Boxworth End, Swavesey

Flood Risk and Drainage Appraisal

On behalf of **Axis Land Partnerships**

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1 Introduction

1.1 Scope of Report

1.1.1 This appraisal report sets out the high-level flood risk and drainage strategy for up to 70 residential units on Land East of Boxworth End, Swavesey, Cambridgeshire. It has been prepared for Axis Land Partnerships, (ALP) who are promoting the land for allocation in the emerging Greater Cambridge Local Plan.

1.1.2 This appraisal report is a desk-based review of publicly available information, documents and reports, supplemented by consultation with stakeholders.

1.1.3 This report considers existing site conditions and the nature of existing flood risk constraints associated with fluvial, groundwater, tidal/coastal, reservoirs/impounded water features, surface water and sewer sources. This appraisal report briefly sets out the policy context in which promotion of Land East of Boxworth End would be assessed. . A high-level flood risk and drainage strategy for the development is then presented.

1.2 Purpose of this report

1.2.1 The purpose of this report is to explore how the strengths of a development in this location can be harnessed and developed to enable local flood risk and surface water drainage policy objectives to be met. A brief overview of the impacts associated with development in this location, both in terms of opportunities for sustainable surface water drainage and in terms of flood risk have also been provided.

1.2.2 The document has been prepared as a template for the sustainable surface water drainage strategy for the site but also to help inform the next stage of Greater Cambridge Local Plan process.

1.3 Report Structure

1.3.1 The remainder of this report is structured as follows:

- **Section 2** sets out in more detail the existing site details and hydrological context of the site, from existing data sources and studies;
- **Section 3** summaries the existing flood risk and surface water drainage policies which have been and are to be considered in the future development of the site;
- **Section 4** provides details on the existing flood risk conditions effecting the site both from existing data sources and studies;
- **Section 5** gives an early indication of a future surface water drainage strategy which could be used at the site based on preliminary calculations and assumptions;
- **Section 6** considers how well the site meets local flood risk and surface water drainage policy.

1.4 Consultation

1.4.1 Key stakeholders have been consulted to acquire site-specific information on flood risk and drainage, to confirm design criteria/principles that should be adopted for the purposes of informing the development of a surface water drainage strategy and the production of a future Flood Risk Assessment (FRA). The following stakeholders were consulted:

- Environment Agency (EA);
- Cambridgeshire County Council (CCC) (the Lead Local Flood Authority (LLFA));

- Anglian Water (AW);
- South Cambridgeshire District Council (SCDC);
- Swavesey Internal Drainage Board.

1.4.2 The following documents and surveys are also relevant to the development and have been reviewed to inform this appraisal:

- OS Mapping;
- Topographic Survey carried out by Survey Solutions dated February 2020 (Ref:25746ea-01 Rev A);
- Online Government flood maps;
- South Cambridgeshire and Cambridge City Level 1 Strategic Flood Risk Assessment (Sept 2010);
- Geological website;
- South Cambridgeshire Local Plan dated September 2018.

1.4.3 A site visit was undertaken on 4th February 2020 to understand the existing surface water drainage at the site.

2 Existing Baseline Information

2.1 Site Location

2.1.1 The site is located east of Bucking Way Road, Boxworth End, south of Swavesey. The site consists of mainly agricultural land with a wooded area and a pond occupying the south-west area of site. The total site area of approximately 3.2 hectares.

2.1.2 A watercourse and gardens associated with properties on Buckling Way Road mainly border the western boundary of the site. Residential development associated with Pine Grove lies to the north of the site. Agricultural land lies to the east of the site. Land associated with Boxworth End Farm bounds the south of the site.

2.1.3 A Site Location Plan with Aerial Photography, reference Figure 01b, is contained in **Appendix A.** Figure 1 below shows the site location.

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Figure 1: Site Location

2.2 Development vision

2.2.1 The site is being considered for up to 70 residential units, with access proposed off Bucking Way Road, in the south west corner of the site.

2.3 Site Topography

2.3.1 A topographic survey undertaken by Survey Solutions dated February 2020 ((Ref:25746ea-01 Rev A) shows site levels range between 11.99m AOD at the southern-most corner of the site to 8.47m AOD at the northern most corner of the site. The site generally falls to the north-west.

2.3.2 Figure 2-2 below and Figure 02 in **Appendix A** shows the topography of the site relative to the immediate surrounding area based on LiDAR data.

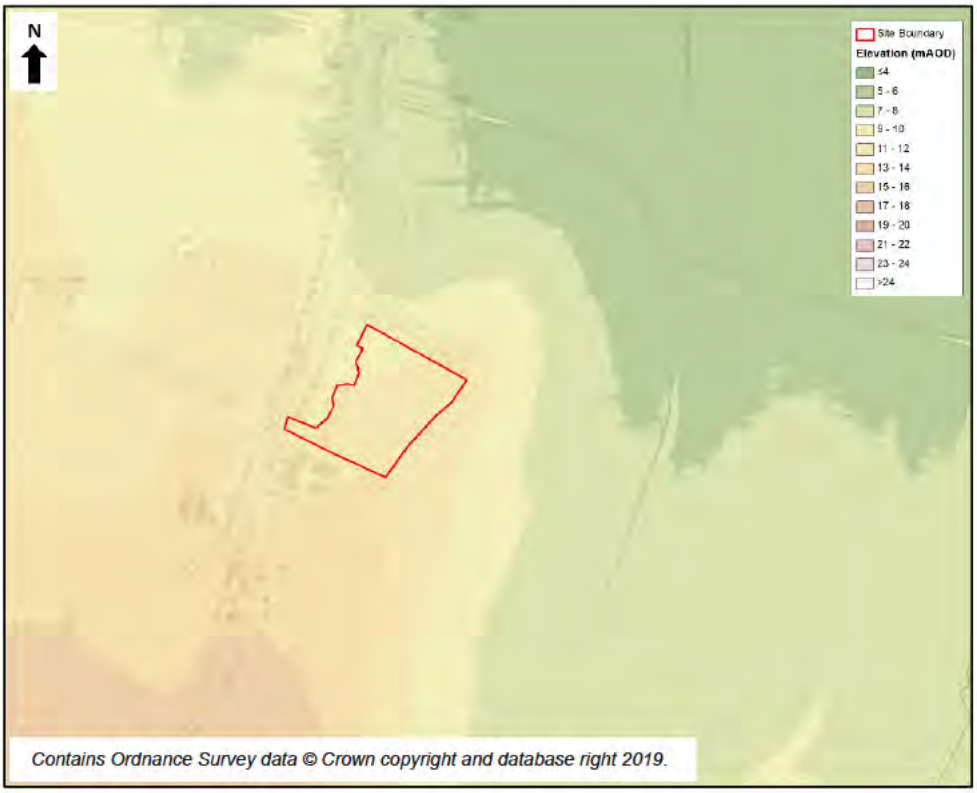

Figure 2: Area Topography

2.4 Hydrological Setting

2.4.1 An Ordinary watercourse crosses the south-west corner of the site and drains northwards along the western site boundary. An ordinary watercourse is defined as a river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a main river.

2.4.2 The Ordinary watercourse is culverted for a short section near the southern site boundary and immediately downstream of the site before re-emerging as an open channel just north of Pine Grove.

2.4.3 The Ordinary watercourse enters the management of the Swavesey Internal Drainage Board (IDB) (Drain 17) downstream of the site adjacent to the Pine Grove development north of the site (see drawing enclosed in **Appendix B**).

2.4.4 The Ordinary watercourse is part of the IDB pumped system, which discharges to the Swavesey Drain, an Environment Agency Main River, at High Causeway Pumping Station (see Figure No: 47801/GIS001). Outflows from Swavesey Drain are also controlled by sluice gates at Webbs Hole, which closes to prevent high flows from the River Great Ouse backing up into the system. The whole network is therefore effectively tide-locked when the River Great Ouse is high, potentially for up to 14 days at a time.

2.4.5 A pump station has been constructed at Webb's Hole Sluice by SCDC to over-pump water from the Swavesey Drain to the Ouse during sluice gate closure. This 1 cumec pump was constructed as mitigation for increased flows arising from the expansion of Utton's Drove

WWRC. The design has allowed for improved conveyance through the system as well as evacuation of an equivalent volume to the treated effluent. Although this asset currently has the potential to benefit the fluvial regime (as the WWRC has yet to reach full discharge capacity), the long-term fluvial betterment should not be relied upon.

2.4.6 There is an existing pond within the site, located near the western boundary. Based on observations made during a site visit the pond appears to have no obvious piped inlets or outlets.

2.5 Geological Context

2.5.1 The British Geological Survey (BGS) extracts show the site is not underlain by superficial deposits. The site is underlain by the West Walton Formation and Ampthill Clay Formation comprising Mudstone. Geological information is enclosed in **Appendix A**.

2.5.2 The Soil Association Maps (see extract in **Appendix C**) show that the site is underlain wholly by soil type 411d (Hanslope). The permeability characteristics of soil type 411d is summarised in Table 1 below.

Table 1: Soil Association types found at site

Soil Type	Coverage	Description	BFIHOST
411d (Hanslope)	100% of site.	Slowly permeable calcareous clayey soils. Some slowly permeable non-calcareous clayey soils. Slight risk of water erosion.	0.34

2.5.3 During the site visit standing water was observed at more than one location. Based on the current information available infiltration drainage is unlikely to be suitable at the site. However, this assumption, if required by the LLFA, can be confirmed through intrusive ground investigations undertaken to support the site at the planning stage.

2.5.4 Figure 3 shows the site is not located within a Groundwater Source Protection Zone (GSPZ). Therefore, the site is not considered a risk to water quality associated with abstraction. The site is not underlain by aquifer (Superficial Drift) or bedrock aquifer.

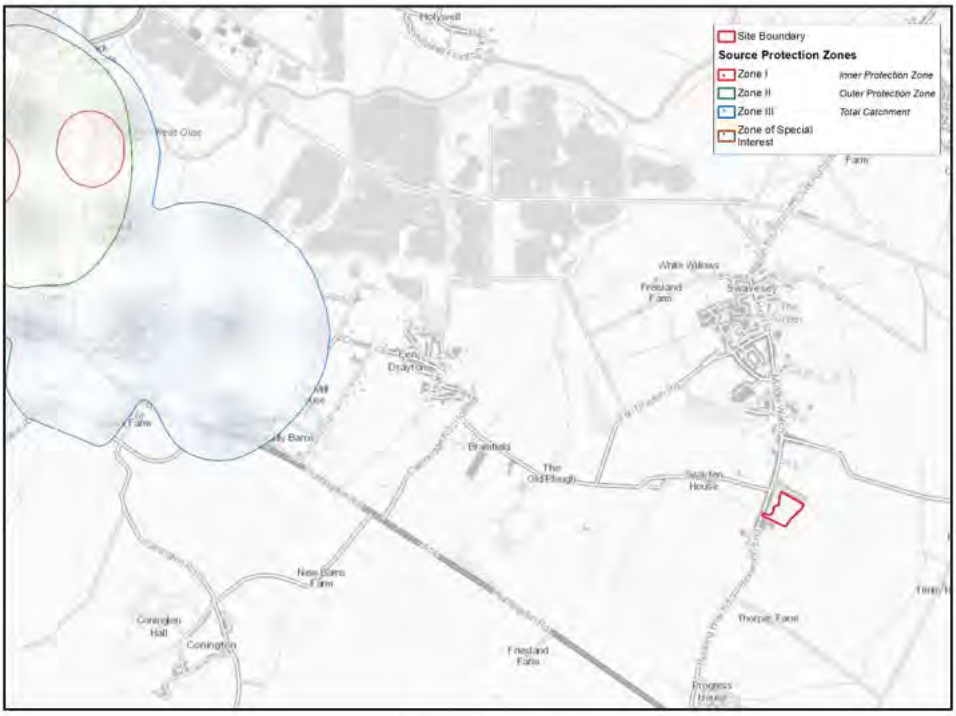

Figure 3: Source Protection Zones

Surface Water On-Site Drainage

2.5.5 The site comprises mainly agricultural land, such that surface water would likely drain to the north-west following the natural topography with eventual discharge to the on-site pond or ordinary watercourse which runs parallel to the western site boundary. Some localised infiltration could occur during the lower storm events.

2.5.6 The topographical survey, and as observed during the site visit, shows there are three outfalls to the ordinary watercourse near the southern boundary where the Ordinary Watercourse changes direction to the north. The outfalls were recorded to be 100mm, 150mm and 225mm in diameter. The outfalls appear to originate from Boxworth End Farm south-east of the site.

2.5.7 An existing surface water drainage catchment plan is enclosed in **Appendix D.**

2.6 Public Sewers

2.6.1 There are no public sewers within the site according to Anglian Water plans enclosed in **Appendix E**.

2.6.2 There are no surface water sewers in the vicinity of the site.

2.6.3 There is a 150mm foul sewer within Boxworth End which conveys which conveys wastewater north-eastwards in the vicinity of the site.

3 Flood Risk and Surface Water Drainage Policy

3.1 Overview

3.1.1 This section provides an overview of national and local flood risk and surface water drainage policy objectives relevant to the area of study. These are the foundation to inform the emerging design of which the site will meet.

3.2 National Policy

3.2.1 The National Planning Policy Framework (NPPF) details the current national planning policy for flood risk in England. The NPPF has strict tests to protect people and property from flooding which all local planning authorities are expected to follow. The accompanying Planning Practice Guidance (PPG) to the NPPF advises on how planning can take account of the risk associated with flooding and coastal change.

3.2.2 The online Flood Maps are used to assign a flood risk classification to all land throughout England with PPG defining the vulnerability of development and land use.

3.2.3 The PPG contains Table 3 (Flood Risk Vulnerability Classification and Flood Zone Compatibility), detailing appropriate development within each of the flood zones based on the vulnerability classification in addition to further planning requirements (e.g. the Sequential and Exception Test) to assess if the development is at an acceptable risk of flooding.

3.2.4 In accordance with the NPPF and PPG, a Flood Risk Assessment (FRA) will be required as the site is greater than 1 hectare.

3.2.5 The Flood Risk vulnerability classification and Flood Zone Compatibility is discussed further in Section 4 of this report.

3.3 Local Policy

3.3.1 The Local Plan refers to the following relevant policies:

- Policy CC/1: Mitigation and Adaption to Climate Change,
- Policy CC/7: Water Quality,
- Policy CC/8: Sustainable Drainage Systems, and
- Policy CC/9: Managing Flood Risk.

3.3.2 Policy CC/1 of the South Cambridgeshire Local Plan states that "*Planning permission will only be granted for proposals that demonstrate and embed the principles of climate change mitigation and adaptation into the development*".

3.3.3 Policy CC/7 states that in order to protect and enhance water quality, all development proposals must demonstrate:

- there are adequate water supply, sewerage and land drainage systems to serve the whole development.
- the quality of ground, surface or water bodies will not be harmed.
- Sustainable Drainage Systems (SuDS) will be incorporated.

3.3.4 Policy CC/8 states that development proposals will be required to demonstrate that:

- Drainage schemes comply with the SuDS Non-statutory technical standards for SuDS and the Cambridgeshire Flood and Water SPD.
- Opportunities are taken to integrate SuDS, create amenity and enhance biodiversity.

- Surface water is managed at source and on surface where viable.
- Maximum use is made of low land take drainage measures.
- Incorporate appropriate pollution control measures.
- Arrangements have been established for the whole life management and maintenance of surface water drainage systems.

3.3.5 Policy CC/9 mentions development will only be permitted where:

- the sequential and exception tests demonstrate the development is acceptable.
- Floor levels are 300mm above the 1 in 100 flood level plus an allowance for climate change.
- incorporate suitable flood protection / mitigation as appropriate. Prepare management and maintenance plans.
- there will be no increase to flood risk elsewhere and opportunities to reduce flood risk elsewhere are explored.

4 Assessment of Flood Risk

4.1 Fluvial Flooding

4.1.1 The first stage when identifying whether a site is at risk of flooding is to consult the Government's Flood Zone maps. This provides an initial indication of the extent of the Flood Zones.

4.1.2 Figure 4 below, an extract of the online Flood Map for Planning (Reference Figure 03 enclosed in **Appendix A**) shows the whole site is located within Flood Zone 1 'Low Probability (less than 1 in 1,000 annual probability (<0.1%) of river flooding.

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Figure 4: Flood Map for Planning

4.1.3 The Flood Map for Planning does not map fluvial flood risk from minor watercourses. However, the "Risk of Flooding from Surface Water" map is considered a reasonable initial indicator of fluvial flood risk from minor watercourses, further details on the surface water flood risk is provided within this appraisal. EA data is enclosed in **Appendix F**.

4.2 Flood Risk from Reservoirs

4.2.1 Figure 5 below, an extract of the Flood Risk from Reservoirs (Reference Figure 11 enclosed in **Appendix A**), shows the risk of flooding in the event of a breach from reservoirs containing 25,000 (or above) cubic metres of water. The maps indicate that the site is not located within an area which is considered at risk in the event of reservoir breach.

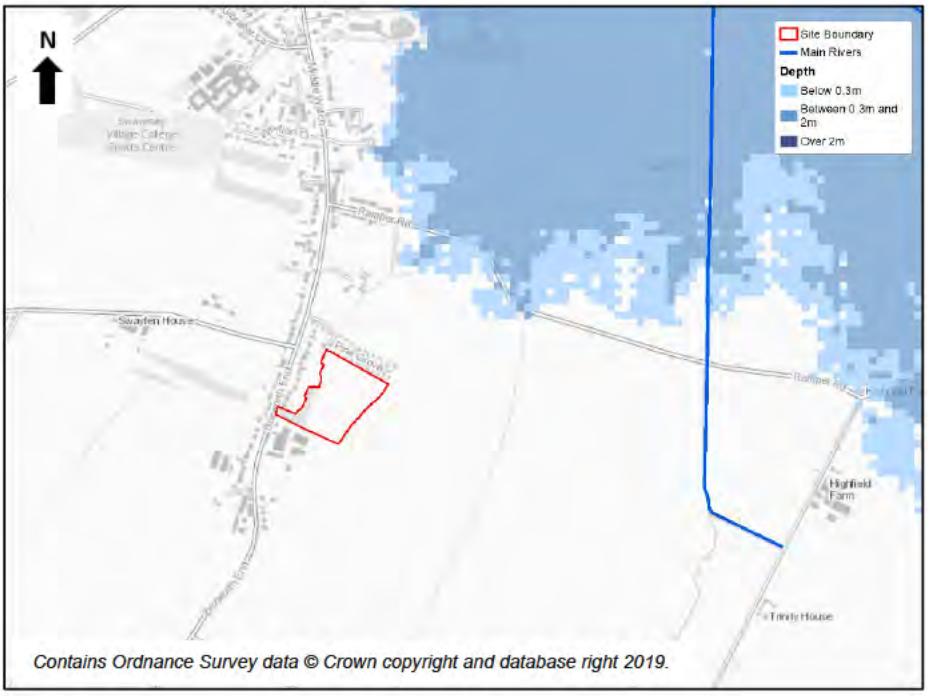


Figure 5: Risk of Flooding from Reservoirs

4.3 Surface Water

4.3.1 Figure 6 is an extract of the Risk of Flooding from Surface Water map, (Reference Figure 4 in Appendix A) shows areas that could potentially be susceptible to surface water flooding in an extreme rainfall event. Please note that the surface water flood maps show modelled information and not historical records.

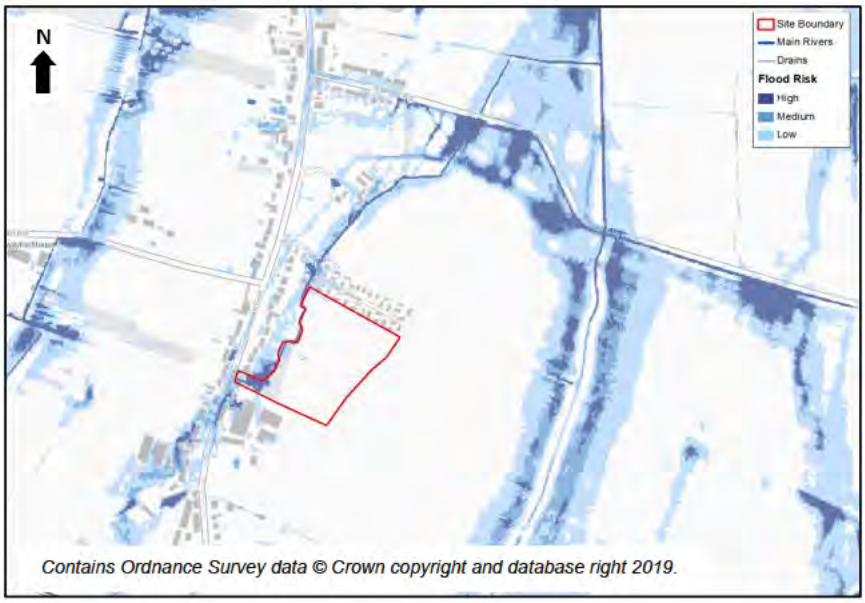


Figure 6: Risk of Flooding from Surface Water

4.3.2 The definitions for each surface water flood risk category is defined in Table 2 below.

Table 2: Surface Water Flood Risk Categories

Risk of flooding	Probability
Very low	< 1 in 1000 (0.1%)
Low	1 in 1000 (0.1%) - 1 in 100 (1%).
Medium	1 in 100 (1%) - 1 in 30 (3.3%)
High	>1 in 30 (3.3%)

4.3.3 Figure 6 above shows the majority of the Site is at 'Very Low' risk of surface water flooding. However, there is an area shown to be at 'Low', 'Medium' and 'High' risk of surface water at the south west corner of the site as a result of the watercourse which runs along the western site boundary.

Figure 7: Surface Water Flood Depth in a low risk scenario

4.3.4 Figure 7 above shows a flood depth of 600-900mm could occur in the south-west corner of the site in a low risk surface water scenario. CCC stated in their formal response that surface water modelling of the watercourse is required to quantify the depth of any flood waters across the proposed access road, in a 1 in 100 (1%) annual exceedance probability (AEP) including an allowance for climate change of 40%. CCC stipulated the depth of flooding must be less than 300mm in this rainfall event to ensure there is safe access and egress along the entrance access road (see response in **Appendix G**).

4.3.5 Stantec have estimated flows at the south-west corner of the site, where the access road is proposed, in the 1% AEP + 40% climate change scenario. A peak flow of 0.67 m^3/s was calculated. Our initial review of channel capacity indicates that the channel is potentially large enough to contain this flow. However, it may be constrained by small culvert sizes upstream and downstream that might cause some out-of-bank flows.

4.3.6 If the entrance road needs to be raised, so there is less than 300mm flood depth, there may be a need for mitigation measures to prevent any detrimental impact of displaced flood water on third party property. We believe there is enough space within the site and access corridor to allow this. However, this will need be confirmed by hydraulic modelling and flood compensation assessments which will be undertaken and considered in the application. The LLFA have confirmed hydraulic modelling is required for the site.

4.3.7 Appropriate easements and offsets to the existing watercourse at the site have been incorporated with the emerging masterplan for the site, in accordance with the requirements of approving stakeholders.

4.4 Groundwater Flooding

4.4.1 There are no BGS borehole records in the vicinity of the site to provide an indication of potential groundwater levels at the site. The nearest BGS boreholes are located south of the site near the junction between Bucking Way Road and Huntingdon Road, approximately 1.5km away.

4.4.2 It is recommended discussions are carried out with the LLFA as to whether an intrusive ground investigation should be carried out to support of the Site at planning.

4.5 Sewer Flooding

4.5.1 AW have no records of flooding in the vicinity that can be attributed to capacity limitations in the public sewerage system (see response in **Appendix D**).

4.6 Historical Flooding

4.6.1 CCC stated they have no historic flood records for the site although they did state a flood incident occurred approximately 0.4km away at Boxworth End (south of the site area). CCC (the LLFA's) formal response is contained within **Appendix G**.

4.6.2 The historical flood map included within the SFRA shows a fluvial flood incident occurred south of the site due to local ditches overtopping. The map also shows a sewer flood incident was recorded near the site (see SFRA map extract in **Appendix H**).

4.6.3 SCDC and Swavesey IDB were also consulted and their responses are awaited.

4.7 Flood Risk Vulnerability Classification

4.7.1 The NPPF PPG 'Flood Risk and Coastal Change' Table 2 identifies the 'Flood risk vulnerability classification' of a site, depending upon the proposed usage. This classification is subsequently applied to PPG Table 3 to determine whether:

- The proposed development is suitable for the flood zone in which it is located, and;
- Whether an Exception Test is required for the proposed development.

4.7.2 The proposed residential development is classed as 'more vulnerable' development.

4.7.3 The location of the proposed development is in Flood Zone 1.

4.8 Sequential Test

4.8.1 The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

4.8.2 The site is located in Flood Zone 1, however due to a small part of the site being at high risk of surface water flooding (see section 4.3 above), it is anticipated successful application of the Sequential Test and Exception Test may be required in accordance with NPPF. This is a planning led document and is therefore recommended that the planner addresses these tests during consultation with the local authority. The principle of sequential test is applied on a site-

specific basis. The sequential approach in the meantime will need to be applied to the site with all residential dwellings located in areas shown to be at very low risk of flooding.

4.9 Climate Change

4.9.1 As the site is located entirely in Flood Zone 1 and at a significant distance from a Main River, as illustrated in Figure 3-1, and a notable height above the flood level, it is considered reasonable to assume that the site is not impacted by fluvial flooding when climate change is taken into consideration.

4.9.2 There is an ordinary watercourse which runs along the western site boundary. As discussed in section 4.3 above, CCC have confirmed detailed modelling of this watercourse is required to quantify the potential depth of flooding in a 1% AEP including an allowance for climate change of 40%. This will need to be undertaken as part of the planning application for the site and based on the high-level assessment already undertaken, we consider there is sufficient space to accommodate any necessary mitigation works to allow for the future development of the site.

4.9.3 The access road will likely need to be raised to ensure safe access and egress can be achieved at the site with flood depths kept to a maximum of 300mm.

4.9.4 We are proposing works to be undertaken to the existing drain adjacent to the access road with an overflow to a new drain and temporary surface water storage area in the site. The temporary storage area should also be promoted as informal play. The volumes and velocities associated with the flooding along the access road and stored within the site will need to be confirmed by hydraulic modelling and flood compensation works.

4.9.5 With regards to anticipated changes in peak rainfall intensity due to climate change, CCC require a 20% increase in rainfall intensities to be used for design purposes to assess the impact on the surface water drainage network. A 40% increase in rainfall intensities should be used to assess the potential flood risk implications in the design rainfall event including whether there is any increased flood risk to third parties as a result of the development. This has been included within the preliminary surface water drainage for the site, refer to section 5 and **Appendix K.**

5 Preliminary Surface Water Strategy

5.1 Overview

5.1.1 As the LLFA, Cambridgeshire County Council are responsible for the approval of surface water drainage systems within new major development.

5.1.2 Major development, as defined within the Town and Country Planning Act (1990), consists of any of the following:

a) the provision of dwelling houses where residential development of 10 or more units; or where the development is to be carried out on a site having an area of 0.5 hectares or more and the number of units is not known;

b) the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or

c) development carried out on a site having an area of 1 hectare or more.

5.1.3 The Webb's Hole Sluice, which is located north of the site, is an Environment Agency controlled gate, which shuts when there is a differential of level between the Ouse and the Swavesey Drain; these closures can be prolonged for up to 14 days. This leads to water backing up the Swavesey Drain and low-lying IDB system through the village of Swavesey while the gate is shut, reducing the function of the drains in times of high flow.

5.1.4 The CCC have stated that additional volumes of water within this drain could potentially lead to wider spread flooding throughout Swavesey and this of concern.

5.1.5 The hydraulic regime is complex and benefits from early evacuation of surface water following an event, making the most of the lag in the rising Ouse levels, but once the system is tide-locked it is heavily constrained.

5.1.6 The LLFA have therefore requested that it would be beneficial to include some telemetry and control on the outlet from the development to hold water on site during larger storm events, when Webb's Hole Sluice shuts. This mitigation measure would safeguard against overloading the existing system in Swavesey and that it has recently been implemented on a number of other developments within the village.

5.1.7 The following section provides an overview of the existing surface water drainage arrangements and the proposed strategy for the management of surface water from the new development.

5.2 Surface Water Drainage Hierarchy

5.2.1 Regional and national planning policy will be taken into account going forward within the emerging drainage strategy for the site.

5.2.2 Local Plan policy CC/8 states development proposals will be required to demonstrate that opportunities are taken to integrate SuDS, create amenity and enhance biodiversity.

5.2.3 Part H of the Building Regulations states that options for the disposal of surface water runoff should be considered in the following hierarchical order:

i. Into the ground (infiltration);

ii. To a surface water body (e.g. watercourse);

iii. To a surface water sewer, highway drain or other drainage system;

iv. To a combined sewer.

5.2.4 Based on the underlying geology and site observations, the site is unlikely to support the use of infiltration features alone, however discussions should be carried out with the LLFA at planning stage to confirm whether intrusive ground investigations need to be undertaken at the site in support of any future planning application.

5.3 Greenfield Runoff Rates

5.3.1 When infiltration is not deemed to be feasible, discharge to watercourse is the next preferred option. There is a watercourse which runs along the western boundary and already accepts greenfield runoff from the site.

5.3.2 The greenfield runoff rate was estimated using the FEH Statistical method based on catchment descriptors for the site. This method resulted in a QBAR (1 in 2.33 annual probability event) greenfield runoff rate of 2.5l/s/ha. Refer to **Appendix I** for the supporting Greenfield Runoff calculations. The LLFA will expect this to be applied to the site.

5.4 Sustainable Drainage Systems (SuDS)

5.4.1 It is a requirement of the NPPF that SuDS are used in all major developments, if feasible. The LLFA also advocates the use of appropriate SUDS in new development as detailed in the Cambridgeshire County Council Surface Water Drainage Guidance for Developers dated November 2019.

5.4.2 CIRIA report C753 'The SuDS Manual' outlines the various types of SuDS, their benefits and limitations, and design considerations associated with each. Not all SuDS components/methods are feasible or appropriate for all developments, factors such as available space, ground conditions and site gradient will influence the feasibility of different methods for a development.

5.4.3 At this stage it is anticipated the SuDS features proposed at the site will be widely dispersed throughout the development.

5.4.4 The design and the integration of proposed SuDS features within the wider landscape strategy and proposals will be carefully considered as part of the masterplanning process and shall themselves, provide an element of Public Open Space use.

5.4.5 The site already has a number of landscape features including woodland, the pond and watercourse which are proposed to be retained and enhanced where possible therefore, the SuDS proposals shall be designed to ensure they enhance and support the landscape proposals going forward.

5.4.6 The proposed SuDS seek to deliver long term mitigation by attenuating and treating the development generated surface water runoff and where possible provide betterment to the receiving watercourse. SuDS will be designed so they are integrated within the wider landscape proposals and will provide opportunities, where possible, to enhance biodiversity and recreation facilities.

5.4.7 As well as providing a drainage function, the SuDS will also form an important part of the project's biodiversity strategy. The proposed SuDS features will be designed so that they maximise opportunities for habitat creation.

5.4.8 The prevailing surface water strategy to be adopted is a network of positive drainage, where feasible consisting of and not limited to:

- Open swales / rills;
- Attenuation Basins;
- Porous Paving; and
- Bio-retention areas.

5.4.9 Upstream on plot drainage solutions such as bio-retention planters (where feasible) and permeable paving could also provide pre-treatment for runoff from hard standing surfaces such a parking areas.

5.4.10 Piped networks may still be utilised in areas based on the LLFA, Highways and Sewerage undertaker adoption requirements.

5.5 Attenuation Storage Requirements

5.5.1 The percentage of impermeable area has been taken as 55% for residential areas. This will be reviewed as development proposals progress.

5.5.2 WinDes Quick Storage Estimates have been undertaken to provide an indication of the volume of storage that would likely be required on site to provide the necessary attenuation based upon rainfall events up to the 1% (1 in 100) annual probability event plus, an additional allowance of 20% and 40% on rainfall intensity, which is to account for the potential impacts of climate change. The climate change allowance is based on the latest Environment Agency *Flood Risk Assessments: Climate Change Allowances* (February 2016, updated Dec 2019).

5.5.3 The proposed final developable area for the future works is not yet known as we are at local plan promotion stage, therefore the amount of storage required for every 1ha of impermeable area has been calculated to be 1089m^3 This is based on the site applicable greenfield Q_{BAR} runoff rate of 2.5l/s/ha and a 1% annual probability rainfall event including an allowance for climate change of 40% (see calculations in **Appendix J**).

5.5.4 As stated in section 5.1, CCC has requested additional storage is provided, considering the effects from the Webb's Hole Sluice when it is shut in times of high-water flows, for up to 14 days. A sensitivity test has therefore been undertaken of the basins to determine the effects of zero discharge during the 14 days on the basins. The basins have been indicatively sized to accommodate this, with an element of free board provided to potentially accommodate a lower rainfall event during the 14 days. It is also imperative that the site also promotes the use of upstream SuDS features, as listed in this report. This is to help facilitate the likely additional storage volumes which will need to be accommodated at the site.

5.5.5 A penstock and telemetric control, in addition to the proposed outfall discharge control will need to be included within the future long-term surface water drainage strategy for the site. The penstock and telemetric control will need to be linked to the EA operated flood gates at Webb's Sluice, so when the EA flood gates are closed the on-site penstock is closed and flows will not be allowed to discharge from the site until such a time as the flood gates are re-opened and there is capacity downstream to accommodate flows from the site.

5.5.6 An approximation of the total storage required for each catchment is shown in the Proposed Surface Water Drainage Strategy drawing enclosed in **Appendix K**. The calculations are only rough estimates which can only be used at this high-level stage. The indicative locations of strategic attenuation basins and their associated outfalls for each catchment are shown. It is anticipated this storage will be supported with more dispersed storage once a masterplan is progressed in the planning stages.

5.5.7 The maximum stored water depth to achieve a gravity outfall will also need to be confirmed at planning stage with review of survey data of the local land drainage network.

5.5.8 The size of any proposed attenuation features will be affected by any groundworks that may take place as part of the development proposals and further drainage modelling to accommodate the zero-discharge requirement.

5.6 Exceedance

5.6.1 To demonstrate that in an exceedance event any flooding does not negatively affect the development, flows up to the 1 in 100 (1%) annual probability plus climate change rainfall event will be managed onsite. Furthermore, the attenuation will be designed to accommodate surface water runoff with no flooding for all storms up to and including the 1 in 100 (1%) annual probability plus 40% climate change event.

5.7 Water Quality and Pollution Control

5.7.1 Appropriate pollution control measures must be included in the surface water drainage system to minimise the risk of contamination or pollution entering the receiving watercourse and aquifer from surface water runoff from the development.

5.7.2 The drainage system will be designed to comply with the requirements of the SuDS treatment train as laid out in CIRIA C753 'The SuDS Manual', described as the 'Simple Index' Approach, in addition to the CCC Surface Water Drainage Guidance for Developers document and the Local Plan. A SuDS treatment plan should be applied for each catchment whereby runoff passes through a variety of SuDS techniques to control volumes of runoff and reduce pollution before discharge to a watercourse.

5.8 Adoption and Maintenance

5.8.1 It is assumed that the surface water infrastructure will be designed to adoptable standards and adopted either by Anglian Water, ICOSA or private management company. The upcoming release of Sewers for Adoption 8th Edition highlights a change in approach whereby sewerage companies including Anglian Water are open to adopting SuDS features provided they meet expected design standards.

5.8.2 CCC Surface Water Drainage Guidance for Developers document dated November 2019 provides outline guidance on how SuDS features should be designed.

6 Conclusions and Recommendations

6.1.1 This Appraisal report sets out the high-level flood risk and drainage strategy for development on Land East of Boxworth End, Swavesey. This site presents an opportunity to deliver strategic growth without causing a detriment to flood riskby considering the following:

- The whole site is located within Flood Zone 1 of the “Flood Map for Planning”, which is appropriate for all types of development.
- There is an ordinary watercourse which runs along part of the southern site boundary and along the western site boundary.
- The south west corner of the site is at a low, medium and high risk of surface water flooding where a flood depth of 900mm could occur in a low risk scenario. As such, Cambridgeshire County Council have confirmed surface water modelling is required to quantify the potential depth of floodwaters across the proposed access road into the site in a 1 in 100 (1%) annual probability event including an allowance for climate change of 40%, to ensure safe access and egress (less than 300mm flood depth) from the development is available. This will be undertaken to inform the future planning application for the site.
- Based on provisional calculations we can confirm the existing channel is potentially large enough to contain the flow associated with this event. If the entrance road needs to be raised, so there is less than 300mm flood depth, mitigation measures may need to be incorporated to prevent any detrimental impact of displaced flood water on third party land. It is assumed at this early stage there is sufficient space within the site and access corridor to accommodate any displaced water. However, this is subject hydraulic modelling and flood compensation assessment.
- As part of the site is located at high risk of surface water flooding, application of the sequential and exception tests may be required. It is recommended the planner addresses these tests with the approving authority. A sequential approach has been undertaken at a site level, with all dwellings located in an area at low risk of surface water flooding.
- Appropriate easements will be applied to the watercourse at the site to ensure they remain free from development and future maintenance access can be retained.
- Infiltration drainage alone is unlikely to be feasible based on site observations and recorded geology, however infiltration testing could be undertaken to support the site at the planning stage, if a requirement of the LLFA.
- The site has the potential to support a range of sustainable measures to manage and control surface water run-off, with the view to deliver an integrated Sustainable Drainage System (SuDS). These features will be fully joined up with ecology/habitat areas, green infrastructure, and public open space. Rather than creating simple functional ‘drainage features’, this integrated approach will contribute to habitat creation and enhance biodiversity, provide multi-functional amenity space, and preserve water quality. This is in line with national and local guidance.
- The volume of surface water being discharged from the development will be carefully controlled to replicate the drainage regime of the existing site in accordance with the Lead Local Flood Authority (Cambridgeshire County Council) surface water drainage design requirements and local planning authority, so as not to cause any increase in off-site flood risk. This will also need to include the requirement for zero-discharge for 14 days as detailed by CCC.

- The SuDS will ensure there is no increase in discharge rates from the site but also will improve water quality discharge, using the principles from the SuDS Manual. Provisional rates have been provided within this appraisal.

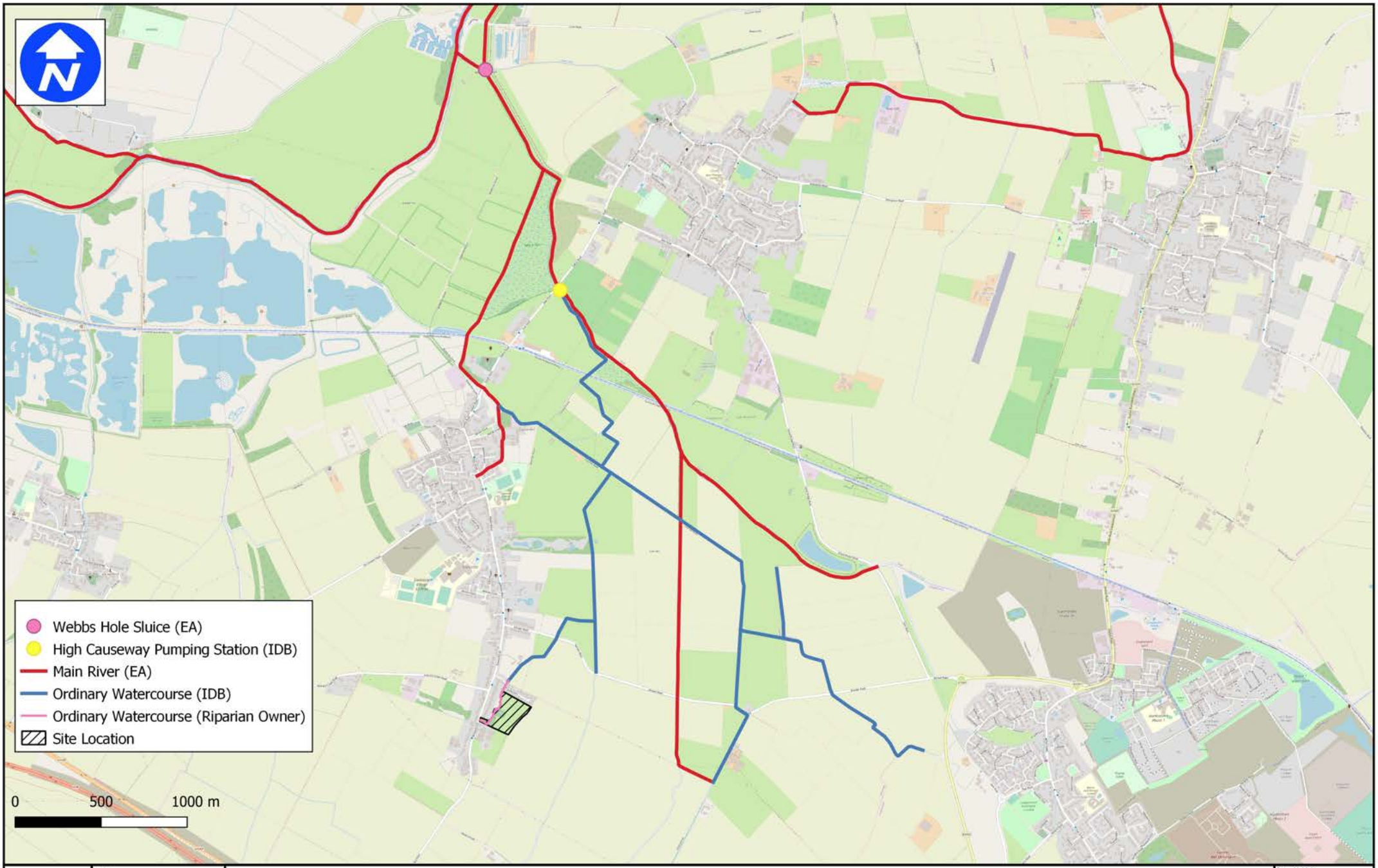
- It is estimated attenuation storage in the order of 1089m^3 per impermeable hectare could be required to attenuate runoff during the 1 in 100 annual probability plus 40% climate change prior to discharge, this may increase once further modelling is undertaken to enable zero-discharge for a period of 14 days. The preliminary surface water drainage strategy has illustrated this is achievable, and it assumed that the extreme storage will be integrated with the landscaping proposals.

6.1.2 Overall the site is well positioned to deliver housing needs without increased flood risk to offsite areas following the implementation of the proposed mitigation measures listed within this report. It also offers the opportunity for environmental enhancement through the introduction of a variety of SuDS. With the implementation of the strategy, it is considered that the site accords with national and local regional planning policy guidance, and that therefore there no flood risk nor drainage reasons why Land East of Boxworth End, Swavesey should not be allocated for residential development in the Greater Cambridge Local Plan.

Appendix A Open Data Flood Maps

- Watercourse Location Plan
- Catchment Topography
- Catchment Boundaries: Comparison of FEH and LiDAR derived catchments
- Upper Catchment Topography
- Soil Association Map
- FEH Catchments
- Land Cover for URBEXT calculation

- Site Location Plan
- Site Location (Aerial Photography)
- Area Topography (LiDAR)
- EA Flood Zone Map
- EA Surface Water Flood Risk
- Reservoir Flood Map
- EA Historic Flood Map
- Source Protection Zone



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Client
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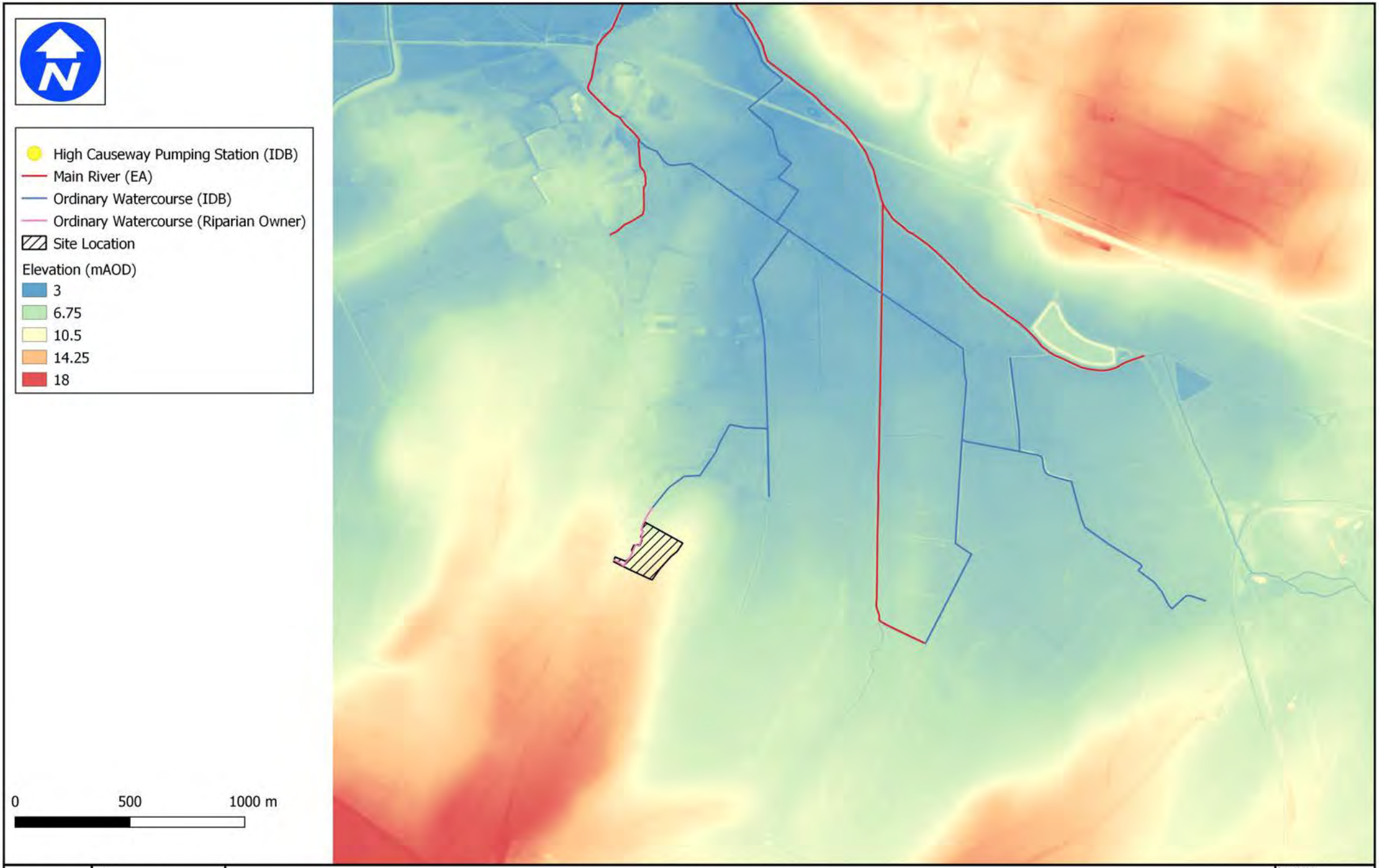
Boxworth End, Swavesey

Watercourse Location Plan

Date: 03.02.20
Scale: 1:20000
Drawn By: CW Checked By: SK
Rev: -
Figure Number:
47801/GIS001



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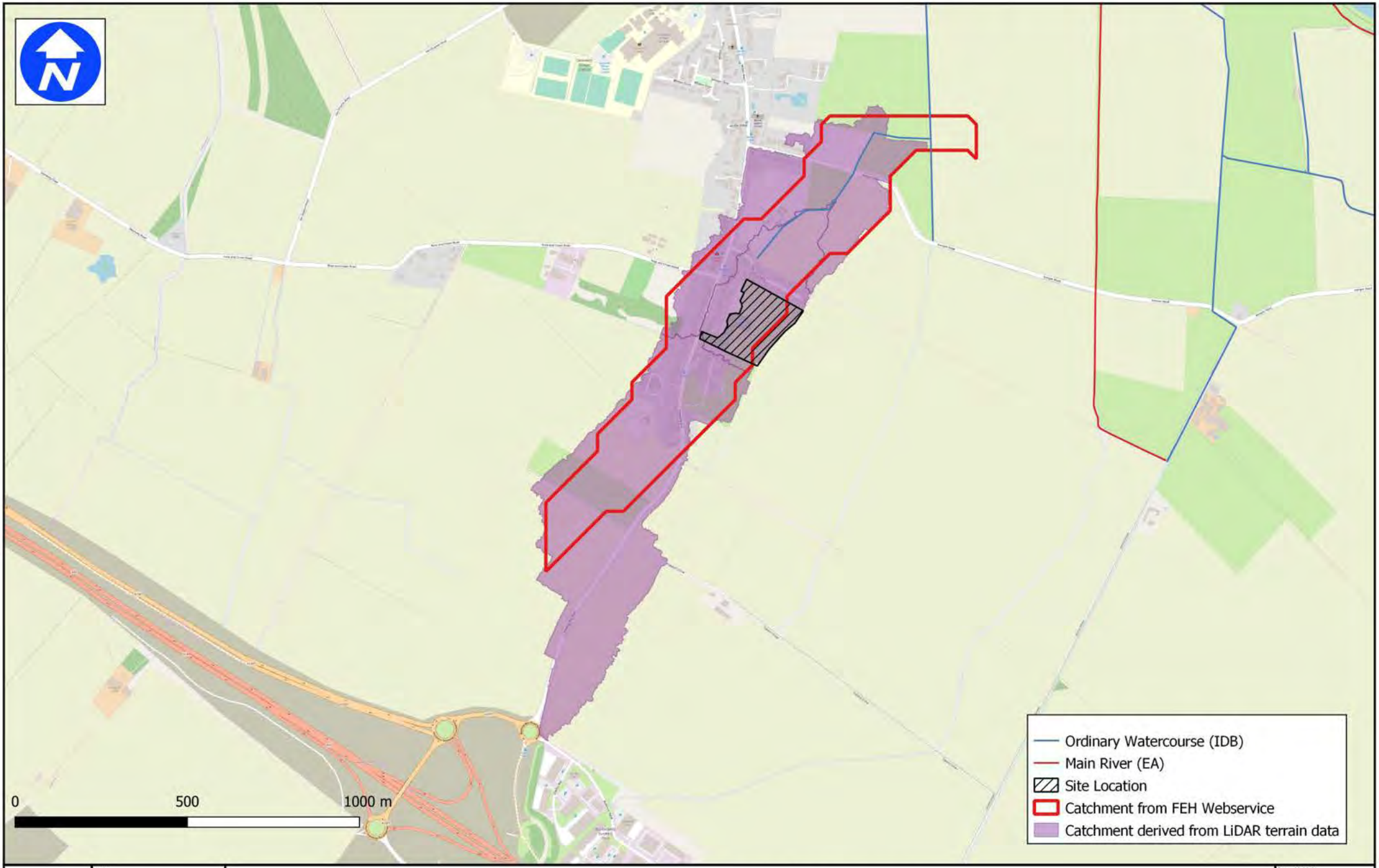
Axis Land Partnerships Ltd

Boxworth End, Swavesey

Catchment Topography

Date: 03.02.20
Scale: 1:15000
Drawn By: CW Checked By: SK
Rev: -
Figure Number:
47801/GIS002



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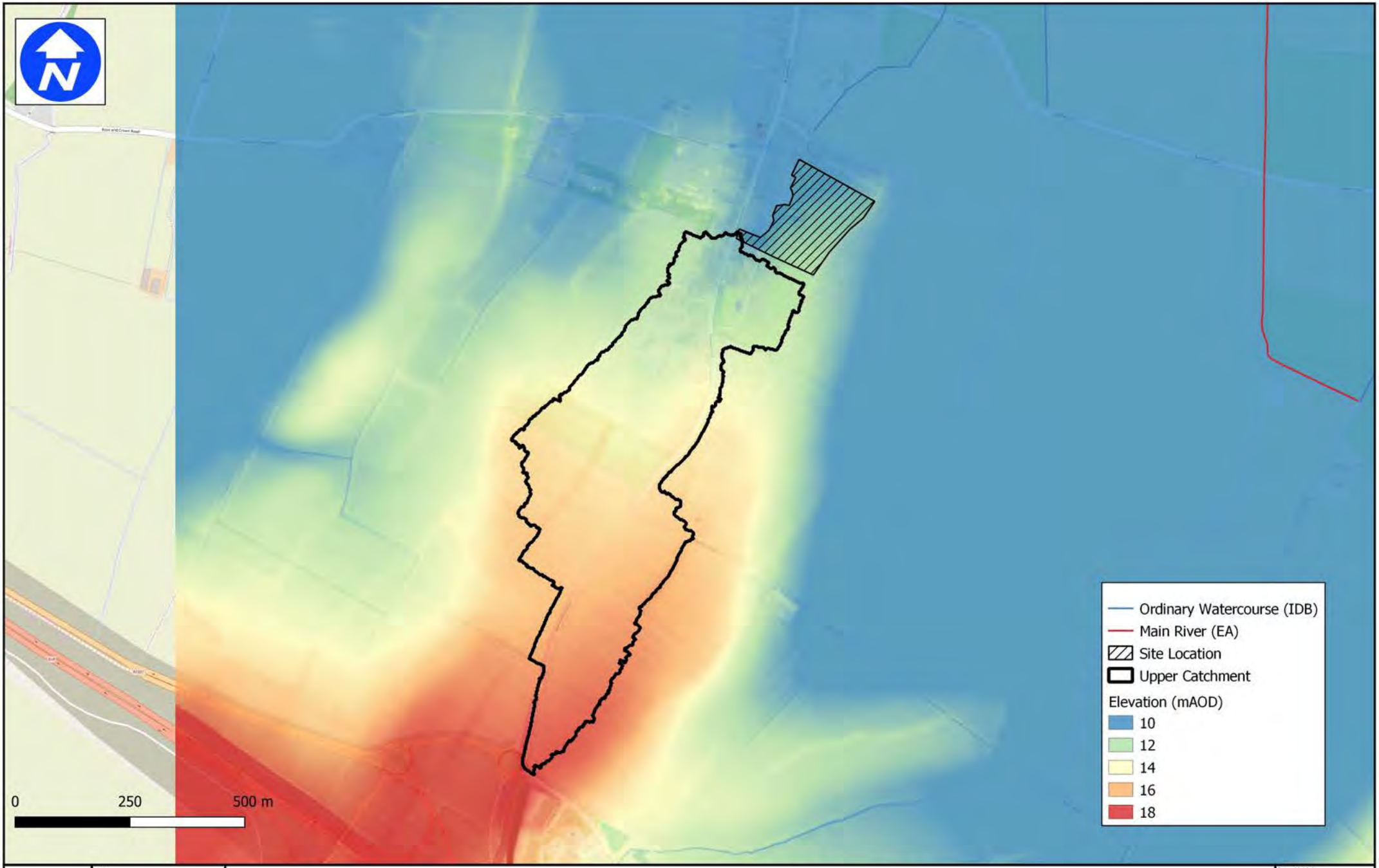
Boxworth End, Swavesey

Catchment Boundaries:
Comparison of FEH and LiDAR derived catchments

Date: 03.02.20
Scale: 1:10000
Drawn By: CW Checked By: SK
Rev: -
Figure Number:
47801/GIS003



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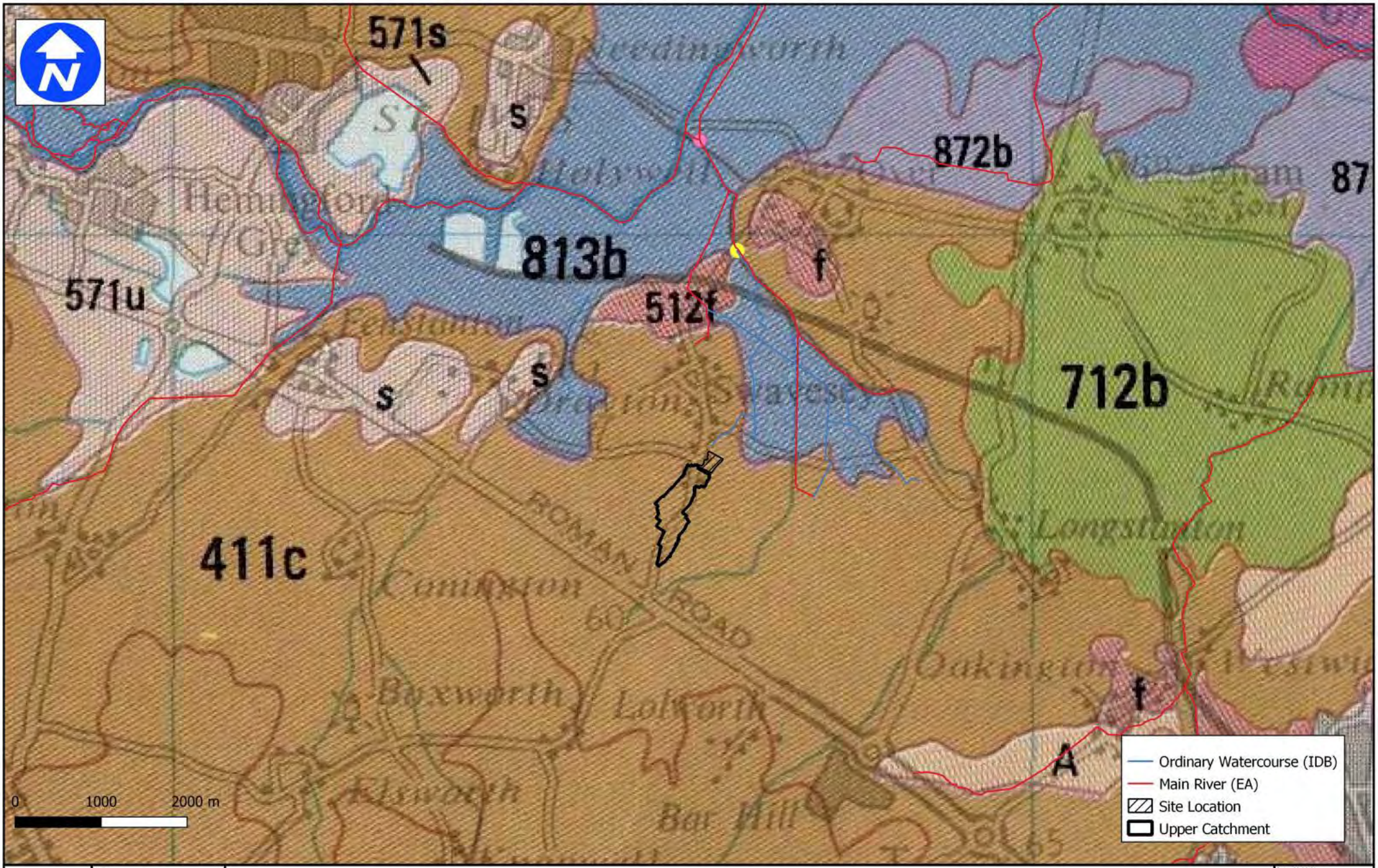
Client
Axis Land Partnerships Ltd

Boxworth End, Swavesey

Upper Catchment Topography

Date: 03.02.20
Scale: 1:7500
Drawn By: CW Checked By: SK
Rev: -
Figure Number:
47801/GIS004



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Client
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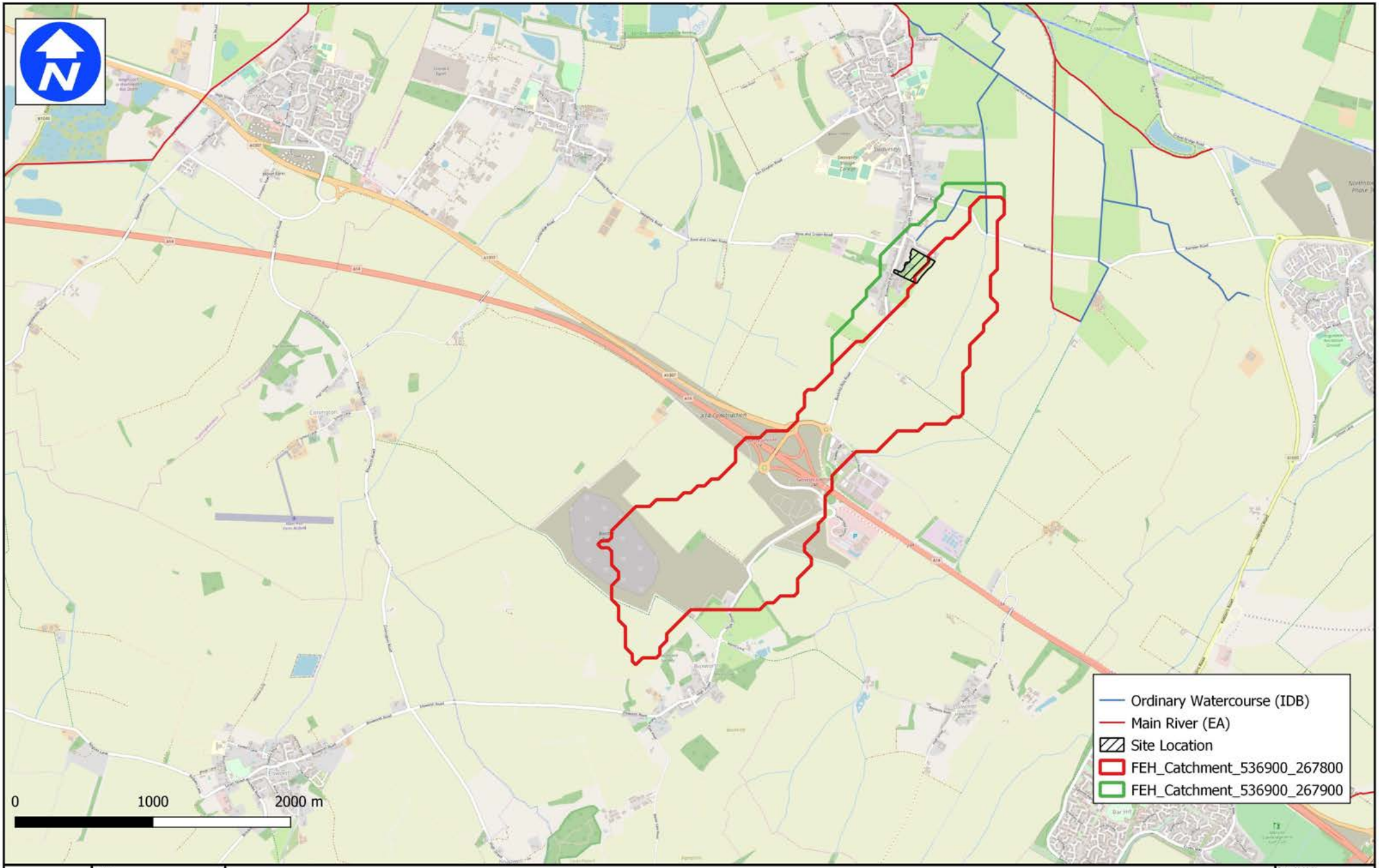
Boxworth End, Swavesey

Soil Association Map

Date: 03.02.20
Scale: 1:40000
Drawn By: CW Checked By: SK
Rev: -
Figure Number:
47801/GIS005



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Boxworth End, Swavesey

FEH Catchments

Date: 03.02.20
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Rev: -
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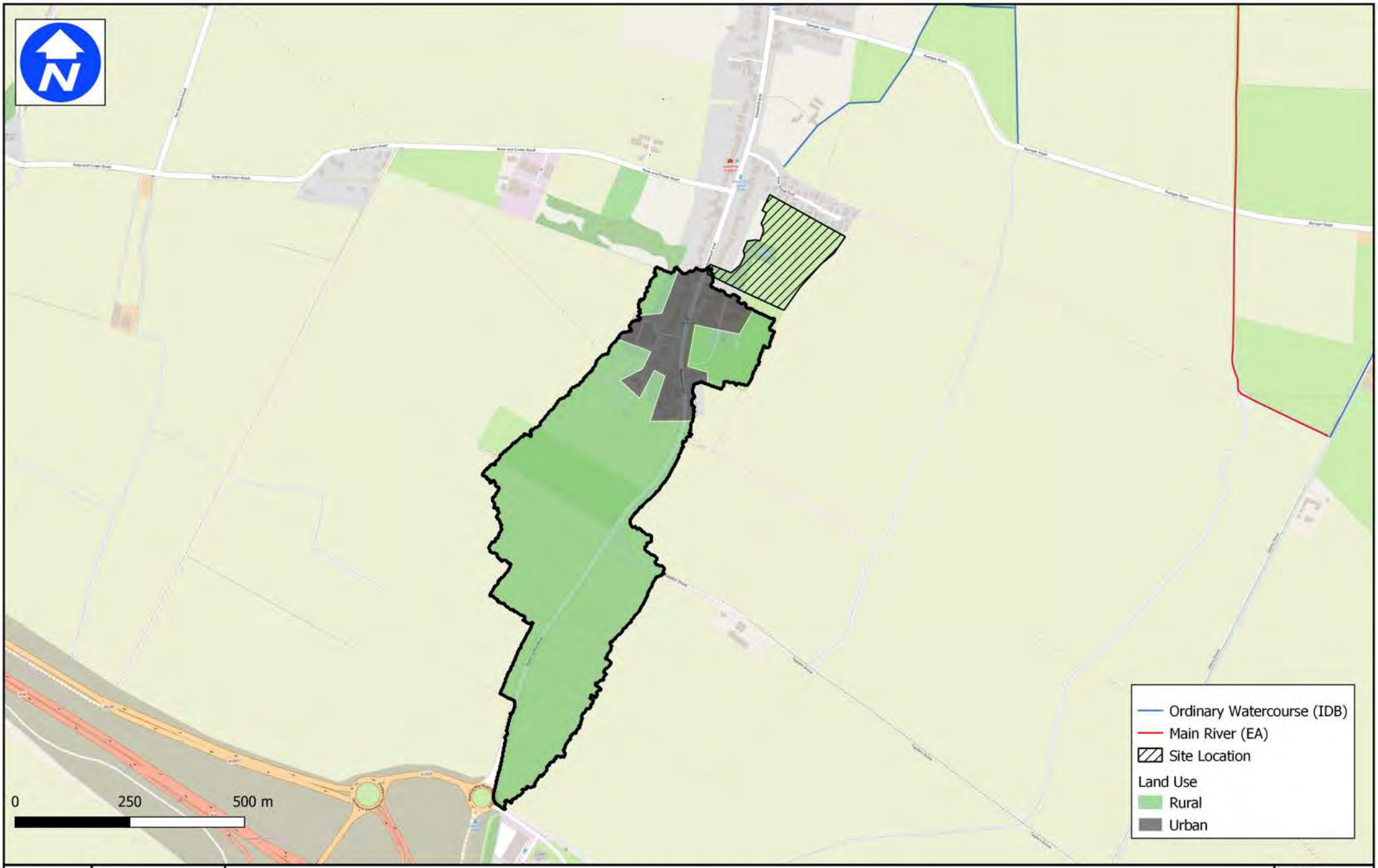
47801/GIS006



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Axis Land Partnerships Ltd

Boxworth End, Swavesey

Land Cover for URBEXT calculation

Date: 03.02.20
Scale: 1:7500
Drawn By: CW Checked By: SK
Rev: -
Figure Number:
47801/GIS007

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BOXWORTH END, SWAVESEY

Site Location

1:10,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 01 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS008a Site Location.mxd

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Client: Axis Land Partnerships Ltd

BOXWORTH END, SWAVESEY

Site Location (Aerial)

0 0.5 1 km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:10,000 @ A3	Date: 04/02/2020
Drawn: MD	Checked: MH
Figure 01	Rev A

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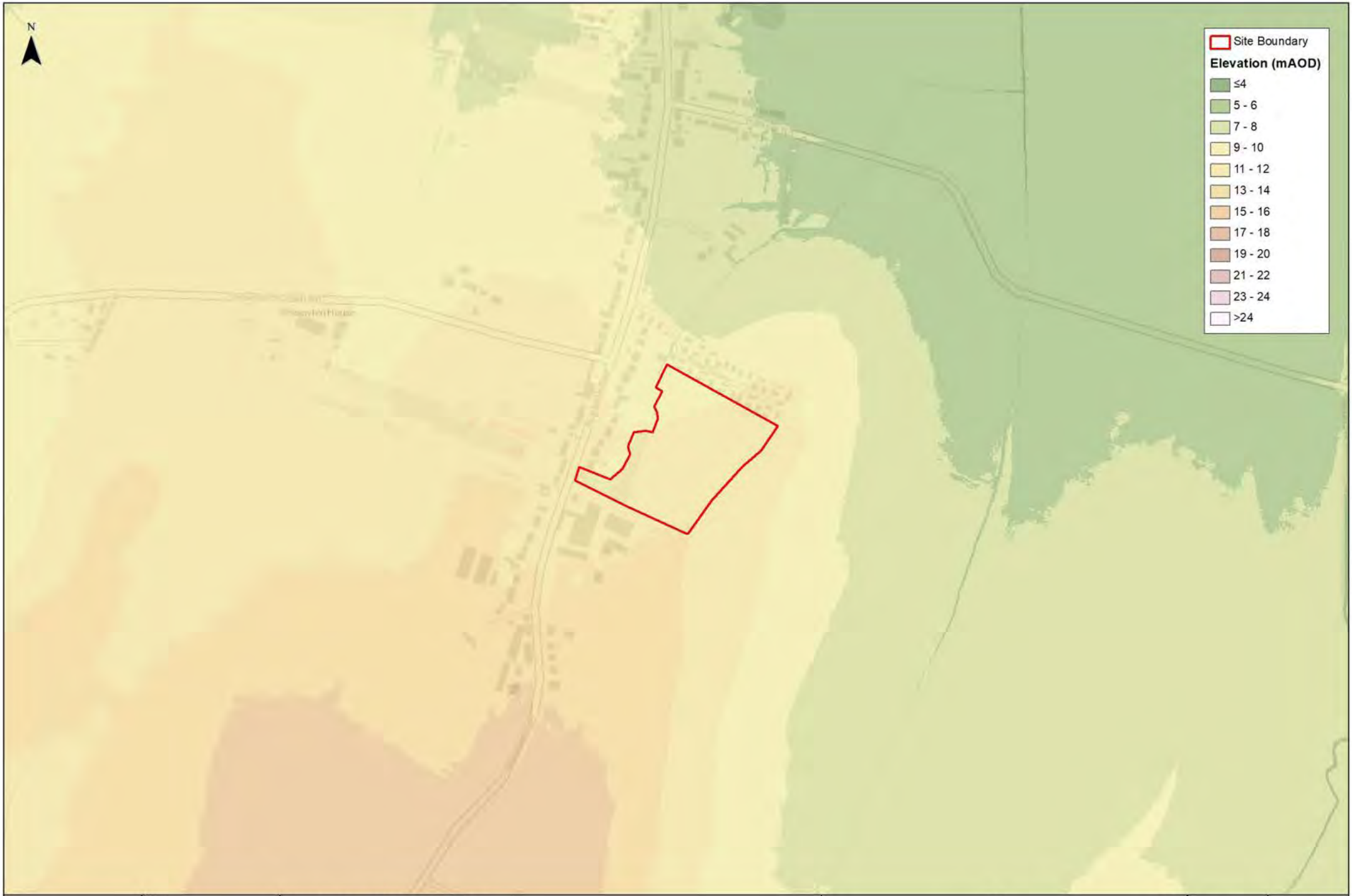

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Client: Axis Land Partnerships Ltd

BOXWORTH END, SWAVESEY

Site Topography (2m LiDAR)

0 250 500 m

1:5,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 02 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS009 Topography.mxd

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BOXWORTH END, SWAVESEY

Environment Agency Flood Zones for Planning

0 0.4 0.8 km

1:8,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 03 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS010 Flood Zones.mxd

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BOXWORTH END, SWAVESEY

Flood Risk from Surface Water (Flood Extents)

0 250 500 m

1:5,000 @ A3	Date: 04/02/2020
Drawn: MD	Checked: MH
Figure 04	Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS011 Flood Risk from Surface Water (Flood Extents).mxd

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BOXWORTH END, SWAVESEY

Flood Risk from Surface Water (High Risk Depth)

0 250 500 m

1:5,000 @ A3	Date: 04/02/2020
Drawn: MD	Checked: MH
Figure 05	Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS012 Flood Risk from Surface Water (High Risk Depth).mxd

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BOXWORTH END, SWAVESEY

Flood Risk from Surface Water (High Risk Velocity)

0 250 500 m

1:5,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 06 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS013 Flood Risk from Surface Water (High Risk Velocity).mxd

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BOXWORTH END, SWAVESEY

Flood Risk from Surface Water (Medium Risk Depth)

0 250 500 m

1:5,000 @ A3	Date: 04/02/2020
Drawn: MD	Checked: MH
Figure 07	Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS014 Flood Risk from Surface Water (Medium Risk Depth).mxd

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BOXWORTH END, SWAVESEY

Flood Risk from Surface Water (Medium Risk Velocity)

0 250 500 m

1:5,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 08 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS015 Flood Risk from Surface Water (Medium Risk Velocity).mxd

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BOXWORTH END, SWAVESEY

Flood Risk from Surface Water (Low Risk Depth)

0 250 500 m

1:5,000 @ A3	Date: 04/02/2020
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Figure 09	Rev A

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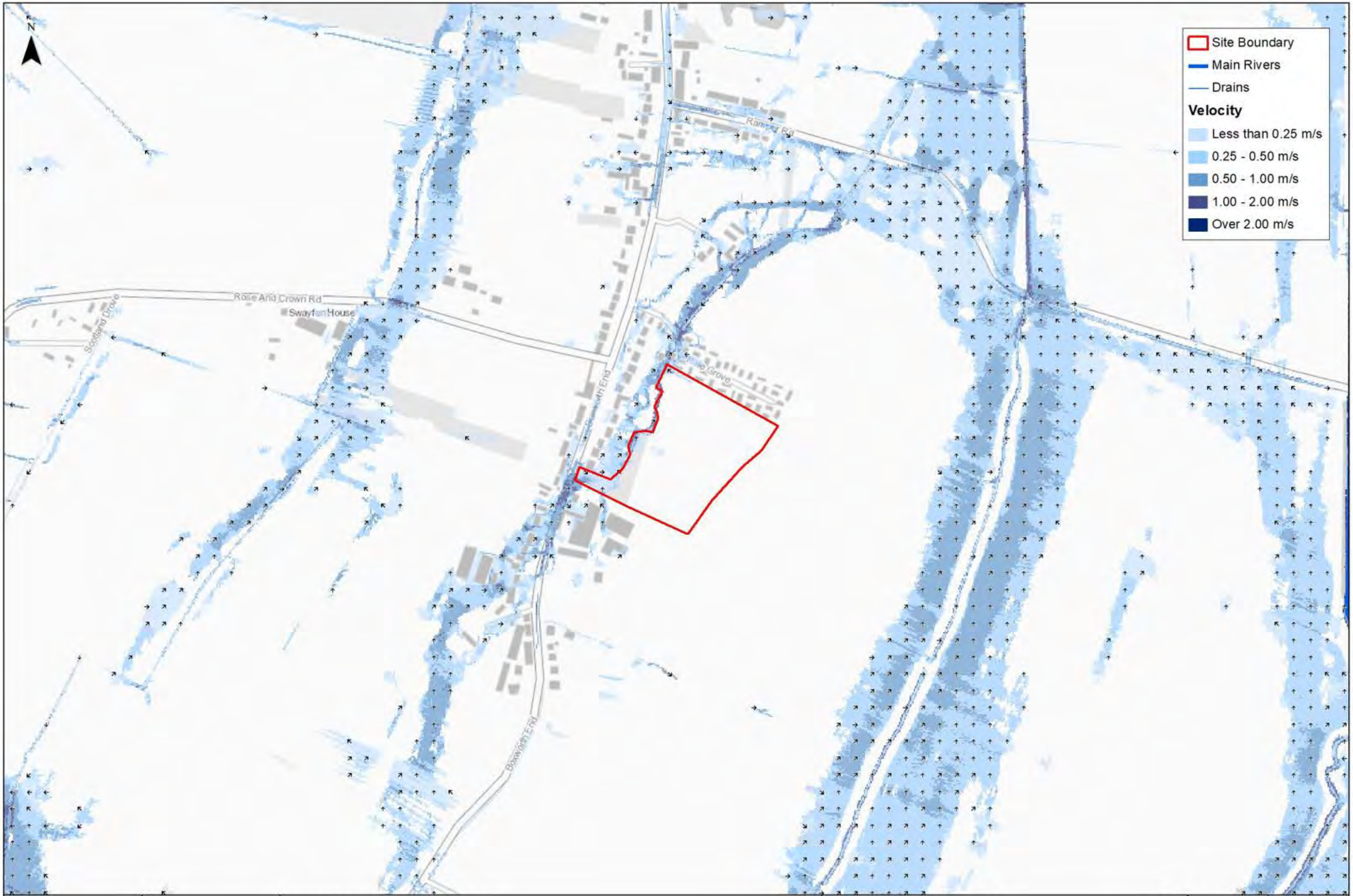

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Client: Axis Land Partnerships Ltd

BOXWORTH END, SWAVESEY

Flood Risk from Surface Water (Low Risk Velocity)

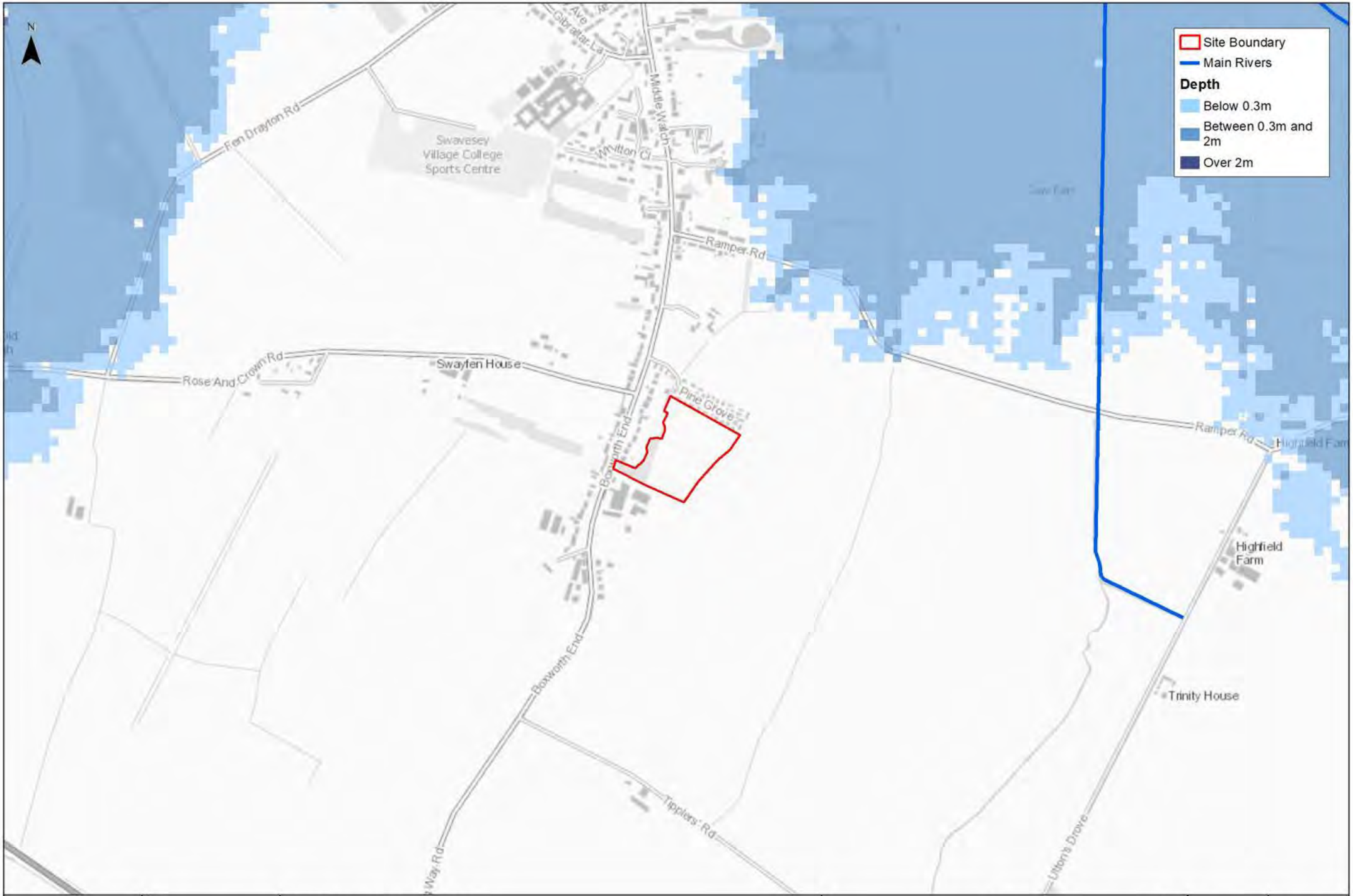
0 250 500 m

1:5,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 10 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS016 Flood Risk from Surface Water (Low Risk Velocity).mxd



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Client: Axis Land Partnerships Ltd

BOXWORTH END, SWAVESEY

Flood Risk from Reservoirs

0 0.4 0.8 km

1:8,000 @ A3	Date: 04/02/2020
Drawn: MD	Checked: MH
Figure 11	Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS017 Flood Risk from Reservoirs.mxd

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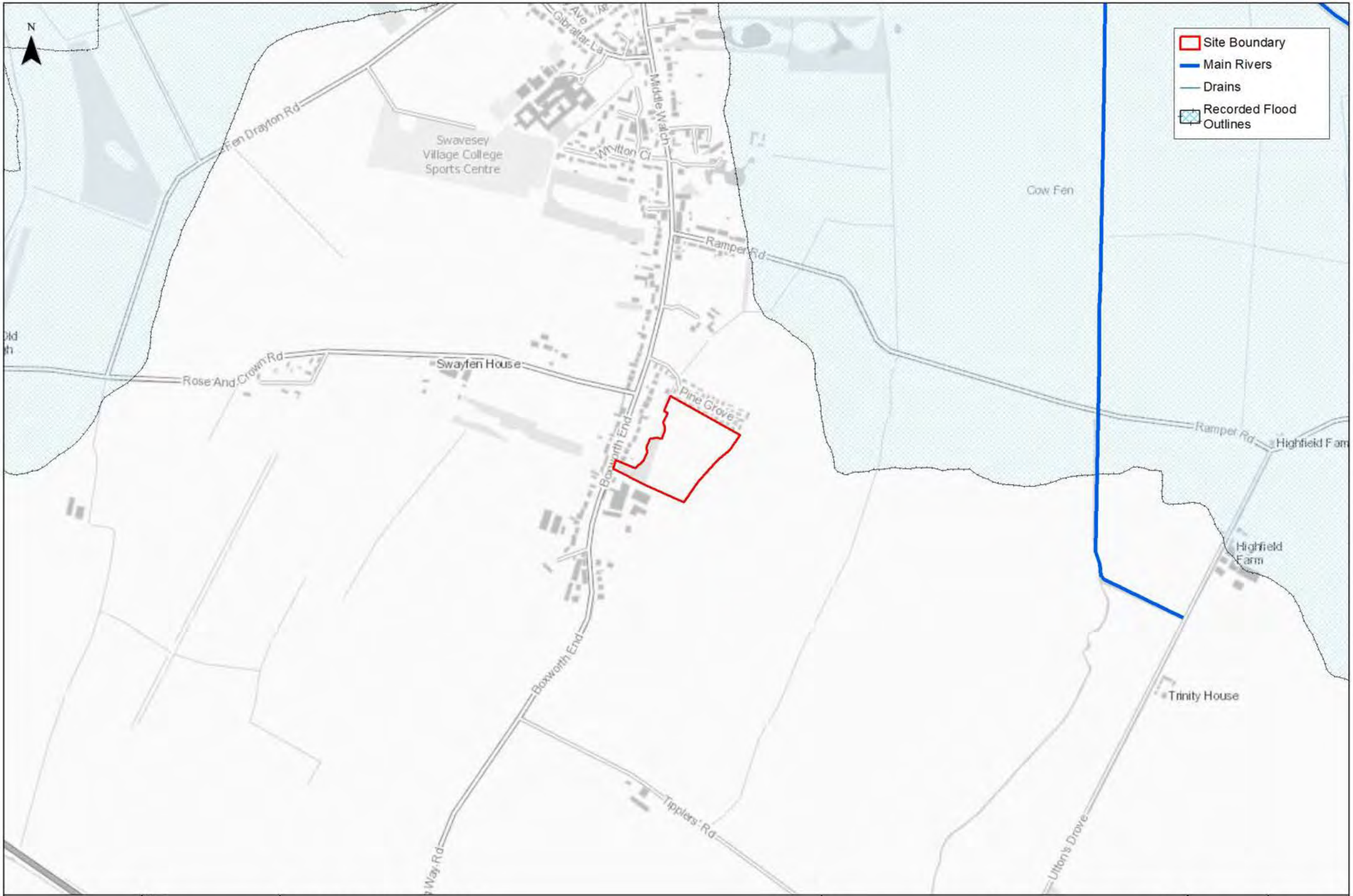
BOXWORTH END, SWAVESEY

Flood Defences, Areas Benefiting from Flood Defences, and Flood Storage Areas

0 0.4 0.8 km

1:8,000 @ A3	Date: 04/02/2020
Drawn: MD	Checked: MH
Figure 12	Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS018 Flood Defences, Areas Benefiting & Storage Areas.mxd



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BOXWORTH END, SWAVESEY

Recorded Flood Outlines

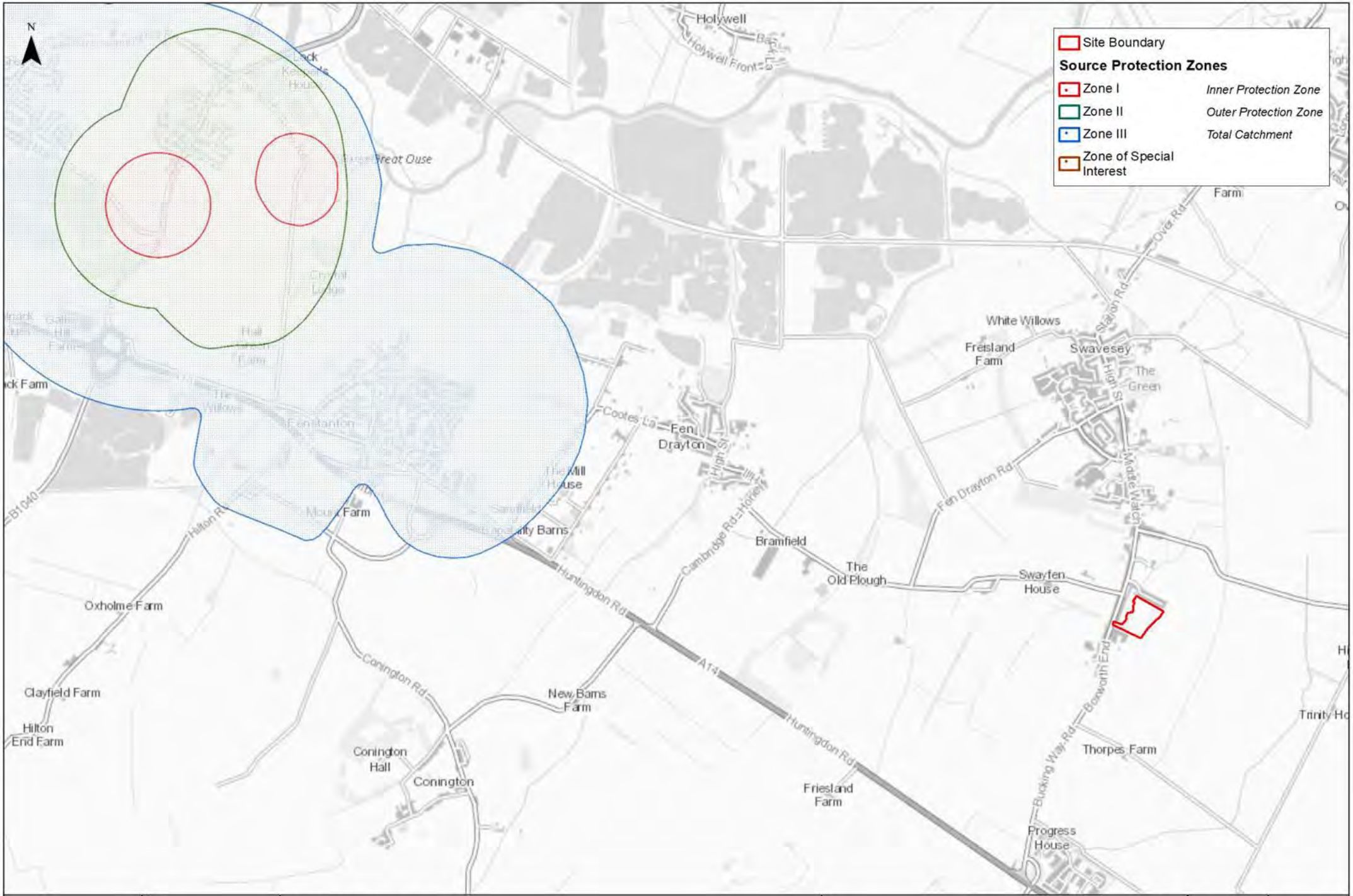
0 0.4 0.8 km

1:8,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 13 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS019 Recorded Flood Outlines.mxd



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BOXWORTH END, SWAVESEY

Source Protection Zones

0 1 2 km

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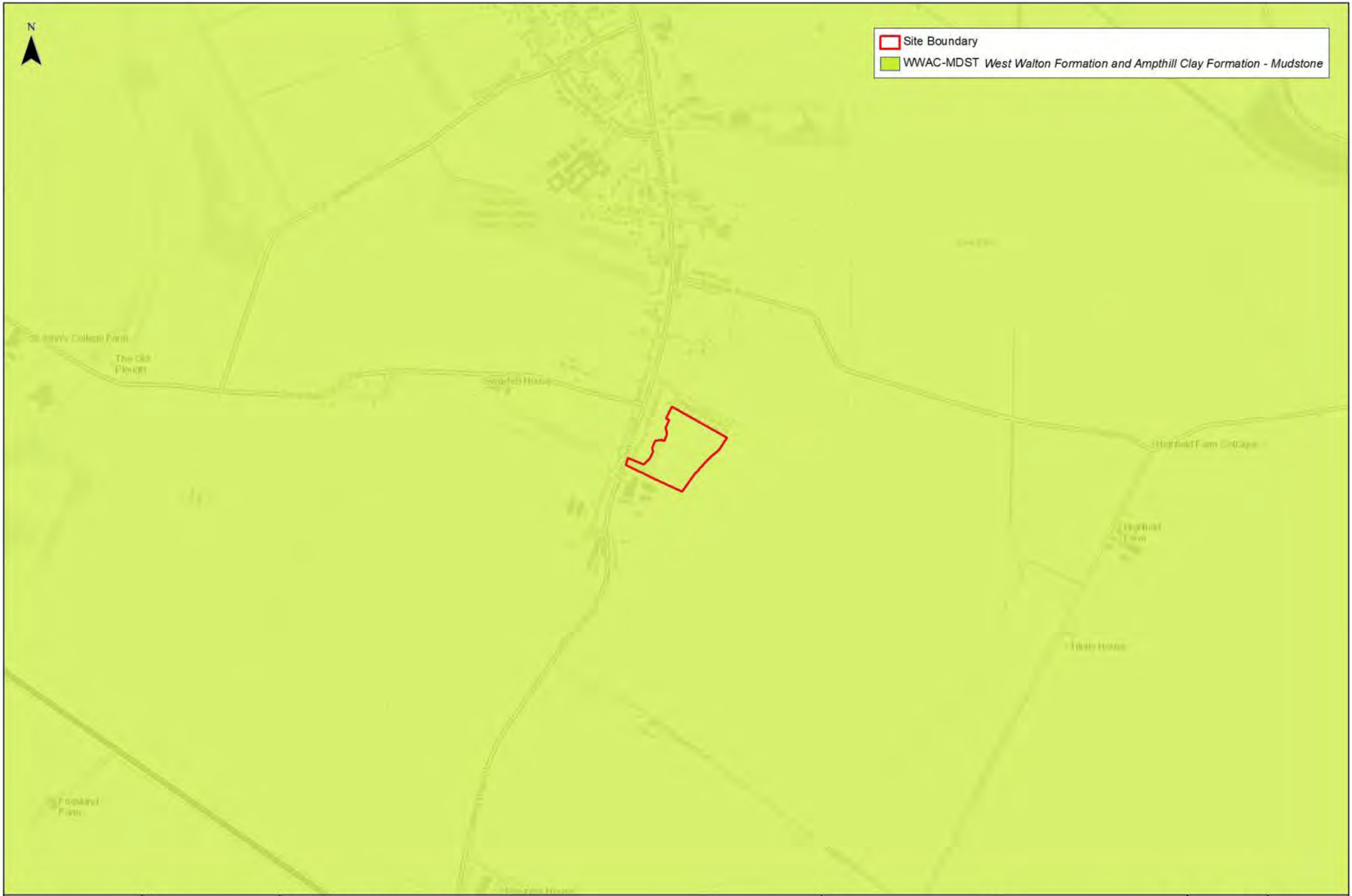
1:20,000 @ A3 | Date: 04/02/2020

Drawn: MD | Checked: MH

Figure 14 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS014 Source Protection Zones.mxd



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BOXWORTH END, SWAVESEY

Bedrock Geology

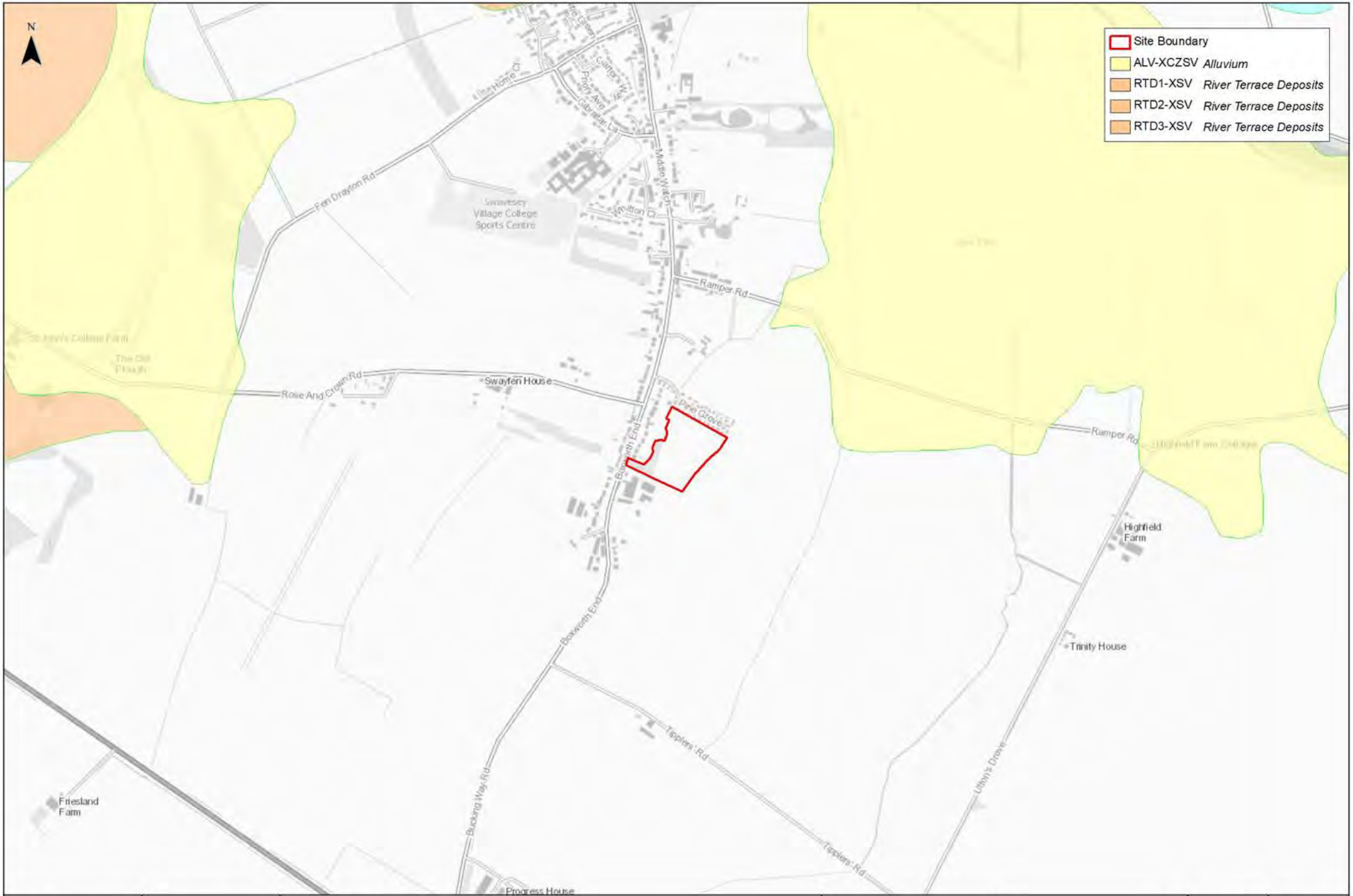
0 0.5 1 km

1:10,000 @ A3 | Date: 05/02/2020

Drawn: MD | Checked: MH

Figure 15 | Rev A

Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS022 Bedrock Geology.mxd



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BOXWORTH END, SWAVESEY

Superficial Deposits Geology

0 0.5 1 km

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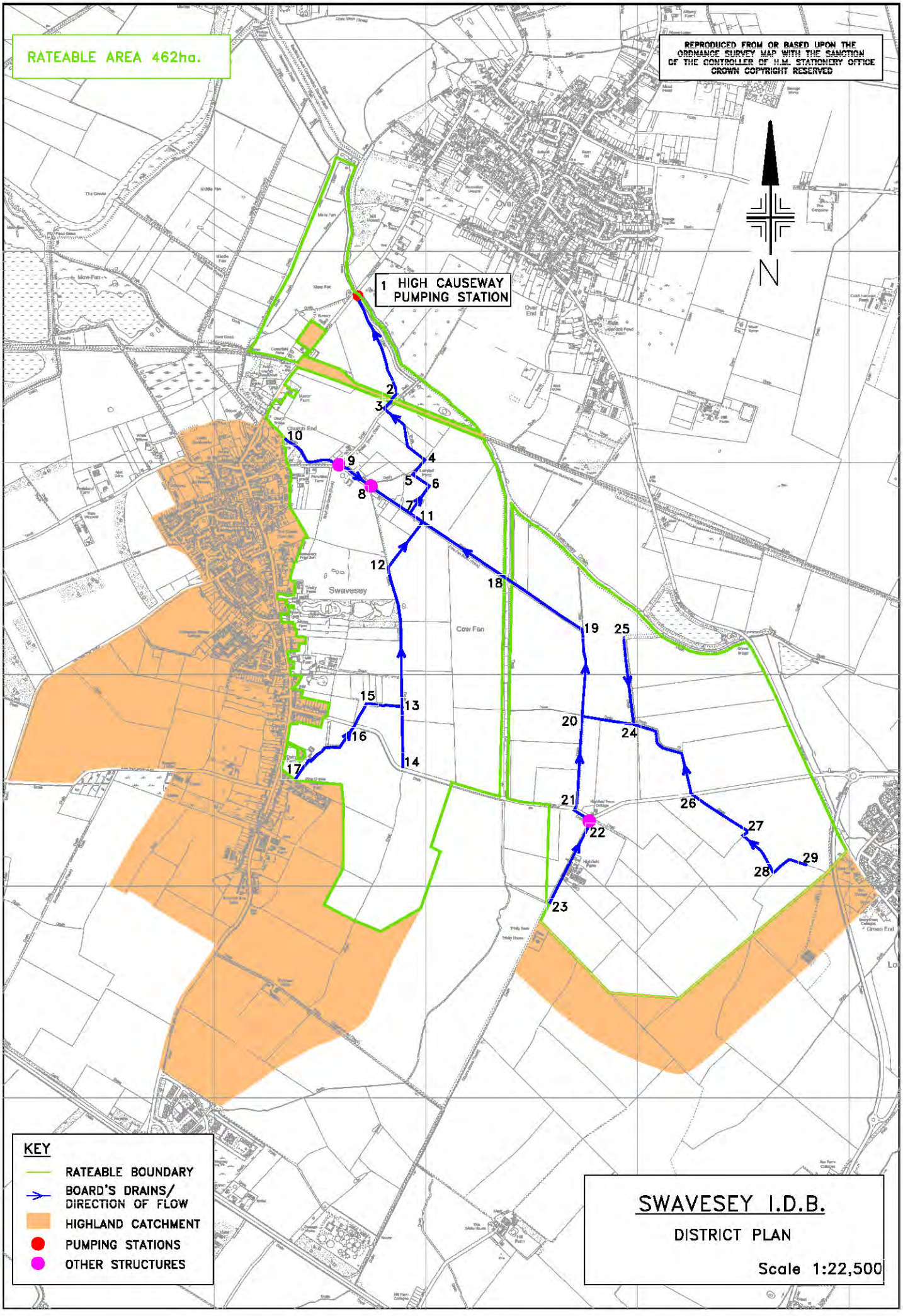
1:10,000 @ A3 | Date: 05/02/2020

Drawn: MD | Checked: MH

Figure 16 | Rev A

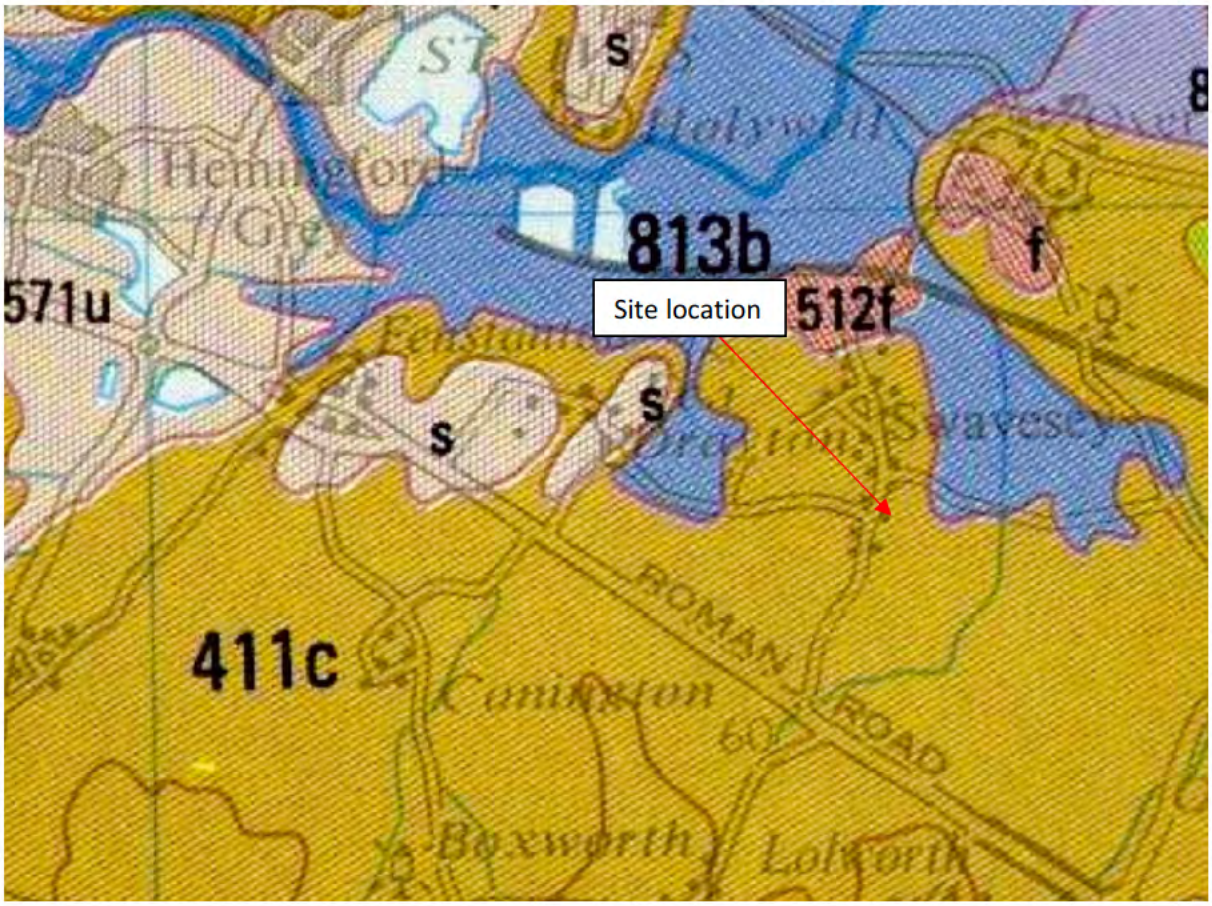
Document Path: J:\47801 Boxworth End Swavesey\GIS\Workspaces\47801 GIS023 Superficial Deposits Geology.mxd

Appendix B IDB Drawing

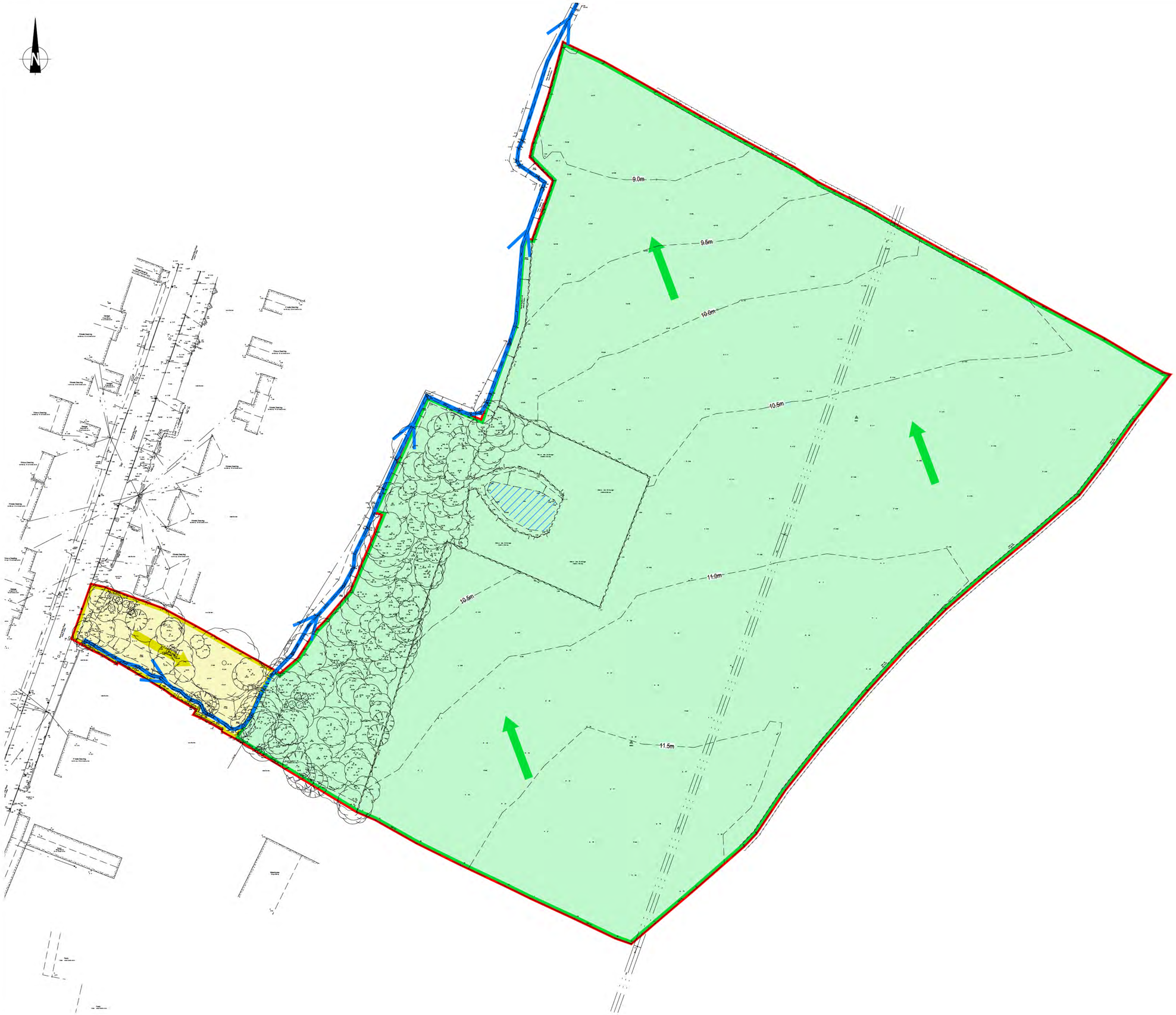

RATEABLE AREA 462ha.
REPRODUCED FROM OR BASED UPON THE ORDNANCE SURVEY MAP WITH THE SANCTION OF THE CONTROLLER OF H.M. STATIONERY OFFICE CROWN COPYRIGHT RESERVED
N
1 HIGH CAUSEWAY PUMPING STATION
Swavesey
Cow Fen
KEY
RATEABLE BOUNDARY
BOARD'S DRAINS/ DIRECTION OF FLOW
HIGHLAND CATCHMENT
PUMPING STATIONS
OTHER STRUCTURES
SWAVESEY I.D.B.
DISTRICT PLAN
Scale 1:22,500

Appendix C Geological Information

Extract of Soil Association Map



Appendix D Existing Drainage Catchment Plan



NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM NEWLYN UNLESS NOTED OTHERWISE.
3. ALL COORDINATES ARE IN METRES RELATIVE TO ORDNANCE SURVEY NATIONAL GRID.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS AND ARCHITECTS DRAWINGS AND SPECIFICATIONS.

LEGEND

- LAND OWNERSHIP BOUNDARY
- EXISTING WATERCOURSE AND DIRECTION OF FLOW
- EXISTING WATERCOURSE CULVERT
- EXISTING POND

SURFACE WATER CATCHMENT AREAS

CATCHMENT COLOUR	CATCHMENT No.	TOTAL AREA (m²)
	1	967
	2	30612

Mark	Revision	Date	Drawn	Chkd	Appd

SCALING NOTE: Do not scale this drawing - any errors or omissions shall be reported to Stantec without delay.
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 their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status

DRAFT

BOXWORTH END, SWAVESEY

EXISTING SURFACE WATER DRAINAGE CATCHMENT PLAN

Client

AXIS LAND PARTNERSHIPS

Date of 1st Issue	Designed	Drawn
NYI	MH	DF
A1 Scale	**Checked**	**Approved**
1:500	-	-
Drawing Number		**Revision**
47801/2001/2601		P0

Stantec

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CAMBRIDGE
Tel: [redacted]

File Location: j:\47801 boxworth end swavesey\cad\dwgs\2001_co\47801_2001_2601 - existing catchment plan.dwg

Appendix E Anglian Water Records and Correspondence

Hartley, Michael

From: Planning Liaison <
Sent: 13 January 2020 15:55
To: Hartley, Michael
Subject: RE: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Dear Mr Hartley

Thank you for your email regarding Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Anglian Water is able to confirm that we have no records of flooding in the vicinity that can be attributed to capacity limitations in the public sewerage system. It is possible that other flooding may have occurred that we do not have records of, other organisations such as the Local Authority, Internal Drainage Board or the Environment Agency may have records

Kind Regards

Sandra De Olim
Pre-Devlopment Advisor
[redacted]

From: Hartley, Michael
Sent: 13 January 2020 13:42
To: Planning Liaison
Subject: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Dear Sir/Madam

Peter Brett Associates have been commissioned to provide flood risk and drainage input for the promotion of the site through the emerging Greater Cambridgeshire Local Plan. The site is located at 536338E 267274N. Nearest post code: CB24 4RA. Location Plan is attached.

Could you please provide us with any information in your possession regarding any incidences of, or possible problems with, flooding associated with your foul, surface water and land drainage in the area of the site?

Thank you

Kind regards,

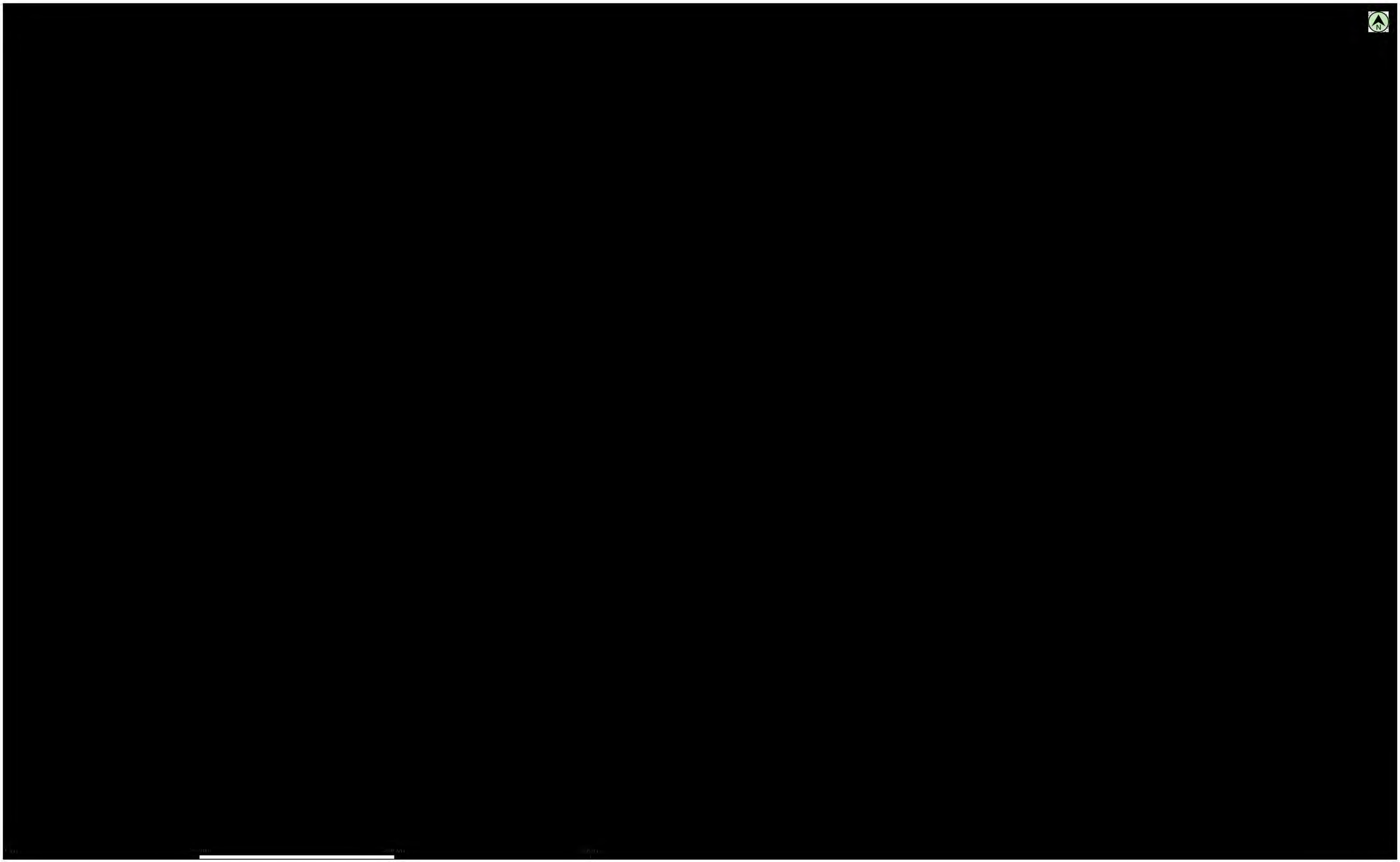
Michael Hartley
Assistant Engineer

Direct:

Cambridge

[redacted]
Main Tel:

PBA has joined the Stantec family, find out more at peterbrett.com.



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Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

mhartley@peterbrett.com
Swavesey

love every drop anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
1201	F	10.973	9.848	1.125
1202	F	-	-	-
1203	F	-	-	-
1204	F	-	-	-
2201	F	10.796	9.196	1.6
2301	F	10.452	8.504	1.948
2401	F	9.586	7.812	1.774
2402	F	10.326	7.641	2.685
3501	F	8.132	6.69	1.442
3502	F	8.769	7.303	1.466

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix F EA Records and Correspondence

Hartley, Michael

From: Enquiries_EastAnglia <E
Sent: 31 December 2019 12:54
To: Hartley, Michael
Subject: EAn/2019/152814 Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Dear Mr Hartley

Thank you for your request of 29 November 2019 about the work you are carrying out at Boxworth End.

We have consulted our Flood and Coastal Risk Mapping team who have provided us with the information below.

The flood map for planning (Rivers and Sea) shows the site to be located within flood zone 1. Sites within flood zone 1 that are more than 1ha, in an area with critical drainage problems or subject to other sources of flooding (such as from surface water drains) require a flood risk assessment. More information can be found here: https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas#assessments

You will need to assess the risk to the site from surface water flooding - it will need to be demonstrated that the development will be safe for its lifetime and not increase flood risk elsewhere. Lead Local Flood Authorities are responsible for managing risk from surface water. Please contact your Lead Local Flood Authority (LLFA) (Cambridgeshire County Council) who will best be able to discuss surface water drainage proposals and requirements for new developments.

Safe access and egress should be provided for your site and it is for the Local Planning Authority to determine if this is provided. The Environment Agency will comment on access and egress if this is affected by flooding from rivers or the sea.

We have no historic flood event information for this area. It is possible that other flooding may have occurred that we do not have records for, and other organisations such as the LLFA or Internal Drainage Board (IDB) (Swavesey) may have records.

The Swavesey IDB can be contacted at:

Asset Management Data and Information can be found online using this link:
https://environment.data.gov.uk/asset-management/index.html

This information is provided subject to the Open Government Licence available here:
www.nationalarchives.gov.uk/doc/open-government-licence/version/3/, which you should read.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

Please get in touch if you have any further queries or contact us within two months if you would like us to review the information we have sent.

Regards
Karen

Karen Brown
[redacted]

Working days: Monday, Tuesday, Wednesday

From: Hartley, Michael
Sent: 29 November 2019 16:06
To: Enquiries_EastAnglia
Subject: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Dear Sir/Madam

Peter Brett Associates have been commissioned to provide flood risk and drainage input for the promotion of the site through the emerging Greater Cambridgeshire Local Plan. The objective is to secure allocation of the residential development (100 dwellings) in the Local Plan. Location Plan is attached.

Review of the online Magic website indicates there is an "ordinary" watercourse which borders the western site boundary (see attached jpg). The "ordinary" watercourse appears to be a tributary of the Swavesey Drain located north of the site. There is an existing pond feature within the red line boundary, located within the western extent of the site.

Our initial assessment has identified the site to be located within Flood Zone 1: Low Probability of flooding from the rivers and sea as defined in the National Planning Policy Framework (NPPF) and accompanying Planning Practice Guidance (PPG).

A review of the online Risk of Flooding from Surface Water map (see attached jpg) however indicates that the site may be subject to surface water flooding, within the location which is currently being promoted for the proposed access route for the site.

We would be grateful if you could please provide comments on the following:

- Viability of the site with respect to flood risk;
- Scope of a future Flood Risk Assessment;
- Level of surface water modelling required of the watercourse (if any?);
- If flood storage compensation is required?

In addition could you please confirm whether the EA have any records of previous flooding of the site.

We are also in consultation with Cambridgeshire County Council, the LLFA and South Cambridgeshire District Council.

If there is a charge for this information please let us know in the earliest instance so we can arrange the necessary payment.

Thank you

Kind regards,

Michael Hartley
Assistant Engineer

Appendix G CCC Correspondence

Hartley, Michael

From: FR Planning
Sent: 23 January 2020 15:09
To: Hartley, Michael
Subject: RE: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Hi Michael,

Thank you for your email, to clarify the points made in previous correspondence please see the below.
By using the Environment Agency Surface Water Flood Risk Maps, this demonstrates that there is a medium risk of flooding between 1% - 3.3% chance in a given year.

This could be up to a depth of 900mm, as a result surface water flooding modelling would be required. The reason behind this is to ensure that there is safe access and egress from the development in all flood events up to and including the 1% AEP storm including 40% allowance for climate change.

Kind Regards,

Gabriella Yeomans
Flood Risk and Biodiversity Assistant
The Flood Risk and Biodiversity Team
Email:
Flood Risk and Biodiversity Team
Cambridgeshire County Council, Box No SH1315, Shire Hall, Cambridge, CB3 0AP

From: Hartley, Michael
Sent: 22 January 2020 15:39
To: FR Planning

Subject: RE: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Hi Gabriella,

Hope you are well.

Could you please clarify the highlighted text in yellow in your email below?

In order to demonstrate the viability of the site with respect to surface water flood risk, surface water modelling needs to be undertaken?

Thank you

Kind regards

Michael Hartley

[redacted]

Stantec

From: FR Planning
Sent: 15 January 2020 11:46
To: Hartley, Michael

Subject: RE: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Good Morning Michael,

I apologise as this was a miscommunication on my behalf which has led to the confusion of a flooding report, I meant to say a flood incident reported. Therefore, do not have any reports on this matter.

This flooding incident reported to CCC was due to a blocked culvert at Boxworth End, Swavesey and was a riparian ownership issue.

I hope this helps and resolves the problem.

Kind Regards,

Gabriella Yeomans
Flood Risk and Biodiversity Assistant

Flood Risk and Biodiversity Team
[redacted]

From: Hartley, Michael <**Sent:** 13 January 2020 15:02
To: FR Planning
Subject: RE: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Dear Gabriella,

Happy New Year.

Just reviewed your response you kindly provided us before Christmas. You noted there is a flooding report for Boxworth End 0.4km south of the site (see highlighted text below), could you please let us how we can retrieve and view the report?

Thank you

Kind regards

Michael Hartley

[redacted]

Stantec

From: FR Planning
Sent: 04 December 2019 15:21
To: Hartley, Michael
Subject: RE: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Good Afternoon Michael,

Thank you for your email, please find the response to your request for Flood Risk Information below.

Proposed Development: Boxworth End, Swavesey

Grid Reference: E536360 , N267350.

Surface water flood risk
For the viability of the site you will need to demonstrate that the surface water flood risk depth across this area is less than 300mm for all storm events up to the 100 year + 40% climate change. Due to the potential issues for the emergency services accessing the site in times of flood, it an alternative means of safe/dry access to the site would be expected in the proposal. This would have to be in line with the NPPF and supporting PPG (Planning Practice Guidance).

Surface water modelling
The LLFA holds no records of surface water modelling for watercourses, therefore cannot provide any comments.

Flood Risk Assessment and Flood Storage
To assist you further with comments on the scope of a Flood Risk Assessment, and flood storage compensation pre-application advice will be required. Please visit the surface water and sustainable drainage systems (SuDS) planning page mentioned above. The online submission and payment service can be found under the Pre-application heading. Please refer to the charging schedule before making the payments .

Historic Flooding
There is no records of historic flooding within the site area, however the historic map layer on GIS shows historic flooding to the north east of the village of Swavesey. It should be noted that this historic map layer represents a large area in and around the village of Swavesey, that has been impacted from historic flooding.

Approximately, 0.4km away at Boxworth End (south of the site area) there is a flooding report, this was recorded in 2013. It is strongly advised to contact the Anglian Water and Environment Agency as there may be local issues associated to their assets. To observe any faults or flooding issues from Highways, I would suggest visiting their faults page.

It should be noted that Webs Hole Sluice is an Environment Agency controlled gate, which shuts in times of high water flows for up to 14 days. This leads to water backing up through the village while the gate is shut, reducing the function of the drains in times of high flow. It has been picked up that additional volumes of water within this drain could potentially lead to wider spread flooding throughout the village of Swavesey. It would therefore be beneficial to include some telemetry and control on the outlet from the development to hold water on site during larger storm events, when Webs Hole Sluice shuts. This would safeguard against overloading the existing system in Swavesey and has recently been implemented on a number of other developments within the village. Any proposals that come forward should not increase the flood risk to the site or surrounding area.

Kind Regards,

Gabriella Yeomans

Flood Risk and Biodiversity Assistant
The Flood Risk and Biodiversity Team
Email:
Flood Risk and Biodiversity Team
Cambridgeshire County Council, Box No SH1315, Shire Hall, Cambridge, CB3 0AP

From: Hartley, Michael
Sent: 29 November 2019 16:03
To: FR Planning
Subject: Boxworth End, Swavesey Flood Risk and Drainage Enquiry

Dear Sir/Madam

Peter Brett Associates have been commissioned to provide flood risk and drainage input for the promotion of the site through the emerging Greater Cambridgeshire Local Plan. The objective is to secure allocation of the residential development (100 dwellings) in the Local Plan. Location Plan is attached.

Review of the online Magic website indicates there is an "ordinary" watercourse which borders the western site boundary (see attached jpg) . The "ordinary" watercourse appears to be a tributary of the Swavesey Drain located north of the site. There is an existing pond feature within the red line boundary, located within the western extent of the site.

Our initial assessment has identified the site to be located within Flood Zone 1: Low Probability of flooding from the rivers and sea as defined in the National Planning Policy Framework (NPPF) and accompanying Planning Practice Guidance (PPG).

A review of the online Risk of Flooding from Surface Water map (see attached jpg) however indicates that the site may be subject to surface water flooding, within the location which is currently being promoted for the proposed access route for the site.

We would be grateful if you could please provide comments on the following:

- Viability of the site with respect to surface water flood risk;
- Scope of a future Flood Risk Assessment;
- Level of surface water modelling required of the watercourse (if any?);
- If flood storage compensation is required?

In addition could you please confirm whether CCC have any records of previous flooding of the site.

If there is a charge for this information please let us know in the earliest instance so we can arrange the necessary payment.

Thank you

Kind regards,

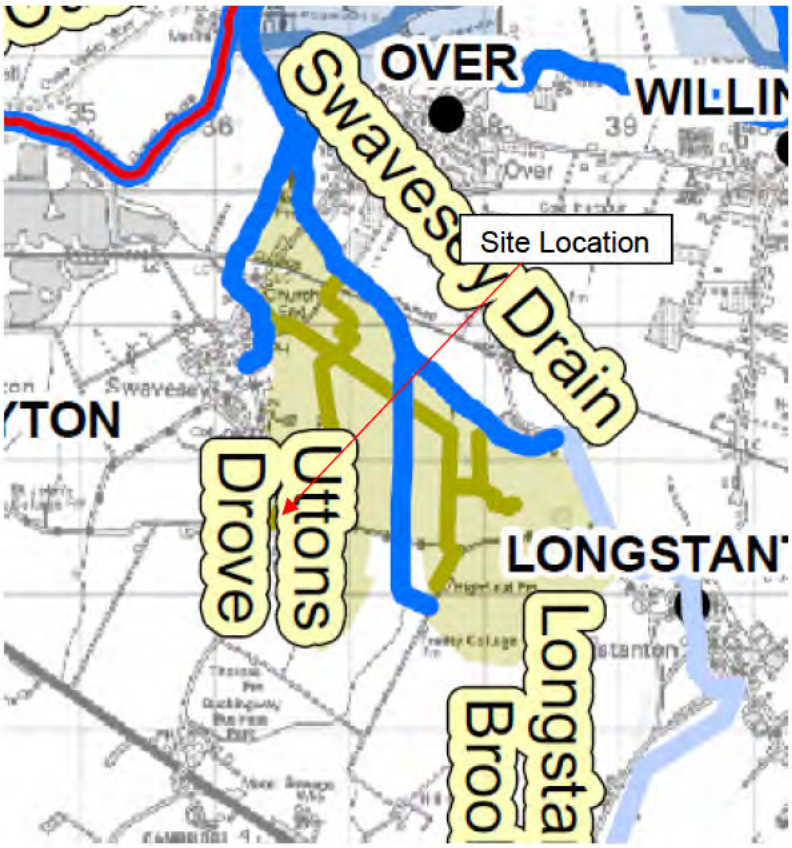
Michael Hartley
Assistant Engineer

[redacted]

Appendix H SFRA Extract

Extracts from South Cambridgeshire District Council and Cambridge City Council Strategic Flood Risk Asessment

Existing watercourses



KEY

South Cambridgeshire DC & Cambridge City Council Boundaries

EA Main River

Ordinary Watercourses

Old West Internal Drainage Board

Swaffam Internal Drainage Board

Waterbeach Level Internal Drainage Board

Beds and Ivel Internal Drainage Board

Swavesey Internal Drainage Board

Willingham and Over Internal Drainage Board

SCDC IDB areas

Bedfordshire & River Ivel IDB

Old West IDB

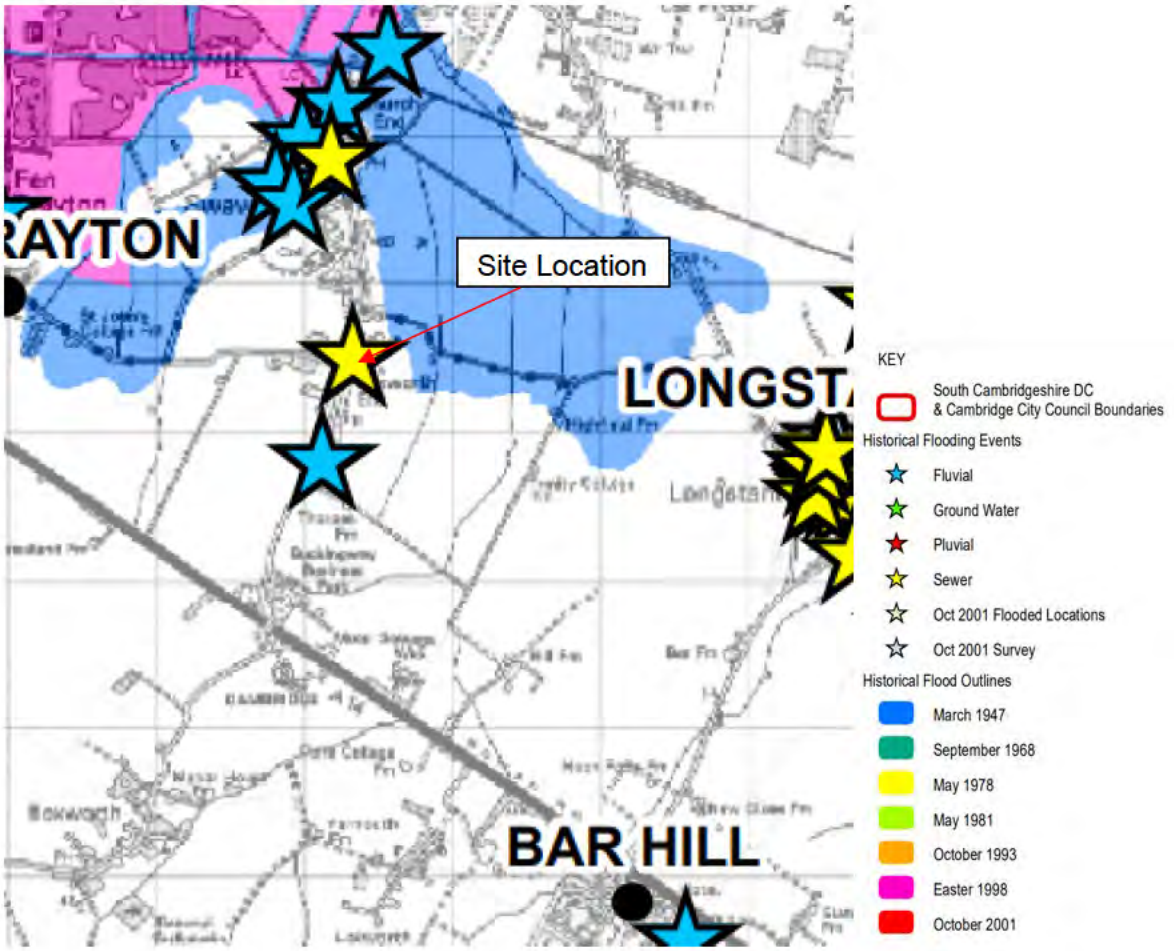
Swaffam IDB

Swavesey IDB

Waterbeach IDB

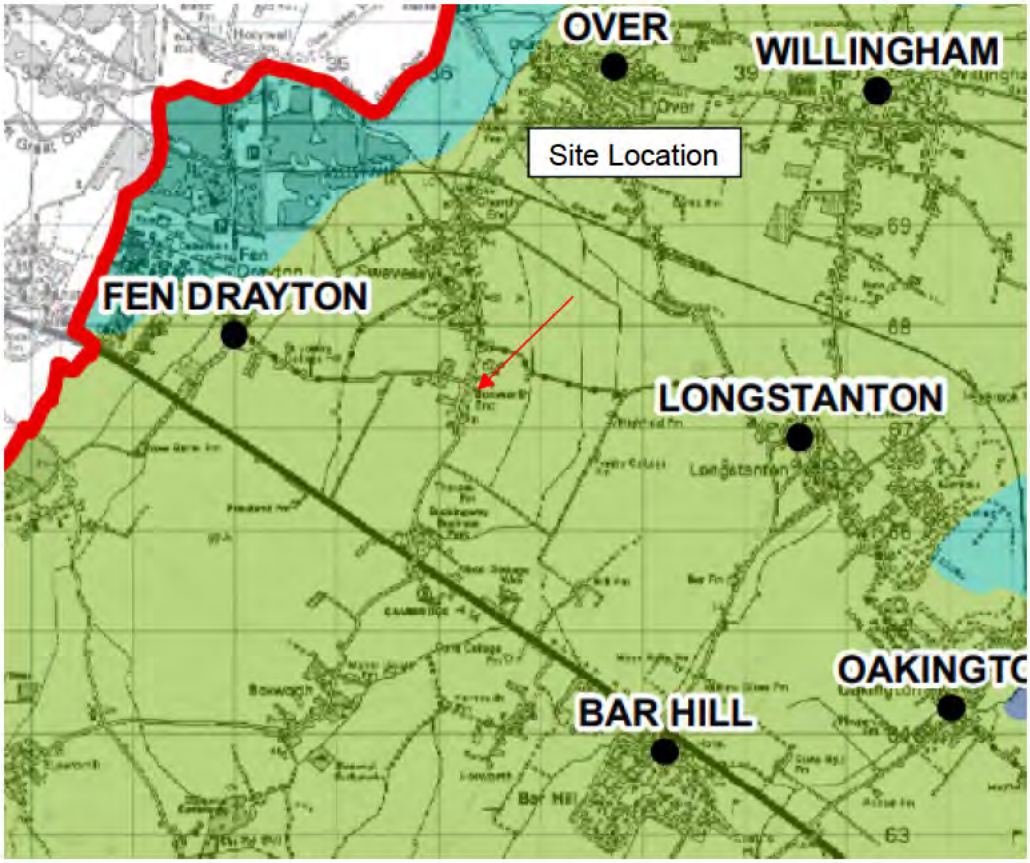
Willingham & Over IDB

Historical Flood Map



10/02/2009	Swavesey	Boxworth End	Local Ditches	Cambs Police

SuDS infiltration feasibility plan



KEY

South Cambridgeshire DC
& Cambridge City Council Boundaries

Low Potential for Infiltration

Uncertain Potential for Infiltration

High Potential for Infiltration

Appendix I Greenfield Calcs

Soils BFI Calculation

Telford House
Fulbourn
Cambridge
Cambridgeshire
CB21 5HB

Client	Axis Land Partnerships
Job Title	Boxworth End, Swavesey
Job No.	47801

Method (1): From Soil Association map:

Look up HOST classes for each Soil Association Type in Appendix B of H126

	Fraction of site area	SO L class	HOST classes	% in each HOST clas	BFI value
Soil Association 1	1	411c	20	23.08	0 524
			23	61.54	0 218
			25	15.38	0.17
					0
				Total =	0.2812424

	Fraction of site area	SO L class	HOST classes	% in each HOST clas	BFI value
Soil Association 2	0	0	0	0	0
			0	0	0
			0	0	0
			0	0	0
				Total =	0

	Fraction of site area	SO L class	HOST classes	% in each HOST clas	BFI value
Soil Association 3	0	0	0	0	0
			0	0	0
			0	0	0
			0	0	0
				Total =	0

Total = 1 *Must add to one*

BFI = **0.28**

DOCUMENT ISSUE RECORD

Calculation Ref	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
47801/4001/001	-	19.12.19	MJH	FVA		

FEH Greenfield Runoff
Per Hectare

Using 2008 QMED Equation

Stantec

Project Title	Boxworth End, Swavesey
Project No	47801

Me hodology as set out in SuDS Manual 24.3.2 — SUDS Manual Chapter 24

1 Retrieve FEH Catchment Information

Export catchment data from FEH CDROM as .csv file and save in FEH data export

Catchment Descriptors	**BFIHOST**	0.280		*see note 1*
	SAAR	538.0		*see note 1*
	FARL	1.0		*see note 2*

2 Derive QBAR (mean annual flood)

Define area	**Site Area**	1.0	ha	
	Applied Area	50.0	ha	*see note 3*
FEH Index Flood (SuDS Manual Equation 24 2)	**QMED (Q_2)**	2.2	l/s	*see note 4*
Calculate QBAR by dividing QMED by 2yr growth factor	**QBAR**	2.5	l/s	*see note 5*

3 Select appropriate growth factors

FSR Hydrological Region		5
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

(refer to FSR Hydrological Region tab)

4 Derive Flood Frequency

Greenfield Runoff per 1ha

100yr Peak Runoff Rate	Q_{100}	8.9	l/s	Q_{100}	8.9	l/s/ha
30yr Peak Runoff Rate	Q_{30}	6.4	l/s	Q_{30}	6.4	l/s/ha
10yr Growth Curve Factor	Q_{10}	4.1	l/s	Q_{10}	4.1	l/s/ha
QBAR Peak Runoff Rate	QBAR	2.5	l/s	Q_{BAR}	2.5	l/s/ha
2yr Peak Runoff Rate	Q_2	2.2	l/s	Q_2	2.2	l/s/ha
1yr Peak Runoff Rate	Q_1	2.2	l/s	Q_1	2.2	l/s/ha

Location of FEH Data (as Hyperlink)

DOCUMENT ISSUE RECORD

Rev	Comments	Prepared	Date	Checked	Date
	All checked	MH	19.12.19	FVA	19.12.2019

Sheet created by Alex Bearne

Last updated 03.01.18 Recommended Review 01.07.18

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 the owner.

Note 1 FEH Web version 3 allows extraction of BFIHOST and SAAR values for each square kilometre grid If you do not think the BFIHOST value is representative of your site then it is possible to derive it manually. This should only very occasionally be necessary. BFI can be derived manually using the the methodology set out in the Flood Estimation Handbook (see *Manual Derivation of BFIHOST tab).*

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

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

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.

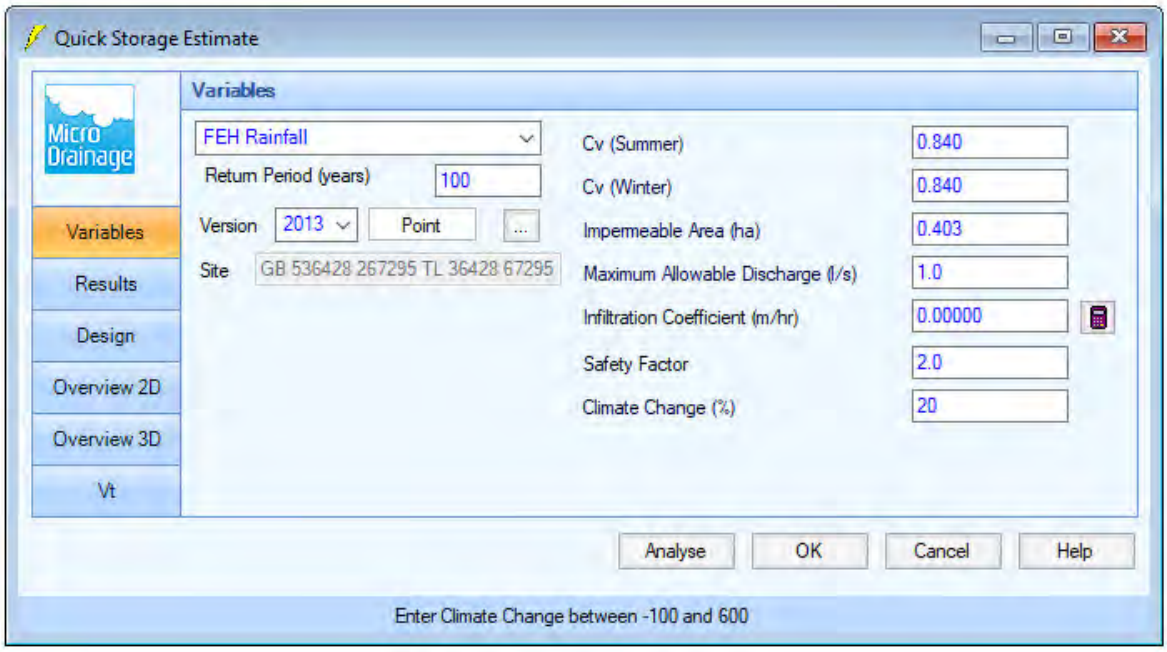
Checked by Natasha Vaughan, Clare Waller, David Collis

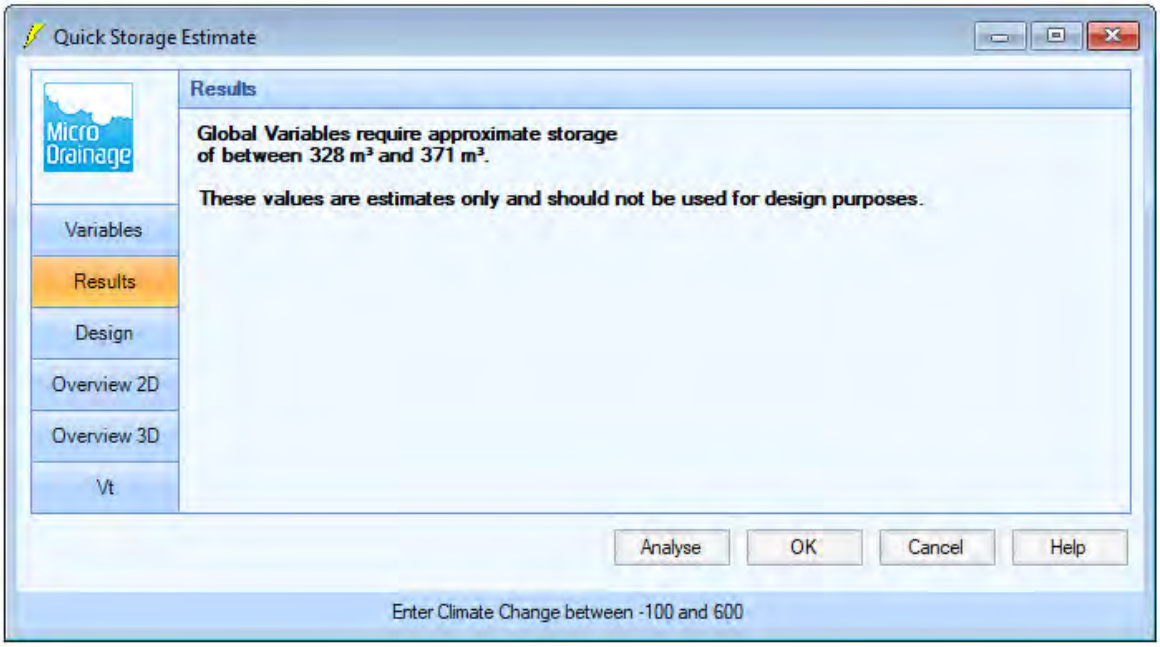
Appendix J Quick Storage Calcs

Quick Storage Calculations

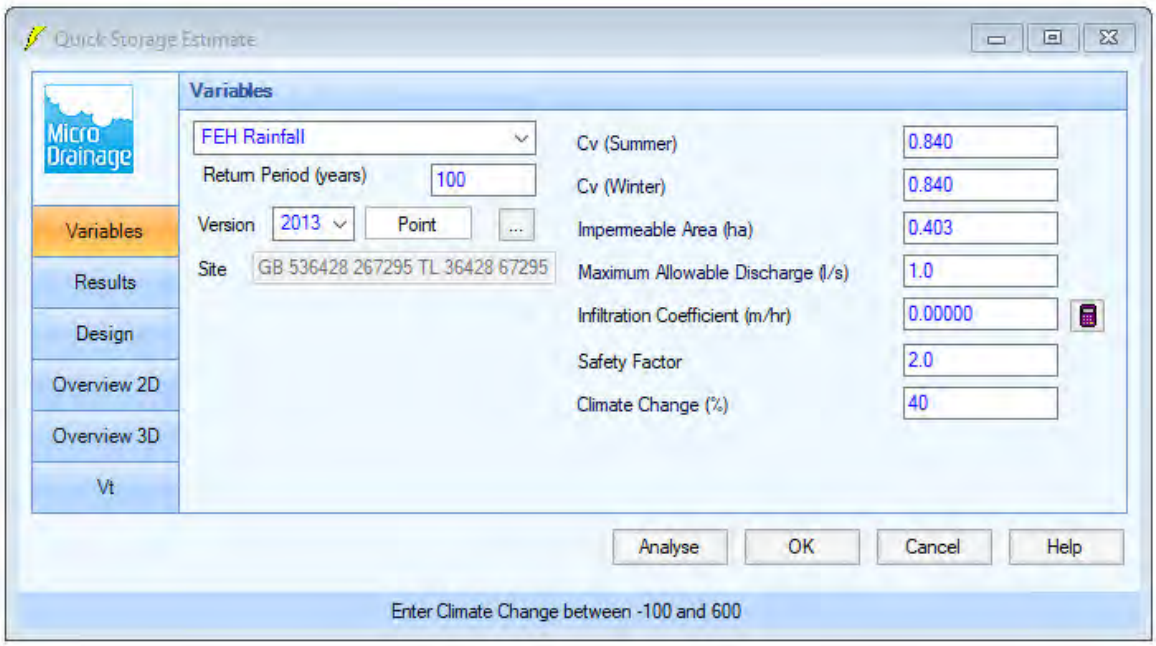
Southern Parcel

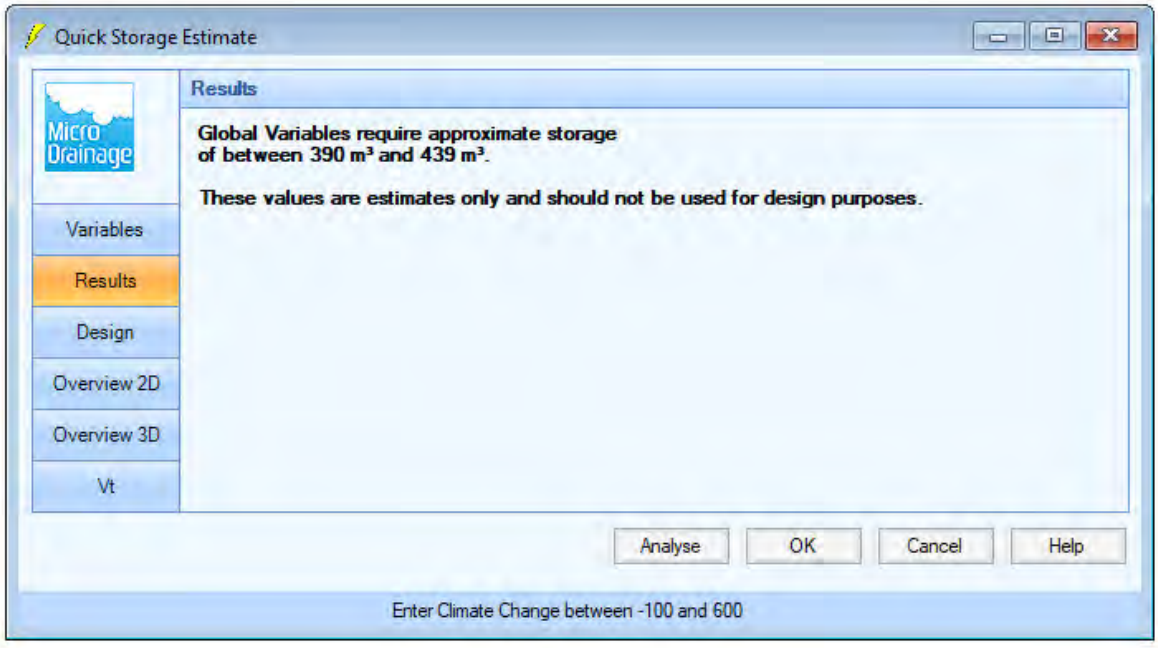
1% AEP + 20% CC





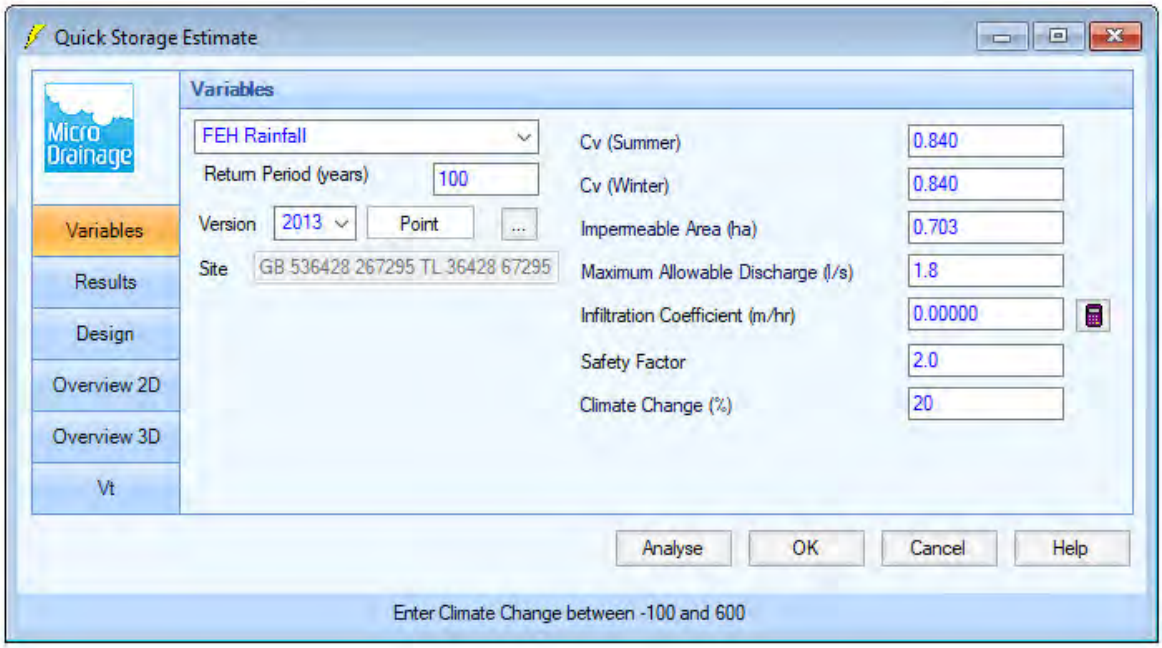
1% AEP + 40% CC

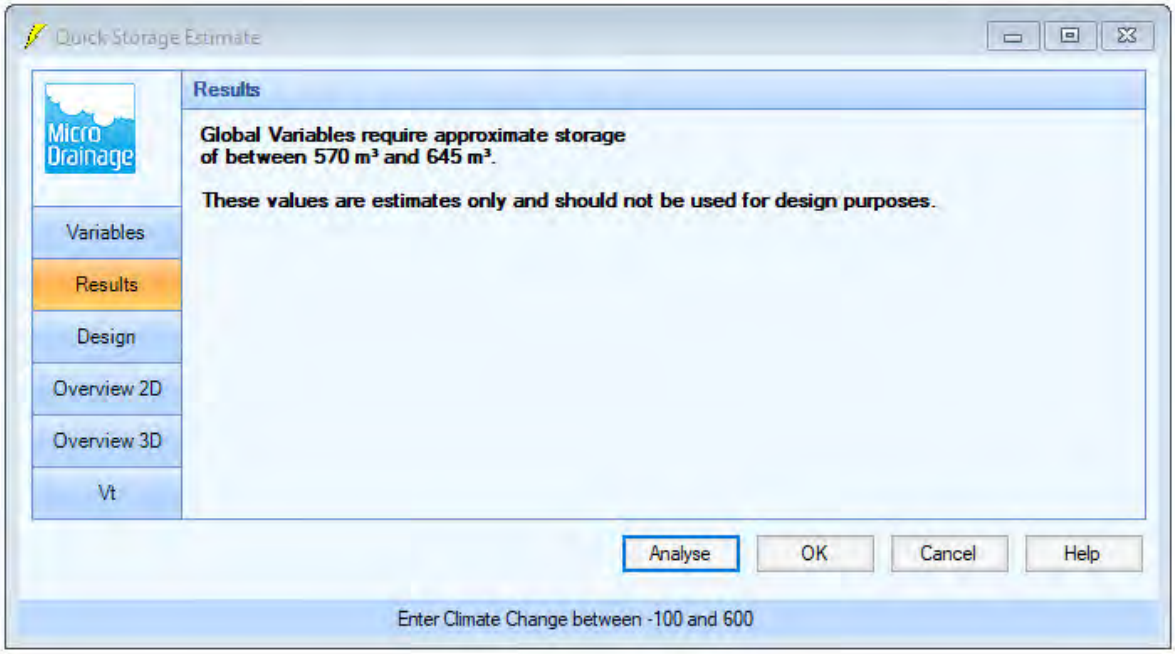

Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 100
Version 2013
Point
Site GB 536428 267295 TL 36428 67295
Cv (Summer) 0.840
Cv (Winter) 0.840
Impermeable Area (ha) 0.403
Maximum Allowable Discharge (l/s) 1.0
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 40
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage of between 390 m³ and 439 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600

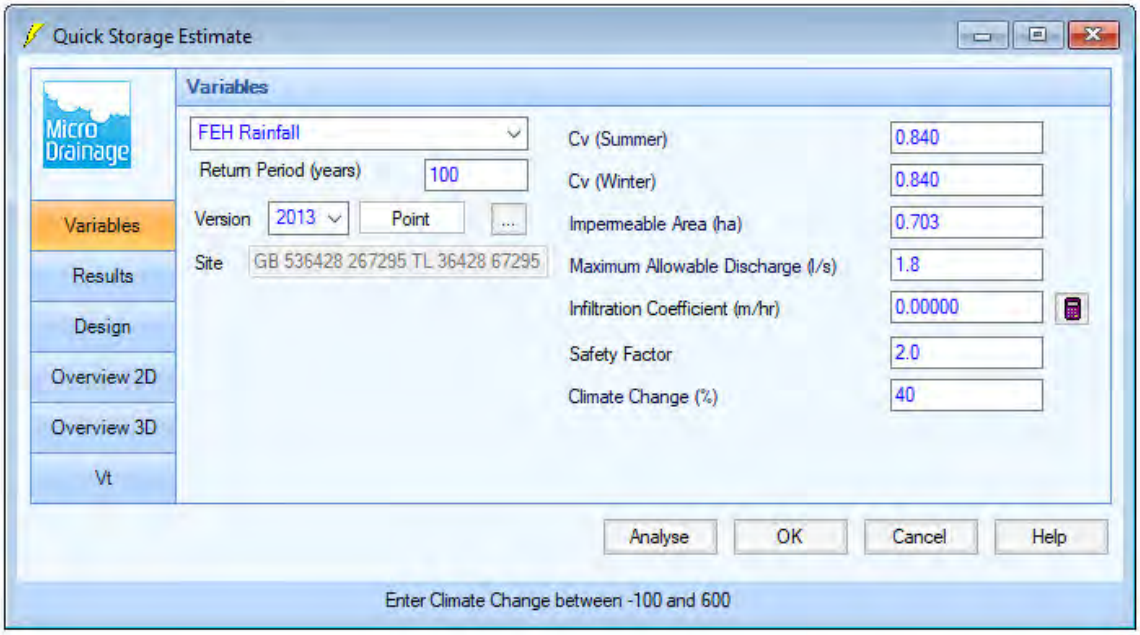
Northern Parcel

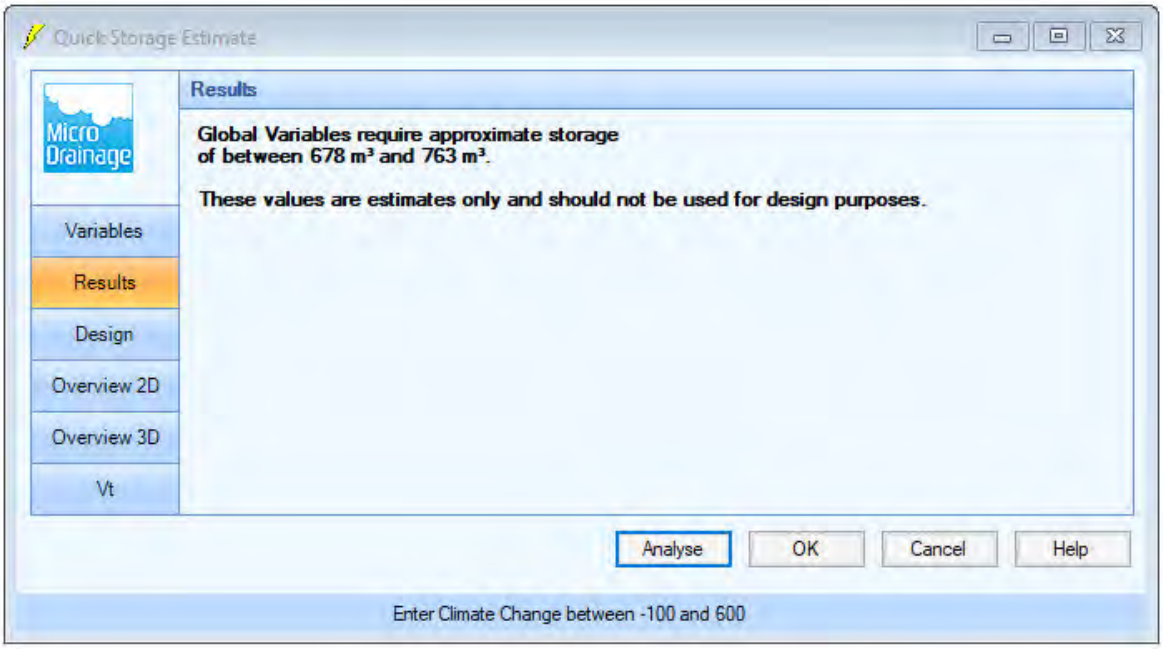
1% AEP+20% CC





1% AEP+40% CC


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 100
Version 2013 Point ...
Site GB 536428 267295 TL 36428 67295
Cv (Summer) 0.840
Cv (Winter) 0.840
Impermeable Area (ha) 0.703
Maximum Allowable Discharge (l/s) 1.8
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 40
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage of between 678 m³ and 763 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600

Appendix K Outline Proposed Drainage Strategy

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM NEWLYN UNLESS NOTED OTHERWISE.
3. ALL COORDINATES ARE IN METRES RELATIVE TO ORDNANCE SURVEY NATIONAL GRID.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS AND ARCHITECTS DRAWINGS AND SPECIFICATIONS.
5. ATTENUATION REQUIREMENTS HAVE BEEN BASED ON A DISCHARGE RATE OF 2.5l/s/ha.
6. IT HAS BEEN ASSUMED THE DEVELOPMENT HAS A 55% IMPERMEABLE AREA INCLUDING URBAN CREEP.
7. UPSTREAM SuDS WILL NEED TO BE PROVIDED IN ACCORDANCE WITH GUIDANCE.
8. ATTENUATION REQUIREMENTS HAVE BEEN CALCULATED USING QUICK STORAGE ESTIMATES WITHIN THE MICRODRAINAGE SOFTWARE.
9. SIZING OF THE ATTENUATION BASINS DO NOT ASSUME A SURCHARGED OUTFALL.

LEGEND

- LAND OWNERSHIP BOUNDARY
- EXISTING WATERCOURSE AND DIRECTION OF FLOW
- EXISTING WATERCOURSE CULVERT
- EXISTING POND
- PROPOSED ATTENUATION BASIN
- PROPOSED OUTFALL TO EXISTING WATERCOURSE
- PROPOSED CULVERT
- PROPOSED DRAINAGE PATH - CATCHMENT 1
- PROPOSED DRAINAGE PATH - CATCHMENT 2
- 9.5m EXISTING CONTOUR LEVEL (mAOD)

Mark	Revision	Date	Drawn	Chkd	Appd
P1	MASTERPLAN UPDATE	13.02.20	MH	SK	

SCALING NOTE: Do not scale this drawing - any errors or omissions shall be reported to Stantec without delay.

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 their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status

PRELIMINARY

BOXWORTH END, SWAVESEY

OUTLINE PROPOSED SURFACE WATER DRAINAGE PLAN

Client

AXIS LAND PARTNERSHIPS

Date of 1st Issue	Designed	Drawn
05.02.2020	MH	TH
A1 Scale	**Checked**	**Approved**
1:500	ACS	-

Drawing Number: 47801/2001/2602

Revision: P1

Stantec

stantec.com/uk

CAMBRIDGE
Tel: [redacted]