RIVER	☑	☑	10,350	3,000	10,350	0
P22	HUNGERDYKE - EAST	☐	☐	1,210	0	0	0
P23	HUNGERDIKE - WEST	☐	☐	495	0	0	0
P24	HURN SOUTH	☑	☑	2,310	0	665	0
P25	HURN BANK DRAIN AND BRANCH	☑	☐	1,770	0	0	0
P26	LOW LANE	☐	☐	180	0	0	0
P27	MAJORS	☐	☑	1,375	200	875	0
P28	MARSH LEVEL	☐	☐	1,015	0	0	0
P29	MIDDLE MARSH ROAD	☑	☐	2,235	0	0	0
P30	MOULTON COMMON CONNECTION	☐	☐	735	0	0	0
P31	MOULTON COMMON - EAST	☐	☐	2,560	0	0	0
P32	MOULTON COMMON - WEST	☐	☑	3,175	500	3,175	0
P33	MOULTON RIVER	☑	☑	8,375	0	3,445	0
P34	MOULTON RIVER BRANCH	☑	☐	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)
P: HOLBEACH RIVER CATCHMENT							
P35	NEW SEA BANK	☐	☐	2,550	0	0	0
P36	NEW SEA BANK OLD OUTFALL ROUTE	☐	☐	820	0	0	0
P37	NORTHONS LANE	☐	☑	700	0	160	0
P38	OLD SEA BANK SOKE DYKE	☐	☑	2,630	500	2,630	0
P39	OLD SLUICE	☐	☐	590	0	0	0
P40	OUNDLE VICARAGE	☐	☐	1,250	0	0	0
P41	PEARTREE	☐	☑	3,530	0	3,530	0
P42	PENNY HILL	☐	☐	640	0	0	0
P43	PENNY HILL ROAD	☐	☑	325	325	325	0
P44	RODIKE MILL	☐	☐	1,550	0	0	0
P45	ROMAN BANK	☐	☑	1,020	1,020	1,020	0
P46	SARACENS HEAD	☐	☐	200	0	0	0
P47	SAVAGES LOW	☐	☐	1,100	0	0	0
P48	SAVAGES LOW BRANCH	☐	☐	345	0	0	0
P49	SCARLET GATE	☐	☐	460	0	0	0
P50	SECOND DROVE	☑	☐	380	0	0	0
P51	SPALDING GATE	☐	☐	755	0	0	0
P52	STOCKWELL GATE	☐	☐	525	0	0	0
P53	THIRD DROVE	☑	☐	360	0	0	0
P54	WARDS SOKE DYKE	☐	☐	4,340	0	0	0
P55	WASHWAY ROAD A17	☐	☑	1,860	1,000	1,160	0
P56	WASHWAY ROAD - SARACENS HEAD	☐	☐	595	0	0	0
P57	WASHWAY MILL	☐	☐	730	0	0	0
P58	WHAPLODE LODGE	☐	☐	1,410	0	0	0
P59	WHAPLODE & MOULTON MARSH	☐	☐	1,345	0	0	0
P60	WHAPLODE RIVER	☑	☑	6,150	2,000	6,150	0
P61	WOODHOUSE	☑	☑	2,185	0	295	0
P62	OLD PEARTREE	☐	☐	1,100	0	0	0
P63	FOSDYKE MARSH SOKE DYKE CONNECTION	☐	☐	380	0	0	0
P64	FIELD MEADOWS PIPELINE	☐	☐	195	0	0	0
Total Length for Holbeach River Catchment (km)				**100.61**	**15.98**	**41.71**	**0.00**

** SOW = Strategic Ordinary Watercourse*

From:	Ellie Roberts
To:	Leekam, Hugh
Subject:	RE: Holbeach, University of Leicester, Centre of Excellence, Surface Water Drainage Planning Amendments
Date:	02 June 2023 12:03:04
Attachments:	image003.png image004.png image005.png image006.png image007.png image008.png

---

Hi Hugh,

Our catchment engineer has advised me that the levels below are our most recent data, however the catchment is being re-modelled and we expect to have new data later this year.

It is unfortunate that the whole site did not come forward with a drainage strategy for which we could have given one consented discharge rate to match the 1.4l/s as quoted by Dominic. The attached email however should not be taken as consent and it may be the case that on a new application a different rate may be acceptable based on intermediate development and its effects on the catchment. Is the new site intended to drain through the existing outfall or would there be a separate discharge point?

We would expect that the proposed discharge rate is limited to a maximum of Qbar equivalent, and would encourage an application for the whole site which we could review as one consent. If approved, the parcels as they come forward could evidence to us that they are contributing pro-rata to the overall system to ensure it works as consented.

I hope this is useful, happy to discuss further.

Kind Regards,

Ellie

Eleanor Roberts, BSc (Hons), MCIWEM
Senior Sustainable Development Officer
Water Management Alliance
m: 07827 356752| e: ellie.roberts@wlma.org.uk

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

The Stills, 1 Floor, 80 Turnmill Street, London EC1M 5QU
Direct: +44 20 3824 6623
Mobile:
Hugh.Leekam@stantec.com

From: Leekam, Hugh
Sent: Wednesday, May 17, 2023 9:55 AM
To: 'Ellie Roberts' <Ellie.Roberts@wlma.org.uk>
Cc: 'info@wlma.org.uk' <info@wlma.org.uk>; Fisher, Richard <richard.fisher@stantec.com>
Subject: RE: Holbeach, University of Leicester, Centre of Excellence, Surface Water Drainage Planning Amendments

Good morning Ellie,

It was good to speak to you over the phone last week and be able to introduce myself.

I just wanted to follow-up from our call and see if you had any new updates or information you could provide? In response to the below email, for agreed discharge rates into the surrounding IDB watercourse channels, at the proposed Holbeach, University of Leicester, Centre of Excellence site.

As I mentioned on the phone, this information is becoming more urgent for us to be able to complete the surface water drainage strategy at the site.

Please let me know if you need us to provide you with any further information to help with your assessment.

Many thanks,

Hugh

From: Leekam, Hugh
Sent: 29 March 2023 15:08
To: Ellie Roberts <Ellie.Roberts@wlma.org.uk>
Cc: info@wlma.org.uk; Fisher, Richard <richard.fisher@stantec.com>
Subject: Holbeach, University of Leicester, Centre of Excellence, Surface Water Drainage Planning Amendments

Dear Sir/Madam,

We are working on a new 16ha site 'Food Enterprise Zone' development site (Science Park) on western flank of the town of Holbeach in Lincolnshire, Spalding, PE12 7PY (site centre OS grid reference 534,730m E, 325,750m N).

In October 2017 Stantec produced a supporting drainage strategy for the site on behalf of South Holland District Council, at which point we agreed a discharge rate with the South Holland IDB for the whole site based on **1.4 l/ha** peak discharge to drain into the surrounding IDB watercourse channels, from any proposed impermeable areas at the site, resulting in an allowable peak flow of **8.6 l/s**.

Since that time the site has obtained approval under a Local Development Order (LDO), with the added proposal for a new Centre of Excellence site included within the proposed

'Food Enterprise Zone' development that is being built out. Since the first planning application in 2017 was completed, high groundwater levels have been identified at the site. To account for these high groundwater levels and the proposal for a new Centre of Excellence building at the site. A new surface water drainage design has been proposed to utilise a gravel pit, to counteract the buoyancy force from the high groundwater and to account for outfall surcharge.

However, the lots over the site are coming forward for development in a piecemeal manner, and we note from correspondence related to the University of Leicester, Centre of Excellence, Holbeach – Surface Water Drainage Planning Amendments (Planning Permission reference: **H09-0771-16**) in August 2019 that the IDB agreed to a discharge rate of **5l/s**, due to the much smaller site area, the resulting lower runoff rates and the need to meet minimum allowable discharge requirements without risk of blockage.

We are updating our strategy to provide drainage design advice and assess associated attenuation requirements for the further sites coming forward and wanted to check on the current IDB requirements.

Can you advise if the minimum allowable rate to discharge into the IDB watercourse is still agreed at **5 l/s** on the basis that the sites are so small that a pro-rata of the previously agreed 1.4l/s/ha is below this level?, or have there been any relevant policy changes within the IDB's guidance on discharge rates that we would need to apply?

Many thanks,

Hugh Leekam
Assistant Flood Risk Engineer

The Stills, 1st Floor, 80 Turnmill Street, London EC1M 5QU
Direct: +44 20 3824 6623
Mobile:
Hugh.Leekam@stantec.com

Appendix C Existing Runoff Rates

- Brownfield Runoff Rates
- Greenfield Runoff Rates

Brownfield Runoff Rates
Modified Rational Method

Stantec

Project Title	Holbeach Food Enterprise Zone (FEZ), Lincolnshire - Surface Water Drainage	
Project No	11500	0

Existing Site Condition

Rainfall Model		FEH	
Storm Duration		15.00	mins
Global Time of Entry		5.00	mins
Volumetric Runoff Coefficient	Cv	0.90	
Routing Coefficient	Cr	1.30	
Contributing Area	A	1.00	ha

	Average Rainfall Intensity, i (mm/hr)	Runoff Rate , Q (l/s)	
1 in 1 Year	26.84	87.3	FSR
1 in 2 Year	36.66	119.2	FEH13 model
1 in 30 Year	90.63	294.8	FEH13 model
1 in 100 Year	122.75	399.3	FEH13 model

1 hour storm duration from convention

Based on the Modified Rational Method as described in CIRIA C753 - The SuDS Manual 2015

EQ. 24.5 Modified rational method equation to determine peak flow rates

$$Q = 2.78\,C\,i\,A$$

where:

Q = design event peak rate of runoff (l/s)
C = non-dimensional runoff coefficient which is dependent on the catchment characteristics

$$C = C_V\,C_R$$

where C_V = volumetric runoff coefficient
C_R = dimensionless routing coefficient

i = rainfall intensity for the design return period (in mm/hr) and for a duration equal to the "time of concentration" of the network
A = total catchment area being drained (ha)

Note: 2.78 is a conversion factor to address the rainfall unit being in mm/hr.

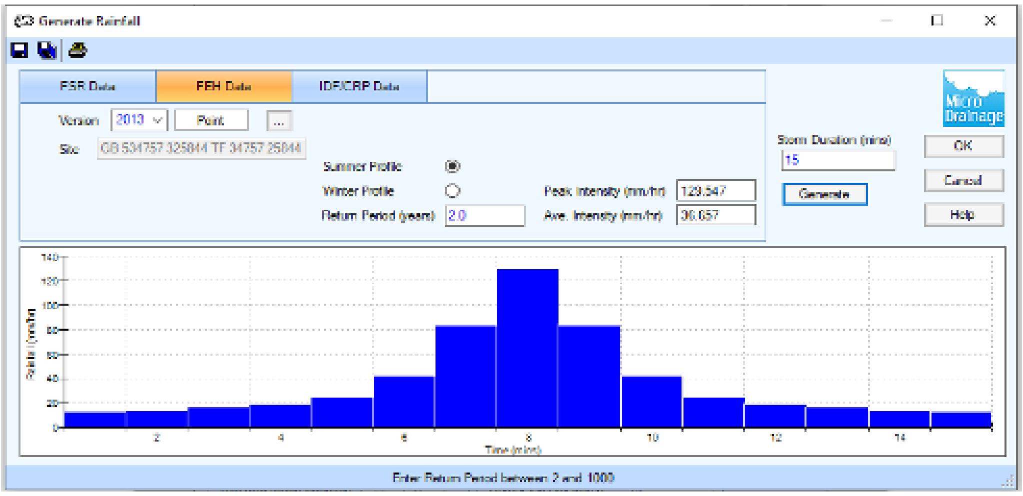
Runoff Volume 100yr 6hour storm

Rainfall intensity 6 hour storm 15.78 mm/hr

Runoff Volume (m^3) 1108.50

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
-	Original calculation	HL	12/05/2023	EE	19/06/2023


Generate Rainfall
FSR Data
FEH Data
IDF/CRP Data
Version
2013
Point
Site
GB 534757 325844 TF 34757 25844
Summer Profile
Winter Profile
Return Period (years)
2.0
Peak Intensity (mm/hr)
129.547
Ave. Intensity (mm/hr)
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Storm Duration (mins)
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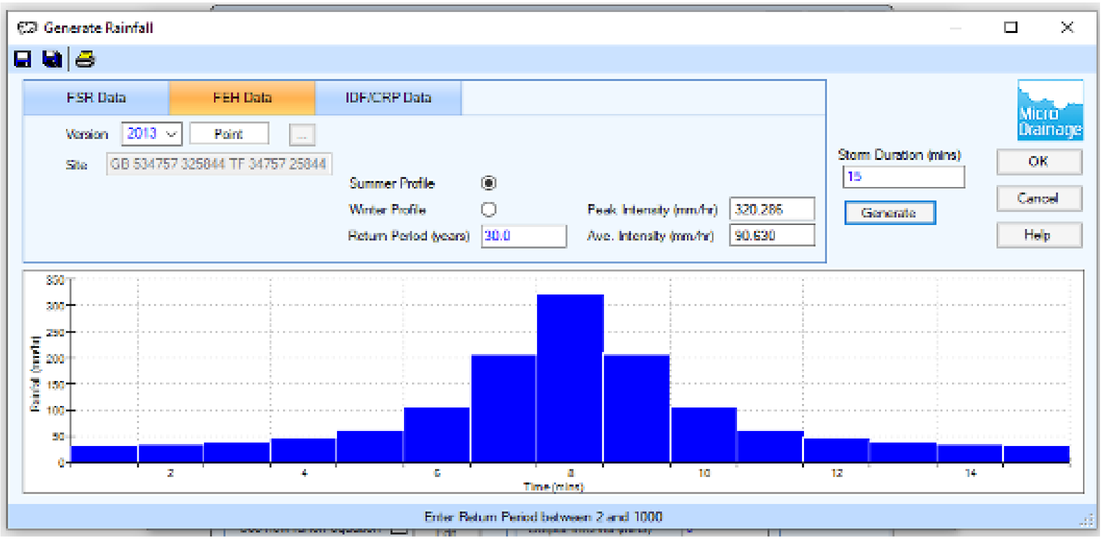
Cancel
Help
Micro Drainage
Time (mins)
Enter Return Period between 2 and 1000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FSR Data
FEH Data
IDF/CRP Data
Version
2013
Point
Site
GB 534757 325844 TF 34757 25844
Summer Profile
Winter Profile
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Peak Intensity (mm/hr)
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Ave. Intensity (mm/hr)
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Help
Micro Drainage
Rainfall (mm/hr)
Time (mins)
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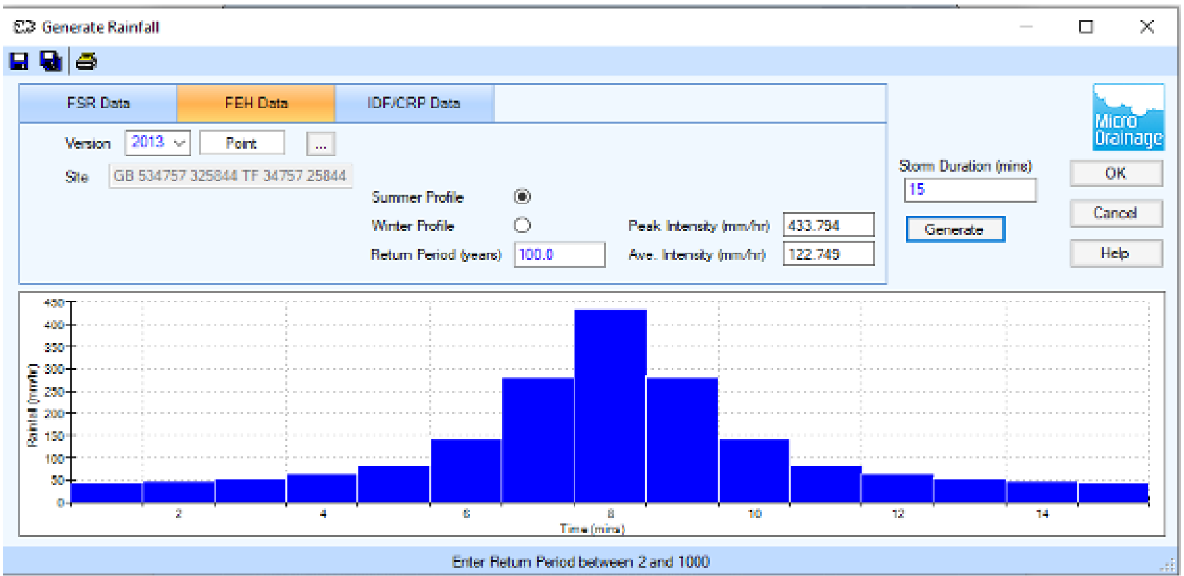
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FSR Data
FEH Data
IDF/CRP Data
Version
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Point
Site
GB 534757 325844 TF 34757 25844
Summer Profile
Winter Profile
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Peak Intensity (mm/hr)
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Ave. Intensity (mm/hr)
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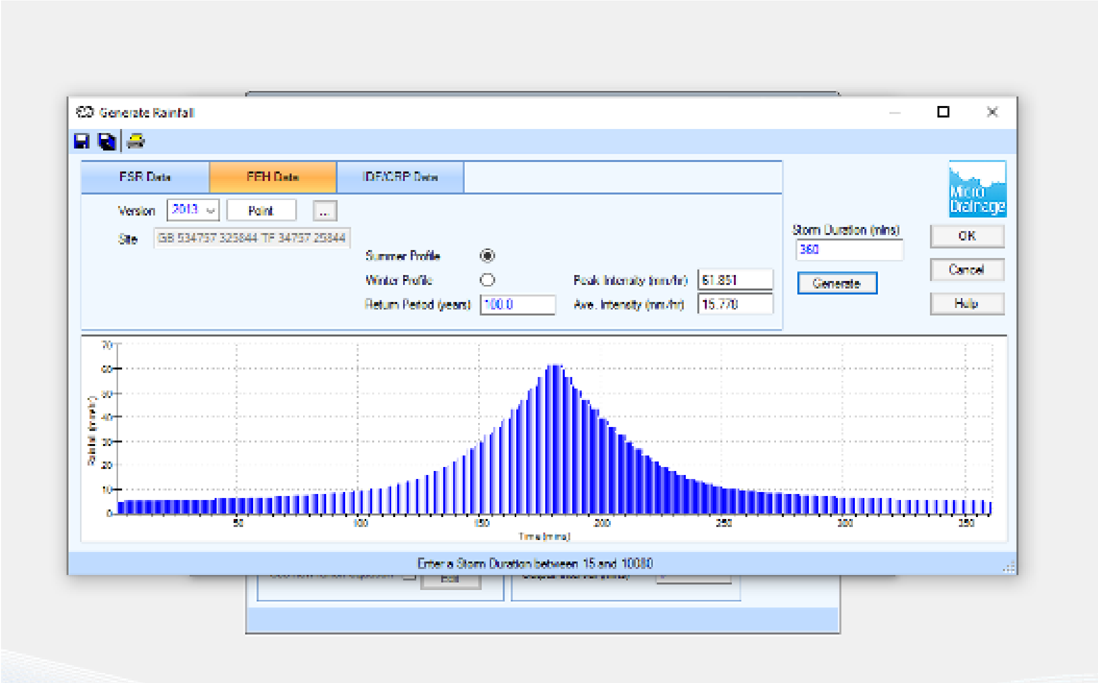
Help
Micro Drainage
Rainfall (mm/hr)
Time (mins)
Enter Return Period between 2 and 1000


Generate Rainfall
FSR Data
FEH Data
IDF/CRP Data
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Point
Site
GB 534757 325844 TF 34757 25844
Summer Profile
Winter Profile
Return Period (years)
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Peak Intensity (mm/hr)
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Ave. Intensity (mm/hr)
15.770
Storm Duration (mins)
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Help
Time (mins)
Enter a Storm Duration between 15 and 10080

FEH Greenfield Runoff

Using the 2008 Statistical Method QMED Equation

Stantec

Project Title	Holbeach Food Enterprise Zone (FEZ), Lincolnshire - Surface Water Drainage
Project No	11500

Methodology as set out in SuDS Manual 24.3.2 — SUDS Manual Chapter 24

1 Retrieve FEH Catchment Information

Define BFIHOST definition source		FEH	*see note 1*
Catchment Descriptors	**BFIHOST**	0.682	
	SAAR	574.0	*see note 1*
	FARL	1.0	*see note 2*

2 Derive QBAR (mean annual flood)

Define area	**Site Area**	10.5	ha	
	Applied Area	50.0	ha	*see note 3*
FEH Index Flood (SuDS Manual Equation 24.2)	**QMED (Q_2)**	8.8	l/s	*see note 4*
Calculate QBAR by dividing QMED by 2yr growth factor	**QBAR**	9.9	l/s	*see note 5*

3 Select appropriate growth factors

FSR Hydrological Region		5	*(refer to FSR Hydrological Region tab)*
100yr Growth Curve Factor	GQ_{100}	3.56	
30yr Growth Curve Factor	GQ_{30}	2.55	
10yr Growth Curve Factor	GQ_{10}	1.65	
2yr Growth Curve Factor	GQ_2	0.89	
1yr Growth Curve Factor	GQ_1	0.87	

4 Derive Flood Frequency

Greenfield Runoff per 1ha

100yr Peak Runoff Rate	Q_{100}	35.3	l/s	Q_{100}	3.4	l/s/ha
30yr Peak Runoff Rate	Q_{30}	25.3	l/s	Q_{30}	2.4	l/s/ha
10yr Growth Curve Rate	Q_{10}	16.4	l/s	Q_{10}	1.6	l/s/ha
QBAR Peak Runoff Rate	QBAR	9.9	l/s	Q_{BAR}	0.9	l/s/ha
2yr Peak Runoff Rate	Q_2	8.8	l/s	Q_2	0.8	l/s/ha
1yr Peak Runoff Rate	Q_1	8.6	l/s	Q_1	0.8	l/s/ha

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
-	Original calculation	H Leekam	04/05/2023	E Edney	04/05/2023

Notes This spreadsheet has been created to allow derivation of greenfield runoff rates using the FEH statistical method applied in a manner consistent with the recommendations of the SuDS Manual. If you have recommendations to improve this spreadsheet please contact Alex Bearne.

Note 1 FEH Web version 3 allows extraction of BFIHOST and SAAR values for each square kilometre grid Export point data from FEH Webs Service as .XML file and save in project folder and import in the FEH Point Data Import tab. If you do not think the BFIHOST value is representative of your site then it is possible to derive it manually. This should not normally be necessary. BFI can be derived manually using the methodology set out in the Flood Estimation Handbook (see Manual Derivation *of BFIHOST tab)* or can be defined from ground investigation information.
As default the sheet references the imported FEH data

Note 2 FARL value is a measure of attenuation from reservoirs and lakes for the majority of studies this should be set to 1 (representing no attenuation). If your site includes a large water body with an attenuating affect on runoff please consult a hydrologist.
FARL is a measurement of studies water bodies in the catchment so that their attenuation effects so this term becomes 1.0 and therefore drops out. (see page 23 of the Preliminary rainfall runoff management for developments EA/Defra 2013)
Rainfall runoff management for developments.pdf

Note 3 If the site area is less than 50 hectare the spreadsheet will calculate QMED for 50ha and scale the results automatically to the defined Site Area

Note 4 QMED is calculated using the statistical equation as revised by Kjeldsen in 2008

$$Q_{MED} = 8.3062AREA^{0.8510} \cdot 0.1536^{(1000/SAAR)} \cdot FARL^{3.4451} \cdot 0.0460^{BFIHOST\text{^}2}$$

Rainfall runoff management for developments.pdf
It is reproduced as Equation 24.2 in the SUDS Manual (pg 512)

Note 5 QBAR is calculated by dividing QMED by the growth factor for the 2 year event, as per the methodology set out in paragraph 6.2.2 of 'Rainfall runoff management for developments' . QBAR is then used as the index flood for the basis of applying the growth factors.

Appendix D Drainage Strategy Information

- Pick Everard – Outline Masterplan Drawing – 210649-PEV-XX-ZZ-DR-A-0010, November 2022
- MicroDrainage Source Control Results (Holbeach Plot Drainage Areas)

NO DIMENSIONS TO BE SCALED FROM THIS DRAWING

CDM - RESIDUAL HAZARDS The following are considered to be significant risks relevant to this drawing, which could not be fully mitigated or removed through design:

Areas Schedule				
Plot	Area (sqm)	Building	No. Storeys	GEA Area (sqm)
1	5153	A	2	2094
2	3281	B	2	2412
3	3573	C	2	2580
4	3020	D	2	1800
5	4179	E	2	2730
6	9471	F	3	7524
		G	3	3285
7	5339	H	3	3456
8	9315	I	2	2762
		J	2	1960
9	1955	L	1.5	768
10	13451	M	2	1820
		N	3	1764
		O	3	1686
		P	1	311
11	4933	Q	1.5	2325
12	5932	R	1.5	2385
13	4406	S	2	2044
Road Linear Length (m)		810 (approx.)		
Overall Development Area		79,137sqm / 7.9ha		
Overall Non-Net Area		43,706sqm / 4.37ha		
Total Phase 2 Area		122,843sqm / 12.28ha		

*Tracking to plots access only

*Plot layout subject to tenant requirements

P05	Plot outline colour and SOA update	06.10.22	RJM	RJT
P04	Revised Plot 9 to work as a B1 unit	27.09.22	RJM	RJT
P03	Revised Plots 8 and 9 as per IAgri Proposed Dev.	23.09.22	RJM	RJT
P02	Revised Plots 8 and 9 as per IAgri Proposed Dev.	15.10.21	NCD	RJT
P01	Draft Issue 01	06.08.21	NCD	RJT

Client

Lincolnshire County Council

Gleeds

Project

Peppermint Park FEZ

Drawing Title

Outline Masterplan

Suitability Status

S3 - Suitable for Review and Comment

Job No.	Scale	Size	Rev
210649	**1:2500**	**@ A3**	**P05**

Drawing Number

210649-PEV-XX-ZZ-DR-A-0010

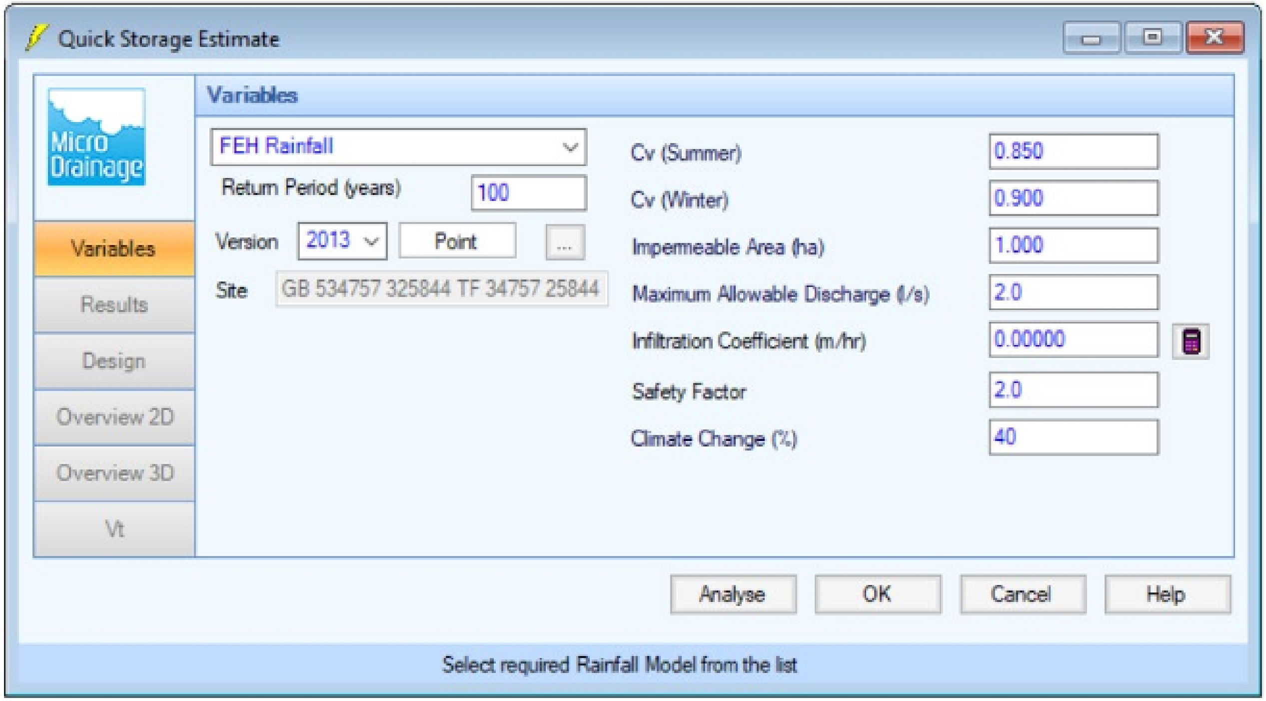
Project Code - Originator - Zone - Level - Type - Role - Number

PICK EVERARD

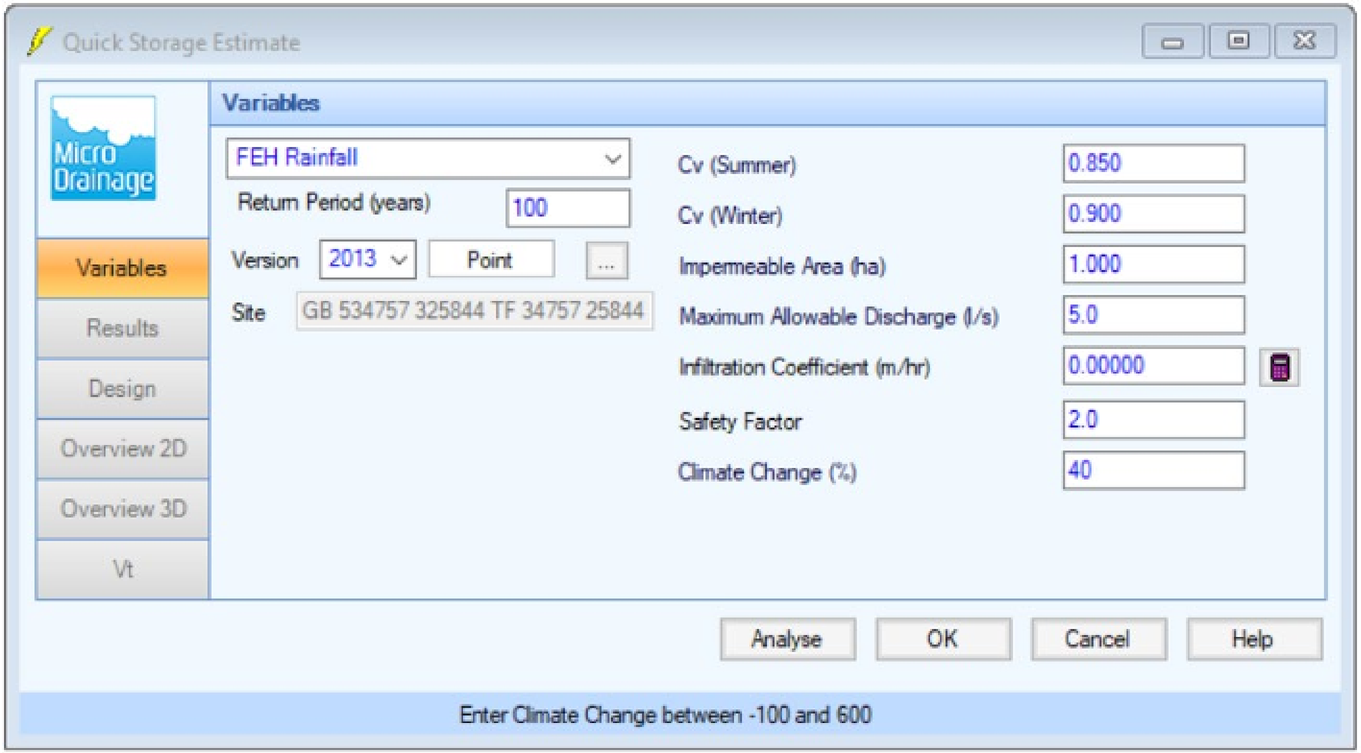
T 0345 045 0050 www.pickeverard.co.uk

Source Control

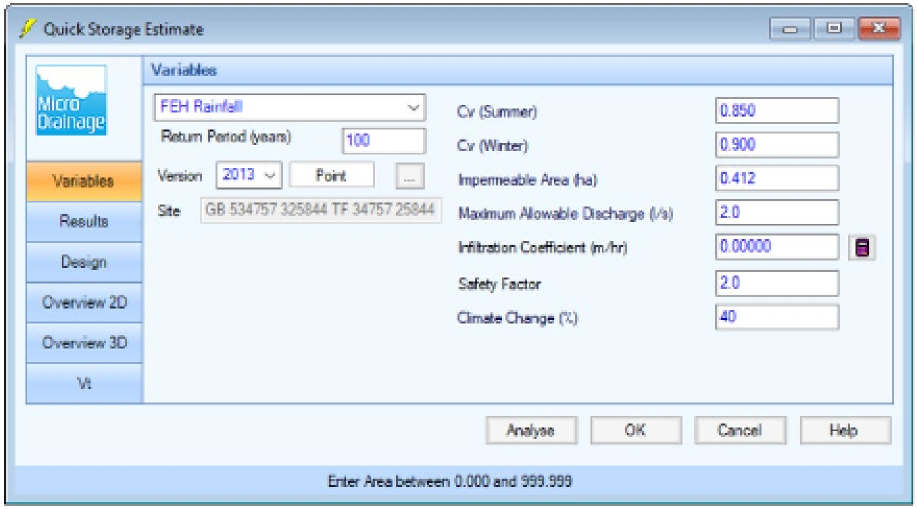
Proposed Plots On-site Quick Storage Estimates at Proposed Discharge Rate of 2l/s

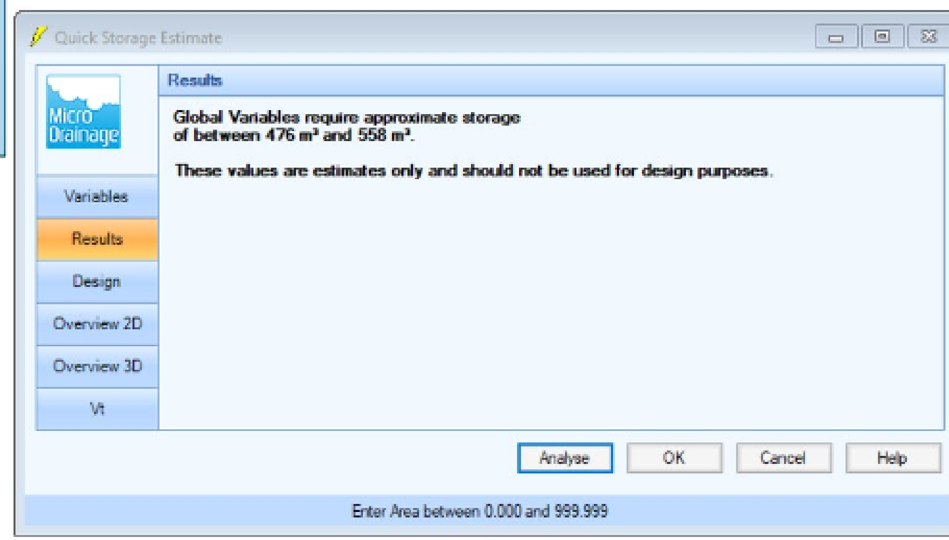


Proposed Plots On-site Quick Storage Estimates at Proposed Discharge Rate of 5l/s

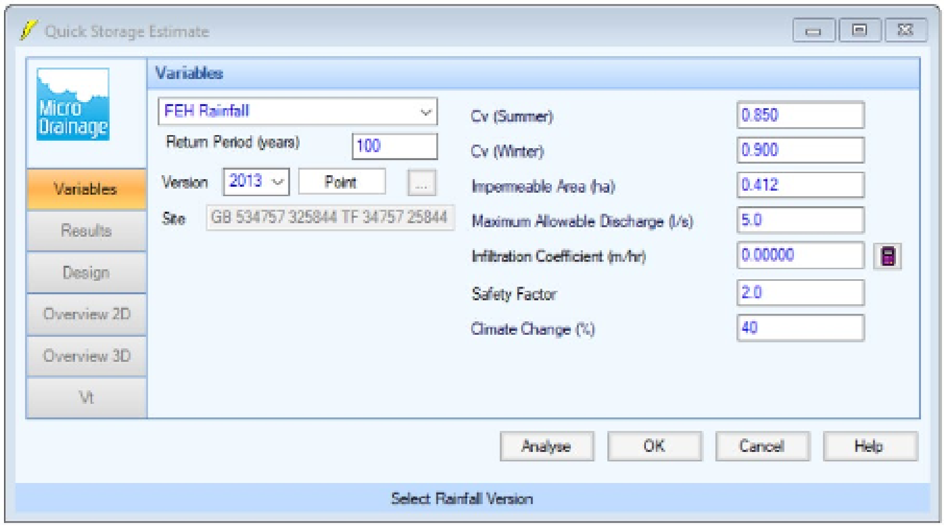


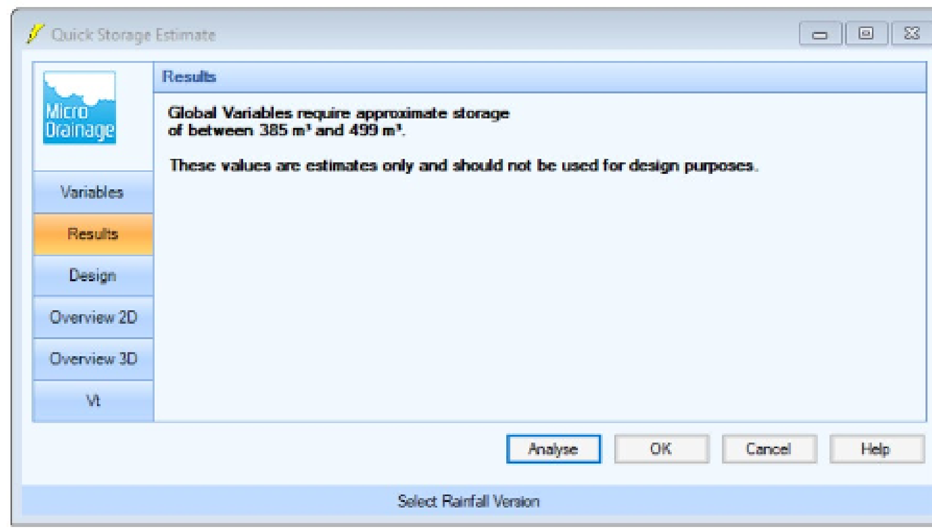
Plot 1 Proposed Discharge Rate of 2l/s





Plot 1 Proposed Discharge Rate of 5l/s





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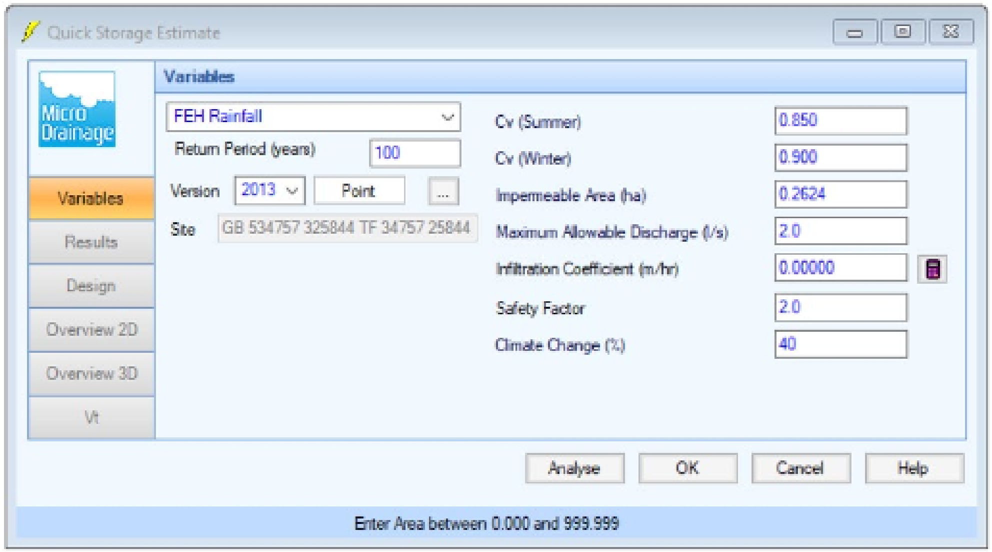
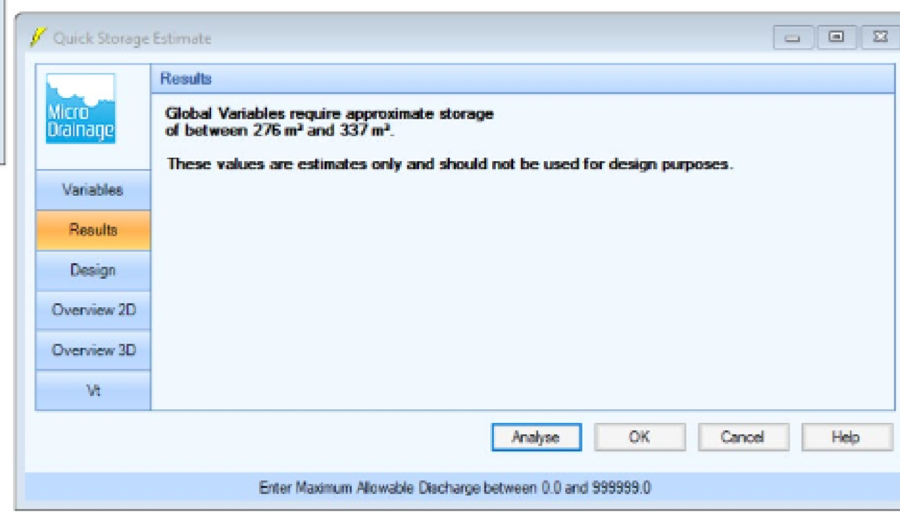
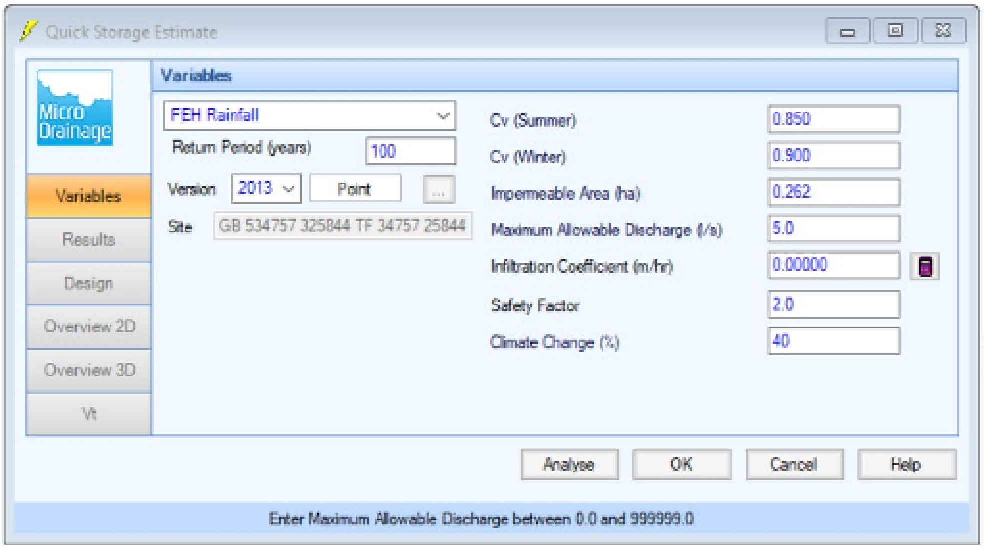
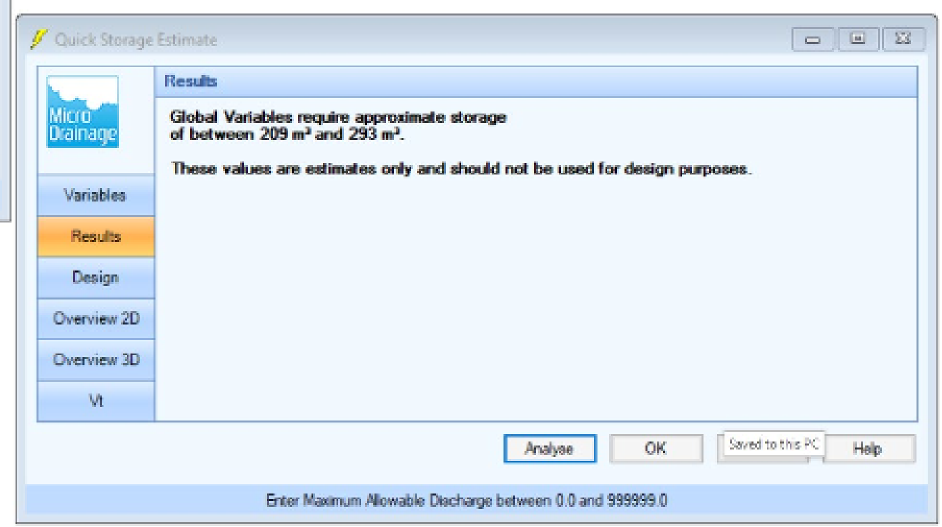


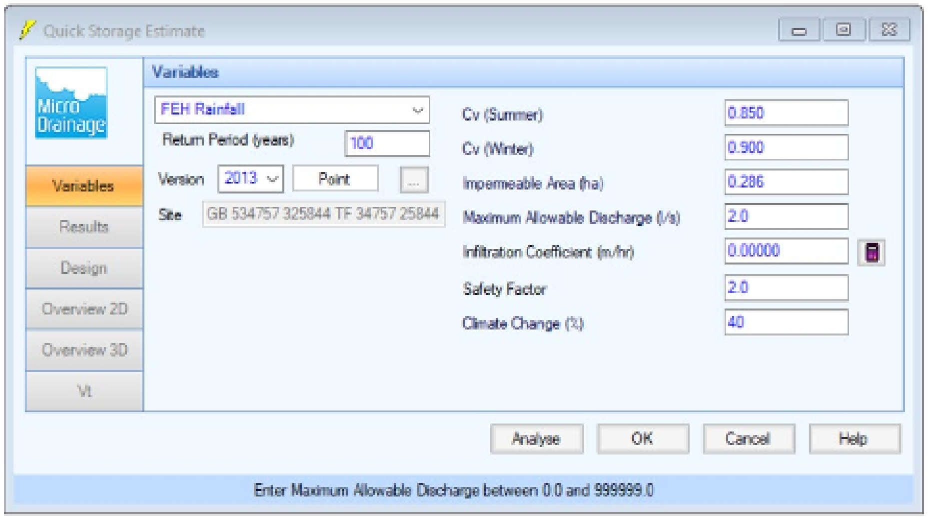


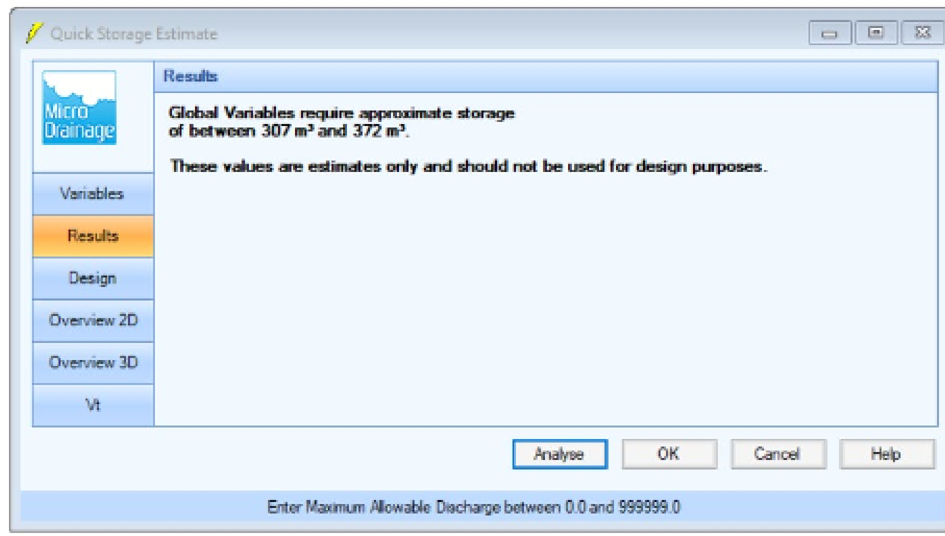
Plot 2 Proposed Discharge Rate of 5l/s



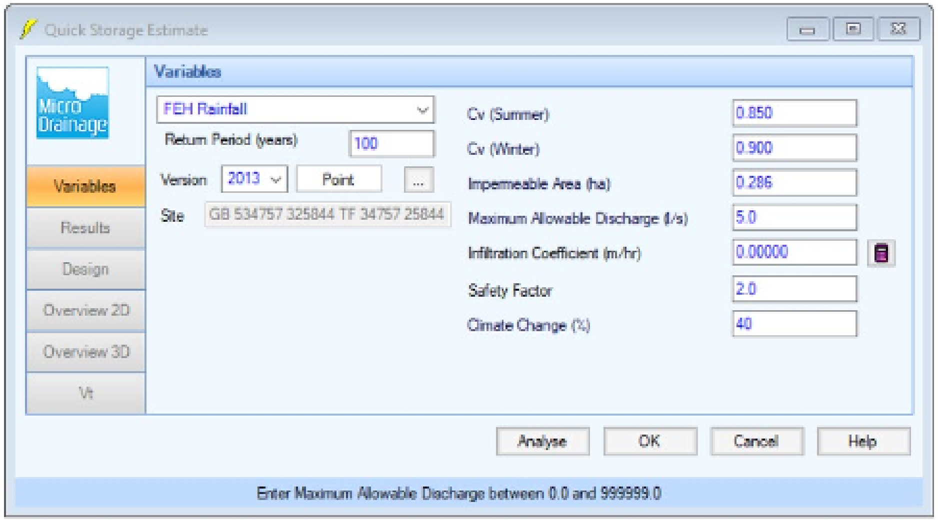


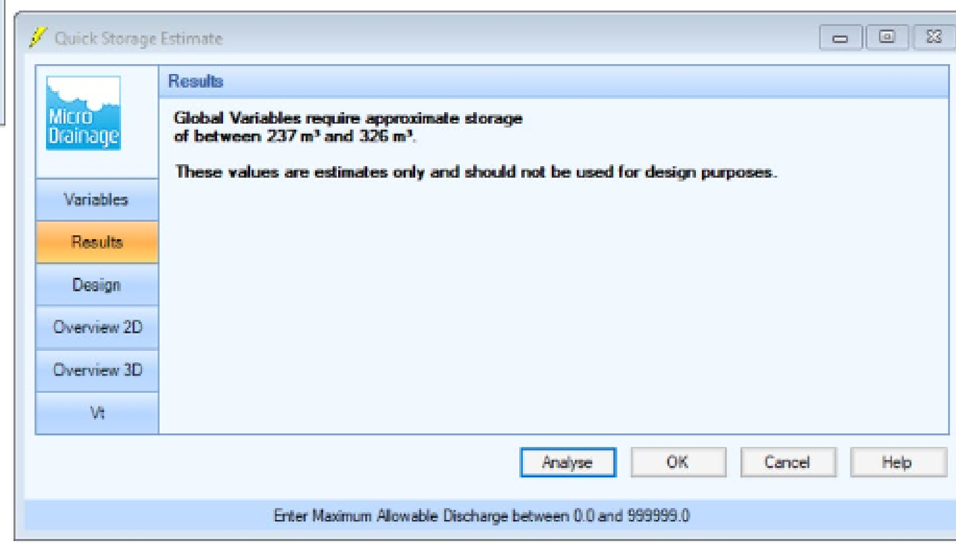
Plot 3 Proposed Discharge Rate of 2l/s





Plot 3 Proposed Discharge Rate of 5l/s





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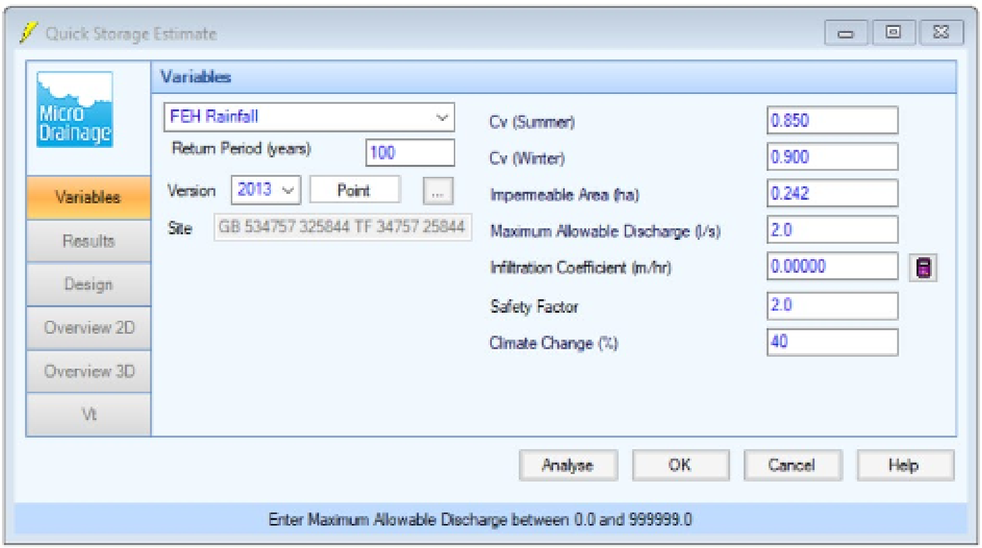
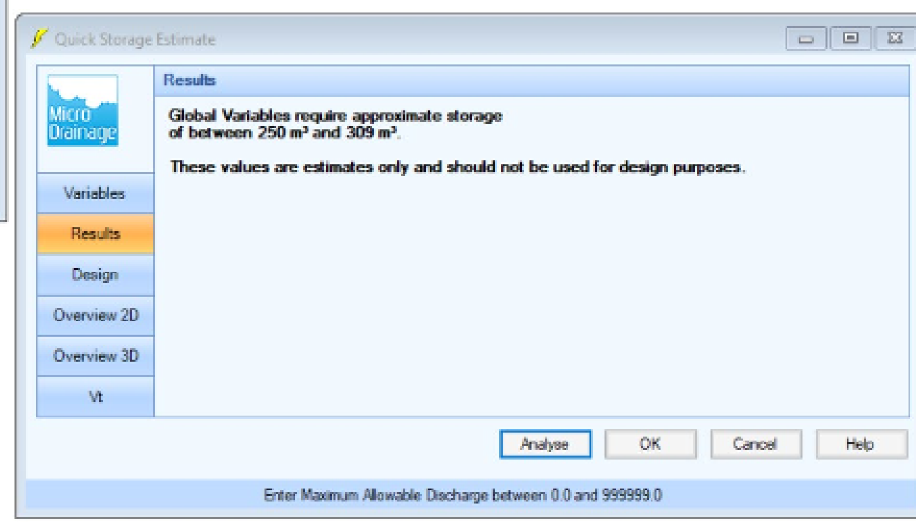
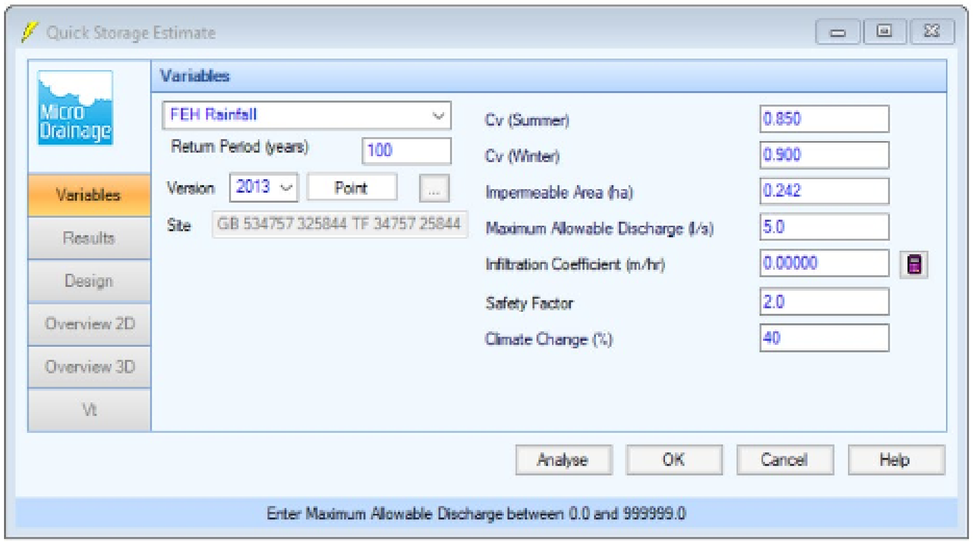
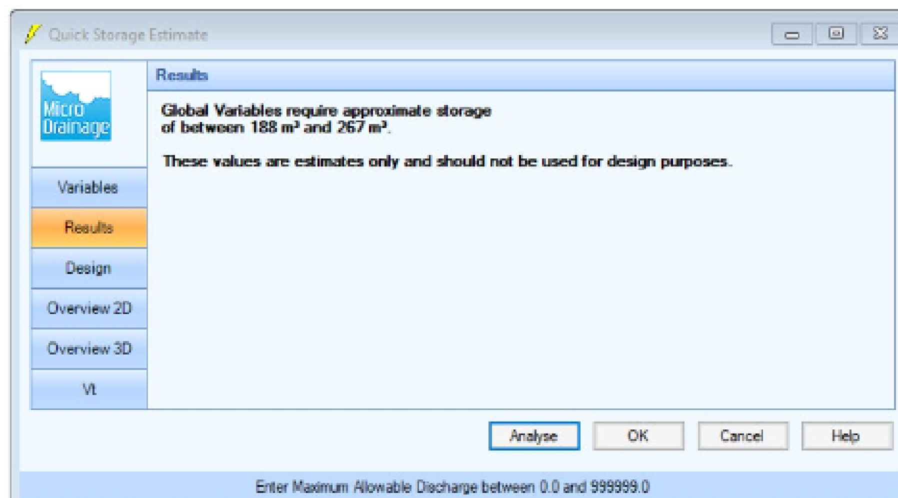


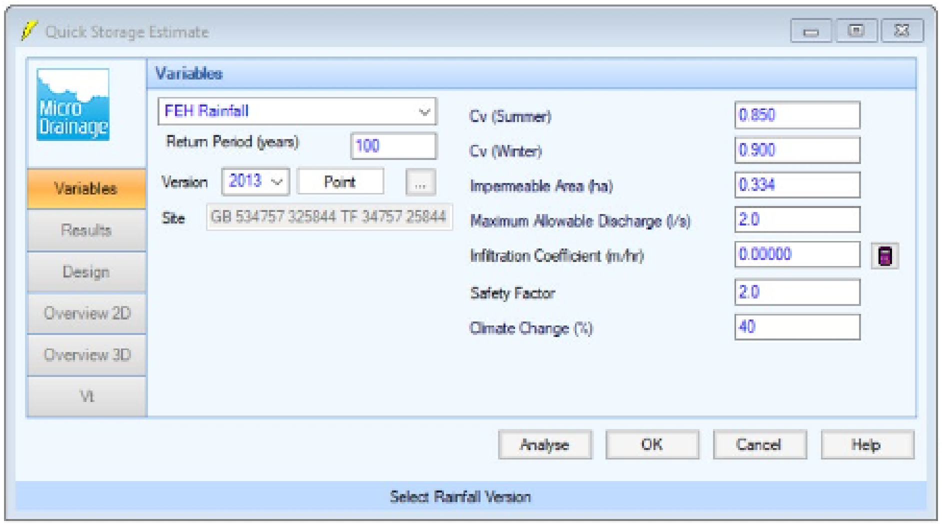


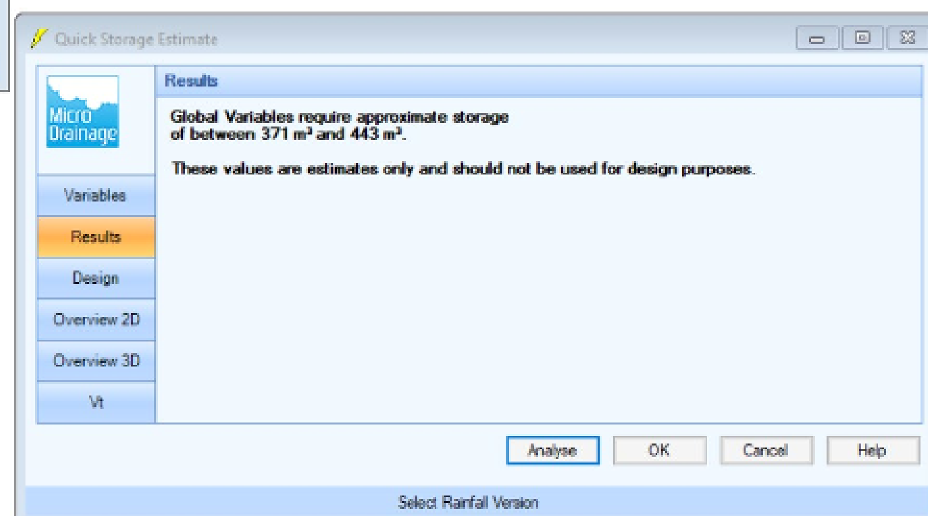
Plot 4 Proposed Discharge Rate of 5l/s



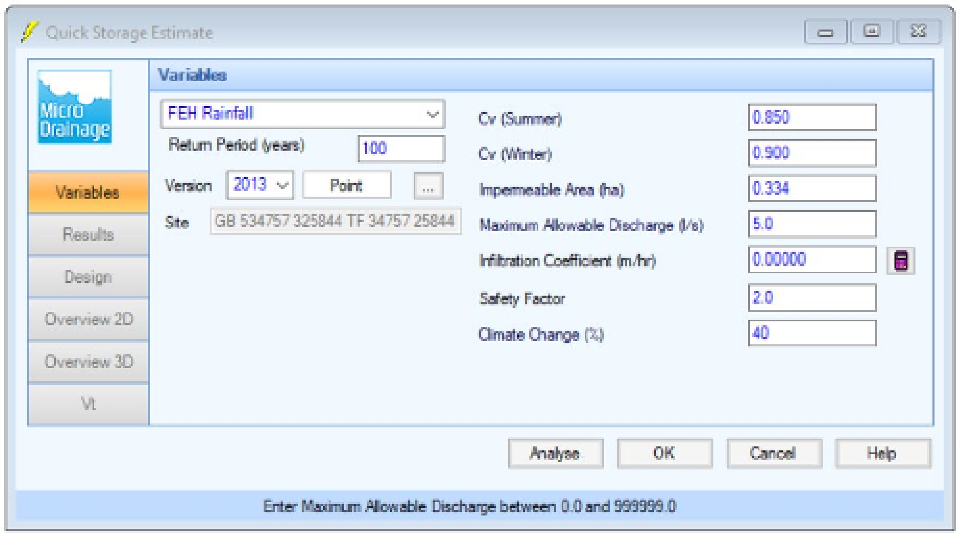


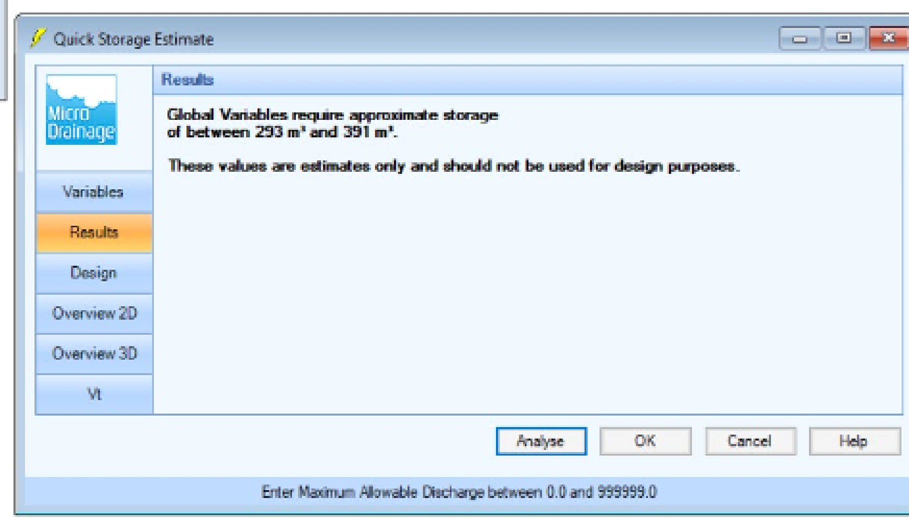
Plot 5 Proposed Discharge Rate of 2l/s



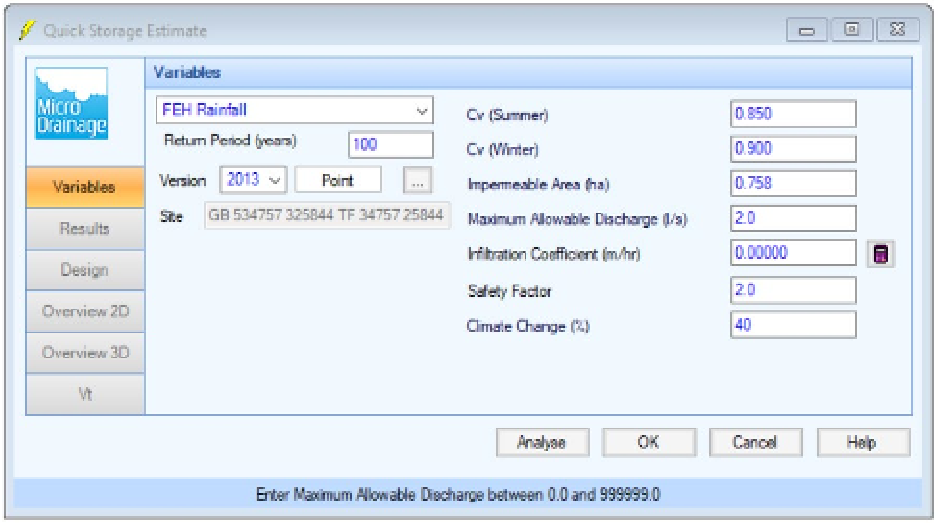


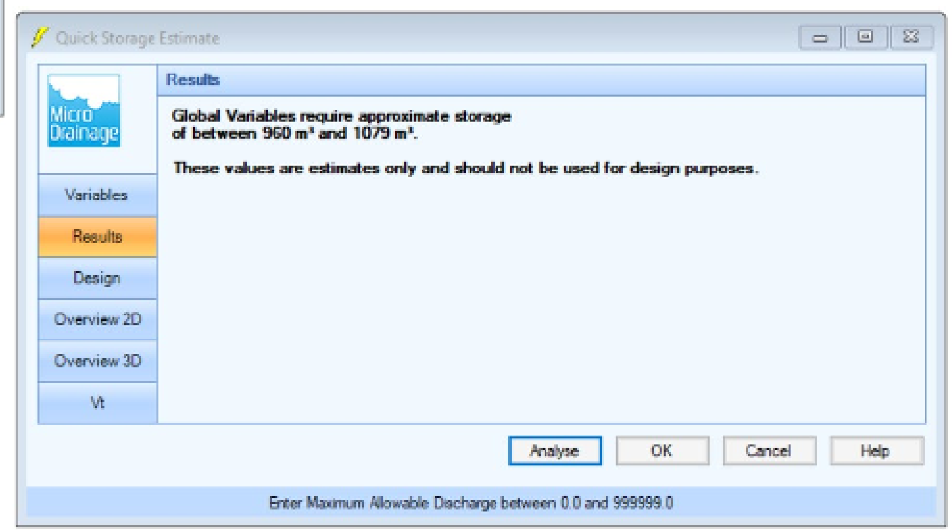
Plot 5 Proposed Discharge Rate of 5l/s



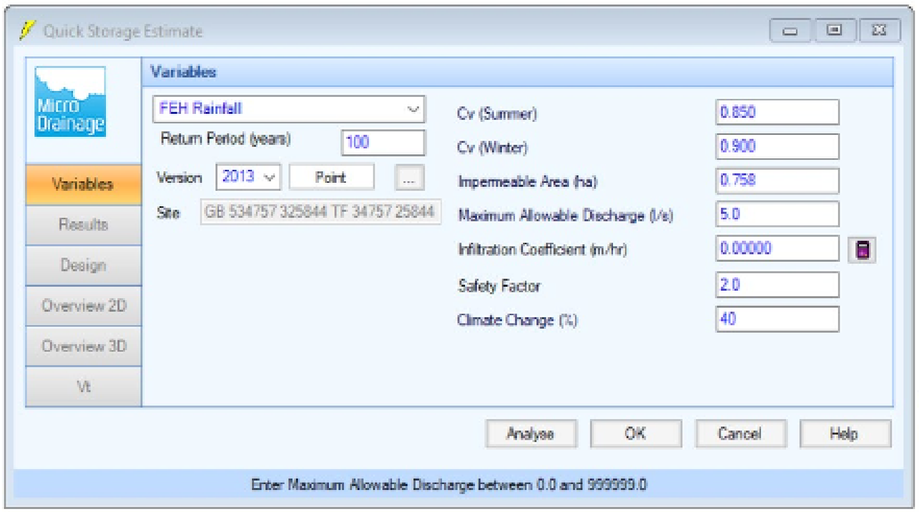


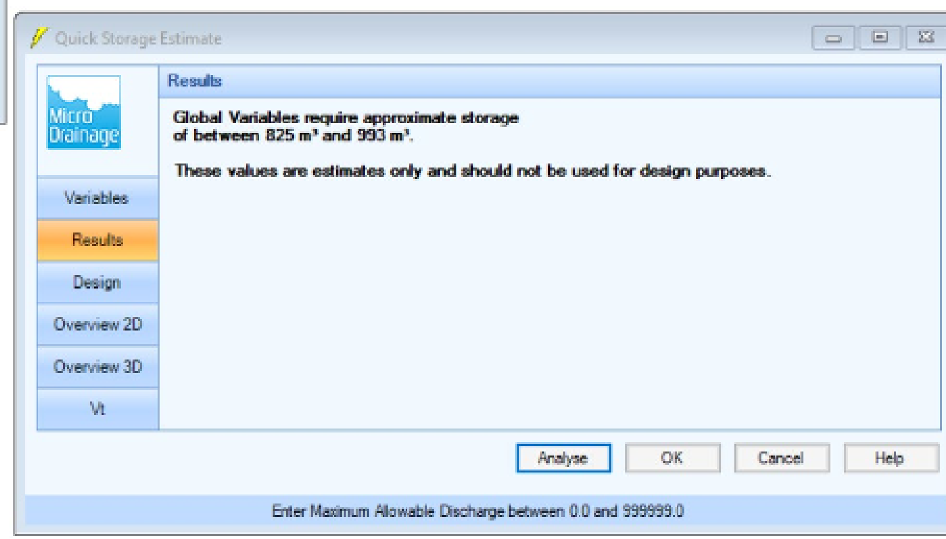
Plot 6 Proposed Discharge Rate of 2l/s



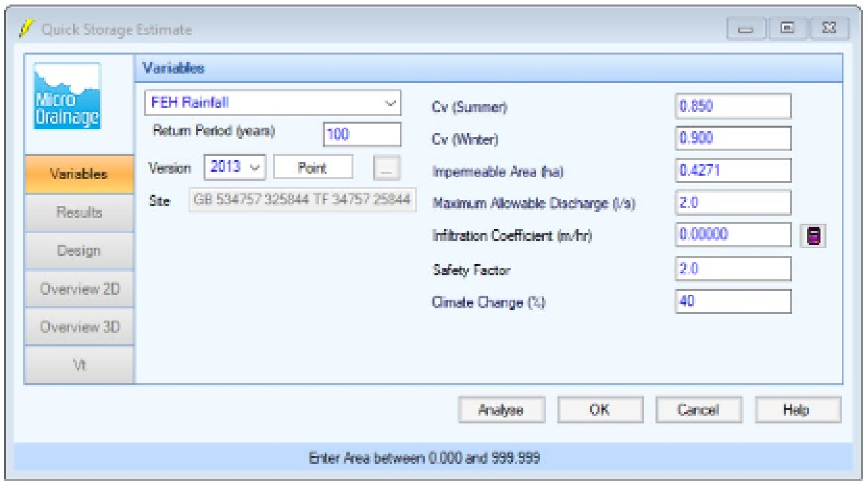


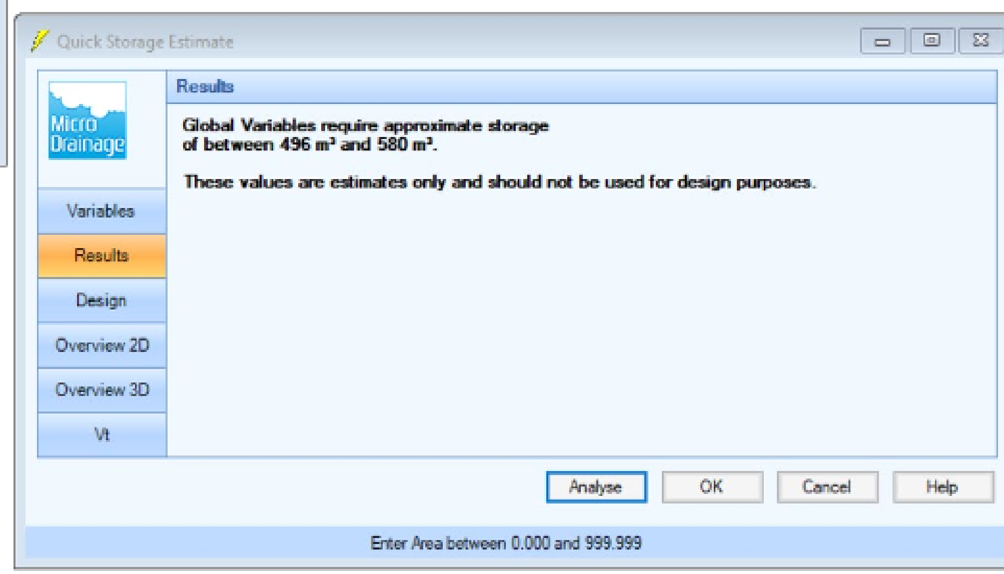
Plot 6 Proposed Discharge Rate of 5l/s



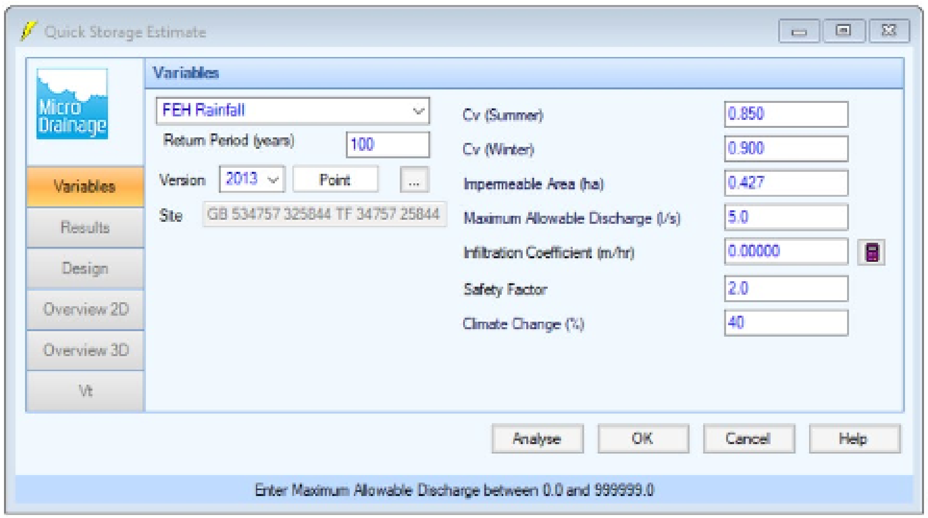


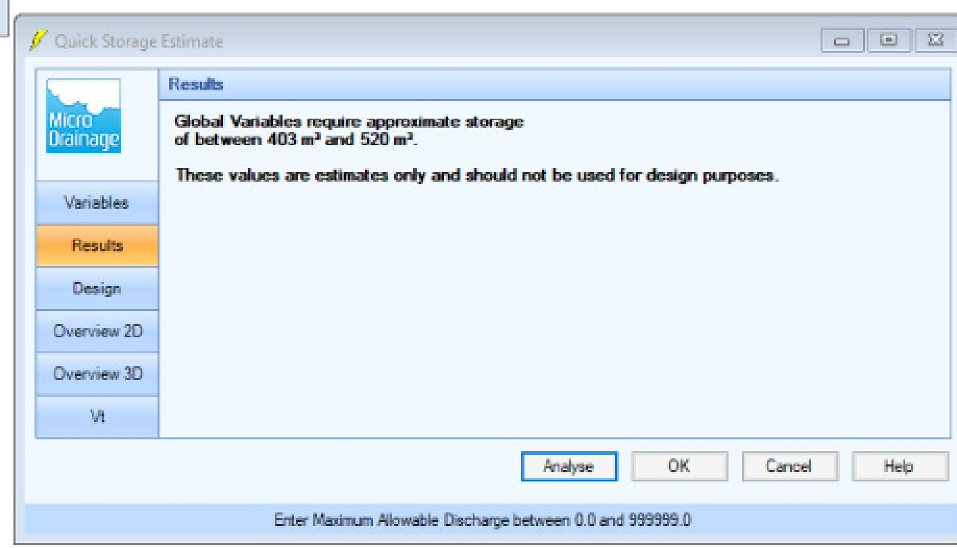
Plot 7 Proposed Discharge Rate of 2l/s



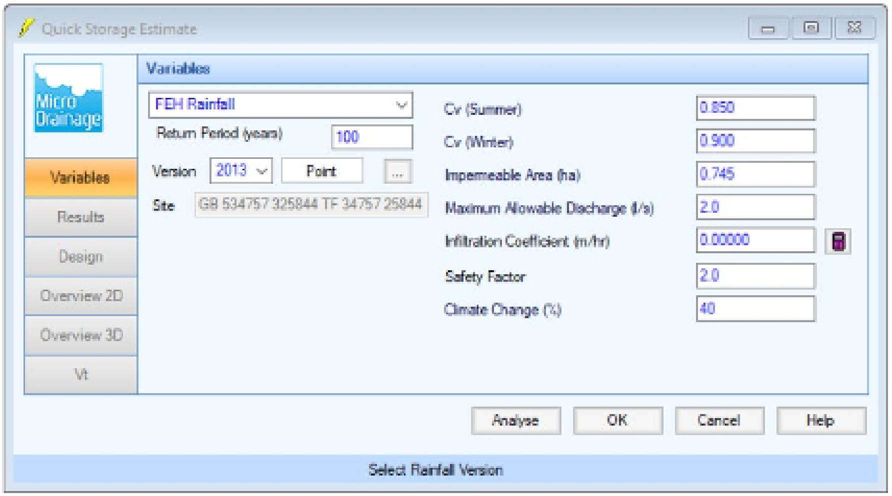


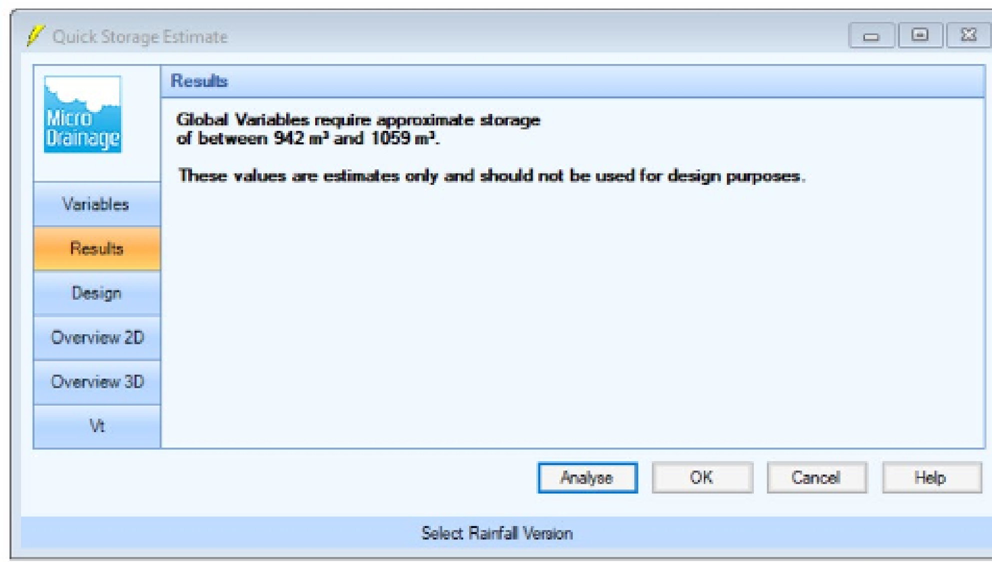
Plot 7 Proposed Discharge Rate of 5l/s



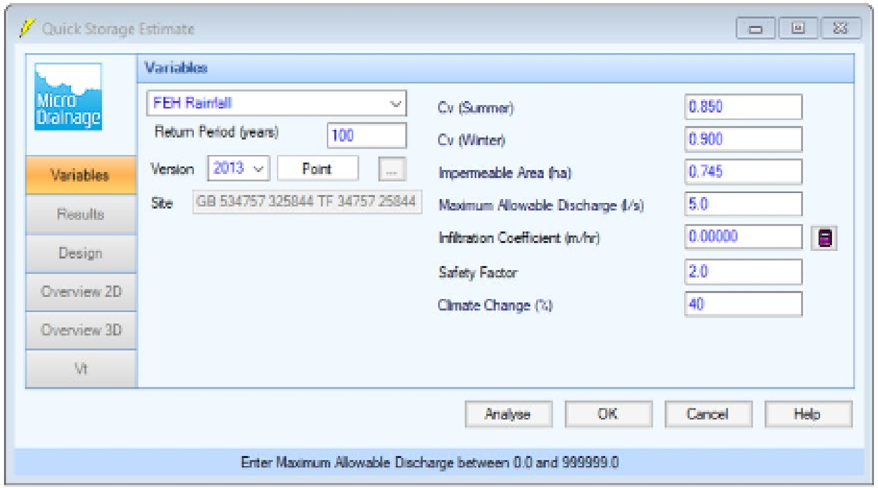


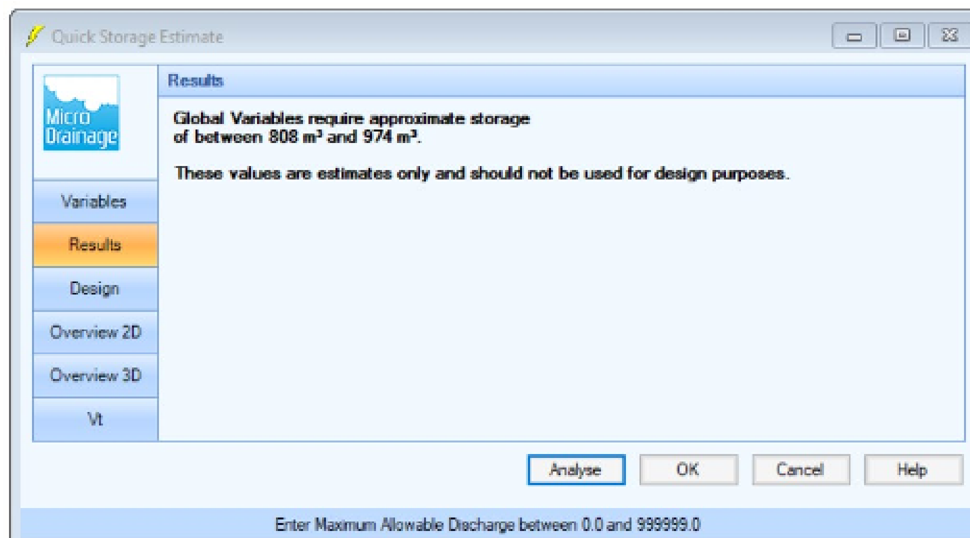
Plot 8 Proposed Discharge Rate of 2l/s



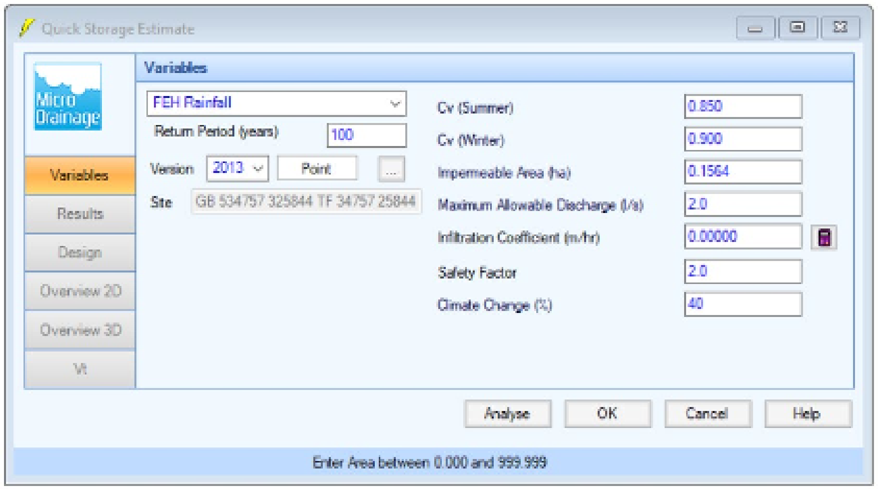


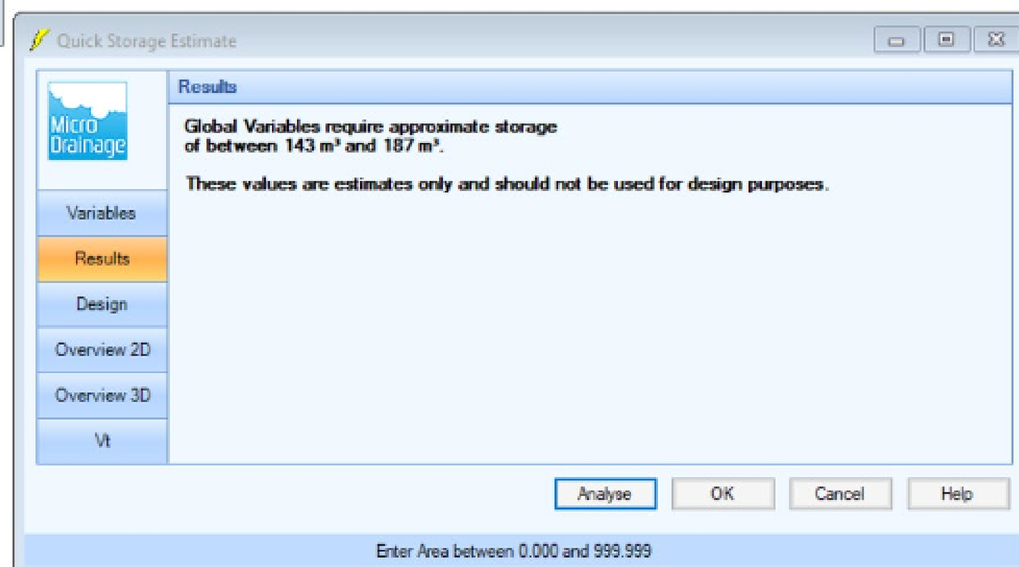
Plot 8 Proposed Discharge Rate of 5l/s



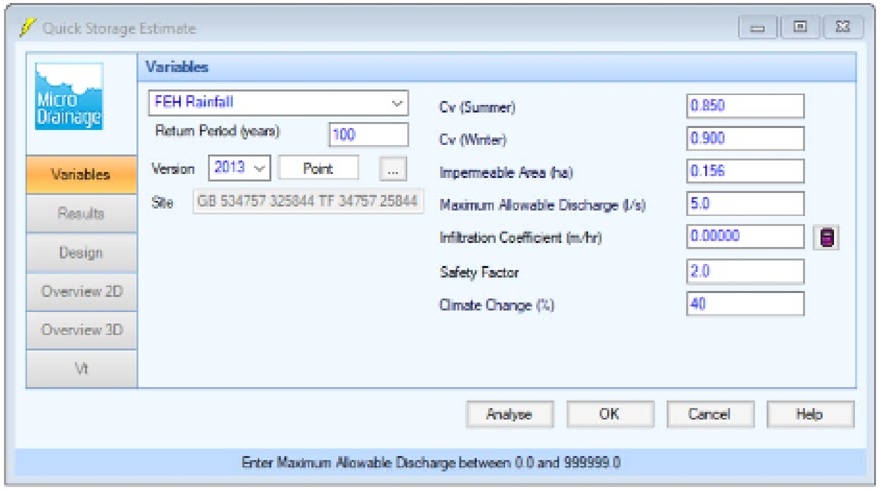


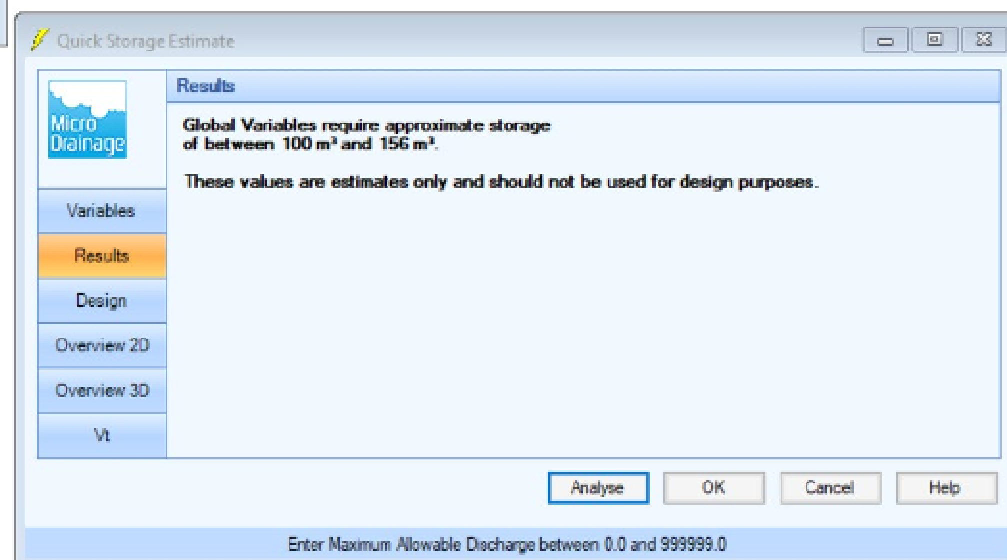
Plot 9 Proposed Discharge Rate of 2l/s





Plot 9 Proposed Discharge Rate of 5l/s





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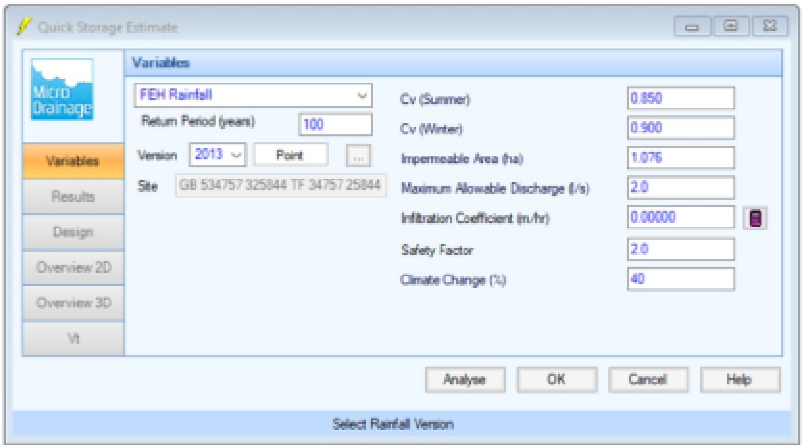
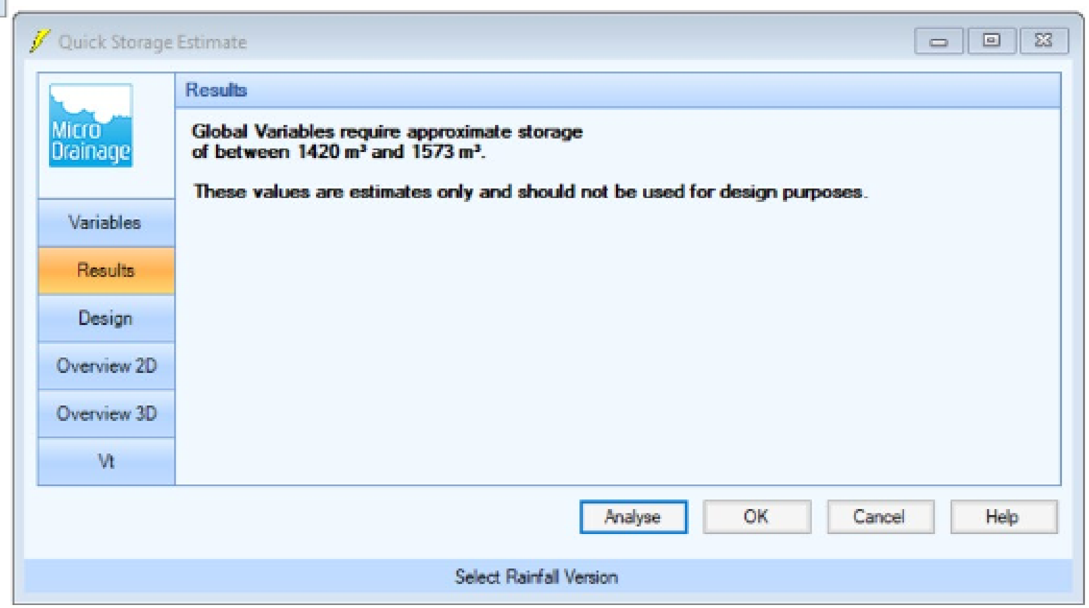
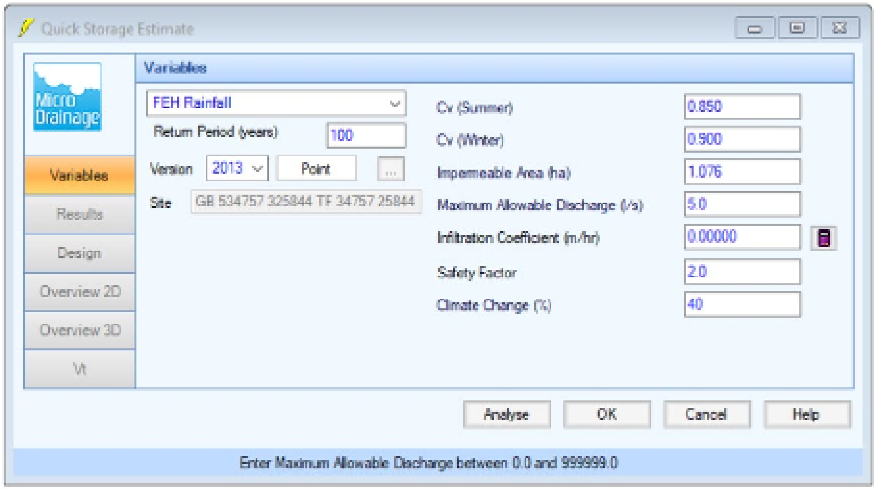
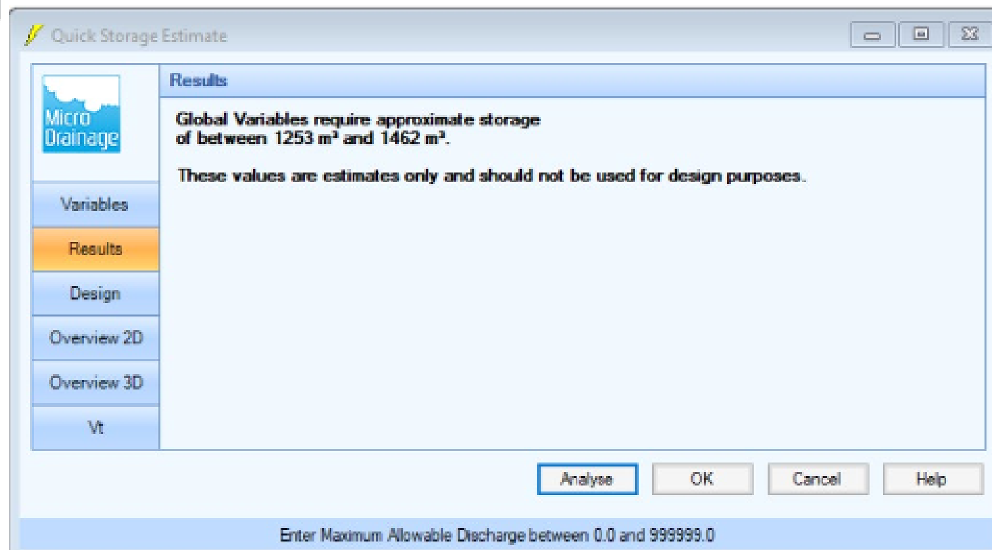




Plot 10 Proposed Discharge Rate of 5l/s





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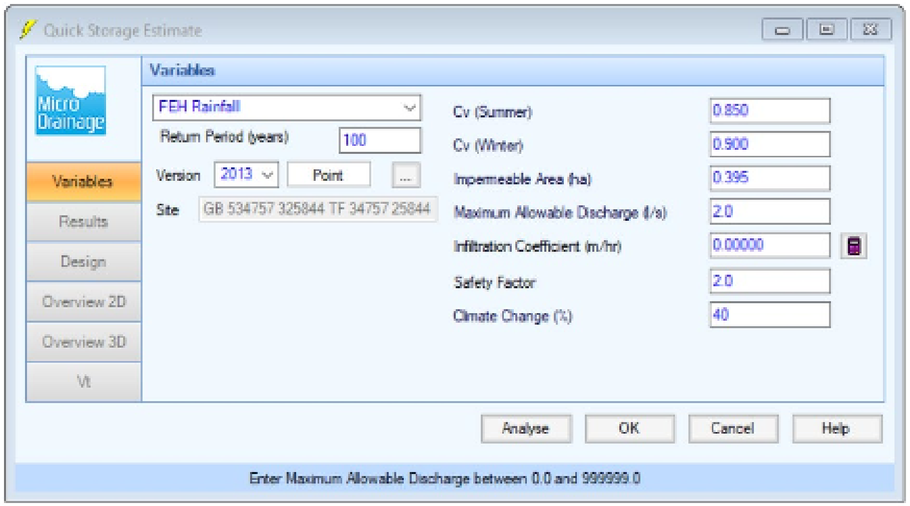
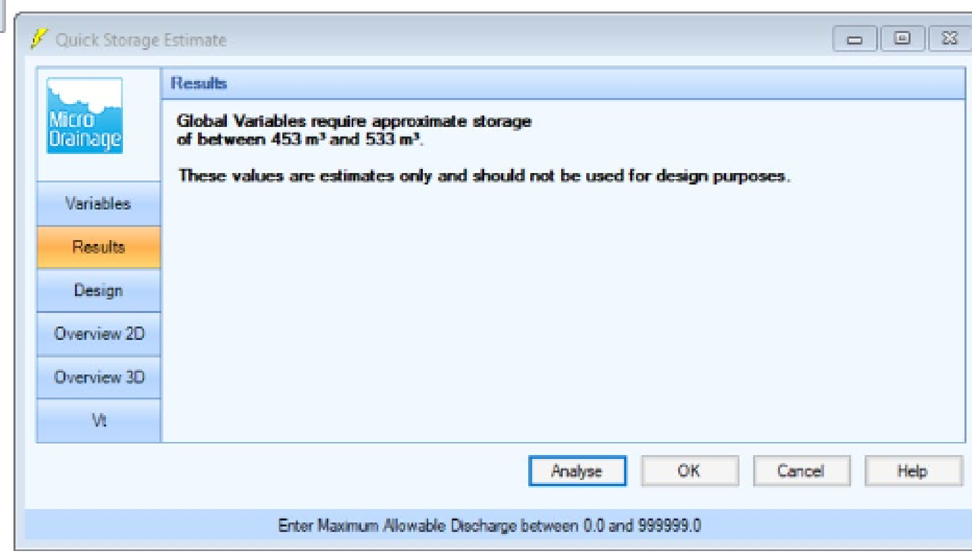
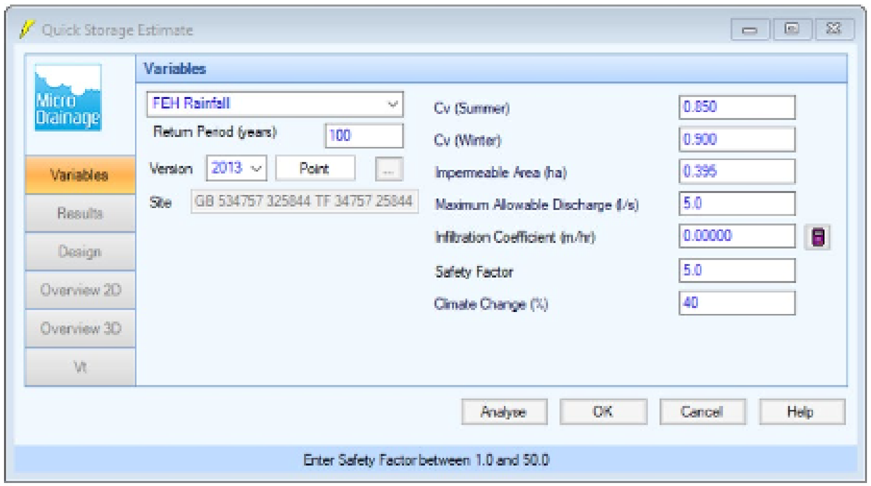
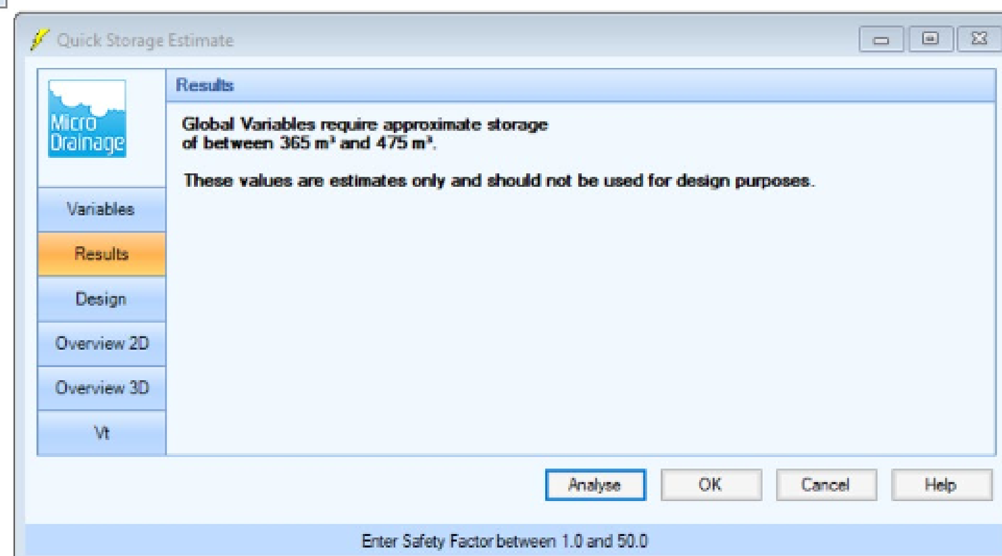




Plot 11 Proposed Discharge Rate of 5l/s





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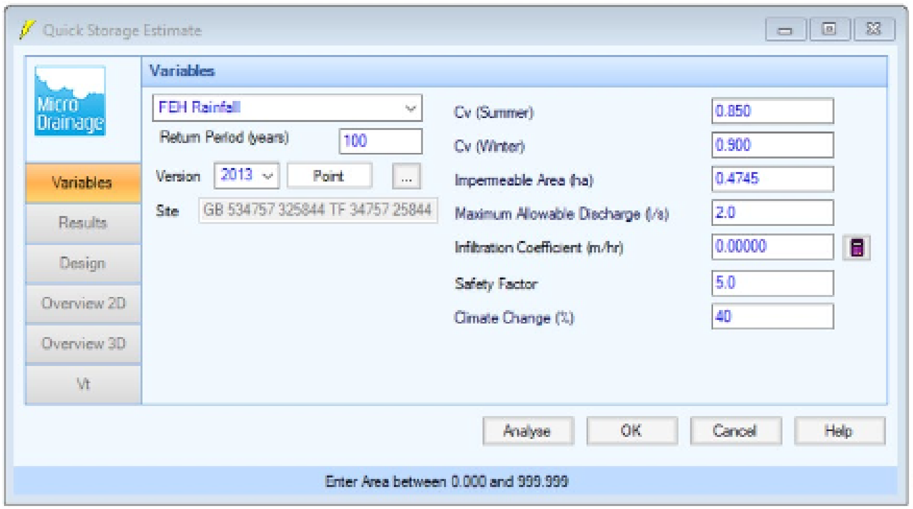
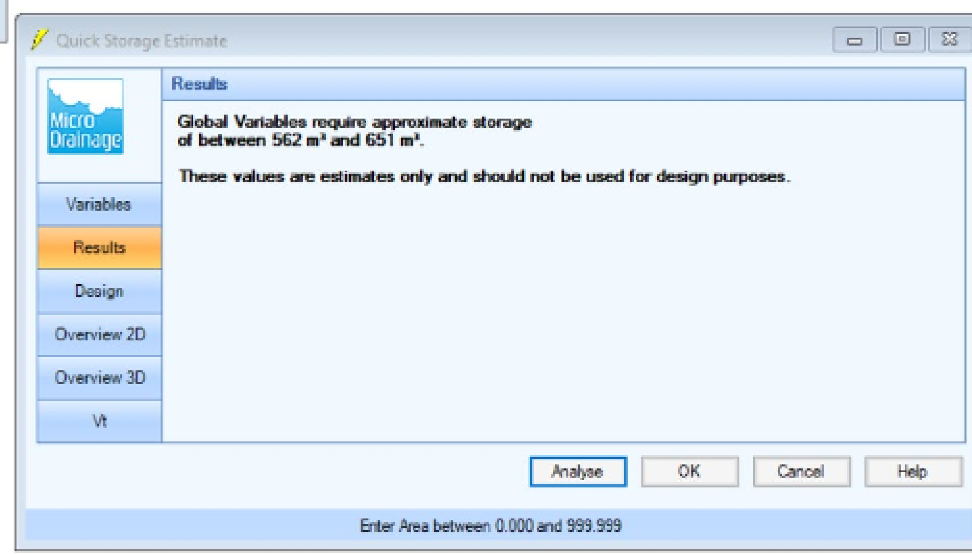
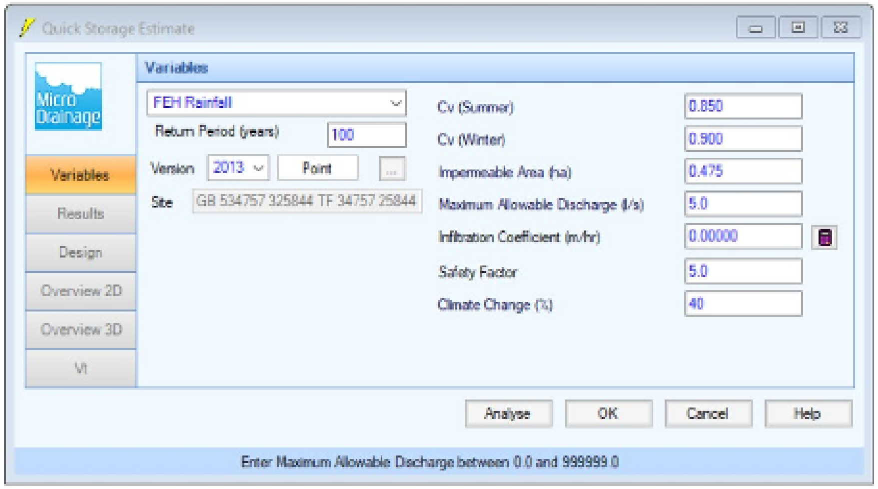
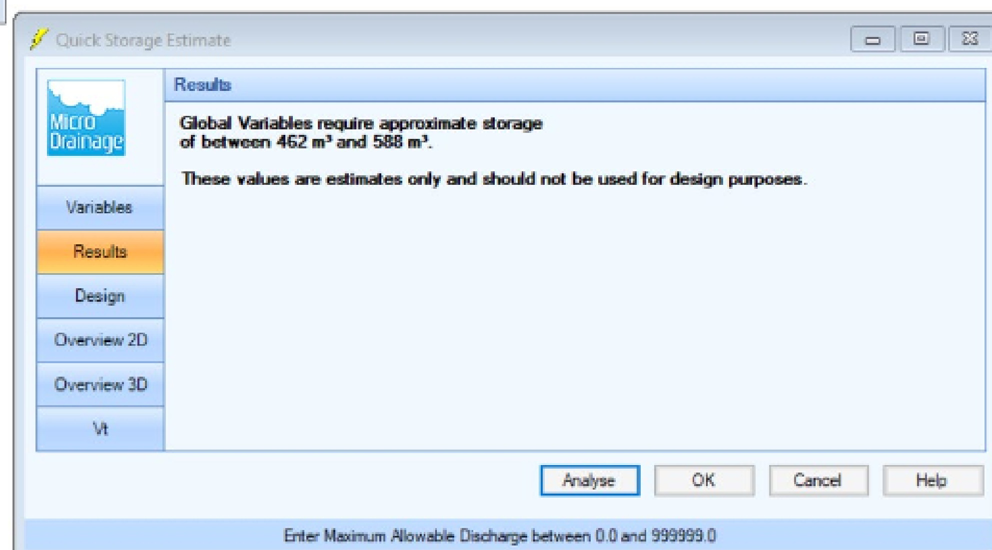


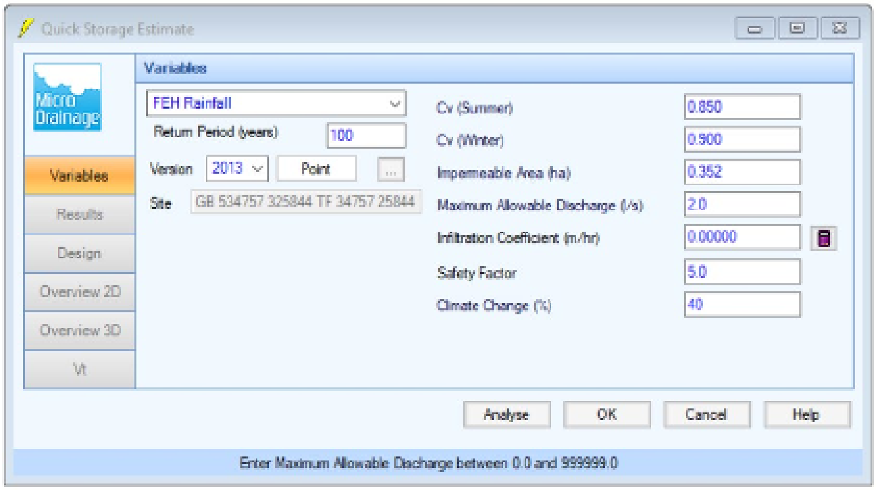


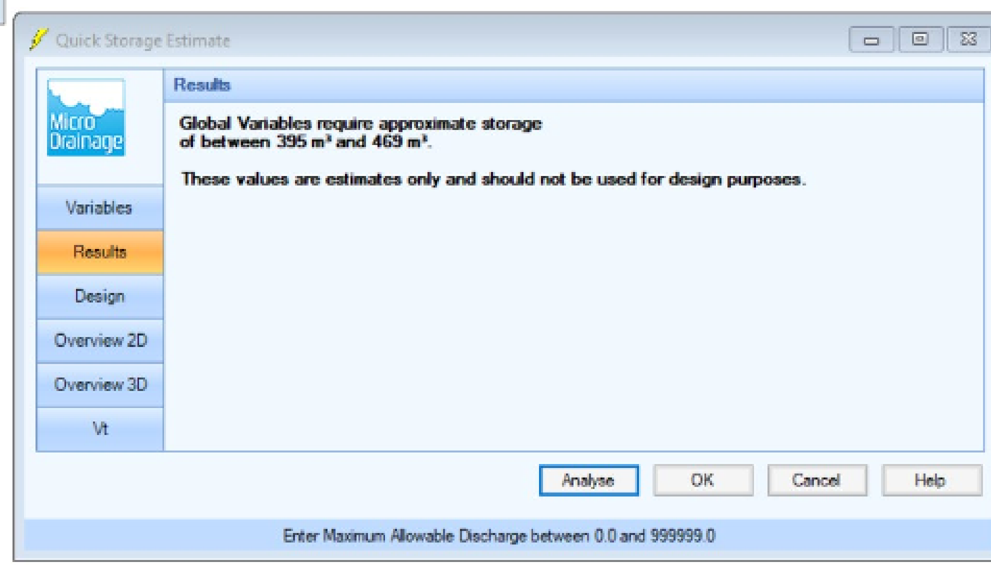
Plot 12 Proposed Discharge Rate of 5l/s





Plot 13 Proposed Discharge Rate of 2l/s





Plot 13 Proposed Discharge Rate of 5l/s