Borough Council of King's Lynn and West Norfolk

WEST WINCH GROWTH AREA

PRELIMINARY FLOOD RISK ASSESSMENT AND SURFACE WATER AND DRAINAGE STRATEGY

70071439-FRA
APRIL 2023

PUBLIC

Borough Council of King's Lynn and West Norfolk

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REPORT (FIRST ISSUE) PUBLIC

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DATE: APRIL 2023

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PRELIMINARY FLOOD RISK ASSESSMENT AND SURFACE WATER AND DRAINAGE STRATEGY

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1 INTRODUCTION

1.1.1 WSP has been commissioned by Borough Council of King's Lynn and West Norfolk to prepare a Preliminary Flood Risk Assessment (FRA) and Surface Water Drainage Strategy to inform the Local Plan examination[1] regarding the deliverability and deliverability timeframe/trajectory for the West Winch Growth Area (hereby referred to as the 'Proposed Development').

1.1.2 The Proposed Development is located on greenfield land to the South of King's Lynn (the 'Site') with a total area of approximately 198.11 ha. The Ordnance Survey Grid Reference for the Site is TF 63715 16285 and the nearest postcode is PE33 0NR.

1.1.3 This document has been prepared to provide a preliminary assessment of the risk of flooding posed to the Site by all potential sources and to determine the key principles for draining the Proposed Development in a sustainable manner commensurate with national and local policy.

1.1.4 The aim of this FRA is to identify if an extra 2,390 homes can be sustainably added to the West Winch Growth Area , taking the total number of proposed homes up to 4,000.

1.1.5 Previous planning applications (Ref: 13/0615/OM and Ref: 18/02289/OM) proposed up to 1,110 homes and 500 homes at the Site respectively. This report will assess the potential addition of 2,390 homes within the West Winch Growth Area in support of its allocation within the Local Plan.

[1] Borough Council of King's Lynn & West Norfolk (2022) *Local Plan Review Pre-Submission Stage 2021*; accessed April 2023 from https://www.west-norfolk.gov.uk/info/951/local_plan_review_2016-2036_examination/986/local_plan_review_pre-submission_stage_2021

2 EXISTING SITE

2.1 SITE DESCRIPTION

2.1.1 The Site is located on greenfield land to the south of King's Lynn with a total site area of 198.11 ha. A site location plan can be found in Figure 2-1 below, as well as Appendix A.

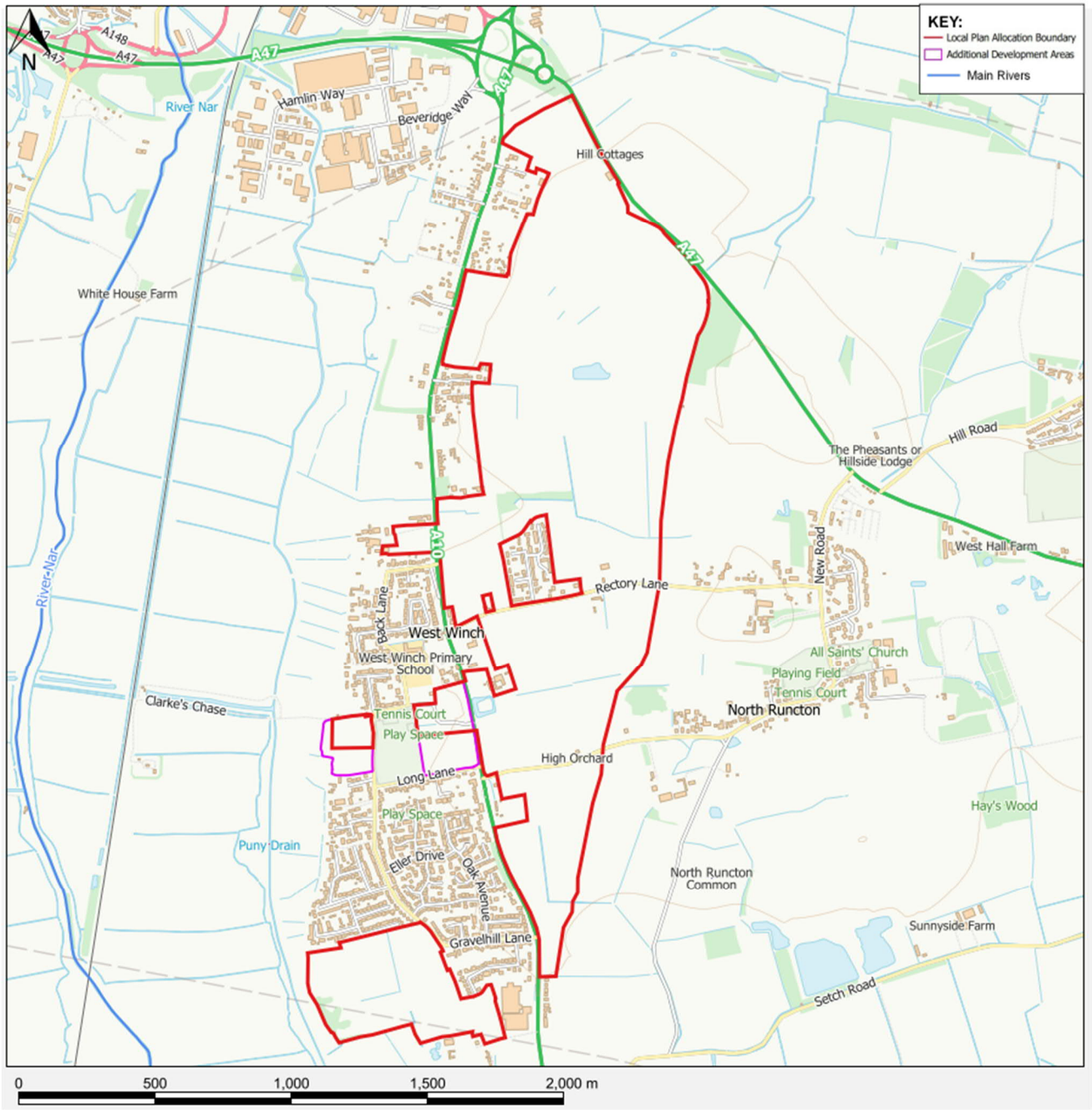


Figure 2-1 - Location Plan

2.1.2 The Site is bound by King's Lynn and the Hardwick Roundabout to the north, North Runcton to the east, Setchey to the south, and West Winch to the west. The A10 West Winch Road travels through parts of the west of the Site.

2.2 EXISTING TOPOGRAPHY

2.2.1 The existing topography at the Site has been reviewed using publicly available Light Detection and Ranging (LiDAR) data. The Site is shown to generally fall from east to west, with a highest ground level of approximately 20.57 m Above Ordnance Datum (AOD) in the east of the Site, and a lowest ground level of approximately 1.55 m AOD in the south-west of the Site. The existing ground levels at the Site are shown in Appendix A

2.2.2 A catchment delineation exercise has been undertaken using Global Mapper[2] to determine the existing topographic catchments at the Site. The Site is shown to consist of approximately 9 topographic catchments which currently drain runoff generated by the Site to a combination of existing surface waterbodies at the greenfield runoff rates detailed in Section 7.1. The existing catchments are shown in Appendix A.

2.3 GEOLOGY AND HYDROGEOLOGY

2.3.1 The British Geological Survey's 1:50,000 Onshore Digital Mapping[3], reproduced in Appendix A.3 for reference, shows the bedrock geology at the Site to consist of a combination of the Leziate Member (Sand) in the east part of the Site, the Mintlyn member (Sand) in the central part of the Site, the Roxham Member and Runcton Member (Sand) in the central-west part of the Site, and the Kimmeridge Clay Formation (Mudstone) in the west part of the Site.

2.3.2 The bedrock is shown to be overlain predominately by superficial deposits of Lowestoft Formation (Diamicton) through the centre of the Site, with the Raised Beach Deposits (Gravel) and Head (Clay, Silt, Sand and Gravel) shown to be present in the west part of the Site, and Tottenhill Gravel Member found in the north of the Site.

2.3.3 DEFRA's Magic Mapping[4] shows no part of the Site lies within a source protection zone. Records associated with 24 historic boreholes within the site boundary, predominately in the northern part of the Site, have been reviewed. Mapping of this can be found in Appendix A.4. Drilling ranged from 0-10m below ground level (bgl) in the north of the Site, and 10-30m bgl in the central and southern part of the Site. The maximum recorded groundwater depth was 8ft bgl (2.4m bgl), however these logs are from 1972 and are unlikely to be representative of current groundwater levels at the Site.

2.4 EXISTING WATERBODIES

2.4.1 The existing waterbodies at, and in the vicinity of, the Site are shown in Figure 2-1 and on the Existing Watercourses plan in Appendix A.

[2] Blue Marble Geographics (2023) *Global Mapper v20.0.0*
[3] British Geological Survey (2023) *GeoIndex Onshore*; accessed April 2023 from http://mapapps2.bgs.ac.uk/geoindex/home.html
[4] DEFRA (2021) *MAGiC map*; accessed April 2023 from https://magic.defra.gov.uk/MagicMap.aspx

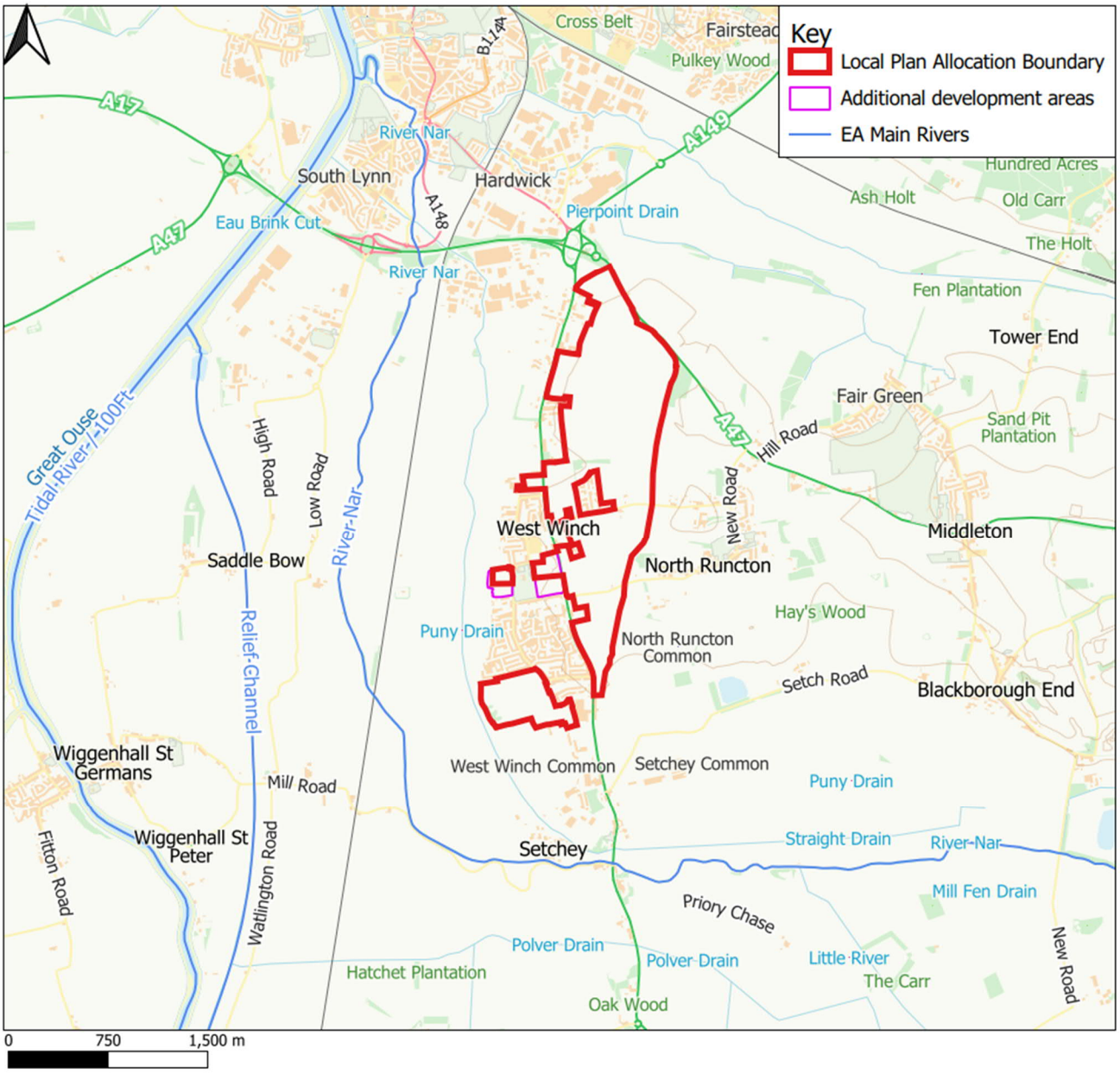


Figure 2-2 – Existing Watercourses

2.4.2 The Puny Drain lies approximately 50m to the west of the Site at its closest point, and approximately 751m at its largest distance. The Pierpoint Drain lies approximately 275m north of the Site.

2.4.3 There are two Environment Agency designated Main Rivers in the vicinity of the Site. The River Nar lies to the west of the Site and runs parallel to the western boundary flowing south to north, at a minimum distance of 0.75km, and a maximum distance of 1.72km from the Site. The River Great Ouse and Great Ouse Relief Channel lie further west of the River Nar and flows from south to north prior to discharge into The Wash.

2.4.4 A tributary west of the Site (Puny Drain Relief Channel) which is pumped, connects the Puny Drain into the Great Ouse Relief Channel through a syphoned system under the River Nar and the railway.

2.4.5 There are several additional existing drainage ditches within the Site which, from a review of LiDAR data, are understood to drain to the Puny Drain. The presence and condition of these waterbodies is to be confirmed by a site-specific topographic survey to inform the ongoing development of the conceptual surface water drainage strategy presented in Chapter 7 of this report.

2.5 EXISTING FLOOD DEFENCES

2.5.1 The Environment Agency's Flood Map for Planning[5], which is reproduced in Appendix A.4 for reference, does not show the Site to benefit from the presence of any formal flood defences.

2.6 EXISTING SEWERS AND DRAINAGE INFRASTRUCTURE

2.6.1 Utility information received shows no existing Anglian Water surface water sewer infrastructure. The nearest surface water sewers are located within the existing residential developments to the west of the Site.

2.6.2 A foul sewer crosses west to east through the central part of the Site.

[5] Environment Agency (2023) *Flood Map for Planning*; accessed February 2023 from https://flood-map-for-planning.service.gov.uk/

3 CONSULTATION, POLICY, AND GUIDANCE

3.1 FLOOD RISK POLICY

3.1.1 NATIONAL PLANNING POLICY FRAMEWORK

3.1.2 The National Planning Policy Framework[6] (NPPF) requires a Flood Risk Assessment (FRA) to be undertaken for all proposed developments within Flood Zones 2 and 3 along with those in Flood Zone 1 with an area greater than 1 ha. Consequently, an FRA would be required to be provided in support of any future planning applications for the Proposed Development and would need to '*demonstrate that the proposed development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall*'.

3.1.3 The NPPF also requires development to be allocated to sites at lowest risk of flooding from any source through the application of the Sequential Test and, depending on the results of the Sequential Test, development proposals may also need to satisfy the requirements of the Exception Test.

3.1.4 BOROUGH COUNCIL OF KING'S LYNN & WEST NORFOLK LOCAL PLAN (2016)

3.1.5 The Borough Council of King's Lynn & West Norfolk Local Plan[7] that was adopted in 2016 will guide development until March 2026 has been reviewed as part of this assessment. The following policies are considered relevant to the Site and the Proposed Development from the perspective of flood risk and drainage.

3.1.5.1 Policy E.2.6 – Strategic Context

- Policy CS09 of the Core Strategy, 'Housing Distribution', provides for an allocation in this general area of at least 1,600 new homes, with supporting infrastructure. It also identifies this as establishing a direction for future growth beyond the plan period (i.e. beyond 2026). (Work by the Prince's Foundation for the Built Environment (sponsored by a major landowner and undertaken with the active involvement of local people), together with sites and information put forward, suggests that a total of 3,000 to 3,500 additional dwellings could potentially be accommodated in the fullness of time.

3.1.5.2 Policy E2.1 – West Winch Growth Area Strategic Policy

- Incorporation of Sustainable Drainage Systems to address surface water run-off, flood risk, biodiversity and the avoidance of groundwater pollution.
- Submission of a site-specific Flood Risk Assessment.

3.1.5.3 Policy E.2.73 – Sustainable Urban Drainage Systems

- The development should incorporate SUDS to reduce any increases in surface water drainage. Public and private areas of hard-standing should be permeable wherever possible. SUDS may

[6] Ministry of Housing, Communities and Local Government (2023) *The National Planning Policy Framework*
[7] Borough Council of King's Lynn & West Norfolk (2016) *Local Plan – Site Allocations & Development Management Policies Plan*; accessed April 2023 https://www.west-norfolk.gov.uk/info/20220/site_allocations_and_development_management_policies_plan/514/adopted_plan

be combined with a system to help regulate water flows from roofs to the drainage system and grey water recycling. Installation of green roofs, where soil and plant material are attached to create a living surface, can also reduce water run-off as well as providing insulation and creating a habitat for wildlife.

3.2 CLIMATE CHANGE

3.2.1 The Environment Agency's climate change allowances[8], updated on 27 May 2022, provide the basis for assessing the potential impacts of climate change on flood risk posed to the Proposed Development.

3.2.2 The increase in peak river flows projected for the 2080s for the North West Norfolk Management Catchment in which the Site is shown to be located are given in Table 3-1 below. These allowances will need to be applied to any future assessment of the fluvial flood risk posed to the Site.

Table 3-1 – Climate Change Allowances: Peak River Flow

Allowance Category	Total potential change anticipated for the "2080s"
Upper end	57%
Higher central	33%
Central	23%

3.2.3 The increase in peak rainfall intensity projected for the North West Norfolk Management Catchment for a storm event with a 3.33% annual probability and 1% annual probability are shown in tables 3-2 and 3-3 below.

3.2.4 These allowances will need to be applied when developing the surface water drainage strategy for the Proposed Development.

Table 3-2 – Climate Change Allowances: Peak Rainfall Intensity 3.3% AEP event

Allowance Category	Total potential change anticipated for the "2070s" (lifetime up to 2125)
Upper end	35%
Central	20%

[8] Environment Agency (2023) *Flood risk assessments: climate change allowances*; accessed April 2023 from https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Table 3-3 – Climate Change Allowances: Peak Rainfall Intensity 1% AEP event

Allowance Category	Total potential change anticipated for the "2070s" (lifetime up to 2125)
Upper end	40%
Central	25%

3.2.5 For development with a lifespan extending beyond 2100, the development should be designed so that for the upper end allowance in the 1% Annual Exceedance Probability (AEP) event:

- There is no increase in flood risk elsewhere.
- Development will be safe from surface water flooding.

3.3 GUIDANCE

3.3.1 NON-STATUTORY SUSTAINABLE DRAINAGE TECHNICAL STANDARDS

3.3.2 The Non-statutory Technical Standards for Sustainable Drainage Systems[9] provides national best-practice guidance on the requirements for SuDS.

3.3.3 For greenfield developments, the peak runoff rate from the Proposed Development to any highway drain, sewer or surface waterbody should never exceed the peak greenfield runoff rate for the same event.

3.3.4 For greenfield developments, where reasonably practicable, the runoff volume from the Proposed Development to any highway drain, sewer or surface waterbody should also not exceed the greenfield runoff volume for an event that has a 1% chance of occurring in any given year. If this is not practical, the runoff volume must be discharged at a rate that does not increase flood risk.

3.3.5 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 3.33% annual probability rainfall event, and flooding does not occur during a 1% annual probability rainfall event in any part of a building or utility plant susceptible to water. The design must ensure, that where reasonably practicable, flows resulting from rainfall in excess of a 1% annual probability rainfall event are managed in exceedance routes that minimise risks to people and property.

3.3.6 Components must be designed to ensure structural integrity of the drainage system, and any adjacent structures over the design lifetime of the Proposed Development and the materials which are specified by the design must be of a suitable nature for their intended use.

[9] Defra (2015) *Non-statutory standards for sustainable drainage systems*; obtained April 2023 from https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

3.3.7 Pumping should only be used to facilitate drainage for those parts of the Site where it is not reasonably practicable to drain water by gravity.

3.3.8 The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the system. Any drainage which does occur must be minimised and restricted before the drainage system is classified as complete.

4 STAKEHOLDER CONSULTATION

4.1.1 The Environment Agency, Norfolk County Council (in its role as Leal Local Flood Authority [LLFA]) and Anglian Water have been consulted as part of this study to obtain historic flood records along with any flood risk and drainage information pertinent to the proposed redevelopment of the Site. A summary of the responses received to date are provided in Table 4-1- Stakeholder Consultation Summary below with full copies of the correspondence provided in Appendix B.

Table 4-1- Stakeholder Consultation Summary

Stakeholder	Response
The Environment Agency	The Environment Agency have been consulted on 3rd April 2023 and a response is currently awaited.
Norfolk County Council LLFA	A meeting was held between WSP and the LLFA on 20th April 2023 to discuss the principles of flood risk and surface water management at the Site from which the following key points arose: ▪ Offsite watercourse connectivity should be reviewed using publicly available mapping and confirmed through a site-specific topographic survey as the project progresses. ▪ Existing surface water flow-paths which are shown to be generated off-site should be incorporated as blue/green corridors in the emerging masterplan, with no dwellings proposed within the peak flood extents given for the 0.1% annual probability event. ▪ A variable of '1' should be used for the CV summer and winter variables in the storage estimations to reflect an upcoming policy change. ▪ The LLFA are keen for each catchment to be able to drain independently and not be reliant on any other catchments. ▪ Clarification was made over consideration of the two previous planning applications. WSP will look at the Site as a whole with the previous applications to be used to provide a more detailed look at specific areas of the Site.
Anglian Water	Anglian Water confirmed that it holds no records of historic flood events at the Site which can be attributed to capacity limitations in the public sewerage system.
East of the Ouse, Polver & Nar Internal Drainage Board (IDB)	The IDB confirms that the Site is outside of the East of the Ouse, Polver and Nar IDB, but part of the Site indirectly drains to it via. the existing drainage ditches shown to be present within the Site. The IDB requested that indirect discharges to the Puny Drain should be limited to 1.1 l/s/ha to reflect the capacity of the Puny Pumping Station.

5 PROPOSED DEVELOPOMENT

5.1 DESCRIPTION

5.1.1 The Proposed Development is described in the adopted West Winch Growth Area Framework Masterplan Supplementary Planning Document (SPD)[10], an extract of which is provided in Appendix C, and is shown to consist of the provision of 4,000 residential dwellings alongside two new primary schools, multiple community centres, a sports centre, a health centre, recreational land-uses and green infrastructure (including allotments and habitat creation).

5.2 VULNERABILITY CLASSIFICATION

5.2.1 Table 2 of the NPPF Flood Risk and Coastal Change Planning Practice Guidance[11] (PPG) classifies the proposed residential, educational land-uses as 'More Vulnerable' with respect to flood risk. The proposed local centres would be classified as 'Less Vulnerable' whilst the proposed amenity open space, outdoor sports and recreational land-uses would be classified as 'Water-Compatible'.

5.3 SEQUENTIAL AND EXCEPTION TESTS

5.3.1 The purpose of the Sequential Test is to ensure that land use planning takes due regard of flood risk, to ensure that areas at low or no risk of flooding are developed in preference to areas at higher risk.

5.3.2 The NPPF Sequential Test aims to steer development, if possible, towards areas at the lowest risk of flooding, avoiding development within Flood Zones 2 and 3.

5.3.3 Table 3 of the NPPF Flood Risk and Coastal Change PPG, reproduced in Table 5-1 - Flood Risk Vulnerability and Flood Zone Incompatibility below, identifies the different land use vulnerabilities that are appropriate within each Flood Zone.

5.3.4 The Site was allocated within the adopted Local Plan and is therefore considered to have passed the Sequential Test. The sequential approach should be adopted in developing detailed proposals for development at the Site to locate the most vulnerable land-uses within the Proposed Development in areas of lowest flood risk. Any development proposed within Flood Zone 3a that would be classified as 'more vulnerable' with respect to flood risk would be required to pass the Exception Test.

[10] Borough Council of King's Lynn & West Norfolk (2023) *Supplementary Planning Document - West Winch Growth Area Framework Masterplan; obtained April 2023 from* https://www.west-norfolk.gov.uk/info/359/west_winch_strategic_growth_area/973/south_east_king_s_lynn_growth_area_framework_masterplan

[11] Ministry of Housing, Communities and Local Government (2022) *Flood Risk and Coastal Change Planning Practice Guidance*

Table 5-1 - Flood Risk Vulnerability and Flood Zone Incompatibility

Flood Risk Vulnerability Classification	Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
More Vulnerable	Development is appropriate	Development is appropriate	Exception Test Required	Development should not be permitted
Less Vulnerable	Development is appropriate	Development is appropriate	Development is appropriate	Development should not be permitted
Water-Compatible	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate

6 OVERVIEW OF FLOOD RISK

6.1 INTRODUCTION

6.1.1 The following section provides an overview of flood risk to the Site. An initial assessment has been undertaken for each source that could affect the Proposed Development in accordance with the requirements of the NPPF and the associated Flood Risk and Coastal Change PPG. The results of this assessment are summarised in Table 6-1 – Flood Risk Summary below.

Table 6-1 – Flood Risk Summary

Source of Flooding	Baseline Risk	Comments
Tidal	Very Low	No mitigation measures are likely to be required to manage the risk of flooding posed from this source.
Fluvial	Very Low – High	Further consultation with the Environment Agency and the LLFA should be undertaken to determine the potential requirement for detailed hydraulic modelling and hydrological assessments to confirm the baseline risk of fluvial flooding posed to the Site. The sequential approach should be adopted throughout the masterplanning process to locate the most vulnerable land-uses within the Proposed Development in areas of lowest flood risk.
Pluvial	Very Low – High	The surface water drainage strategy for the Proposed Development should be designed to manage all storm events up to the 1% annual probability event including the central allowance for climate change. Checks should be undertaken to ensure that any flooding during a 1% annual probability event including the upper end allowance are contained within the Proposed Development and do not present a risk to people or property. The connectivity of the existing ditch network off-site, which includes sections of culverted watercourse, should be determined to inform any future planning application for the Proposed Development. Finished ground and floor levels should be designed to minimise the impact on people and property during storm events in excess of the design storm event. Existing surface water flow-paths identified on the Environment Agency's Risk of Flooding from Surface Water mapping to be incorporated into the layout of the Proposed Development as appropriate.
Groundwater	Low	No mitigation measures are likely to be required to manage the risk of flooding posed from this source.
Sewers and Drainage Infrastructure	Low	No mitigation measures are likely to be required to manage the risk of flooding posed from this source as there are no surface water sewers crossing the Site.

		An assessment should still be undertaken to assess the existing topography in the vicinity of the existing public sewer network to determine the risk of flooding posed from this source in sufficient detail to inform any future planning applications for the Proposed Development.
Artificial Sources	Very Low	No mitigation measures are likely to be required to manage the risk of flooding posed from this source.

6.2 FLOODING FROM COASTAL / TIDAL SOURCES

6.2.1 The Environment Agency's Flood Map for Planning, reproduced in Appendix A shows the Site to predominantly lie within Flood Zone 1 with the closest estuary, the River Great Ouse which feeds into The Wash, located approximately 1.7 km west of the Site. Consequently, the current risk of tidal flooding to the Site is considered to be very low.

6.3 FLOODING FROM FLUVIAL SOURCES

6.3.1 The Environment Agency Flood Map for Planning shows the majority of the Site to lie in Flood Zone 1. Flood Zone 1 is defined as land assessed as being subject to a low risk of flooding from Main Rivers with an annual probability of flooding of less than 0.1%.

6.3.2 A small area in the south-western part of the Site is shown to lie within Flood Zone 2 and Flood Zone 3. Flood Zone 2 is defined as land subject to a medium risk of flooding from Main Rivers with an annual probability of between 1% and 0.1% whilst Flood Zone 3 is defined as land subject to a high risk of flooding with an annual probability of greater than 1%. The area of the Site shown to lie partly within Flood Zone 2 and Flood Zone 3 is located in the south of the Site.

6.3.3 Further consultation with the Environment Agency and the LLFA should be undertaken to determine the scope of the FRA which will be required to accompany any future planning applications for the Proposed Development, including the potential requirement to undertake detailed hydraulic modelling and hydrological assessments to confirm the baseline risk of fluvial flooding posed to the Site.

6.3.4 The sequential approach should be adopted to ensure applications proposals only locate the most vulnerable land-uses within the Proposed Development in areas of lowest flood risk. Consequently, the existing fluvial flood risk posed to the south-western part of the Site, adjacent to Gravehill Lane, presents a potential constraint on the Proposed Development.

6.3.5 The risk of fluvial flooding posed by Ordinary Watercourses is not represented by the Flood Map for Planning. The current best available representation of the risk of flooding posed to the Site by Ordinary Watercourses is the Risk of Flooding from Surface Water mapping described in Section 6.4 below.

6.3.6 Consequently, the risk of fluvial flooding to the Site is considered to range from very low to high.

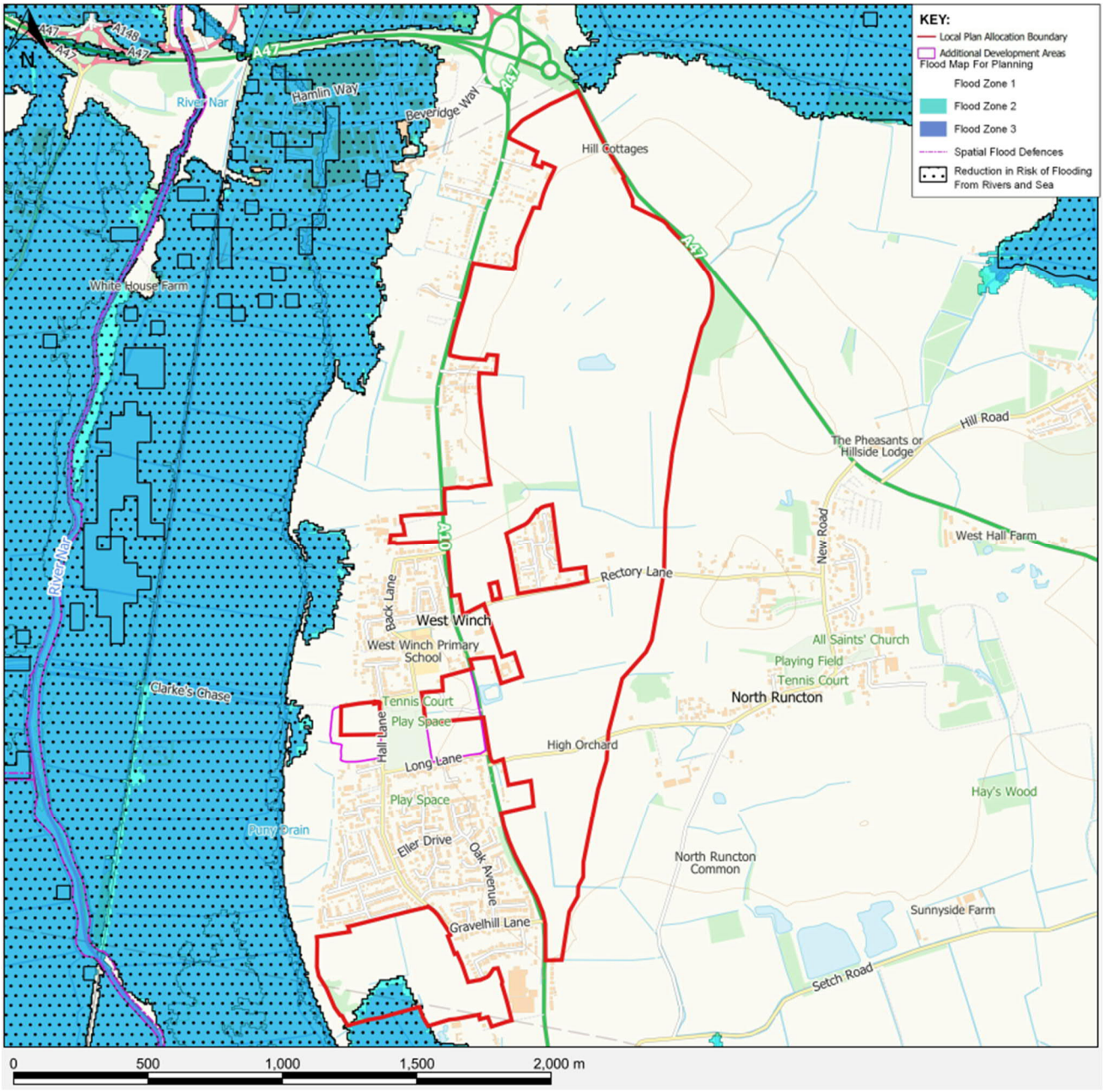


Figure 6-1 – Environment Agency Flood Map for Planning

6.4 FLOODING FROM PLUVIAL SOURCES

6.4.1 The Environment Agency's Risk of Flooding from Surface Water mapping[12], reproduced in, shows the majority of the Site to be subject to an annual probability of flooding of less than 0.1% and therefore at a very low risk of surface water flooding.

6.4.2 The Risk of Flooding from Surface Water mapping shows multiple locations where existing surface water flow paths originate within the Site associated with the existing topography and the network of Ordinary Watercourses and drainage ditches shown to be present at the Site. One flow route originates off-site and flows east to west through the central section of the Site. These areas are shown to be subject to a risk of flooding ranging from low (between 0.1% and 1% annual probability) to high (greater than 3.3% annual probability).

6.4.3 Any flow paths through the Site, which are shown to originate off-site, would need incorporated as blue corridors within the masterplan of the Proposed Development. Any residential dwellings should be outside of the peak flood extents given for the 0.1% annual probability event.

6.4.4 The Proposed Development would increase the peak rate and total volume of runoff generated by the Site due to the proposed increase in impermeable surfaces which would result in an increase in surface water flood risk to the Site and the surrounding area in the absence of suitable mitigation. A surface water drainage strategy delivered in accordance with the requirements of the local and national policy would therefore be required to ensure that there would be no increase in flooding as a result of the Proposed Development.

6.4.5 The connectivity of the existing ditch network off-site, which includes sections of culverted watercourse, should be determined to inform any future planning application for the Proposed Development.

[12] Environment Agency (2023) *Risk of Flooding from Surface Water mapping*; accessed February 2023 from https://www.gov.uk/check-long-term-flood-risk

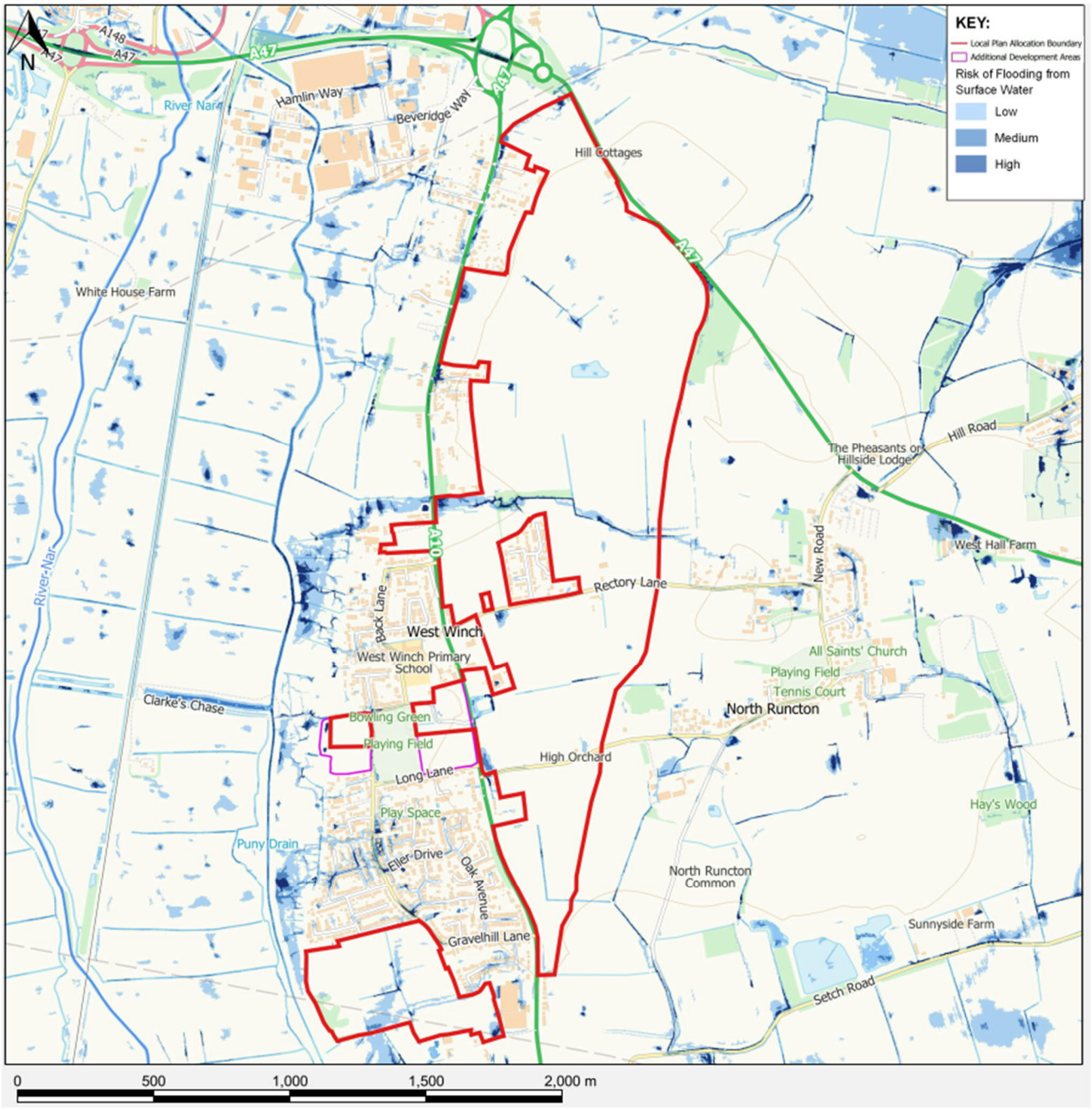


Figure 6-2 – Environment Agency Risk of Flooding from Surface Water

6.5 FLOODING FROM SEWER AND DRAINAGE INFRASTRUCTURE SOURCES

6.5.1 Anglian Water have confirmed that it holds no records of historic flooding incidents at the Site.

6.5.2 Utility records show that there are no surface water sewers that cross the Site. A foul sewer crosses within the Site, however this is unlikely to pose a risk of flooding as it is separate from the surface water system.

6.5.3 An assessment should still be undertaken to assess the existing topography in the vicinity of the existing public sewer network to determine the risk of flooding posed from this source in sufficient detail to inform any future planning applications for the Proposed Development.

6.6 FLOODING FROM ARTIFICIAL SOURCES

6.6.1 The Environment Agency's Risk of Flooding from Reservoirs Mapping[13] does not show the Site does to be located within the extreme inundation area of any reservoirs. Consequently, the risk of reservoir flooding to the Site is considered to be low.

[13] Environment Agency (2023) *Risk of Flooding from Surface Water mapping*; accessed March 2023 from https://www.gov.uk/check-long-term-flood-risk

7 CONCEPTUAL SURFACE WATER DRAINAGE STRATEGY

7.1 EXISTING DRAINAGE REGIME

7.1.1 The majority of the existing Site drains indirectly to the Puny Drain via. the existing network of drainage ditches and Ordinary Watercourses at, and the vicinity of, the Site. This drain is managed and maintained by the East of Ouse, Polver and Nar IDB. Historically the Puny Drain discharged into the River Great Ouse, however following the construction of the Puny Drain Relief Channel in 2008, the drain is now pumped via an outfall into the River Great Ouse Relief Channel, near Saddle Bow. Catchments 2 and 3 in the Northern part of the Site drain northwards into Pierpoint Drain which is managed and maintained by the King's Lynn IDB .

7.1.2 The agricultural fields in the West Winch area tend to drain to open ditches which convey surface water to the Puny Drain. Some of these ditches are culverted under roads and built-up areas.

7.1.3 The Revitalised Flood Hydrograph Method Version 2 (ReFH2) was used to generate the peak greenfield runoff flow rates using Flood Estimation Handbook (FEH) point data was obtained from the UK Centre for Ecology and Hydrology Flood Estimation Handbook Web Service[14], the results of which are summarised in Table 7-1 below. Full copies of the calculations are provided in Appendix D for reference.

Table 7-1 – Peak Greenfield Runoff Flow Rates

Event - Annual Probability (%)	Peak Runoff Rate (l/s) – 50ha	Peak Unit Runoff Rate (l/s/ha)
100	27.4	0.5
50	32.6	0.7
3.33	92.9	1.9
1	138.1	2.8

7.2 SURFACE WATER DRAINAGE REQUIREMENTS

7.2.1 The key requirements for draining the Proposed Development drawn from the policy and guidance documents detailed in Section 3 are given below:

- Surface water drainage infrastructure within the Proposed Development should be designed to accommodate the 1% annual probability storm event plus the upper-end allowance for climate change;

[14] UK Centre for Ecology & Hydrology (2023) *Flood Estimation Handbook Web Service*; available at https://fehweb.ceh.ac.uk/GB/map

- Any flooding predicted to occur during the 1% annual probability storm event plus the upper end allowance for climate change must be contained within the Proposed Development and should not present a risk to people or property;
- The volume of runoff generated by the Proposed Development should not exceed the acceptable discharge rate of 1.1 l/s/ha as stated by the IDB into the Puny Drain;
- The Proposed Development should incorporate appropriate SuDS features that reflect the principles set out in the adopted West Winch Growth Area Framework Masterplan SPD;
- The Proposed Development should incorporate infiltration-based SuDS features where appropriate;
- The Proposed Development should utilise SuDS features with multi-functional benefits in preference to traditional underground storage systems and should be integrated with the proposed green infrastructure network in order to maximise potential ecological and recreational benefits;
- A suitable allowance for urban creep should be applied to the proposed impermeable areas associated with the proposed residential parcels; and,
- The surface water drainage strategy should adequately consider the phasing of the Proposed Development to ensure a comprehensive approach to drainage and that any early phases of the Proposed Development provide the drainage infrastructure to meet the needs of any later interconnecting phases.

7.3 PROPOSED DRAINAGE REGIME

7.3.1 The conceptual surface water drainage strategy presented herein seeks to replicate the existing drainage regime at the Site whilst avoiding increases in the peak rate and total volume of surface water discharges from the Site as a result of the Proposed Development.

7.3.2 The Building Regulations Approved Document H[15] and The SuDS Manual[16] establishes a hierarchy for surface water disposal. This hierarchy stipulates that surface water runoff not collected for reuse must be discharged to one or more of the following in order of priority:

- Discharge into ground (infiltration); or, where not reasonably practicable,
- Discharge to a surface waterbody; or, where not reasonably practicable,
- Discharge to a surface water sewer, highway drain, or another drainage system; or, where not reasonably practicable,
- Discharge to a combined sewer.

7.3.3 The underlying geology at the Site, as given by the published mapping described in Section 2.3, is anticipated to be predominantly impermeable. Consequently, the conceptual surface water drainage strategy is based on an attenuated discharge to the network of existing surface waterbodies shown to be present at, and in the immediate vicinity of, the Site.

[15] HM Government (2015) *The Building Regulations Part H: Drainage and Waste Disposal*
[16] CIRIA (2015) *C753: The SuDS Manual*

7.3.4 Targeted infiltration testing in accordance with the requirements of BRE Digest 365[17] should be undertaken to confirm the permeability of the underlying ground in the Site and infiltration-based SuDS features adopted as appropriate in accordance with the requirements of the drainage hierarchy.

7.3.5 Peak discharge rates are to be limited to the 1.1 l/s/ha (in accordance with correspondence with the IDB) during all events up to and including the 1% annual probability event plus a suitable allowance for climate change. This would ensure that the Proposed Development would provide both peak rate and volume control in accordance with the requirements of the Non-statutory Technical Standards for Sustainable Drainage Systems.

7.3.6 The Framework Masterplan as set out in the adopted West Winch Growth Area Framework Masterplan SPD has been reviewed alongside the exiting topographic catchments described in Section 2.2 to determine proposed drainage catchments which mimic the existing drainage regime at the Site as far as is practicable and to facilitate a phased delivery of the Proposed Development. The proposed drainage catchments along with the associated discharge locations and site-control attenuation features are shown on the Conceptual Surface Water Drainage Strategy drawing in Appendix D.

7.3.7 The proposed discharge locations have been determined from a review of the existing topography, the proposed drainage catchments and the existing surface waterbodies shown by Ordnance Survey mapping. A site-specific topographic survey should be commissioned to confirm the presence, condition, and capacity of these waterbodies to ensure that they are suitable for accepting runoff from the Proposed Development.

7.3.8 For the purposes of this assessment, it has been assumed that source-control SuDS features can be located within the existing easements shown on the Framework Masterplan as set out in the adopted West Winch Growth Area Framework Masterplan SPD. This assumption should be confirmed as the project progresses.

7.3.9 The peak allowable discharge rates and the associated required volumes of attenuation for each proposed drainage catchment are provided in Table 7-2 and Table 7-3 below.

[17] BRE (2016) *BG 365 – Soakaway Design*

Table 7-2 – Contributing Area Summary

Catchment	Total Area (ha)	Developable Area (%)	Developable Area (ha)	Pimp (%)	Urban Creep (%)	Impermeable Area (ha)	Peak Allowable Discharge Rate (l/s)
1	32.4	80	25.9	55	10	15.7	28.4
2	5.7	80	4.6	55	10	2.8	5.0
3	12.3	80	9.9	55	10	6.0	10.8
4	42.2	80	33.7	55	10	20.4	37.0
5	1.7	80	1.3	55	10	0.8	1.4
6	20.3	80	16.3	55	10	9.8	17.8
7	5.8	80	4.6	55	10	2.8	5.0
8	3.6	80	2.9	55	10	1.7	3.1
9	14.1	80	11.3	55	10	6.9	12.4
10	14.8	80	11.8	55	10	7.2	13.0

Table 7-3 – Attenuation Volume Summary

Catchment	Required Attenuation Volume (m^3)	Source Control Attenuation (m^3)	Site Control Attenuation (m^3)	Site Control Attenuation (m^2)
1	22,640	2,270	20,370	34,630
2	4,010	410	3,600	6,120
3	8,620	870	7,750	13,180
4	29,490	2,950	26,540	45,120
5	1,170	120	1,050	1,790
6	14,240	1,430	12,810	21,780
7	4,050	410	3,640	6,190
8	2,530	260	2,270	3,860
9	9,910	1,000	8,910	15,150
10	10,330	1,040	9,290	15,800

7.3.10 The conceptual strategy is based on the following key design principles which were determined in consultation with the LLFA:

- Developable Area - Assumed to be 80% of the total area of each proposed drainage catchment to account for areas of public open space within the Proposed Development;
- Impermeable Area - A Percentage Impermeability (PIMP) value of 55% has been applied to the Developable Area within each proposed drainage catchment based on an assumed land-use equivalent to medium density housing;
- Urban Creep - An additional allowance of 10% has been added to the proposed Impermeable Areas within each proposed drainage catchment in accordance with Table 4 of Norfolk County Council's Lead Local Flood Authority Guidance Document;
- Climate Change - The upper end allowance of 40% has been applied to the peak rainfall intensity based on the anticipated design life of the Proposed Development and the latest Environment Agency guidance described in Section 3.2;
- Source Control SuDS Features - Source control SuDS features (e.g. raingardens, bioretention areas, swales etc.) have been assumed to provide 10% of the total required volumes of attenuation for each proposed drainage catchment; and,
- Site Control SuDS Features – Attenuation basins designed in accordance with the requirements of The SuDS Manual have been assumed to provide 90% of the total required volumes of attenuation for each proposed drainage catchment.

7.3.11 These assumptions should be reviewed and refined as the project progresses to ensure that they remain representative of the layout and density of the various proposed land-uses within the Proposed Development.

7.3.12 The site-control attenuation features shown on the Conceptual Surface Water Drainage Strategy drawing are indicative and subject to detailed investigations at the planning stage in consultation with the LLFA.

7.3.13 Opportunities should be sought to incorporate appropriate source control SuDS features within the proposed development parcels that offer complementary water quantity, water quality, biodiversity and amenity benefits.

7.3.14 The conceptual surface water drainage strategy should be reviewed alongside the proposed green-infrastructure strategy to identify further opportunities to provide multi-functional spaces within the Proposed Development and maximise the potential biodiversity and amenity opportunities presented by development at the Site.

7.4 WATER QUALITY MANAGEMENT

7.4.1 Tables 4.3 and 26.1 of The SuDS Manual identify that the anticipated pollution hazard levels associated with the various land-uses within the Proposed Development would range from low to medium and that the treatment required prior to discharge from the Proposed Development to surface water should be assessed using the simple index approach.

Table 7-4 – Pollution Hazard Level and Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, low traffic roads and non-residential parking with infrequent change (e.g. schools and offices)	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7

7.4.2 Table 26.3 of The SuDS Manual states that the mitigation indices for detention basins are 0.5, 0.5 and 0.6 for total suspended solids, metals, and hydrocarbons respectively. Consequently, any proposed land-uses classified as having a medium pollution hazard level would be required to pass through a minimum of one additional stage of treatment, dependant on the mitigation indices for the additional SuDS features utilised, to ensure that sufficient treatment is provided prior to discharge from the Proposed Development.

7.4.3 Should infiltration-based SuDS features be incorporated within the Proposed Development following targeted infiltration testing at the Site, the mitigation indices for discharges to groundwater presented in Table 26.4 of The SuDS Manual should be adopted as the basis for the simple index approach for the associated drainage catchments.

7.5 ADOPTION AND MAINTENANCE

7.5.1 ANGLIAN WATER

7.5.2 The proposed surface water drainage network along with any proposed SuDS features that are classified as a sewer by the Design and Construction Guidance18 (DCG) could be offered to Anglian Water for adoption under Section 104 of the Water Industry Act (1991). Any proposed

[18] Water UK (2022) *Sewerage Sector Guidance Appendix C – Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England;* obtained February 2023 from https://www.water.org.uk/sewerage-sector-guidance-approved-documents/

SuDS features that are offered for adoption would need to be located in publicly accessible areas within the Proposed Development and not include any land drainage or off-site connectivity.

7.5.3 SUDS APPROVAL BODY

7.5.4 The Government has announced its intention to enact Schedule 3 to the Flood and Water Management Act (2010). The enactment of Schedule 3 would see the creation of SuDS Approval Bodies (SABs), a role that is expected to be adopted by existing LLFAs. The SABs would be responsible for reviewing and approving any construction work which has drainage implications prior to commencement and would adopt drainage systems where appropriate.

7.5.5 The enactment of Schedule 3 is anticipated to implemented in 2024 following an extensive consultation period to be held throughout 2023. Consequently, any surface water drainage strategies developed in support of future planning applications for the Proposed Development after the implementation of Schedule 3 are likely to require SAB approval. The enactment of Schedule 3 would also present an opportunity to offer SuDS features within the Proposed Development to the SAB for adoption.

7.5.6 Whilst the associated design standards are yet to be confirmed, they are anticipated to reflect those given by the Non-statutory Requirements for Sustainable Drainage Systems and the best practice guidance detailed in The SuDS Manual on which the conceptual surface water drainage strategy has been based.

7.5.7 Consequently, the conceptual surface water drainage strategy should be periodically reviewed in conjunction with the LLFA to ensure that the emerging requirements of the SAB are incorporated within the design as the project progresses.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

8.1.1 This document has been prepared to provide a preliminary assessment of the risk of flooding posed to the Site by all potential sources and to determine the key principles for draining the Proposed Development in a sustainable manner commensurate with national and local policy. The aim of this FRA is to identify if an extra 2,390 homes can be sustainably added to the West Winch Growth Area, taking the total number of proposed homes up to 4000.

8.1.2 The existing topography at the Site has been reviewed using publicly available LiDAR data and shows the Site to generally fall from east to west. A catchment delineation exercise has been undertaken which shows the Site to consist of approximately 9 existing topographic catchments.

8.1.3 The underlying geology at the Site is predominately impermeable, consisting of Leziate Member (sand), Mintlyn Member (sand), Roxham and Runcton Member (sand) and Kimmerridge Clay Formation (mudstone).

8.1.4 A high-pressure gas main runs east to west across the centre of the Site, with restrictions in place precluding development in the gas main exclusion zone.

8.1.5 DEFRA's Magic Mapping shows no part of the Site to lie within a Source Protection Zone.

8.1.6 The Environment Agency, Norfolk County Council, East of the Ouse, Polver & Nar Internal Drainage Board (IDB) and Anglian Water have been consulted as part of this study to obtain historic flood records along with any flood risk and drainage information pertinent to the proposed redevelopment of the Site. None of the stakeholders consulted hold any records of historic flooding at the Site with the exception of the Environment Agency from which a response is still awaiting at the time of writing.

8.1.7 There are two Environment Agency designated Main Rivers in the vicinity of the Site alongside a network of Ordinary Watercourses and drainage ditches. The risk of fluvial flooding posed to the Site from these sources is shown to be low for most of the Site, except for a small area in the South of the Site in Flood Zone 2 and 3.

8.1.8 The risk of surface water flooding posed to the Site is mainly low, with some localised areas at high risk. There is a surface water flow path, originating off-site, which flows through the centre of the Site.

8.1.9 Any flow paths which originate off-site would need to be incorporated into the detailed site-specific proposals/applications as blue/green corridors, ensuring no residential development is located within these areas.

8.1.10 The majority of the Site currently drains via natural overland runoff towards the lower lying areas of the Site to the west and the network of existing drainage ditches shown to be present at the Site, draining into the Puny Drain. Catchments 2 and 3 in the Northern part of the Site drain northwards into Pierpoint Drain.

8.1.11 The conceptual surface water drainage strategy developed as part of this study seeks to replicate the existing drainage regime at the Site whilst avoiding increases in the peak rate and total volume of surface water discharges from the Site as a result of the Proposed Development.

8.1.12 The conceptual surface water drainage strategy is based on an attenuated discharge to the network of existing surface waterbodies shown to be present at, and in the immediate vicinity of, the Site in accordance with the drainage hierarchy.

8.1.13 Peak discharge rates are to be limited to 1.1 l/s/ha, in accordance with correspondence with the IDB, during all events up to and including the 1% annual probability event plus a suitable allowance for climate change.

8.1.14 The Framework Masterplan as set out in the adopted West Winch Growth Area Framework Masterplan SPD has been reviewed alongside the existing topographic catchments to determine proposed drainage catchments which mimic the existing drainage regime at the Site as far as is practicable and to facilitate a phased delivery of the Proposed Development.

8.1.15 Proposed discharge locations have been determined from a review of the existing topography, the proposed drainage catchments and the existing surface waterbodies identified by Ordnance Survey mapping.

8.1.16 The proposed drainage catchments along with the associated discharge locations and indicative site-control attenuation features are shown on the Conceptual Surface Water Drainage Strategy drawing. The site-control attenuation features shown on the Conceptual Surface Water Drainage Strategy drawing are indicative and subject to detailed investigations at the planning stage in consultation with the LLFA.

8.2 RECOMMENDATIONS

8.2.1 The sequential approach should be adopted in developing detailed proposals for development at the Site to locate the most vulnerable land-uses within the Proposed Development in areas of lowest flood risk.

8.2.2 Further consultation with the Environment Agency and the LLFA should be undertaken to determine the potential requirement for detailed hydraulic modelling and hydrological assessments to be undertaken to confirm the baseline risk of fluvial flooding posed to the Site.

8.2.3 The existing surface water flow path in the central part of the Site, which originates off-site, as identified on the Environment Agency's Risk of Flooding from Surface Water mapping should incorporated into the layout of the Proposed Development as a blue corridor and residential dwellings should located be outside of the 0.1% annual probability surface water flood extents.

8.2.4 The existing drainage ditches shown to be present at the Site should be retained and incorporated within the design of the Proposed Development. The LLFA should be consulted at the earliest opportunity should the diversion, culverting, or removal of any of the existing waterbodies within the Site be required to facilitate the delivery of the Proposed Development.

8.2.1 The proposed site-control attenuation features shown on the Conceptual Surface Water Drainage Strategy drawing should be incorporated within the design of the Proposed Development to ensure that adequate space is allocated for the management of surface water generated by the Proposed Development.

8.2.2 A site-specific topographic survey should be commissioned to confirm the presence, condition and capacity of the receiving waterbodies and the connectivity of the existing ditch network off-site in which the conceptual surface water drainage strategy is proposing to discharge runoff generated by the Proposed Development.

8.2.3 The key design principles on which the conceptual surface water drainage is based should be reviewed and refined as the project progresses to ensure that they remain representative of the layout and density of the various proposed land-uses within the Proposed Development.

8.2.4 Opportunities should be sought to incorporate source control SuDS features that offer complementary water quantity, water quality, biodiversity and amenity benefits within the individual development parcels.

8.2.5 The conceptual surface water drainage strategy should be reviewed alongside the proposed green-infrastructure strategy to identify further opportunities to provide multi-functional spaces within the Proposed Development and to maximise the potential biodiversity and amenity opportunities presented by development at the Site.

8.2.6 The conceptual surface water drainage strategy should be periodically reviewed in conjunction with the LLFA to ensure that the emerging requirements of the SAB relating to the expected enactment of Schedule 3 of the Flood and Water Management Act (201) are incorporated within the design as the project progresses.

8.2.1 The assumption that source-control SuDS features can be located within the existing easements shown on The Framework Masterplan as set out in the adopted West Winch Growth Area Framework Masterplan SPD should be confirmed as the project progresses.

8.2.2 Targeted infiltration testing and groundwater monitoring in accordance with the requirements of BRE Digest 365 should be undertaken at the Site and to confirm whether infiltration-based SuDS features can be adopted as appropriate in accordance with the requirements of the drainage hierarchy.

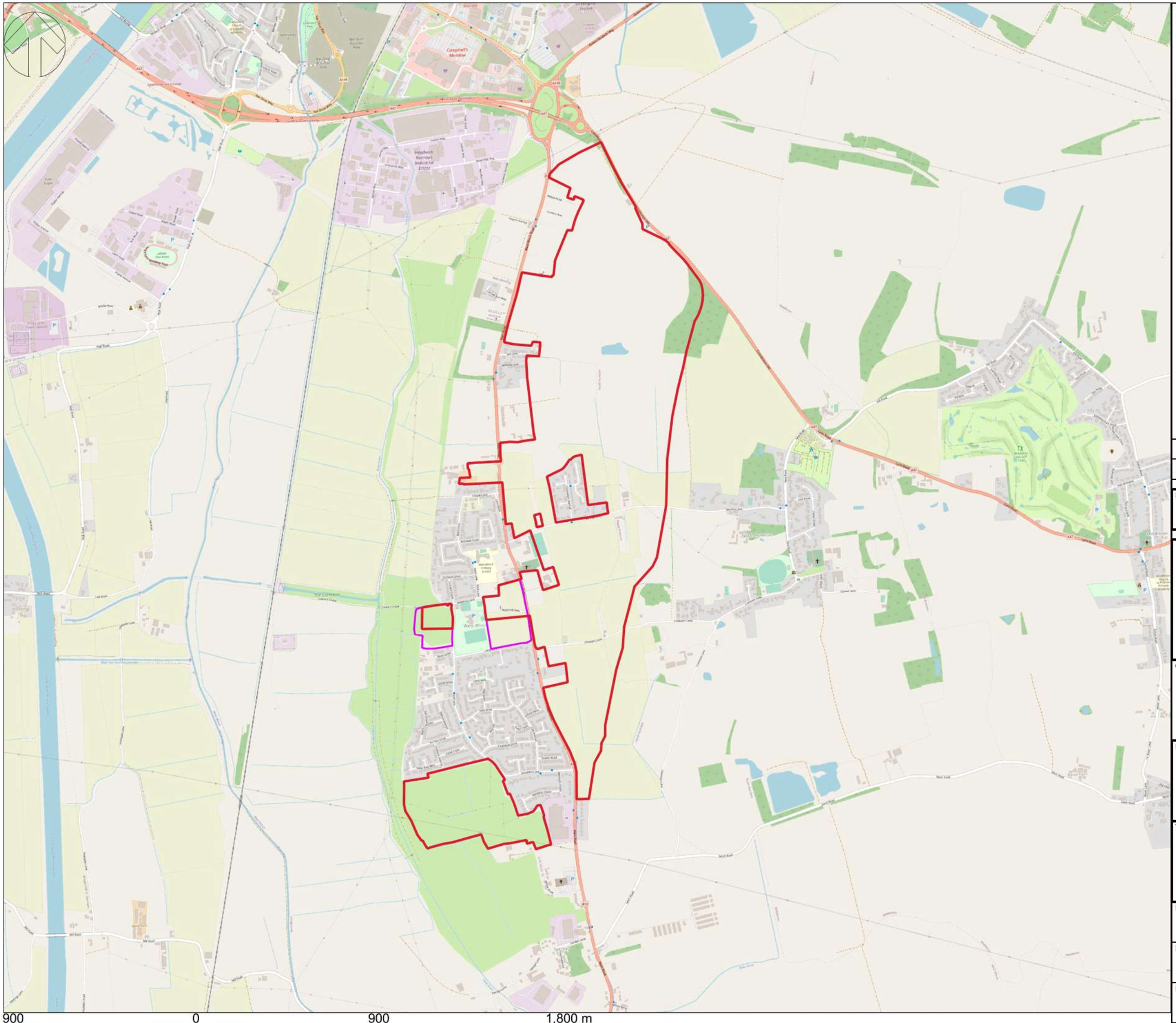
8.2.3 Finished ground and floor levels should be designed to minimise the impact on people and property during storm events in excess of the design storm event.

Appendix A

EXISTING SITE PLANS

Appendix A.1

SITE LOCATION



Do not scale - Use only figured dimensions
The contractor is to check all dimensions on site and report any discrepancies to the site Supervisor
This drawing is to be read in conjunction with other standard documentation

Note:
This plan is furnished as a general guide only and the Statutory Undertakers concerned state that no warranty as to its correctness is given or implied. It must not be relied upon in the excavations or other works made in the vicinity of each utilities service.

Key:

- Local Plan Allocation Boundary
- Additional Development Areas

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	24/04/23	SL	FIRST ISSUE	JH	SK

DRAWING STATUS:
S1 - FOR COORDINATION

Matrix House, Basing View, Basingstoke, RG21 4FF
+44 (0)1256 318 800
wsp.com

CLIENT:
Borough Council of King's Lynn and West Norfolk

PROJECT:
West Winch Growth Area

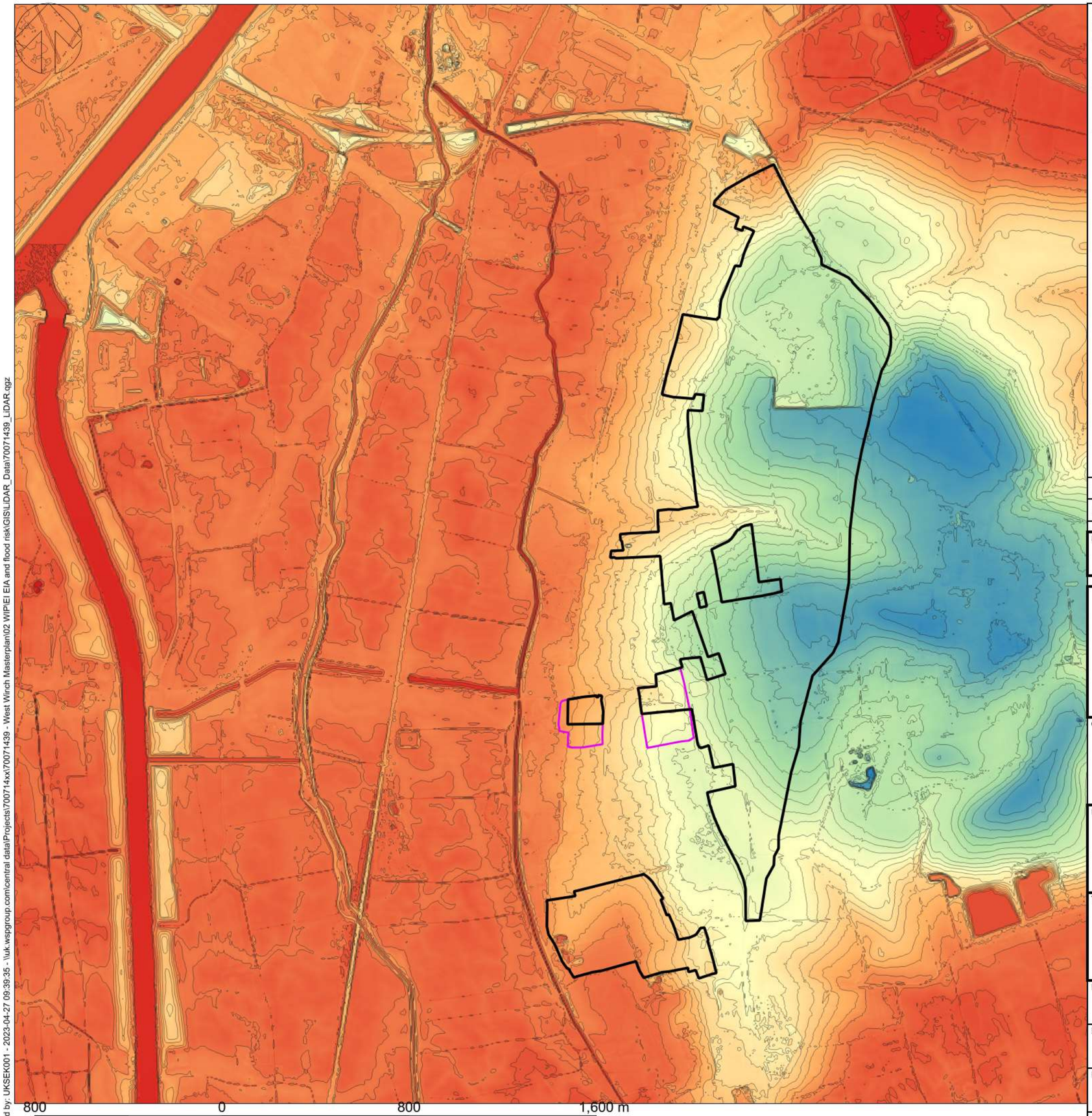
TITLE:
Site Location

DRAWN:	CHECKED:	APPROVED:
SL	JH	SK
PROJECT No: 70071439	SCALE @A3: 1:18,000	DATE: 27/04/2023

DRAWING No: 70071439-LOC-2
REV: B

Appendix A.2

EXISTING TOPOGRAPHY



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Key:

- Local Plan Allocation Boundary
- Additional Development Areas

LiDAR DTM 1m 2022 (mAOD)
Band 1 (Gray)
22.07
-1.43

LiDAR DTM 1m 2022 Contours
1m

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	24/04/23	SL	FIRST ISSUE	JH	SK

DRAWING STATUS:
S1 - FOR COORDINATION

Matrix House, Basing View, Basingstoke, RG21 4FF
+44 (0)1256 318 800 wsp.com

CLIENT:
Borough Council of King's Lynn and West Norfolk

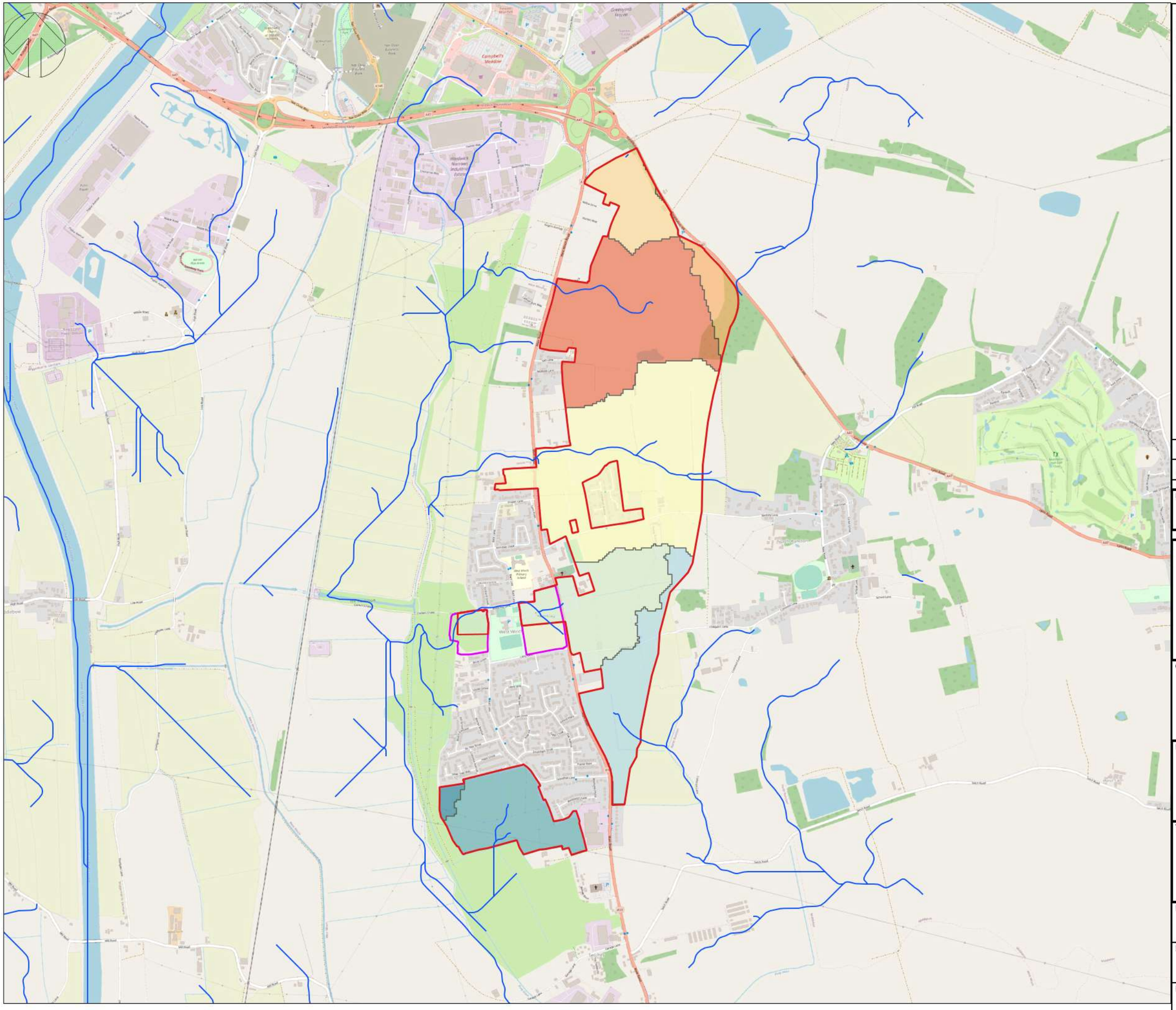
PROJECT:
West Winch Growth Area

TITLE:
Existing Topography

DRAWN:	CHECKED:	APPROVED:
SL	JH	SK

PROJECT No:	SCALE @A3:	DATE:
70071439	1:17,000	27/04/2023

DRAWING No:	REV:
70071439-TOP-2	B



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Key:

- Local Plan Allocation Boundary
- Additional Development Areas
- Existing Catchment Lines

Existing Catchment Areas

- A
- B
- C
- D
- E
- F
- G
- H

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	24/04/23	SL	FIRST ISSUE	JH	SK

DRAWING STATUS:
S1 - FOR COORDINATION

Matrix House, Basing View, Basingstoke, RG21 4FF
+44 (0)1256 318 800 wsp.com

CLIENT:
Borough Council of King's Lynn and West Norfolk

PROJECT:
West Winch Growth Area

TITLE:
Existing Catchments

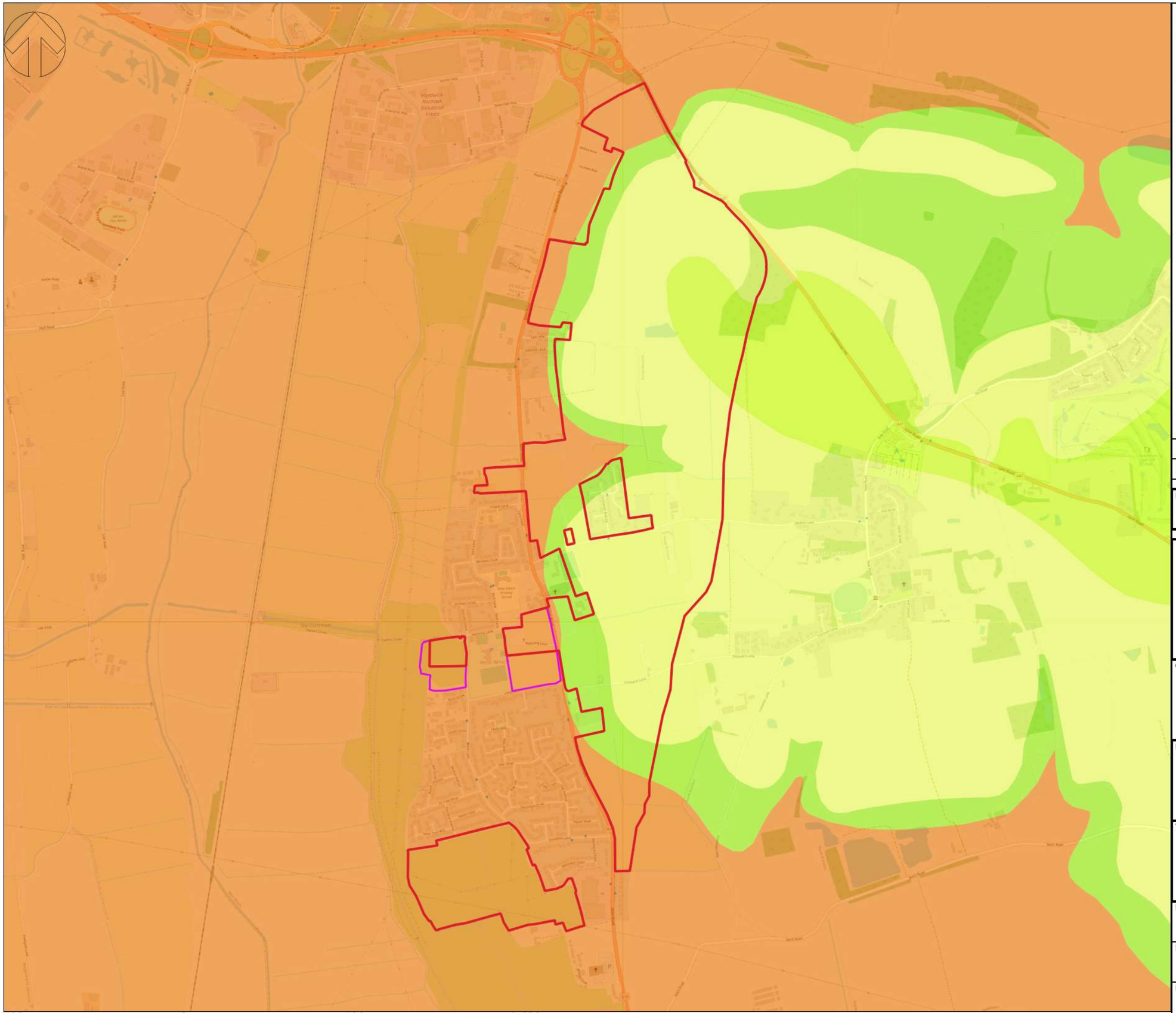
DRAWN:	CHECKED:	APPROVED:
SL	JH	SK

PROJECT No:	SCALE @A3:	DATE:
70071439	1:18,000	27/04/2023

DRAWING No:	REV:
70071439-CATCH-1	A

Appendix A.3

GEOLOGY AND HYDROGEOLOGY



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Key:

- Local Plan Allocation Boundary
- Additional Development Areas

1:50k BGS Bedrock Geology

- Kimmeridge Clay Formation - Mudstone
- Roxham Member and Runcton Member (Undifferentiated) - Sand
- Mintlyn Member - Sand
- Leziate Member - Sand

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	24/04/23	SL	FIRST ISSUE	JH	SK

DRAWING STATUS: S1 - FOR COORDINATION

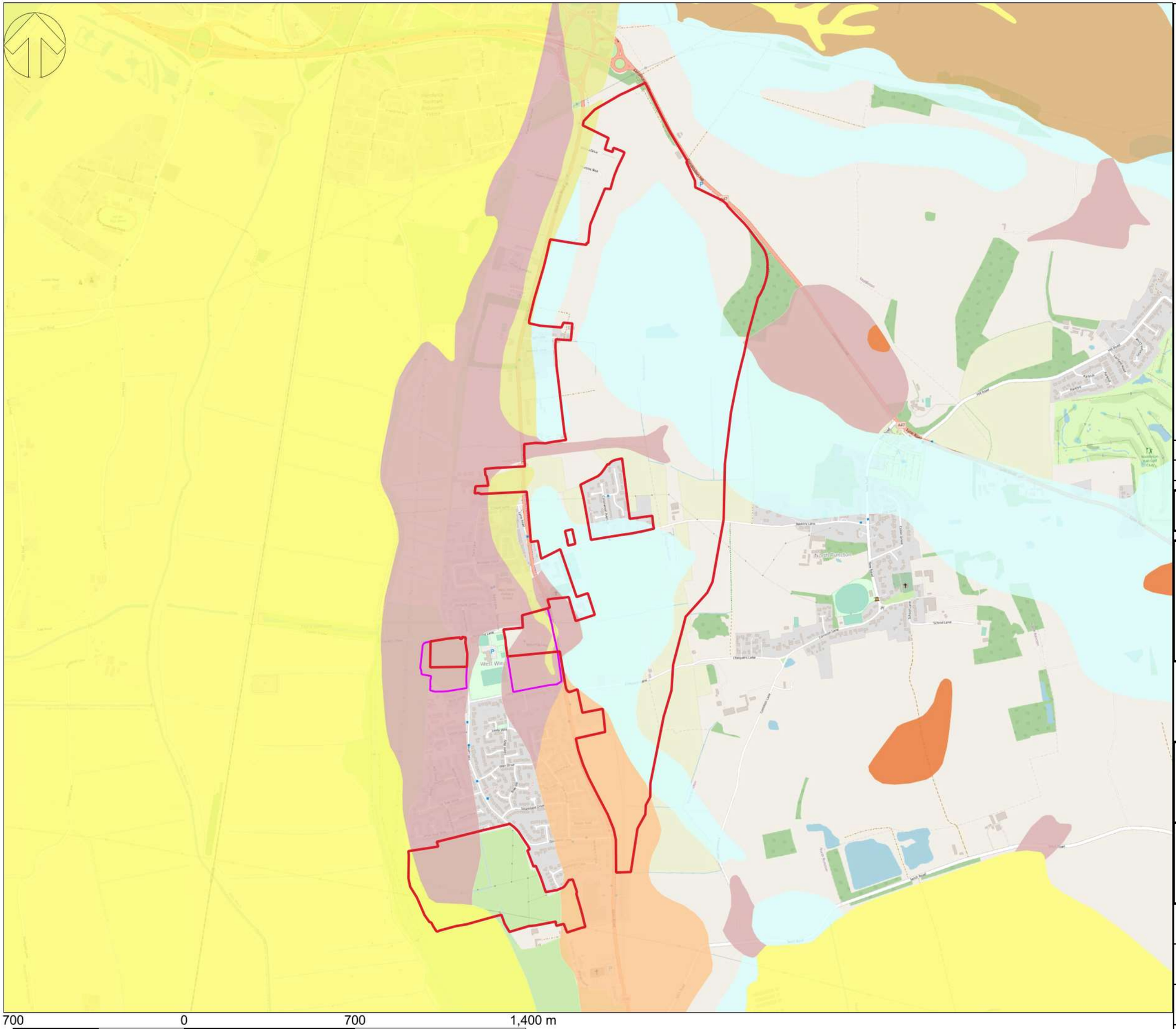
wsp
Matrix House, Basing View, Basingstoke, RG21 4FF
+44 (0)1256 318 800 wsp.com

CLIENT: Borough Council of King's Lynn and West Norfolk

PROJECT: West Winch Growth Area

TITLE: BGS Bedrock Geology

DRAWN:	CHECKED:	APPROVED:
SL	JH	SK
PROJECT No: 70071439	SCALE @A3: 1:15,000	DATE: 27/04/2023
DRAWING No: 70071439-BG-2		REV: B



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Key:

- Local Plan Allocation Boundary
- Additional Development Areas

1:50k BGS Superficial Deposits

- Tidal Flat Deposits - Clay and Silt
- Head - Clay, Silt, Sand and Gravel
- Tottenhill Gravel Member - Gravel
- Lowestoft Formation - Diamicton
- Lowestoft Formation - Sand and Gravel
- Raised Beach Deposits - Gravel

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	24/04/23	SL	FIRST ISSUE	JH	SK

DRAWING STATUS:
S1 - FOR COORDINATION

Matrix House, Basing View, Basingstoke, RG21 4FF
+44 (0)1256 318 800 wsp.com

CLIENT:
Borough Council of King's Lynn and West Norfolk

PROJECT:
West Winch Growth Area

TITLE:
BGS Superficial Deposits

DRAWN:	CHECKED:	APPROVED:
SL	JH	SK
PROJECT No: 70071439	SCALE @A3: 1:15,000	DATE: 27/04/2023

DRAWING No: 70071439-SD-2 REV: B

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Appendix A.4

FLOOD MAP PACK

FLOOD MAP PACK

Limitations & Quality Assurance

Pack Prepared By

SL

Pack Checked By

JH

Pack Authorised By

SK

Limitations:

This pack is based on flood risk information available and current at the time of preparation based on data provided by third parties.

Conclusions drawn based on this pack are limited in their accuracy in proportion to the validity of the datasets this pack is based on.

WSP cannot be held responsible for the accuracy of the third-party data and the interpretation of this pack may change if the data is amended or updated after the date of production.

WSP UK Ltd makes no warranties or guarantees, actual or implied, in relation to this pack, or the ultimate commercial, technical, economic, or financial effect on the project to which it relates, and bears no responsibility or liability related to its use other than as set out in the contract under which it was supplied.

Overview

Site Information

PROJECT
70071439

SITE
West Winch

CLIENT
Norfolk County Council

EASTINGS, NORTHINGS
563548, 316492

SITE AREA
175.69 hectares

WSP CONTACT
SL

Pages

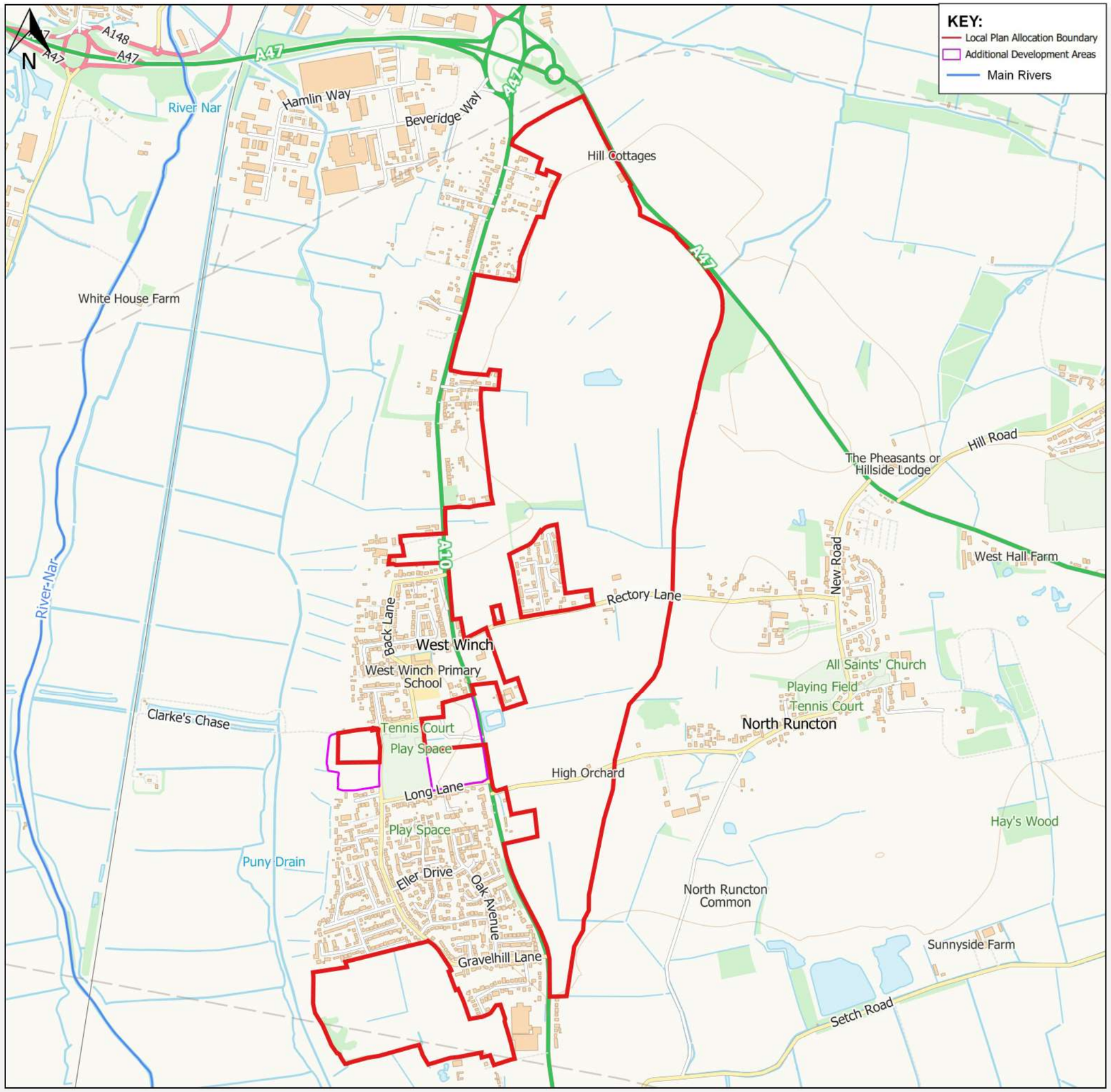
Site Location

CLOSEST MAIN RIVER

River Nar

DISTANCE BETWEEN SITE AND CLOSEST MAIN RIVER

1149.9m



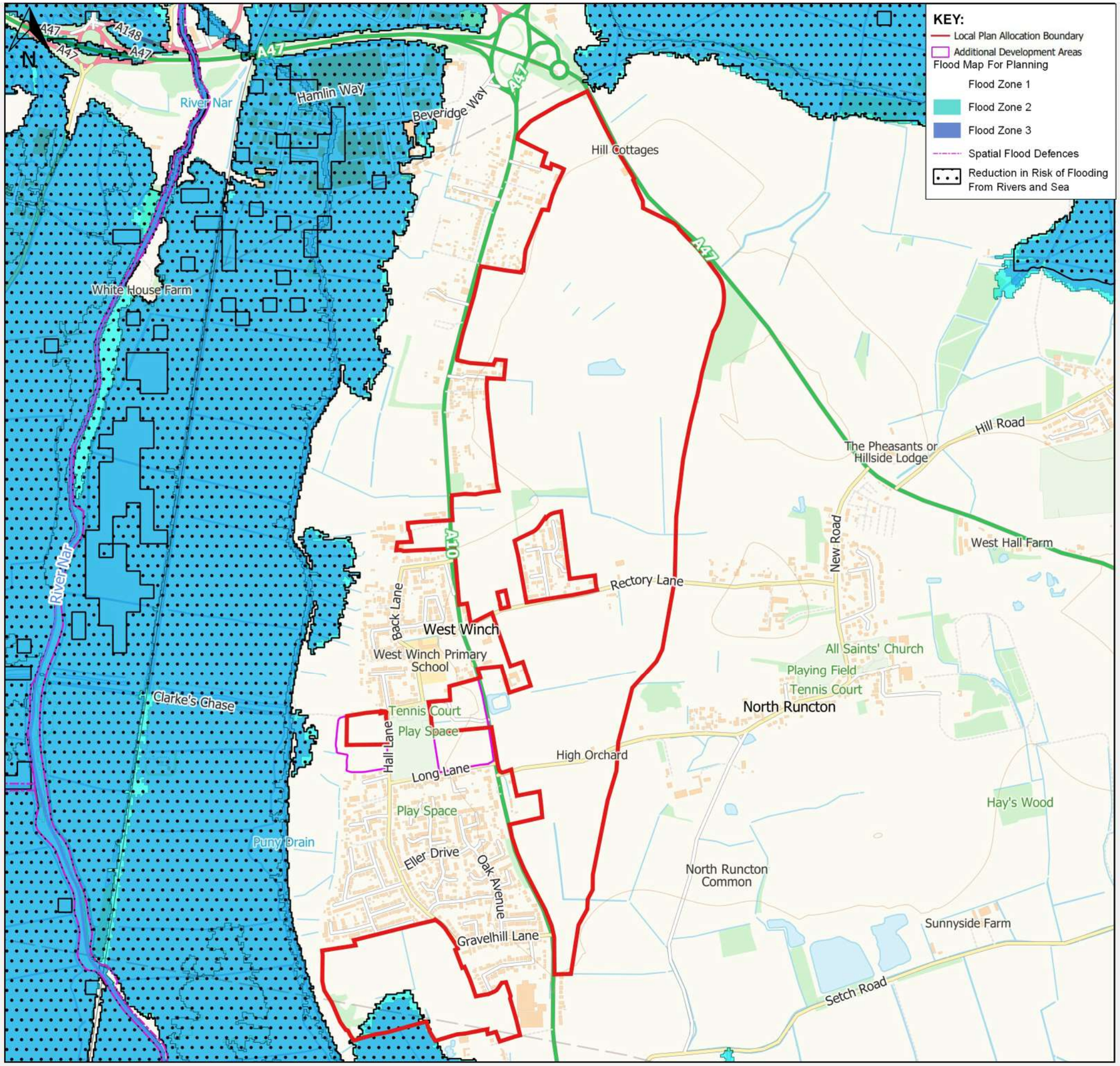
This data is indicative only and reference should always be made to the legal documentation. It should be noted that amendments to the datasets are made frequently and that the information may change.

Flood Map for Planning

Flood zone maps are modelled using local and national river and sea data. This information provides an indication of the likelihood of flooding and is intended for planning use only.

- **Flood Zone 1 -** Land having a less than 1 in 1,000 annual probability (0.1% AEP) of river or sea flooding - all land outside Zones 2 and 3).
- **Flood Zone 2 -** Land having between a 1 in 100 and 1 in 1,000 annual probability (0.1% - 1.0% AEP) of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability (0.1% - 0.5% AEP) of sea flooding.
- **Flood Zone 3 -** Land having a 1 in 100 or greater annual probability (>1.0% AEP) of river flooding; or Land having a 1 in 200 or greater annual probability (>0.5% AEP) of sea flooding.

Reduction in Risk of Flooding from Rivers and Sea due to Defences -Reduction in Risk of Flooding from Rivers and Sea due to Defences is a spatial dataset that indicates where areas have reduced flood risk from rivers and sea due to the presence of flood defences. The dataset has been created to help initiate conversations about the impact our flood defences have on the risk of flooding from the rivers and sea,and as a prompt to find out more about the flood defences in a particular area of interest. It does not replace any local, more detailed information.



This data is indicative only and reference should always be made to the legal documentation. It should be noted that amendments to the datasets are made frequently and that the information may change.

Risk of Flooding from Rivers and Sea

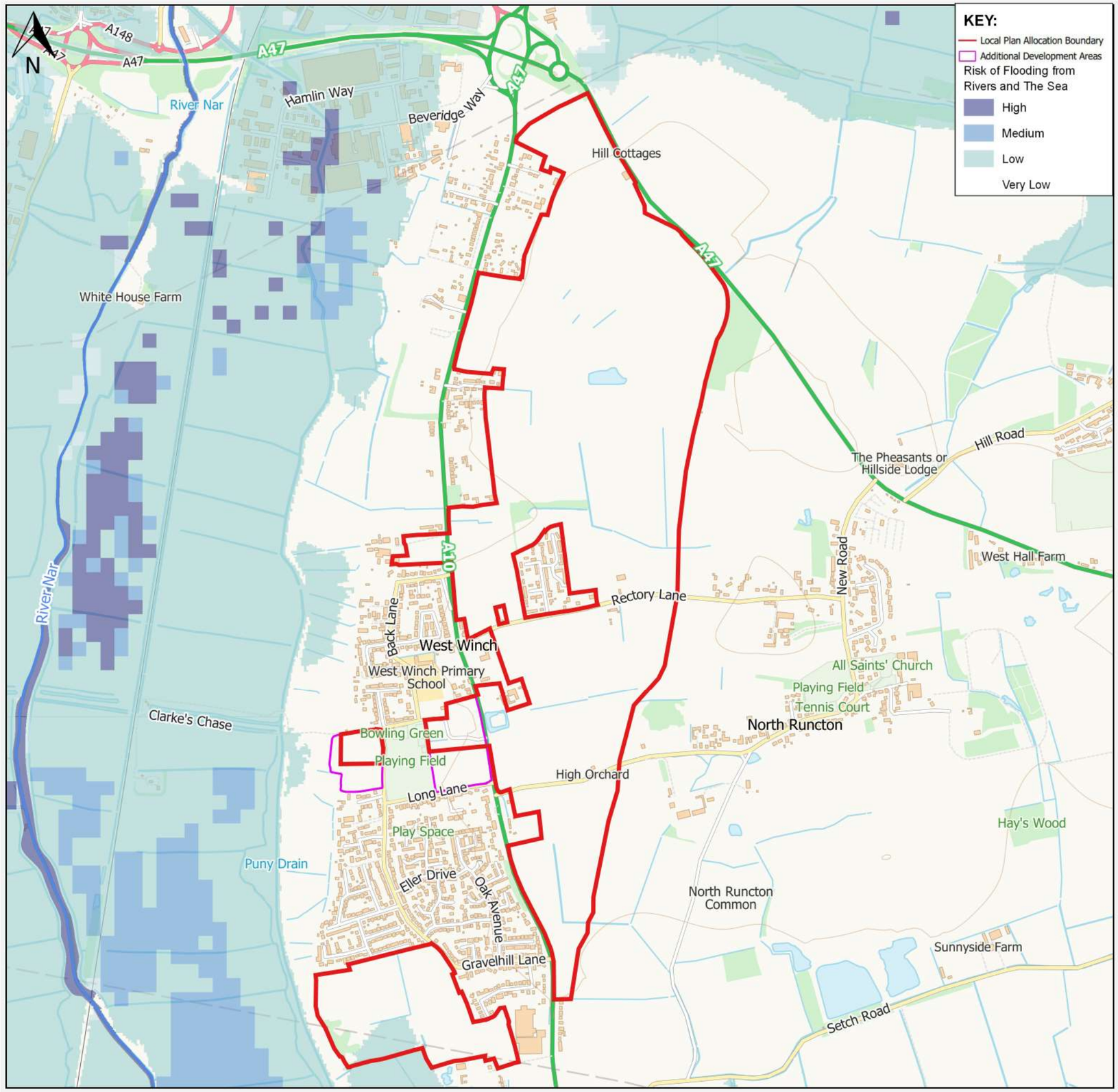
This map takes into account the effect of any flood defences in the area. These defences reduce but do not completely stop the chance of flooding as they can be overtopped, or fail.

High Risk - Land having a 1 in 30 or greater annual probability (>3.3% AEP) of flooding from rivers or the sea.

Medium Risk - Land having between a 1 in 30 and a 1 in 100 annual probability (1.0% - 3.3%) of flooding from rivers or the sea.

Low Risk - Land having between a 1 in 100 and a 1 in 1000 annual probability (0.1% - 1.0%) of flooding from rivers or the sea.

Very Low Risk - Land having a less than 1 in 1,000 annual probability (0.1% AEP) of flooding from rivers or the sea.



This data is indicative only and reference should always be made to the legal documentation. It should be noted that amendments to the datasets are made frequently and that the information may change.

Risk of Flooding from Surface Water

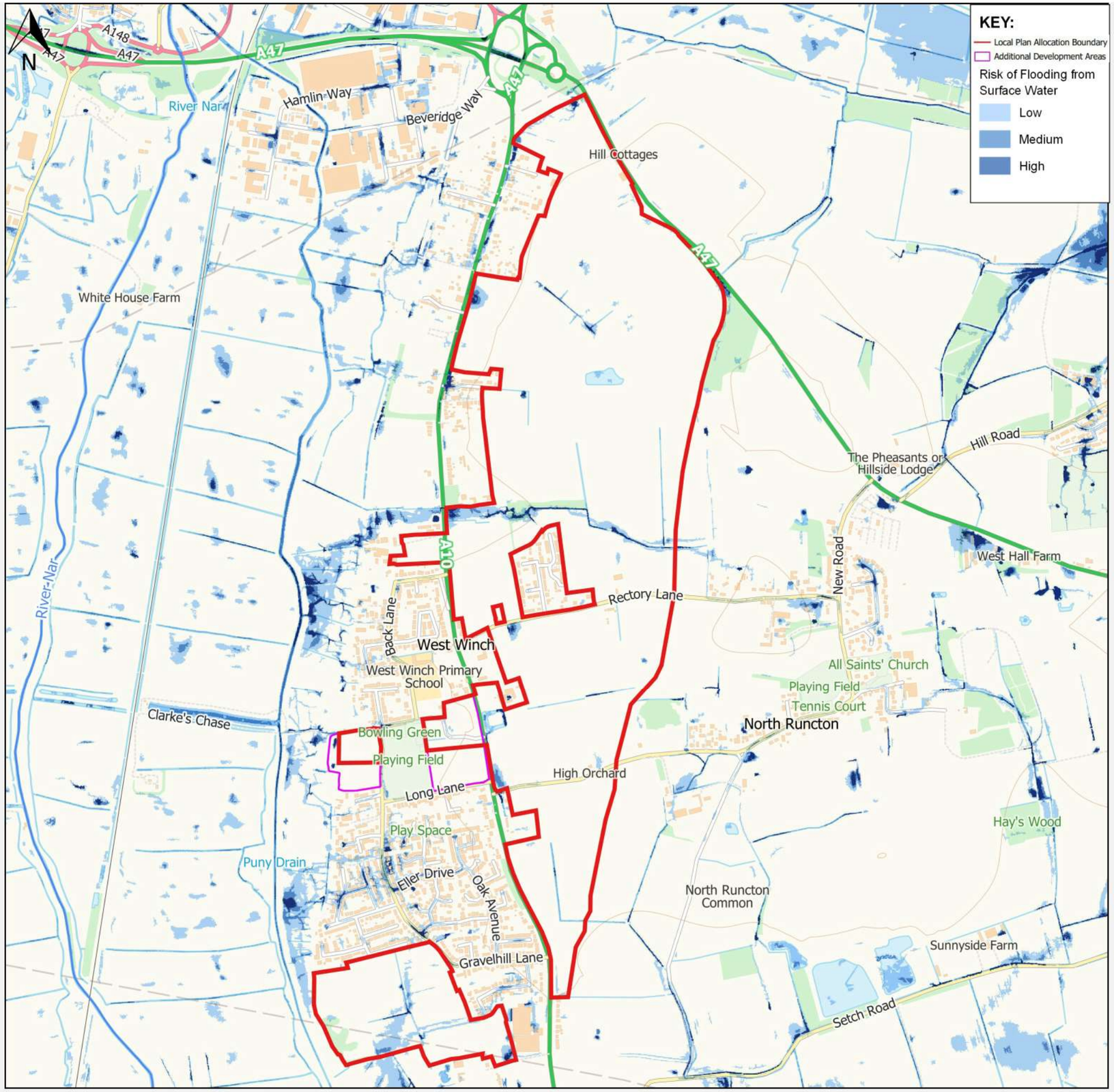
Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

High Risk - Land having a 1 in 30 or greater annual probability (>3.3% AEP) of flooding from surface water.

Medium Risk - Land having between a 1 in 30 and a 1 in 100 annual probability (1.0% - 3.3%) of flooding from surface water.

Low Risk - Land having between a 1 in 100 and a 1 in 1000 annual probability (0.1% - 1.0%) of flooding from surface water.

Very Low Risk - Land having a less than 1 in 1,000 annual probability (0.1% AEP) of flooding from surface water.



This data is indicative only and reference should always be made to the legal documentation. It should be noted that amendments to the datasets are made frequently and that the information may change.

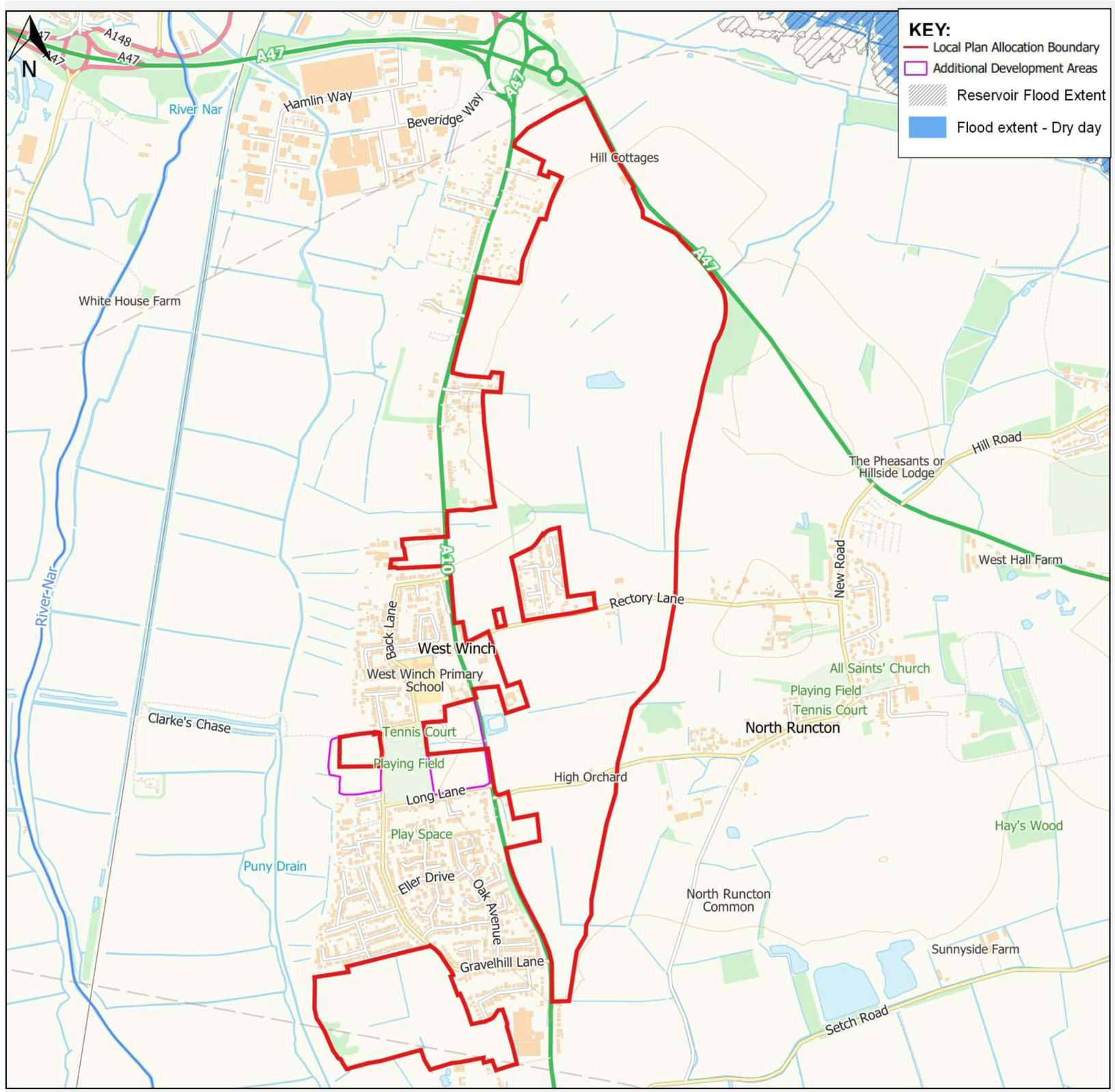
Risk of Flooding from Reservoirs

The Risk of Flooding from Reservoirs (wet day) layer shows the individual flood extents for all large raised reservoirs in the event that they were to fail and release the water held on a "wet day" when local rivers had already overflowed their banks.

It represents a prediction of a credible worst-case scenario, however it's unlikely that any actual flood would be this large. The data gives no indication of likelihood or probability of reservoir flooding.

The Risk of Flooding from Reservoirs (dry day) shows flood extents for all large raised reservoirs in the event that they were to fail and release the water held on a "dry day" when local rivers are at normal levels.

These national datasets are "indicative" not "definitive". Definitive information can only be provided by individual local authorities and you should refer directly to their information for all purposes that require the most up to date and complete dataset.



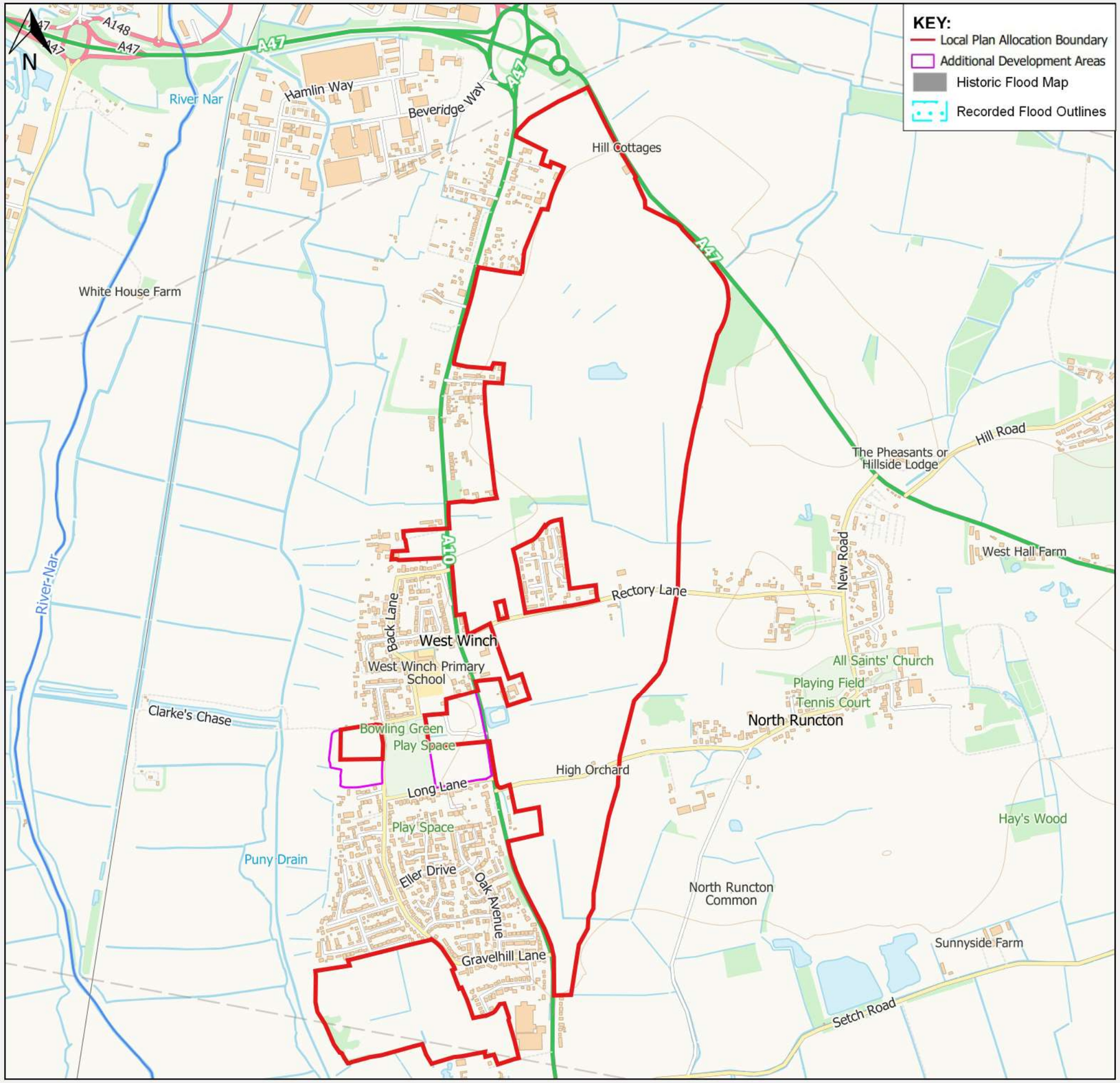
This data is indicative only and reference should always be made to the legal documentation. It should be noted that amendments to the datasets are made frequently and that the information may change.

Previous Flooding

RECORDED FLOOD OUTLINES
Recorded Flood Outlines shows all records of historic flooding from rivers, the sea, groundwater and surface water. The absence of coverage by Recorded Flood Outlines for an area does not mean that the area has never flooded, only that there are currently no records of flooding in this area. It is also possible that the pattern of flooding in this area has changed and that this area would now flood or not flood under different circumstances. The Recorded Flood Outlines take into account the presence of defences, structures, and other infrastructure where they existed at the time of flooding. It includes flood extents that may have been affected by overtopping, breaches or blockages. Any flood extents shown do not necessarily indicate that properties were flooded internally.

HISTORIC FLOOD MAP
The Historic Flooding shows the maximum extent of individual Recorded Flood Outlines from river, the sea and groundwater springs that meet a set criteria. It shows areas of land that has previously been subject to flooding. This excludes flooding from surface water, except in areas where it is impossible to determine whether the source is fluvial or surface water, but the dominant source is fluvial. If an area is not covered by the Historic Flood Map it does not mean that the area has never flooded, only that the EA do not currently have records of flooding in this area that meet the criteria for inclusion. It is also possible that the pattern of flooding in this area has changed and that this area would now flood or not flood under different circumstances. Outlines that don't meet these criteria are stored in the Recorded Flood Outlines dataset. The Historic Flood Map takes into account the presence of defences, structures, and other infrastructure where they existed at the time of flooding. It will include flood extents that may have been affected by overtopping, breaches or blockages. Flooding is shown to the land and does not necessarily indicate that properties were flooded internally.

If an area is not covered by these layers, it does not mean that the area has never flooded, only that there are not currently records of flooding in the area.



Flood Alert and Warning Areas

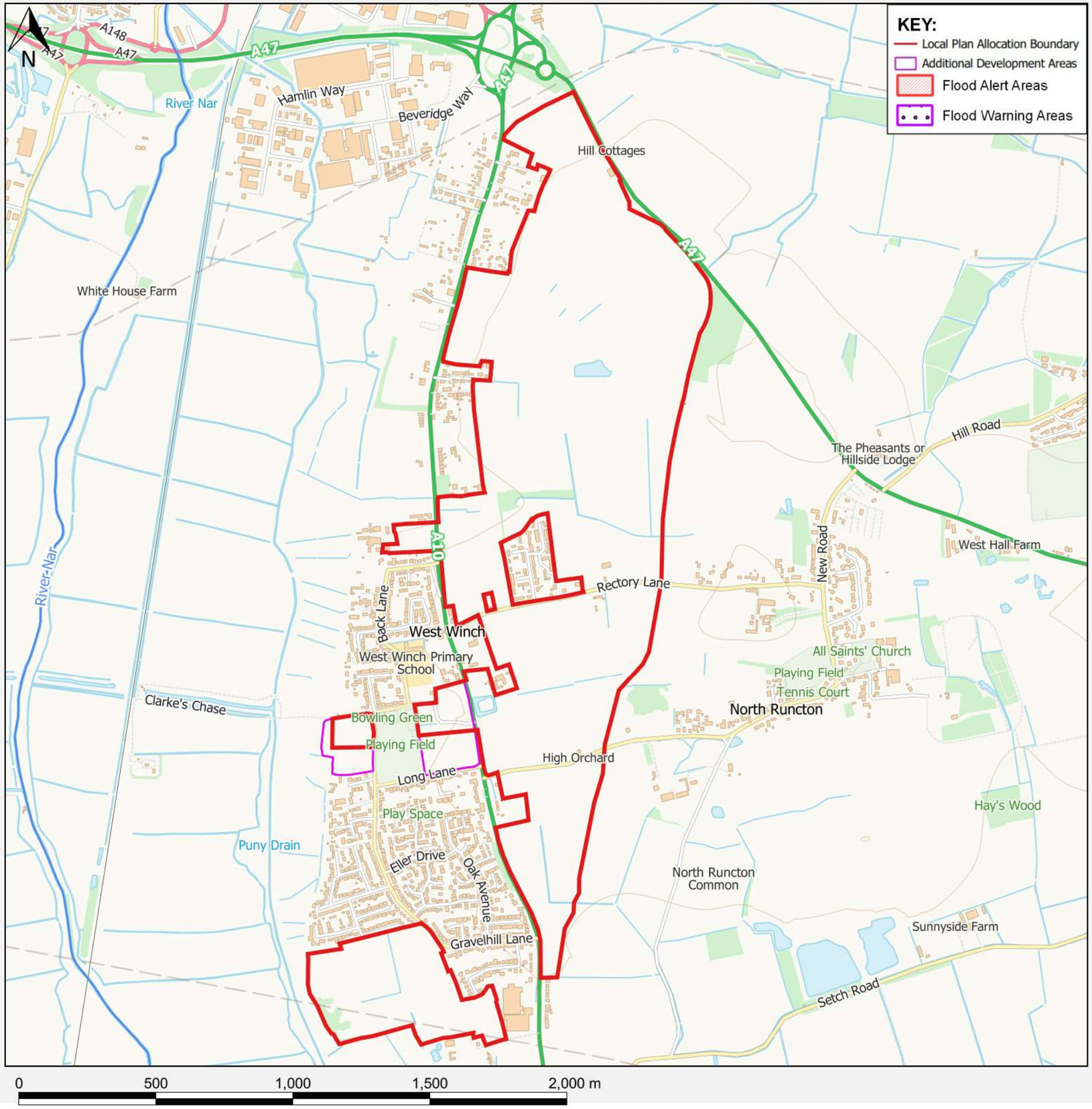
FLOOD ALERT AREAS

Flood Alert Areas are areas where it is possible for flooding to occur from rivers, sea and in some location's groundwater. A single Flood Alert Area may cover the floodplain within the Flood Warning Service Limit of multiple catchments of similar characteristics containing a number of Flood Warning Areas. A Flood Alert Area may also match that of a corresponding Flood Warning Area and warn for the possibility of flooding in that area. In some coastal locations a Flood Alert may be issued for spray or overtopping and be defined by a stretch of coastline. Practical and administrative factors may also influence the exact extent of a Flood Alert Area. A Flood Alert is issued to warn people of the possibility of flooding and encourage them to be alert stay vigilant and make early / low impact preparations for flooding. Flood Alerts are issued earlier than Flood Warnings to provide advance notice of the possibility of flooding and may be issued when there is less confidence that flooding will occur in a Food Warning Area.

FLOOD WARNING AREAS

Flood Warning Areas are areas where flooding is expected to occur and where a Flood Warning Service is provided. Areas generally contain properties that are expected to flood from rivers or the sea and in some areas, from groundwater. Specifically, Flood Warning Areas define locations within the Flood Warning Service Limit that represent a discrete community at risk of flooding. The purpose of Flood Warnings is to alert people that flooding is expected, and they should take action to protect themselves and their property. Flood Warnings are issued when flooding is expected to occur, Severe Flood Warnings are issued to similar areas when there is a danger to life or widespread disruption is expected.

If an area is not covered by these layers, it does not mean that the area has never flooded, only that there are not currently records of flooding in the area.



This data is indicative only and reference should always be made to the legal documentation. It should be noted that amendments to the datasets are made frequently and that the information may change.

Source Protection Zones & Borehole Records

Source Protection Zones
Source Protection Zones (SPZs) are defined around large and public potable groundwater abstraction sites. The purpose of SPZs is to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction.

The following subdivisions are defined within SPZs:

Zone 1: (Inner Protection Zone) - This zone is defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has as a minimum a 50-metre radius. It is based principally on biological decay criteria and is designed to protect against the transmission of toxic chemicals and water-borne disease.

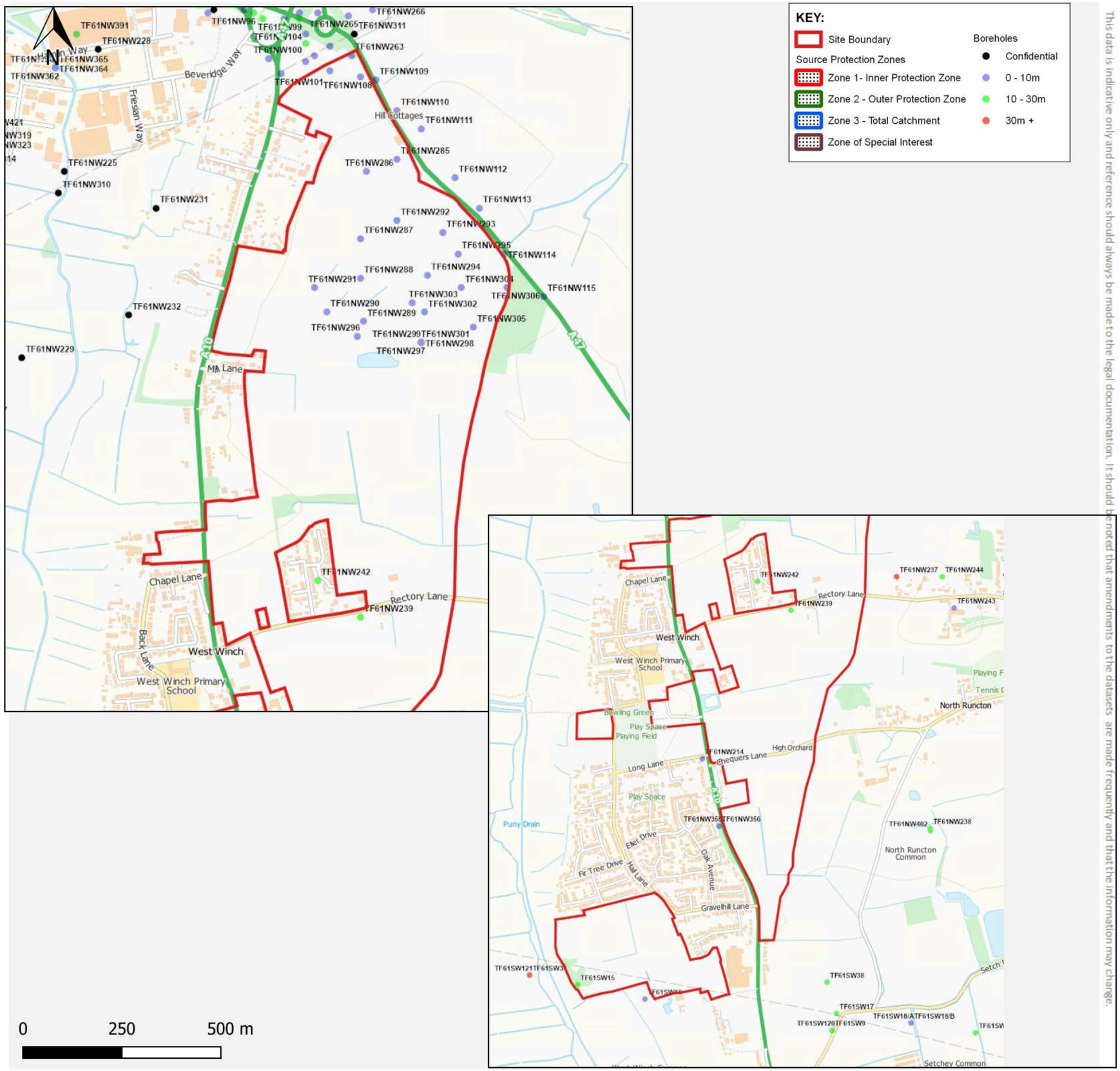
Zone 2: (Outer Protection Zone) - This zone is defined by the 400-day travel time from a point below the water table. Additionally this zone has a minimum radius of 250 or 500 metres, depending on the size of the abstraction. The travel time is derived from consideration of the minimum time required to provide delay, dilution and attenuation of slowly degrading pollutants

.

Zone 3: (Total catchment) - This zone is defined as the total area needed to support the abstraction or discharge from the protected groundwater source.

Zone 4, or 'Zone of Special Interest' is occasionally defined for some groundwater sources. These zones highlight areas (mainly on non-aquifers) where known local conditions mean that potentially polluting activities could impact on a groundwater source, even though the area is outside the normal catchment of that source.

Borehole Records
Borehole records are made available from the British Geological Survey. Boreholes range from one to several thousand metres deep. Borehole records are produced from a geologist's or surveyor's observations of the rock core extracted from the ground and typically include locality and lithological descriptions with depth and thickness. Geophysical logs may also be noted from on-site measurements.



70 Chancery Ln
London
WC2A 1AF

Flood Map Pack | wsp.com

WSP Sustainable Water Management
+44 (0)20 7314 5000

Appendix B

STAKEHOLDER CORRESPONDENCE

From: Jean Heading <jean@elydrainageboards.co.uk>
Sent: 11 April 2023 16:46
To: Luff, Sasha
Subject: RE: Flood Risk Enquiry - West Winch

Dear Sasha,

The site is outside of the East of the Ouse, Polver and Nar Internal Drainage District, but part of the site does drain into it.

The Board has been involved with correspondence and meetings in relation to this site and has previously made it's position clear.

In answer to your questions:-

> We have no detailed record of any historic flood incidents. However, the Board is aware of flooding occurring in West Winch, outside of our District. The Lead Local Flood Authority should be approached for their comments.
>
> Part of the site drains into the Board's District through a third party watercourse. The Board has previously stated that if the site discharges through these watercourses, it should determine if they have the capacity to do so, and a maintenance plan should be established for them. Water is eventually drained to our Puny Pumping Station. The acceptable greenfield run-off rate is 1.1 litres/sec/ha.
>
> We do not have any flood modelling for the area.

Please let me know if you have any further questions.

Best Regards,

Andrew Newton
General Manager to East of the Ouse, Polver & Nar IDB

From: Luff, Sasha <sasha.luff@wsp.com>
Sent: Friday, March 31, 2023 4:21 PM
To: Jean Heading <jean@elydrainageboards.co.uk>
Cc: Hope, Jasmine <Jasmine.Hope@wsp.com>
Subject: Flood Risk Enquiry - West Winch

Dear Madam,

Land at West Winch, King's Lynn – Flood Risk Assessment

We are reviewing the flood risk for the above site in King's Lynn (see attached site location plan).

The Ordnance Survey Grid Reference for the site is TF 63715 16285, and the nearest postcode is PE33 0NR.

We understand the site is situated within East of the Ouse, Polver and Nar IDB.

To support our assessment of flood risk for the site it would be helpful if you can provide us with a copy of the following information if it is available:

> The details of any historic flood incidents at the site or in the immediate vicinity of the site;
> The details of any flood risk management assets within the site or within the immediate vicinity of the site;
> Details of any flood modelling you may hold for the site or the adjacent surface water bodies; and
> Any other relevant information in relation to flood risk or drainage of the identified site.

We would welcome any additional comments you may have with respect to the site.

Kind Regards,

Sasha

Sasha Luff
Graduate Engineer – Water Risk Management and Engineering
BSc (Hons), GradCIWEM
Pronouns: She/Her

T +44 1256 318 546

From: Planning Liaison <planningliaison@anglianwater.co.uk>
Sent: 04 April 2023 12:47
To: Hope, Jasmine
Subject: RE: West Winch, King's Lynn - Sewer Flood History Data

Good afternoon Jasmine

Thank you for your email regarding West Winch, King's Lynn - Sewer Flood History Data

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 Olim
Pre-Development Engineer
Mobile: 07929804300
Team: 07929 786 955
Email: planningliaison@anglianwater.co.uk
Website: https://www.anglianwater.co.uk/developing/planning--capacity/

Anglian Water Services Limited
Thorpe Wood House, Thorpe Wood, Peterborough, Cambridgeshire, PE3 6WT

From: Hope, Jasmine <Jasmine.Hope@wsp.com>
Sent: Monday, April 3, 2023 5:29 PM
To: Planning Liaison <planningliaison@anglianwater.co.uk>
Subject: West Winch, King's Lynn - Sewer Flood History Data

Dear Sir/Madam,

West Winch, King's Lynn
Flood Risk Assessment - Enquiry

We have been instructed by our client to carry out an assessment of flood risk at the above site. The OS grid reference for the site is TF 63715 16285 and the nearest postcode is PE33 0NR. Please find enclosed a location map for your reference.

We are writing to request sewer flood history information please. Once a quotation has been received payment will be arranged.

Kind regards,

Jasmine

Jasmine Hope
Senior Engineer – Water Risk Management and Engineering
BSc (Hons), MCIWEM

T+ 44 01256 318821

WSP in the UK
Matrix House, Basing View
Basingstoke
RG21 4FF

wsp.com

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Appendix C

PROPOSED DEVELOPMENT PLANS

KEY

- Masterplan Boundary
- Existing A10
- Proposed Access road
- Proposed Entry points
- Proposed Access road junction points
- Informal Foot / Cycle paths through Landscape Areas
- Proposed Residential Development
- Proposed Primary Schools
- Proposed Retail - Community Use
- Proposed Community Use
- Proposed Employment Area
- Proposed Mix Use - Community Use
- Proposed Playspace / Playing Fields
- Proposed Green Amenity Open Space
- Proposed Attenuation Ponds
- Existing high pressure gas pipe offsets
- Existing high voltage overhead powerline offsets

N

0m 100m 250m 500m

SOUTH EAST KING'S LYNN GROWTH AREA MASTERPLAN SPD

Overall Framework Masterplan

Scale: 1:5000 @ A1
23rd November 2022

Borough Council of King's Lynn & West Norfolk

wsp

Appendix D

CONCEPTUAL SURFACE WATER DRAINAGE STRATEGY

Appendix D.1

GREENFIELD RUNOFF RATE CALCULATIONS

UK Design Flood Estimation

Generated on Tuesday, April 18, 2023 2:49:24 PM by UKSEK001
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: D0C6-6167

Site name: FEH_Point_Descriptors_563622_316604_v4_0_0_Edit

Easting: 563622

Northing: 316604

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.5

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 2 year

Summary of results

Rainfall - FEH 2013 model (mm):	24.16	Total runoff (ML):	0.64
Total Rainfall (mm):	15.98	Total flow (ML):	2.13
Peak Rainfall (mm):	3.63	Peak flow (m³/s):	0.03

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	05:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	1 [0.98]	Yes
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	67.18	No
Cmax (mm)	934.79	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.14	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	61.54	No
BR	2.7	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.3508	0.0000	0.0253	0.0000	0	0
00:30:00	0.5878	0.0000	0.0427	0.0001	6.34E-07	5.86E-05
01:00:00	0.9797	0.0000	0.0719	0.0003	4.24E-06	0.000276
01:30:00	1.6199	0.0000	0.1211	0.0007	1.54E-05	0.000764
02:00:00	2.6362	0.0000	0.2032	0.0017	4.16E-05	0.00171
02:30:00	3.6314	0.0000	0.2920	0.0033	9.59E-05	0.00343
03:00:00	2.6362	0.0000	0.2208	0.0061	0.000199	0.00633
03:30:00	1.6199	0.0000	0.1394	0.0101	0.000374	0.0104
04:00:00	0.9797	0.0000	0.0857	0.0146	0.00064	0.0152
04:30:00	0.5878	0.0000	0.0519	0.0193	0.00101	0.0203
05:00:00	0.3508	0.0000	0.0311	0.0237	0.00147	0.0252
05:30:00	0.0000	0.0000	0.0000	0.0273	0.00201	0.0293
06:00:00	0.0000	0.0000	0.0000	0.0293	0.00261	0.0319
06:30:00	0.0000	0.0000	0.0000	0.0293	0.00323	0.0326
07:00:00	0.0000	0.0000	0.0000	0.0280	0.00383	0.0318
07:30:00	0.0000	0.0000	0.0000	0.0257	0.00439	0.0301
08:00:00	0.0000	0.0000	0.0000	0.0230	0.00489	0.0279
08:30:00	0.0000	0.0000	0.0000	0.0201	0.00532	0.0254
09:00:00	0.0000	0.0000	0.0000	0.0174	0.00568	0.0231
09:30:00	0.0000	0.0000	0.0000	0.0150	0.00599	0.021
10:00:00	0.0000	0.0000	0.0000	0.0130	0.00625	0.0193
10:30:00	0.0000	0.0000	0.0000	0.0112	0.00646	0.0177
11:00:00	0.0000	0.0000	0.0000	0.0095	0.00664	0.0162
11:30:00	0.0000	0.0000	0.0000	0.0080	0.00677	0.0147
12:00:00	0.0000	0.0000	0.0000	0.0064	0.00688	0.0133
12:30:00	0.0000	0.0000	0.0000	0.0050	0.00695	0.0119
13:00:00	0.0000	0.0000	0.0000	0.0036	0.00698	0.0106
13:30:00	0.0000	0.0000	0.0000	0.0024	0.00699	0.0094
14:00:00	0.0000	0.0000	0.0000	0.0014	0.00698	0.00841
14:30:00	0.0000	0.0000	0.0000	0.0008	0.00695	0.00771
15:00:00	0.0000	0.0000	0.0000	0.0004	0.0069	0.00728
15:30:00	0.0000	0.0000	0.0000	0.0002	0.00685	0.00701
16:00:00	0.0000	0.0000	0.0000	0.0000	0.0068	0.00685
16:30:00	0.0000	0.0000	0.0000	0.0000	0.00675	0.00675
17:00:00	0.0000	0.0000	0.0000	0.0000	0.00669	0.00669

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:30:00	0.0000	0.0000	0.0000	0.0000	0.00664	0.00664
18:00:00	0.0000	0.0000	0.0000	0.0000	0.00658	0.00658
18:30:00	0.0000	0.0000	0.0000	0.0000	0.00653	0.00653
19:00:00	0.0000	0.0000	0.0000	0.0000	0.00648	0.00648
19:30:00	0.0000	0.0000	0.0000	0.0000	0.00642	0.00642
20:00:00	0.0000	0.0000	0.0000	0.0000	0.00637	0.00637
20:30:00	0.0000	0.0000	0.0000	0.0000	0.00632	0.00632
21:00:00	0.0000	0.0000	0.0000	0.0000	0.00627	0.00627
21:30:00	0.0000	0.0000	0.0000	0.0000	0.00622	0.00622
22:00:00	0.0000	0.0000	0.0000	0.0000	0.00617	0.00617
22:30:00	0.0000	0.0000	0.0000	0.0000	0.00612	0.00612
23:00:00	0.0000	0.0000	0.0000	0.0000	0.00607	0.00607
23:30:00	0.0000	0.0000	0.0000	0.0000	0.00602	0.00602
24:00:00	0.0000	0.0000	0.0000	0.0000	0.00597	0.00597
24:30:00	0.0000	0.0000	0.0000	0.0000	0.00592	0.00592
25:00:00	0.0000	0.0000	0.0000	0.0000	0.00588	0.00588
25:30:00	0.0000	0.0000	0.0000	0.0000	0.00583	0.00583
26:00:00	0.0000	0.0000	0.0000	0.0000	0.00578	0.00578
26:30:00	0.0000	0.0000	0.0000	0.0000	0.00573	0.00573
27:00:00	0.0000	0.0000	0.0000	0.0000	0.00569	0.00569
27:30:00	0.0000	0.0000	0.0000	0.0000	0.00564	0.00564
28:00:00	0.0000	0.0000	0.0000	0.0000	0.0056	0.0056
28:30:00	0.0000	0.0000	0.0000	0.0000	0.00555	0.00555
29:00:00	0.0000	0.0000	0.0000	0.0000	0.00551	0.00551
29:30:00	0.0000	0.0000	0.0000	0.0000	0.00546	0.00546
30:00:00	0.0000	0.0000	0.0000	0.0000	0.00542	0.00542
30:30:00	0.0000	0.0000	0.0000	0.0000	0.00537	0.00537
31:00:00	0.0000	0.0000	0.0000	0.0000	0.00533	0.00533
31:30:00	0.0000	0.0000	0.0000	0.0000	0.00529	0.00529
32:00:00	0.0000	0.0000	0.0000	0.0000	0.00524	0.00524
32:30:00	0.0000	0.0000	0.0000	0.0000	0.0052	0.0052
33:00:00	0.0000	0.0000	0.0000	0.0000	0.00516	0.00516
33:30:00	0.0000	0.0000	0.0000	0.0000	0.00512	0.00512
34:00:00	0.0000	0.0000	0.0000	0.0000	0.00508	0.00508
34:30:00	0.0000	0.0000	0.0000	0.0000	0.00503	0.00503
35:00:00	0.0000	0.0000	0.0000	0.0000	0.00499	0.00499

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
35:30:00	0.0000	0.0000	0.0000	0.0000	0.00495	0.00495
36:00:00	0.0000	0.0000	0.0000	0.0000	0.00491	0.00491
36:30:00	0.0000	0.0000	0.0000	0.0000	0.00487	0.00487
37:00:00	0.0000	0.0000	0.0000	0.0000	0.00483	0.00483
37:30:00	0.0000	0.0000	0.0000	0.0000	0.0048	0.0048
38:00:00	0.0000	0.0000	0.0000	0.0000	0.00476	0.00476
38:30:00	0.0000	0.0000	0.0000	0.0000	0.00472	0.00472
39:00:00	0.0000	0.0000	0.0000	0.0000	0.00468	0.00468
39:30:00	0.0000	0.0000	0.0000	0.0000	0.00464	0.00464
40:00:00	0.0000	0.0000	0.0000	0.0000	0.0046	0.0046
40:30:00	0.0000	0.0000	0.0000	0.0000	0.00457	0.00457
41:00:00	0.0000	0.0000	0.0000	0.0000	0.00453	0.00453
41:30:00	0.0000	0.0000	0.0000	0.0000	0.00449	0.00449
42:00:00	0.0000	0.0000	0.0000	0.0000	0.00446	0.00446
42:30:00	0.0000	0.0000	0.0000	0.0000	0.00442	0.00442
43:00:00	0.0000	0.0000	0.0000	0.0000	0.00439	0.00439
43:30:00	0.0000	0.0000	0.0000	0.0000	0.00435	0.00435
44:00:00	0.0000	0.0000	0.0000	0.0000	0.00431	0.00431
44:30:00	0.0000	0.0000	0.0000	0.0000	0.00428	0.00428
45:00:00	0.0000	0.0000	0.0000	0.0000	0.00424	0.00424
45:30:00	0.0000	0.0000	0.0000	0.0000	0.00421	0.00421
46:00:00	0.0000	0.0000	0.0000	0.0000	0.00418	0.00418
46:30:00	0.0000	0.0000	0.0000	0.0000	0.00414	0.00414
47:00:00	0.0000	0.0000	0.0000	0.0000	0.00411	0.00411
47:30:00	0.0000	0.0000	0.0000	0.0000	0.00408	0.00408
48:00:00	0.0000	0.0000	0.0000	0.0000	0.00404	0.00404
48:30:00	0.0000	0.0000	0.0000	0.0000	0.00401	0.00401
49:00:00	0.0000	0.0000	0.0000	0.0000	0.00398	0.00398
49:30:00	0.0000	0.0000	0.0000	0.0000	0.00395	0.00395
50:00:00	0.0000	0.0000	0.0000	0.0000	0.00391	0.00391
50:30:00	0.0000	0.0000	0.0000	0.0000	0.00388	0.00388
51:00:00	0.0000	0.0000	0.0000	0.0000	0.00385	0.00385
51:30:00	0.0000	0.0000	0.0000	0.0000	0.00382	0.00382
52:00:00	0.0000	0.0000	0.0000	0.0000	0.00379	0.00379
52:30:00	0.0000	0.0000	0.0000	0.0000	0.00376	0.00376
53:00:00	0.0000	0.0000	0.0000	0.0000	0.00373	0.00373

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
53:30:00	0.0000	0.0000	0.0000	0.0000	0.0037	0.0037
54:00:00	0.0000	0.0000	0.0000	0.0000	0.00367	0.00367
54:30:00	0.0000	0.0000	0.0000	0.0000	0.00364	0.00364
55:00:00	0.0000	0.0000	0.0000	0.0000	0.00361	0.00361
55:30:00	0.0000	0.0000	0.0000	0.0000	0.00358	0.00358
56:00:00	0.0000	0.0000	0.0000	0.0000	0.00355	0.00355
56:30:00	0.0000	0.0000	0.0000	0.0000	0.00352	0.00352
57:00:00	0.0000	0.0000	0.0000	0.0000	0.00349	0.00349
57:30:00	0.0000	0.0000	0.0000	0.0000	0.00346	0.00346
58:00:00	0.0000	0.0000	0.0000	0.0000	0.00344	0.00344
58:30:00	0.0000	0.0000	0.0000	0.0000	0.00341	0.00341
59:00:00	0.0000	0.0000	0.0000	0.0000	0.00338	0.00338
59:30:00	0.0000	0.0000	0.0000	0.0000	0.00335	0.00335
60:00:00	0.0000	0.0000	0.0000	0.0000	0.00333	0.00333
60:30:00	0.0000	0.0000	0.0000	0.0000	0.0033	0.0033
61:00:00	0.0000	0.0000	0.0000	0.0000	0.00327	0.00327
61:30:00	0.0000	0.0000	0.0000	0.0000	0.00325	0.00325
62:00:00	0.0000	0.0000	0.0000	0.0000	0.00322	0.00322
62:30:00	0.0000	0.0000	0.0000	0.0000	0.00319	0.00319
63:00:00	0.0000	0.0000	0.0000	0.0000	0.00317	0.00317
63:30:00	0.0000	0.0000	0.0000	0.0000	0.00314	0.00314
64:00:00	0.0000	0.0000	0.0000	0.0000	0.00312	0.00312
64:30:00	0.0000	0.0000	0.0000	0.0000	0.00309	0.00309
65:00:00	0.0000	0.0000	0.0000	0.0000	0.00307	0.00307
65:30:00	0.0000	0.0000	0.0000	0.0000	0.00304	0.00304
66:00:00	0.0000	0.0000	0.0000	0.0000	0.00302	0.00302
66:30:00	0.0000	0.0000	0.0000	0.0000	0.00299	0.00299
67:00:00	0.0000	0.0000	0.0000	0.0000	0.00297	0.00297
67:30:00	0.0000	0.0000	0.0000	0.0000	0.00294	0.00294
68:00:00	0.0000	0.0000	0.0000	0.0000	0.00292	0.00292
68:30:00	0.0000	0.0000	0.0000	0.0000	0.0029	0.0029
69:00:00	0.0000	0.0000	0.0000	0.0000	0.00287	0.00287
69:30:00	0.0000	0.0000	0.0000	0.0000	0.00285	0.00285
70:00:00	0.0000	0.0000	0.0000	0.0000	0.00283	0.00283
70:30:00	0.0000	0.0000	0.0000	0.0000	0.0028	0.0028
71:00:00	0.0000	0.0000	0.0000	0.0000	0.00278	0.00278

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
71:30:00	0.0000	0.0000	0.0000	0.0000	0.00276	0.00276
72:00:00	0.0000	0.0000	0.0000	0.0000	0.00274	0.00274
72:30:00	0.0000	0.0000	0.0000	0.0000	0.00272	0.00272
73:00:00	0.0000	0.0000	0.0000	0.0000	0.00269	0.00269
73:30:00	0.0000	0.0000	0.0000	0.0000	0.00267	0.00267
74:00:00	0.0000	0.0000	0.0000	0.0000	0.00265	0.00265
74:30:00	0.0000	0.0000	0.0000	0.0000	0.00263	0.00263
75:00:00	0.0000	0.0000	0.0000	0.0000	0.00261	0.00261
75:30:00	0.0000	0.0000	0.0000	0.0000	0.00259	0.00259
76:00:00	0.0000	0.0000	0.0000	0.0000	0.00256	0.00256
76:30:00	0.0000	0.0000	0.0000	0.0000	0.00254	0.00254
77:00:00	0.0000	0.0000	0.0000	0.0000	0.00252	0.00252
77:30:00	0.0000	0.0000	0.0000	0.0000	0.0025	0.0025
78:00:00	0.0000	0.0000	0.0000	0.0000	0.00248	0.00248
78:30:00	0.0000	0.0000	0.0000	0.0000	0.00246	0.00246
79:00:00	0.0000	0.0000	0.0000	0.0000	0.00244	0.00244
79:30:00	0.0000	0.0000	0.0000	0.0000	0.00242	0.00242
80:00:00	0.0000	0.0000	0.0000	0.0000	0.0024	0.0024
80:30:00	0.0000	0.0000	0.0000	0.0000	0.00238	0.00238
81:00:00	0.0000	0.0000	0.0000	0.0000	0.00236	0.00236
81:30:00	0.0000	0.0000	0.0000	0.0000	0.00235	0.00235
82:00:00	0.0000	0.0000	0.0000	0.0000	0.00233	0.00233
82:30:00	0.0000	0.0000	0.0000	0.0000	0.00231	0.00231
83:00:00	0.0000	0.0000	0.0000	0.0000	0.00229	0.00229
83:30:00	0.0000	0.0000	0.0000	0.0000	0.00227	0.00227
84:00:00	0.0000	0.0000	0.0000	0.0000	0.00225	0.00225
84:30:00	0.0000	0.0000	0.0000	0.0000	0.00223	0.00223
85:00:00	0.0000	0.0000	0.0000	0.0000	0.00222	0.00222
85:30:00	0.0000	0.0000	0.0000	0.0000	0.0022	0.0022
86:00:00	0.0000	0.0000	0.0000	0.0000	0.00218	0.00218
86:30:00	0.0000	0.0000	0.0000	0.0000	0.00216	0.00216
87:00:00	0.0000	0.0000	0.0000	0.0000	0.00215	0.00215
87:30:00	0.0000	0.0000	0.0000	0.0000	0.00213	0.00213
88:00:00	0.0000	0.0000	0.0000	0.0000	0.00211	0.00211
88:30:00	0.0000	0.0000	0.0000	0.0000	0.00209	0.00209
89:00:00	0.0000	0.0000	0.0000	0.0000	0.00208	0.00208

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
89:30:00	0.0000	0.0000	0.0000	0.0000	0.00206	0.00206
90:00:00	0.0000	0.0000	0.0000	0.0000	0.00204	0.00204
90:30:00	0.0000	0.0000	0.0000	0.0000	0.00203	0.00203
91:00:00	0.0000	0.0000	0.0000	0.0000	0.00201	0.00201
91:30:00	0.0000	0.0000	0.0000	0.0000	0.00199	0.00199
92:00:00	0.0000	0.0000	0.0000	0.0000	0.00198	0.00198
92:30:00	0.0000	0.0000	0.0000	0.0000	0.00196	0.00196
93:00:00	0.0000	0.0000	0.0000	0.0000	0.00195	0.00195
93:30:00	0.0000	0.0000	0.0000	0.0000	0.00193	0.00193
94:00:00	0.0000	0.0000	0.0000	0.0000	0.00191	0.00191
94:30:00	0.0000	0.0000	0.0000	0.0000	0.0019	0.0019
95:00:00	0.0000	0.0000	0.0000	0.0000	0.00188	0.00188
95:30:00	0.0000	0.0000	0.0000	0.0000	0.00187	0.00187
96:00:00	0.0000	0.0000	0.0000	0.0000	0.00185	0.00185
96:30:00	0.0000	0.0000	0.0000	0.0000	0.00184	0.00184
97:00:00	0.0000	0.0000	0.0000	0.0000	0.00182	0.00182
97:30:00	0.0000	0.0000	0.0000	0.0000	0.00181	0.00181
98:00:00	0.0000	0.0000	0.0000	0.0000	0.00179	0.00179
98:30:00	0.0000	0.0000	0.0000	0.0000	0.00178	0.00178
99:00:00	0.0000	0.0000	0.0000	0.0000	0.00177	0.00177
99:30:00	0.0000	0.0000	0.0000	0.0000	0.00175	0.00175
100:00:00	0.0000	0.0000	0.0000	0.0000	0.00174	0.00174
100:30:00	0.0000	0.0000	0.0000	0.0000	0.00172	0.00172
101:00:00	0.0000	0.0000	0.0000	0.0000	0.00171	0.00171
101:30:00	0.0000	0.0000	0.0000	0.0000	0.00169	0.00169
102:00:00	0.0000	0.0000	0.0000	0.0000	0.00168	0.00168
102:30:00	0.0000	0.0000	0.0000	0.0000	0.00167	0.00167
103:00:00	0.0000	0.0000	0.0000	0.0000	0.00165	0.00165
103:30:00	0.0000	0.0000	0.0000	0.0000	0.00164	0.00164
104:00:00	0.0000	0.0000	0.0000	0.0000	0.00163	0.00163
104:30:00	0.0000	0.0000	0.0000	0.0000	0.00161	0.00161
105:00:00	0.0000	0.0000	0.0000	0.0000	0.0016	0.0016
105:30:00	0.0000	0.0000	0.0000	0.0000	0.00159	0.00159
106:00:00	0.0000	0.0000	0.0000	0.0000	0.00158	0.00158
106:30:00	0.0000	0.0000	0.0000	0.0000	0.00156	0.00156
107:00:00	0.0000	0.0000	0.0000	0.0000	0.00155	0.00155

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
107:30:00	0.0000	0.0000	0.0000	0.0000	0.00154	0.00154
108:00:00	0.0000	0.0000	0.0000	0.0000	0.00152	0.00152
108:30:00	0.0000	0.0000	0.0000	0.0000	0.00151	0.00151
109:00:00	0.0000	0.0000	0.0000	0.0000	0.0015	0.0015
109:30:00	0.0000	0.0000	0.0000	0.0000	0.00149	0.00149
110:00:00	0.0000	0.0000	0.0000	0.0000	0.00148	0.00148
110:30:00	0.0000	0.0000	0.0000	0.0000	0.00146	0.00146
111:00:00	0.0000	0.0000	0.0000	0.0000	0.00145	0.00145
111:30:00	0.0000	0.0000	0.0000	0.0000	0.00144	0.00144
112:00:00	0.0000	0.0000	0.0000	0.0000	0.00143	0.00143
112:30:00	0.0000	0.0000	0.0000	0.0000	0.00142	0.00142
113:00:00	0.0000	0.0000	0.0000	0.0000	0.00141	0.00141
113:30:00	0.0000	0.0000	0.0000	0.0000	0.00139	0.00139
114:00:00	0.0000	0.0000	0.0000	0.0000	0.00138	0.00138
114:30:00	0.0000	0.0000	0.0000	0.0000	0.00137	0.00137
115:00:00	0.0000	0.0000	0.0000	0.0000	0.00136	0.00136
115:30:00	0.0000	0.0000	0.0000	0.0000	0.00135	0.00135
116:00:00	0.0000	0.0000	0.0000	0.0000	0.00134	0.00134
116:30:00	0.0000	0.0000	0.0000	0.0000	0.00133	0.00133
117:00:00	0.0000	0.0000	0.0000	0.0000	0.00132	0.00132
117:30:00	0.0000	0.0000	0.0000	0.0000	0.00131	0.00131
118:00:00	0.0000	0.0000	0.0000	0.0000	0.0013	0.0013
118:30:00	0.0000	0.0000	0.0000	0.0000	0.00129	0.00129
119:00:00	0.0000	0.0000	0.0000	0.0000	0.00128	0.00128
119:30:00	0.0000	0.0000	0.0000	0.0000	0.00126	0.00126
120:00:00	0.0000	0.0000	0.0000	0.0000	0.00125	0.00125
120:30:00	0.0000	0.0000	0.0000	0.0000	0.00124	0.00124
121:00:00	0.0000	0.0000	0.0000	0.0000	0.00123	0.00123
121:30:00	0.0000	0.0000	0.0000	0.0000	0.00122	0.00122
122:00:00	0.0000	0.0000	0.0000	0.0000	0.00121	0.00121
122:30:00	0.0000	0.0000	0.0000	0.0000	0.0012	0.0012
123:00:00	0.0000	0.0000	0.0000	0.0000	0.00119	0.00119
123:30:00	0.0000	0.0000	0.0000	0.0000	0.00119	0.00119
124:00:00	0.0000	0.0000	0.0000	0.0000	0.00118	0.00118
124:30:00	0.0000	0.0000	0.0000	0.0000	0.00117	0.00117
125:00:00	0.0000	0.0000	0.0000	0.0000	0.00116	0.00116

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
125:30:00	0.0000	0.0000	0.0000	0.0000	0.00115	0.00115
126:00:00	0.0000	0.0000	0.0000	0.0000	0.00114	0.00114
126:30:00	0.0000	0.0000	0.0000	0.0000	0.00113	0.00113

Appendix

Catchment descriptors

Name	Value	User-defined value used?
BFIHOST	0.72	No
BFIHOST19	0.79	No
PROPWET (mm)	0.23	No
SAAR (mm)	613	No

UK Design Flood Estimation

Generated on Tuesday, April 18, 2023 2:49:41 PM by UKSEK001
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: D0C6-6167

Site name: FEH_Point_Descriptors_563622_316604_v4_0_0_Edit

Easting: 563622

Northing: 316604

Country: England, Wales or Northern Ireland

Catchment Area (km^2): 0.5

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 30 year

Summary of results

Rainfall - FEH 2013 model (mm):	59.55	Total runoff (ML):	1.83
Total Rainfall (mm):	39.38	Total flow (ML):	6.06
Peak Rainfall (mm):	8.95	Peak flow (m^3/s):	0.09

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	05:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	1 [0.98]	Yes
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	67.18	No
Cmax (mm)	934.79	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.14	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	61.54	No
BR	2.7	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.8647	0.0000	0.0625	0.0000	0	0
00:30:00	1.4487	0.0000	0.1066	0.0001	1.57E-06	0.000145
01:00:00	2.4144	0.0000	0.1826	0.0007	1.05E-05	0.000686
01:30:00	3.9923	0.0000	0.3156	0.0019	3.82E-05	0.00191
02:00:00	6.4970	0.0000	0.5501	0.0042	0.000104	0.00431
02:30:00	8.9499	0.0000	0.8318	0.0085	0.000243	0.00878
03:00:00	6.4970	0.0000	0.6575	0.0160	0.000509	0.0165
03:30:00	3.9923	0.0000	0.4264	0.0268	0.000973	0.0278
04:00:00	2.4144	0.0000	0.2662	0.0396	0.00169	0.0413
04:30:00	1.4487	0.0000	0.1627	0.0530	0.00269	0.0557
05:00:00	0.8647	0.0000	0.0982	0.0659	0.00397	0.0698
05:30:00	0.0000	0.0000	0.0000	0.0766	0.00549	0.0821
06:00:00	0.0000	0.0000	0.0000	0.0831	0.00719	0.0903
06:30:00	0.0000	0.0000	0.0000	0.0840	0.00896	0.0929
07:00:00	0.0000	0.0000	0.0000	0.0805	0.0107	0.0912
07:30:00	0.0000	0.0000	0.0000	0.0744	0.0123	0.0867
08:00:00	0.0000	0.0000	0.0000	0.0667	0.0137	0.0805
08:30:00	0.0000	0.0000	0.0000	0.0585	0.015	0.0735
09:00:00	0.0000	0.0000	0.0000	0.0505	0.0161	0.0666
09:30:00	0.0000	0.0000	0.0000	0.0437	0.017	0.0606
10:00:00	0.0000	0.0000	0.0000	0.0378	0.0177	0.0555
10:30:00	0.0000	0.0000	0.0000	0.0326	0.0183	0.0509
11:00:00	0.0000	0.0000	0.0000	0.0278	0.0188	0.0466
11:30:00	0.0000	0.0000	0.0000	0.0233	0.0192	0.0425
12:00:00	0.0000	0.0000	0.0000	0.0190	0.0196	0.0385
12:30:00	0.0000	0.0000	0.0000	0.0148	0.0198	0.0346
13:00:00	0.0000	0.0000	0.0000	0.0109	0.0199	0.0308
13:30:00	0.0000	0.0000	0.0000	0.0073	0.0199	0.0272
14:00:00	0.0000	0.0000	0.0000	0.0044	0.0199	0.0243
14:30:00	0.0000	0.0000	0.0000	0.0024	0.0198	0.0222
15:00:00	0.0000	0.0000	0.0000	0.0012	0.0197	0.0209
15:30:00	0.0000	0.0000	0.0000	0.0005	0.0195	0.02
16:00:00	0.0000	0.0000	0.0000	0.0002	0.0194	0.0195
16:30:00	0.0000	0.0000	0.0000	0.0000	0.0192	0.0193
17:00:00	0.0000	0.0000	0.0000	0.0000	0.0191	0.0191

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:30:00	0.0000	0.0000	0.0000	0.0000	0.0189	0.0189
18:00:00	0.0000	0.0000	0.0000	0.0000	0.0188	0.0188
18:30:00	0.0000	0.0000	0.0000	0.0000	0.0186	0.0186
19:00:00	0.0000	0.0000	0.0000	0.0000	0.0185	0.0185
19:30:00	0.0000	0.0000	0.0000	0.0000	0.0183	0.0183
20:00:00	0.0000	0.0000	0.0000	0.0000	0.0182	0.0182
20:30:00	0.0000	0.0000	0.0000	0.0000	0.018	0.018
21:00:00	0.0000	0.0000	0.0000	0.0000	0.0179	0.0179
21:30:00	0.0000	0.0000	0.0000	0.0000	0.0177	0.0177
22:00:00	0.0000	0.0000	0.0000	0.0000	0.0176	0.0176
22:30:00	0.0000	0.0000	0.0000	0.0000	0.0174	0.0174
23:00:00	0.0000	0.0000	0.0000	0.0000	0.0173	0.0173
23:30:00	0.0000	0.0000	0.0000	0.0000	0.0172	0.0172
24:00:00	0.0000	0.0000	0.0000	0.0000	0.017	0.017
24:30:00	0.0000	0.0000	0.0000	0.0000	0.0169	0.0169
25:00:00	0.0000	0.0000	0.0000	0.0000	0.0168	0.0168
25:30:00	0.0000	0.0000	0.0000	0.0000	0.0166	0.0166
26:00:00	0.0000	0.0000	0.0000	0.0000	0.0165	0.0165
26:30:00	0.0000	0.0000	0.0000	0.0000	0.0163	0.0163
27:00:00	0.0000	0.0000	0.0000	0.0000	0.0162	0.0162
27:30:00	0.0000	0.0000	0.0000	0.0000	0.0161	0.0161
28:00:00	0.0000	0.0000	0.0000	0.0000	0.016	0.016
28:30:00	0.0000	0.0000	0.0000	0.0000	0.0158	0.0158
29:00:00	0.0000	0.0000	0.0000	0.0000	0.0157	0.0157
29:30:00	0.0000	0.0000	0.0000	0.0000	0.0156	0.0156
30:00:00	0.0000	0.0000	0.0000	0.0000	0.0154	0.0154
30:30:00	0.0000	0.0000	0.0000	0.0000	0.0153	0.0153
31:00:00	0.0000	0.0000	0.0000	0.0000	0.0152	0.0152
31:30:00	0.0000	0.0000	0.0000	0.0000	0.0151	0.0151
32:00:00	0.0000	0.0000	0.0000	0.0000	0.015	0.015
32:30:00	0.0000	0.0000	0.0000	0.0000	0.0148	0.0148
33:00:00	0.0000	0.0000	0.0000	0.0000	0.0147	0.0147
33:30:00	0.0000	0.0000	0.0000	0.0000	0.0146	0.0146
34:00:00	0.0000	0.0000	0.0000	0.0000	0.0145	0.0145
34:30:00	0.0000	0.0000	0.0000	0.0000	0.0144	0.0144
35:00:00	0.0000	0.0000	0.0000	0.0000	0.0142	0.0142

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
35:30:00	0.0000	0.0000	0.0000	0.0000	0.0141	0.0141
36:00:00	0.0000	0.0000	0.0000	0.0000	0.014	0.014
36:30:00	0.0000	0.0000	0.0000	0.0000	0.0139	0.0139
37:00:00	0.0000	0.0000	0.0000	0.0000	0.0138	0.0138
37:30:00	0.0000	0.0000	0.0000	0.0000	0.0137	0.0137
38:00:00	0.0000	0.0000	0.0000	0.0000	0.0136	0.0136
38:30:00	0.0000	0.0000	0.0000	0.0000	0.0135	0.0135
39:00:00	0.0000	0.0000	0.0000	0.0000	0.0133	0.0133
39:30:00	0.0000	0.0000	0.0000	0.0000	0.0132	0.0132
40:00:00	0.0000	0.0000	0.0000	0.0000	0.0131	0.0131
40:30:00	0.0000	0.0000	0.0000	0.0000	0.013	0.013
41:00:00	0.0000	0.0000	0.0000	0.0000	0.0129	0.0129
41:30:00	0.0000	0.0000	0.0000	0.0000	0.0128	0.0128
42:00:00	0.0000	0.0000	0.0000	0.0000	0.0127	0.0127
42:30:00	0.0000	0.0000	0.0000	0.0000	0.0126	0.0126
43:00:00	0.0000	0.0000	0.0000	0.0000	0.0125	0.0125
43:30:00	0.0000	0.0000	0.0000	0.0000	0.0124	0.0124
44:00:00	0.0000	0.0000	0.0000	0.0000	0.0123	0.0123
44:30:00	0.0000	0.0000	0.0000	0.0000	0.0122	0.0122
45:00:00	0.0000	0.0000	0.0000	0.0000	0.0121	0.0121
45:30:00	0.0000	0.0000	0.0000	0.0000	0.012	0.012
46:00:00	0.0000	0.0000	0.0000	0.0000	0.0119	0.0119
46:30:00	0.0000	0.0000	0.0000	0.0000	0.0118	0.0118
47:00:00	0.0000	0.0000	0.0000	0.0000	0.0117	0.0117
47:30:00	0.0000	0.0000	0.0000	0.0000	0.0116	0.0116
48:00:00	0.0000	0.0000	0.0000	0.0000	0.0115	0.0115
48:30:00	0.0000	0.0000	0.0000	0.0000	0.0114	0.0114
49:00:00	0.0000	0.0000	0.0000	0.0000	0.0113	0.0113
49:30:00	0.0000	0.0000	0.0000	0.0000	0.0113	0.0113
50:00:00	0.0000	0.0000	0.0000	0.0000	0.0112	0.0112
50:30:00	0.0000	0.0000	0.0000	0.0000	0.0111	0.0111
51:00:00	0.0000	0.0000	0.0000	0.0000	0.011	0.011
51:30:00	0.0000	0.0000	0.0000	0.0000	0.0109	0.0109
52:00:00	0.0000	0.0000	0.0000	0.0000	0.0108	0.0108
52:30:00	0.0000	0.0000	0.0000	0.0000	0.0107	0.0107
53:00:00	0.0000	0.0000	0.0000	0.0000	0.0106	0.0106

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
53:30:00	0.0000	0.0000	0.0000	0.0000	0.0105	0.0105
54:00:00	0.0000	0.0000	0.0000	0.0000	0.0105	0.0105
54:30:00	0.0000	0.0000	0.0000	0.0000	0.0104	0.0104
55:00:00	0.0000	0.0000	0.0000	0.0000	0.0103	0.0103
55:30:00	0.0000	0.0000	0.0000	0.0000	0.0102	0.0102
56:00:00	0.0000	0.0000	0.0000	0.0000	0.0101	0.0101
56:30:00	0.0000	0.0000	0.0000	0.0000	0.01	0.01
57:00:00	0.0000	0.0000	0.0000	0.0000	0.00996	0.00996
57:30:00	0.0000	0.0000	0.0000	0.0000	0.00988	0.00988
58:00:00	0.0000	0.0000	0.0000	0.0000	0.0098	0.0098
58:30:00	0.0000	0.0000	0.0000	0.0000	0.00972	0.00972
59:00:00	0.0000	0.0000	0.0000	0.0000	0.00964	0.00964
59:30:00	0.0000	0.0000	0.0000	0.0000	0.00956	0.00956
60:00:00	0.0000	0.0000	0.0000	0.0000	0.00949	0.00949
60:30:00	0.0000	0.0000	0.0000	0.0000	0.00941	0.00941
61:00:00	0.0000	0.0000	0.0000	0.0000	0.00933	0.00933
61:30:00	0.0000	0.0000	0.0000	0.0000	0.00926	0.00926
62:00:00	0.0000	0.0000	0.0000	0.0000	0.00918	0.00918
62:30:00	0.0000	0.0000	0.0000	0.0000	0.00911	0.00911
63:00:00	0.0000	0.0000	0.0000	0.0000	0.00903	0.00903
63:30:00	0.0000	0.0000	0.0000	0.0000	0.00896	0.00896
64:00:00	0.0000	0.0000	0.0000	0.0000	0.00889	0.00889
64:30:00	0.0000	0.0000	0.0000	0.0000	0.00882	0.00882
65:00:00	0.0000	0.0000	0.0000	0.0000	0.00875	0.00875
65:30:00	0.0000	0.0000	0.0000	0.0000	0.00867	0.00867
66:00:00	0.0000	0.0000	0.0000	0.0000	0.0086	0.0086
66:30:00	0.0000	0.0000	0.0000	0.0000	0.00853	0.00853
67:00:00	0.0000	0.0000	0.0000	0.0000	0.00847	0.00847
67:30:00	0.0000	0.0000	0.0000	0.0000	0.0084	0.0084
68:00:00	0.0000	0.0000	0.0000	0.0000	0.00833	0.00833
68:30:00	0.0000	0.0000	0.0000	0.0000	0.00826	0.00826
69:00:00	0.0000	0.0000	0.0000	0.0000	0.0082	0.0082
69:30:00	0.0000	0.0000	0.0000	0.0000	0.00813	0.00813
70:00:00	0.0000	0.0000	0.0000	0.0000	0.00806	0.00806
70:30:00	0.0000	0.0000	0.0000	0.0000	0.008	0.008
71:00:00	0.0000	0.0000	0.0000	0.0000	0.00793	0.00793

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
71:30:00	0.0000	0.0000	0.0000	0.0000	0.00787	0.00787
72:00:00	0.0000	0.0000	0.0000	0.0000	0.00781	0.00781
72:30:00	0.0000	0.0000	0.0000	0.0000	0.00774	0.00774
73:00:00	0.0000	0.0000	0.0000	0.0000	0.00768	0.00768
73:30:00	0.0000	0.0000	0.0000	0.0000	0.00762	0.00762
74:00:00	0.0000	0.0000	0.0000	0.0000	0.00756	0.00756
74:30:00	0.0000	0.0000	0.0000	0.0000	0.00749	0.00749
75:00:00	0.0000	0.0000	0.0000	0.0000	0.00743	0.00743
75:30:00	0.0000	0.0000	0.0000	0.0000	0.00737	0.00737
76:00:00	0.0000	0.0000	0.0000	0.0000	0.00731	0.00731
76:30:00	0.0000	0.0000	0.0000	0.0000	0.00725	0.00725
77:00:00	0.0000	0.0000	0.0000	0.0000	0.0072	0.0072
77:30:00	0.0000	0.0000	0.0000	0.0000	0.00714	0.00714
78:00:00	0.0000	0.0000	0.0000	0.0000	0.00708	0.00708
78:30:00	0.0000	0.0000	0.0000	0.0000	0.00702	0.00702
79:00:00	0.0000	0.0000	0.0000	0.0000	0.00697	0.00697
79:30:00	0.0000	0.0000	0.0000	0.0000	0.00691	0.00691
80:00:00	0.0000	0.0000	0.0000	0.0000	0.00685	0.00685
80:30:00	0.0000	0.0000	0.0000	0.0000	0.0068	0.0068
81:00:00	0.0000	0.0000	0.0000	0.0000	0.00674	0.00674
81:30:00	0.0000	0.0000	0.0000	0.0000	0.00669	0.00669
82:00:00	0.0000	0.0000	0.0000	0.0000	0.00663	0.00663
82:30:00	0.0000	0.0000	0.0000	0.0000	0.00658	0.00658
83:00:00	0.0000	0.0000	0.0000	0.0000	0.00653	0.00653
83:30:00	0.0000	0.0000	0.0000	0.0000	0.00647	0.00647
84:00:00	0.0000	0.0000	0.0000	0.0000	0.00642	0.00642
84:30:00	0.0000	0.0000	0.0000	0.0000	0.00637	0.00637
85:00:00	0.0000	0.0000	0.0000	0.0000	0.00632	0.00632
85:30:00	0.0000	0.0000	0.0000	0.0000	0.00627	0.00627
86:00:00	0.0000	0.0000	0.0000	0.0000	0.00622	0.00622
86:30:00	0.0000	0.0000	0.0000	0.0000	0.00617	0.00617
87:00:00	0.0000	0.0000	0.0000	0.0000	0.00612	0.00612
87:30:00	0.0000	0.0000	0.0000	0.0000	0.00607	0.00607
88:00:00	0.0000	0.0000	0.0000	0.0000	0.00602	0.00602
88:30:00	0.0000	0.0000	0.0000	0.0000	0.00597	0.00597
89:00:00	0.0000	0.0000	0.0000	0.0000	0.00592	0.00592

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
89:30:00	0.0000	0.0000	0.0000	0.0000	0.00587	0.00587
90:00:00	0.0000	0.0000	0.0000	0.0000	0.00583	0.00583
90:30:00	0.0000	0.0000	0.0000	0.0000	0.00578	0.00578
91:00:00	0.0000	0.0000	0.0000	0.0000	0.00573	0.00573
91:30:00	0.0000	0.0000	0.0000	0.0000	0.00569	0.00569
92:00:00	0.0000	0.0000	0.0000	0.0000	0.00564	0.00564
92:30:00	0.0000	0.0000	0.0000	0.0000	0.00559	0.00559
93:00:00	0.0000	0.0000	0.0000	0.0000	0.00555	0.00555
93:30:00	0.0000	0.0000	0.0000	0.0000	0.0055	0.0055
94:00:00	0.0000	0.0000	0.0000	0.0000	0.00546	0.00546
94:30:00	0.0000	0.0000	0.0000	0.0000	0.00541	0.00541
95:00:00	0.0000	0.0000	0.0000	0.0000	0.00537	0.00537
95:30:00	0.0000	0.0000	0.0000	0.0000	0.00533	0.00533
96:00:00	0.0000	0.0000	0.0000	0.0000	0.00528	0.00528
96:30:00	0.0000	0.0000	0.0000	0.0000	0.00524	0.00524
97:00:00	0.0000	0.0000	0.0000	0.0000	0.0052	0.0052
97:30:00	0.0000	0.0000	0.0000	0.0000	0.00516	0.00516
98:00:00	0.0000	0.0000	0.0000	0.0000	0.00512	0.00512
98:30:00	0.0000	0.0000	0.0000	0.0000	0.00507	0.00507
99:00:00	0.0000	0.0000	0.0000	0.0000	0.00503	0.00503
99:30:00	0.0000	0.0000	0.0000	0.0000	0.00499	0.00499
100:00:00	0.0000	0.0000	0.0000	0.0000	0.00495	0.00495
100:30:00	0.0000	0.0000	0.0000	0.0000	0.00491	0.00491
101:00:00	0.0000	0.0000	0.0000	0.0000	0.00487	0.00487
101:30:00	0.0000	0.0000	0.0000	0.0000	0.00483	0.00483
102:00:00	0.0000	0.0000	0.0000	0.0000	0.00479	0.00479
102:30:00	0.0000	0.0000	0.0000	0.0000	0.00475	0.00475
103:00:00	0.0000	0.0000	0.0000	0.0000	0.00472	0.00472
103:30:00	0.0000	0.0000	0.0000	0.0000	0.00468	0.00468
104:00:00	0.0000	0.0000	0.0000	0.0000	0.00464	0.00464
104:30:00	0.0000	0.0000	0.0000	0.0000	0.0046	0.0046
105:00:00	0.0000	0.0000	0.0000	0.0000	0.00457	0.00457
105:30:00	0.0000	0.0000	0.0000	0.0000	0.00453	0.00453
106:00:00	0.0000	0.0000	0.0000	0.0000	0.00449	0.00449
106:30:00	0.0000	0.0000	0.0000	0.0000	0.00446	0.00446
107:00:00	0.0000	0.0000	0.0000	0.0000	0.00442	0.00442

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
107:30:00	0.0000	0.0000	0.0000	0.0000	0.00438	0.00438
108:00:00	0.0000	0.0000	0.0000	0.0000	0.00435	0.00435
108:30:00	0.0000	0.0000	0.0000	0.0000	0.00431	0.00431
109:00:00	0.0000	0.0000	0.0000	0.0000	0.00428	0.00428
109:30:00	0.0000	0.0000	0.0000	0.0000	0.00424	0.00424
110:00:00	0.0000	0.0000	0.0000	0.0000	0.00421	0.00421
110:30:00	0.0000	0.0000	0.0000	0.0000	0.00418	0.00418
111:00:00	0.0000	0.0000	0.0000	0.0000	0.00414	0.00414
111:30:00	0.0000	0.0000	0.0000	0.0000	0.00411	0.00411
112:00:00	0.0000	0.0000	0.0000	0.0000	0.00407	0.00407
112:30:00	0.0000	0.0000	0.0000	0.0000	0.00404	0.00404
113:00:00	0.0000	0.0000	0.0000	0.0000	0.00401	0.00401
113:30:00	0.0000	0.0000	0.0000	0.0000	0.00398	0.00398
114:00:00	0.0000	0.0000	0.0000	0.0000	0.00394	0.00394
114:30:00	0.0000	0.0000	0.0000	0.0000	0.00391	0.00391
115:00:00	0.0000	0.0000	0.0000	0.0000	0.00388	0.00388
115:30:00	0.0000	0.0000	0.0000	0.0000	0.00385	0.00385
116:00:00	0.0000	0.0000	0.0000	0.0000	0.00382	0.00382
116:30:00	0.0000	0.0000	0.0000	0.0000	0.00379	0.00379
117:00:00	0.0000	0.0000	0.0000	0.0000	0.00376	0.00376
117:30:00	0.0000	0.0000	0.0000	0.0000	0.00373	0.00373
118:00:00	0.0000	0.0000	0.0000	0.0000	0.0037	0.0037
118:30:00	0.0000	0.0000	0.0000	0.0000	0.00367	0.00367
119:00:00	0.0000	0.0000	0.0000	0.0000	0.00364	0.00364
119:30:00	0.0000	0.0000	0.0000	0.0000	0.00361	0.00361
120:00:00	0.0000	0.0000	0.0000	0.0000	0.00358	0.00358
120:30:00	0.0000	0.0000	0.0000	0.0000	0.00355	0.00355
121:00:00	0.0000	0.0000	0.0000	0.0000	0.00352	0.00352
121:30:00	0.0000	0.0000	0.0000	0.0000	0.00349	0.00349
122:00:00	0.0000	0.0000	0.0000	0.0000	0.00346	0.00346
122:30:00	0.0000	0.0000	0.0000	0.0000	0.00344	0.00344
123:00:00	0.0000	0.0000	0.0000	0.0000	0.00341	0.00341
123:30:00	0.0000	0.0000	0.0000	0.0000	0.00338	0.00338
124:00:00	0.0000	0.0000	0.0000	0.0000	0.00335	0.00335
124:30:00	0.0000	0.0000	0.0000	0.0000	0.00333	0.00333
125:00:00	0.0000	0.0000	0.0000	0.0000	0.0033	0.0033

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
125:30:00	0.0000	0.0000	0.0000	0.0000	0.00327	0.00327
126:00:00	0.0000	0.0000	0.0000	0.0000	0.00325	0.00325
126:30:00	0.0000	0.0000	0.0000	0.0000	0.00322	0.00322

Appendix

Catchment descriptors

Name	Value	User-defined value used?
BFIHOST	0.72	No
BFIHOST19	0.79	No
PROPWET (mm)	0.23	No
SAAR (mm)	613	No

UK Design Flood Estimation

Generated on Tuesday, April 18, 2023 2:48:24 PM by UKSEK001
Printed from the ReFH2 Flood Modelling software package, version 3.1.7439.12207

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: D0C6-6167

Site name: FEH_Point_Descriptors_563622_316604_v4_0_0_Edit

Easting: 563622

Northing: 316604

Country: England, Wales or Northern Ireland

Catchment Area (km^2): 0.5

Using plot scale calculations: Yes

Model: ReFH2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH 2013 model (mm):	81.58	Total runoff (ML):	2.72
Total Rainfall (mm):	53.96	Total flow (ML):	9.00
Peak Rainfall (mm):	12.26	Peak flow (m^3/s):	0.14

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	05:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	1 [0.98]	Yes
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	67.18	No
Cmax (mm)	934.79	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.14	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	61.54	No
BR	2.7	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	1.1847	0.0000	0.0859	0.0000	0	0
00:30:00	1.9848	0.0000	0.1473	0.0002	2.16E-06	0.000199
01:00:00	3.3080	0.0000	0.2548	0.0009	1.45E-05	0.000944
01:30:00	5.4697	0.0000	0.4470	0.0026	5.27E-05	0.00264
02:00:00	8.9014	0.0000	0.7959	0.0058	0.000144	0.00599
02:30:00	12.2621	0.0000	1.2352	0.0120	0.000338	0.0123
03:00:00	8.9014	0.0000	0.9974	0.0227	0.000715	0.0235
03:30:00	5.4697	0.0000	0.6549	0.0385	0.00138	0.0399
04:00:00	3.3080	0.0000	0.4116	0.0573	0.00241	0.0597
04:30:00	1.9848	0.0000	0.2526	0.0773	0.00386	0.0811
05:00:00	1.1847	0.0000	0.1528	0.0966	0.00573	0.102
05:30:00	0.0000	0.0000	0.0000	0.1130	0.00797	0.121
06:00:00	0.0000	0.0000	0.0000	0.1232	0.0105	0.134
06:30:00	0.0000	0.0000	0.0000	0.1250	0.0131	0.138
07:00:00	0.0000	0.0000	0.0000	0.1202	0.0157	0.136
07:30:00	0.0000	0.0000	0.0000	0.1113	0.0181	0.129
08:00:00	0.0000	0.0000	0.0000	0.1000	0.0203	0.12
08:30:00	0.0000	0.0000	0.0000	0.0877	0.0221	0.11
09:00:00	0.0000	0.0000	0.0000	0.0758	0.0237	0.0995
09:30:00	0.0000	0.0000	0.0000	0.0655	0.0251	0.0906
10:00:00	0.0000	0.0000	0.0000	0.0567	0.0262	0.0829
10:30:00	0.0000	0.0000	0.0000	0.0489	0.0272	0.0761
11:00:00	0.0000	0.0000	0.0000	0.0418	0.0279	0.0697
11:30:00	0.0000	0.0000	0.0000	0.0350	0.0286	0.0636
12:00:00	0.0000	0.0000	0.0000	0.0286	0.029	0.0576
12:30:00	0.0000	0.0000	0.0000	0.0224	0.0293	0.0518
13:00:00	0.0000	0.0000	0.0000	0.0165	0.0295	0.046
13:30:00	0.0000	0.0000	0.0000	0.0112	0.0296	0.0408
14:00:00	0.0000	0.0000	0.0000	0.0067	0.0295	0.0363
14:30:00	0.0000	0.0000	0.0000	0.0037	0.0294	0.0331
15:00:00	0.0000	0.0000	0.0000	0.0018	0.0292	0.0311
15:30:00	0.0000	0.0000	0.0000	0.0008	0.029	0.0298
16:00:00	0.0000	0.0000	0.0000	0.0002	0.0288	0.029
16:30:00	0.0000	0.0000	0.0000	0.0000	0.0286	0.0286
17:00:00	0.0000	0.0000	0.0000	0.0000	0.0283	0.0283

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:30:00	0.0000	0.0000	0.0000	0.0000	0.0281	0.0281
18:00:00	0.0000	0.0000	0.0000	0.0000	0.0279	0.0279
18:30:00	0.0000	0.0000	0.0000	0.0000	0.0277	0.0277
19:00:00	0.0000	0.0000	0.0000	0.0000	0.0274	0.0274
19:30:00	0.0000	0.0000	0.0000	0.0000	0.0272	0.0272
20:00:00	0.0000	0.0000	0.0000	0.0000	0.027	0.027
20:30:00	0.0000	0.0000	0.0000	0.0000	0.0268	0.0268
21:00:00	0.0000	0.0000	0.0000	0.0000	0.0266	0.0266
21:30:00	0.0000	0.0000	0.0000	0.0000	0.0263	0.0263
22:00:00	0.0000	0.0000	0.0000	0.0000	0.0261	0.0261
22:30:00	0.0000	0.0000	0.0000	0.0000	0.0259	0.0259
23:00:00	0.0000	0.0000	0.0000	0.0000	0.0257	0.0257
23:30:00	0.0000	0.0000	0.0000	0.0000	0.0255	0.0255
24:00:00	0.0000	0.0000	0.0000	0.0000	0.0253	0.0253
24:30:00	0.0000	0.0000	0.0000	0.0000	0.0251	0.0251
25:00:00	0.0000	0.0000	0.0000	0.0000	0.0249	0.0249
25:30:00	0.0000	0.0000	0.0000	0.0000	0.0247	0.0247
26:00:00	0.0000	0.0000	0.0000	0.0000	0.0245	0.0245
26:30:00	0.0000	0.0000	0.0000	0.0000	0.0243	0.0243
27:00:00	0.0000	0.0000	0.0000	0.0000	0.0241	0.0241
27:30:00	0.0000	0.0000	0.0000	0.0000	0.0239	0.0239
28:00:00	0.0000	0.0000	0.0000	0.0000	0.0237	0.0237
28:30:00	0.0000	0.0000	0.0000	0.0000	0.0235	0.0235
29:00:00	0.0000	0.0000	0.0000	0.0000	0.0233	0.0233
29:30:00	0.0000	0.0000	0.0000	0.0000	0.0231	0.0231
30:00:00	0.0000	0.0000	0.0000	0.0000	0.023	0.023
30:30:00	0.0000	0.0000	0.0000	0.0000	0.0228	0.0228
31:00:00	0.0000	0.0000	0.0000	0.0000	0.0226	0.0226
31:30:00	0.0000	0.0000	0.0000	0.0000	0.0224	0.0224
32:00:00	0.0000	0.0000	0.0000	0.0000	0.0222	0.0222
32:30:00	0.0000	0.0000	0.0000	0.0000	0.022	0.022
33:00:00	0.0000	0.0000	0.0000	0.0000	0.0219	0.0219
33:30:00	0.0000	0.0000	0.0000	0.0000	0.0217	0.0217
34:00:00	0.0000	0.0000	0.0000	0.0000	0.0215	0.0215
34:30:00	0.0000	0.0000	0.0000	0.0000	0.0213	0.0213
35:00:00	0.0000	0.0000	0.0000	0.0000	0.0212	0.0212

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
35:30:00	0.0000	0.0000	0.0000	0.0000	0.021	0.021
36:00:00	0.0000	0.0000	0.0000	0.0000	0.0208	0.0208
36:30:00	0.0000	0.0000	0.0000	0.0000	0.0206	0.0206
37:00:00	0.0000	0.0000	0.0000	0.0000	0.0205	0.0205
37:30:00	0.0000	0.0000	0.0000	0.0000	0.0203	0.0203
38:00:00	0.0000	0.0000	0.0000	0.0000	0.0202	0.0202
38:30:00	0.0000	0.0000	0.0000	0.0000	0.02	0.02
39:00:00	0.0000	0.0000	0.0000	0.0000	0.0198	0.0198
39:30:00	0.0000	0.0000	0.0000	0.0000	0.0197	0.0197
40:00:00	0.0000	0.0000	0.0000	0.0000	0.0195	0.0195
40:30:00	0.0000	0.0000	0.0000	0.0000	0.0193	0.0193
41:00:00	0.0000	0.0000	0.0000	0.0000	0.0192	0.0192
41:30:00	0.0000	0.0000	0.0000	0.0000	0.019	0.019
42:00:00	0.0000	0.0000	0.0000	0.0000	0.0189	0.0189
42:30:00	0.0000	0.0000	0.0000	0.0000	0.0187	0.0187
43:00:00	0.0000	0.0000	0.0000	0.0000	0.0186	0.0186
43:30:00	0.0000	0.0000	0.0000	0.0000	0.0184	0.0184
44:00:00	0.0000	0.0000	0.0000	0.0000	0.0183	0.0183
44:30:00	0.0000	0.0000	0.0000	0.0000	0.0181	0.0181
45:00:00	0.0000	0.0000	0.0000	0.0000	0.018	0.018
45:30:00	0.0000	0.0000	0.0000	0.0000	0.0178	0.0178
46:00:00	0.0000	0.0000	0.0000	0.0000	0.0177	0.0177
46:30:00	0.0000	0.0000	0.0000	0.0000	0.0176	0.0176
47:00:00	0.0000	0.0000	0.0000	0.0000	0.0174	0.0174
47:30:00	0.0000	0.0000	0.0000	0.0000	0.0173	0.0173
48:00:00	0.0000	0.0000	0.0000	0.0000	0.0171	0.0171
48:30:00	0.0000	0.0000	0.0000	0.0000	0.017	0.017
49:00:00	0.0000	0.0000	0.0000	0.0000	0.0169	0.0169
49:30:00	0.0000	0.0000	0.0000	0.0000	0.0167	0.0167
50:00:00	0.0000	0.0000	0.0000	0.0000	0.0166	0.0166
50:30:00	0.0000	0.0000	0.0000	0.0000	0.0164	0.0164
51:00:00	0.0000	0.0000	0.0000	0.0000	0.0163	0.0163
51:30:00	0.0000	0.0000	0.0000	0.0000	0.0162	0.0162
52:00:00	0.0000	0.0000	0.0000	0.0000	0.0161	0.0161
52:30:00	0.0000	0.0000	0.0000	0.0000	0.0159	0.0159
53:00:00	0.0000	0.0000	0.0000	0.0000	0.0158	0.0158

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
53:30:00	0.0000	0.0000	0.0000	0.0000	0.0157	0.0157
54:00:00	0.0000	0.0000	0.0000	0.0000	0.0155	0.0155
54:30:00	0.0000	0.0000	0.0000	0.0000	0.0154	0.0154
55:00:00	0.0000	0.0000	0.0000	0.0000	0.0153	0.0153
55:30:00	0.0000	0.0000	0.0000	0.0000	0.0152	0.0152
56:00:00	0.0000	0.0000	0.0000	0.0000	0.015	0.015
56:30:00	0.0000	0.0000	0.0000	0.0000	0.0149	0.0149
57:00:00	0.0000	0.0000	0.0000	0.0000	0.0148	0.0148
57:30:00	0.0000	0.0000	0.0000	0.0000	0.0147	0.0147
58:00:00	0.0000	0.0000	0.0000	0.0000	0.0146	0.0146
58:30:00	0.0000	0.0000	0.0000	0.0000	0.0144	0.0144
59:00:00	0.0000	0.0000	0.0000	0.0000	0.0143	0.0143
59:30:00	0.0000	0.0000	0.0000	0.0000	0.0142	0.0142
60:00:00	0.0000	0.0000	0.0000	0.0000	0.0141	0.0141
60:30:00	0.0000	0.0000	0.0000	0.0000	0.014	0.014
61:00:00	0.0000	0.0000	0.0000	0.0000	0.0139	0.0139
61:30:00	0.0000	0.0000	0.0000	0.0000	0.0138	0.0138
62:00:00	0.0000	0.0000	0.0000	0.0000	0.0136	0.0136
62:30:00	0.0000	0.0000	0.0000	0.0000	0.0135	0.0135
63:00:00	0.0000	0.0000	0.0000	0.0000	0.0134	0.0134
63:30:00	0.0000	0.0000	0.0000	0.0000	0.0133	0.0133
64:00:00	0.0000	0.0000	0.0000	0.0000	0.0132	0.0132
64:30:00	0.0000	0.0000	0.0000	0.0000	0.0131	0.0131
65:00:00	0.0000	0.0000	0.0000	0.0000	0.013	0.013
65:30:00	0.0000	0.0000	0.0000	0.0000	0.0129	0.0129
66:00:00	0.0000	0.0000	0.0000	0.0000	0.0128	0.0128
66:30:00	0.0000	0.0000	0.0000	0.0000	0.0127	0.0127
67:00:00	0.0000	0.0000	0.0000	0.0000	0.0126	0.0126
67:30:00	0.0000	0.0000	0.0000	0.0000	0.0125	0.0125
68:00:00	0.0000	0.0000	0.0000	0.0000	0.0124	0.0124
68:30:00	0.0000	0.0000	0.0000	0.0000	0.0123	0.0123
69:00:00	0.0000	0.0000	0.0000	0.0000	0.0122	0.0122
69:30:00	0.0000	0.0000	0.0000	0.0000	0.0121	0.0121
70:00:00	0.0000	0.0000	0.0000	0.0000	0.012	0.012
70:30:00	0.0000	0.0000	0.0000	0.0000	0.0119	0.0119
71:00:00	0.0000	0.0000	0.0000	0.0000	0.0118	0.0118

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
71:30:00	0.0000	0.0000	0.0000	0.0000	0.0117	0.0117
72:00:00	0.0000	0.0000	0.0000	0.0000	0.0116	0.0116
72:30:00	0.0000	0.0000	0.0000	0.0000	0.0115	0.0115
73:00:00	0.0000	0.0000	0.0000	0.0000	0.0114	0.0114
73:30:00	0.0000	0.0000	0.0000	0.0000	0.0113	0.0113
74:00:00	0.0000	0.0000	0.0000	0.0000	0.0112	0.0112
74:30:00	0.0000	0.0000	0.0000	0.0000	0.0111	0.0111
75:00:00	0.0000	0.0000	0.0000	0.0000	0.011	0.011
75:30:00	0.0000	0.0000	0.0000	0.0000	0.011	0.011
76:00:00	0.0000	0.0000	0.0000	0.0000	0.0109	0.0109
76:30:00	0.0000	0.0000	0.0000	0.0000	0.0108	0.0108
77:00:00	0.0000	0.0000	0.0000	0.0000	0.0107	0.0107
77:30:00	0.0000	0.0000	0.0000	0.0000	0.0106	0.0106
78:00:00	0.0000	0.0000	0.0000	0.0000	0.0105	0.0105
78:30:00	0.0000	0.0000	0.0000	0.0000	0.0104	0.0104
79:00:00	0.0000	0.0000	0.0000	0.0000	0.0104	0.0104
79:30:00	0.0000	0.0000	0.0000	0.0000	0.0103	0.0103
80:00:00	0.0000	0.0000	0.0000	0.0000	0.0102	0.0102
80:30:00	0.0000	0.0000	0.0000	0.0000	0.0101	0.0101
81:00:00	0.0000	0.0000	0.0000	0.0000	0.01	0.01
81:30:00	0.0000	0.0000	0.0000	0.0000	0.00994	0.00994
82:00:00	0.0000	0.0000	0.0000	0.0000	0.00986	0.00986
82:30:00	0.0000	0.0000	0.0000	0.0000	0.00978	0.00978
83:00:00	0.0000	0.0000	0.0000	0.0000	0.0097	0.0097
83:30:00	0.0000	0.0000	0.0000	0.0000	0.00962	0.00962
84:00:00	0.0000	0.0000	0.0000	0.0000	0.00954	0.00954
84:30:00	0.0000	0.0000	0.0000	0.0000	0.00947	0.00947
85:00:00	0.0000	0.0000	0.0000	0.0000	0.00939	0.00939
85:30:00	0.0000	0.0000	0.0000	0.0000	0.00931	0.00931
86:00:00	0.0000	0.0000	0.0000	0.0000	0.00924	0.00924
86:30:00	0.0000	0.0000	0.0000	0.0000	0.00916	0.00916
87:00:00	0.0000	0.0000	0.0000	0.0000	0.00909	0.00909
87:30:00	0.0000	0.0000	0.0000	0.0000	0.00902	0.00902
88:00:00	0.0000	0.0000	0.0000	0.0000	0.00894	0.00894
88:30:00	0.0000	0.0000	0.0000	0.0000	0.00887	0.00887
89:00:00	0.0000	0.0000	0.0000	0.0000	0.0088	0.0088

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
89:30:00	0.0000	0.0000	0.0000	0.0000	0.00873	0.00873
90:00:00	0.0000	0.0000	0.0000	0.0000	0.00866	0.00866
90:30:00	0.0000	0.0000	0.0000	0.0000	0.00859	0.00859
91:00:00	0.0000	0.0000	0.0000	0.0000	0.00852	0.00852
91:30:00	0.0000	0.0000	0.0000	0.0000	0.00845	0.00845
92:00:00	0.0000	0.0000	0.0000	0.0000	0.00838	0.00838
92:30:00	0.0000	0.0000	0.0000	0.0000	0.00831	0.00831
93:00:00	0.0000	0.0000	0.0000	0.0000	0.00824	0.00824
93:30:00	0.0000	0.0000	0.0000	0.0000	0.00818	0.00818
94:00:00	0.0000	0.0000	0.0000	0.0000	0.00811	0.00811
94:30:00	0.0000	0.0000	0.0000	0.0000	0.00805	0.00805
95:00:00	0.0000	0.0000	0.0000	0.0000	0.00798	0.00798
95:30:00	0.0000	0.0000	0.0000	0.0000	0.00792	0.00792
96:00:00	0.0000	0.0000	0.0000	0.0000	0.00785	0.00785
96:30:00	0.0000	0.0000	0.0000	0.0000	0.00779	0.00779
97:00:00	0.0000	0.0000	0.0000	0.0000	0.00773	0.00773
97:30:00	0.0000	0.0000	0.0000	0.0000	0.00766	0.00766
98:00:00	0.0000	0.0000	0.0000	0.0000	0.0076	0.0076
98:30:00	0.0000	0.0000	0.0000	0.0000	0.00754	0.00754
99:00:00	0.0000	0.0000	0.0000	0.0000	0.00748	0.00748
99:30:00	0.0000	0.0000	0.0000	0.0000	0.00742	0.00742
100:00:00	0.0000	0.0000	0.0000	0.0000	0.00736	0.00736
100:30:00	0.0000	0.0000	0.0000	0.0000	0.0073	0.0073
101:00:00	0.0000	0.0000	0.0000	0.0000	0.00724	0.00724
101:30:00	0.0000	0.0000	0.0000	0.0000	0.00718	0.00718
102:00:00	0.0000	0.0000	0.0000	0.0000	0.00712	0.00712
102:30:00	0.0000	0.0000	0.0000	0.0000	0.00706	0.00706
103:00:00	0.0000	0.0000	0.0000	0.0000	0.00701	0.00701
103:30:00	0.0000	0.0000	0.0000	0.0000	0.00695	0.00695
104:00:00	0.0000	0.0000	0.0000	0.0000	0.00689	0.00689
104:30:00	0.0000	0.0000	0.0000	0.0000	0.00684	0.00684
105:00:00	0.0000	0.0000	0.0000	0.0000	0.00678	0.00678
105:30:00	0.0000	0.0000	0.0000	0.0000	0.00673	0.00673
106:00:00	0.0000	0.0000	0.0000	0.0000	0.00667	0.00667
106:30:00	0.0000	0.0000	0.0000	0.0000	0.00662	0.00662
107:00:00	0.0000	0.0000	0.0000	0.0000	0.00657	0.00657

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
107:30:00	0.0000	0.0000	0.0000	0.0000	0.00651	0.00651
108:00:00	0.0000	0.0000	0.0000	0.0000	0.00646	0.00646
108:30:00	0.0000	0.0000	0.0000	0.0000	0.00641	0.00641
109:00:00	0.0000	0.0000	0.0000	0.0000	0.00636	0.00636
109:30:00	0.0000	0.0000	0.0000	0.0000	0.00631	0.00631
110:00:00	0.0000	0.0000	0.0000	0.0000	0.00625	0.00625
110:30:00	0.0000	0.0000	0.0000	0.0000	0.0062	0.0062
111:00:00	0.0000	0.0000	0.0000	0.0000	0.00615	0.00615
111:30:00	0.0000	0.0000	0.0000	0.0000	0.0061	0.0061
112:00:00	0.0000	0.0000	0.0000	0.0000	0.00605	0.00605
112:30:00	0.0000	0.0000	0.0000	0.0000	0.00601	0.00601
113:00:00	0.0000	0.0000	0.0000	0.0000	0.00596	0.00596
113:30:00	0.0000	0.0000	0.0000	0.0000	0.00591	0.00591
114:00:00	0.0000	0.0000	0.0000	0.0000	0.00586	0.00586
114:30:00	0.0000	0.0000	0.0000	0.0000	0.00581	0.00581
115:00:00	0.0000	0.0000	0.0000	0.0000	0.00577	0.00577
115:30:00	0.0000	0.0000	0.0000	0.0000	0.00572	0.00572
116:00:00	0.0000	0.0000	0.0000	0.0000	0.00567	0.00567
116:30:00	0.0000	0.0000	0.0000	0.0000	0.00563	0.00563
117:00:00	0.0000	0.0000	0.0000	0.0000	0.00558	0.00558
117:30:00	0.0000	0.0000	0.0000	0.0000	0.00554	0.00554
118:00:00	0.0000	0.0000	0.0000	0.0000	0.00549	0.00549
118:30:00	0.0000	0.0000	0.0000	0.0000	0.00545	0.00545
119:00:00	0.0000	0.0000	0.0000	0.0000	0.0054	0.0054
119:30:00	0.0000	0.0000	0.0000	0.0000	0.00536	0.00536
120:00:00	0.0000	0.0000	0.0000	0.0000	0.00532	0.00532
120:30:00	0.0000	0.0000	0.0000	0.0000	0.00527	0.00527
121:00:00	0.0000	0.0000	0.0000	0.0000	0.00523	0.00523
121:30:00	0.0000	0.0000	0.0000	0.0000	0.00519	0.00519
122:00:00	0.0000	0.0000	0.0000	0.0000	0.00515	0.00515
122:30:00	0.0000	0.0000	0.0000	0.0000	0.0051	0.0051
123:00:00	0.0000	0.0000	0.0000	0.0000	0.00506	0.00506
123:30:00	0.0000	0.0000	0.0000	0.0000	0.00502	0.00502
124:00:00	0.0000	0.0000	0.0000	0.0000	0.00498	0.00498
124:30:00	0.0000	0.0000	0.0000	0.0000	0.00494	0.00494
125:00:00	0.0000	0.0000	0.0000	0.0000	0.0049	0.0049

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (mm)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
125:30:00	0.0000	0.0000	0.0000	0.0000	0.00486	0.00486
126:00:00	0.0000	0.0000	0.0000	0.0000	0.00482	0.00482
126:30:00	0.0000	0.0000	0.0000	0.0000	0.00478	0.00478

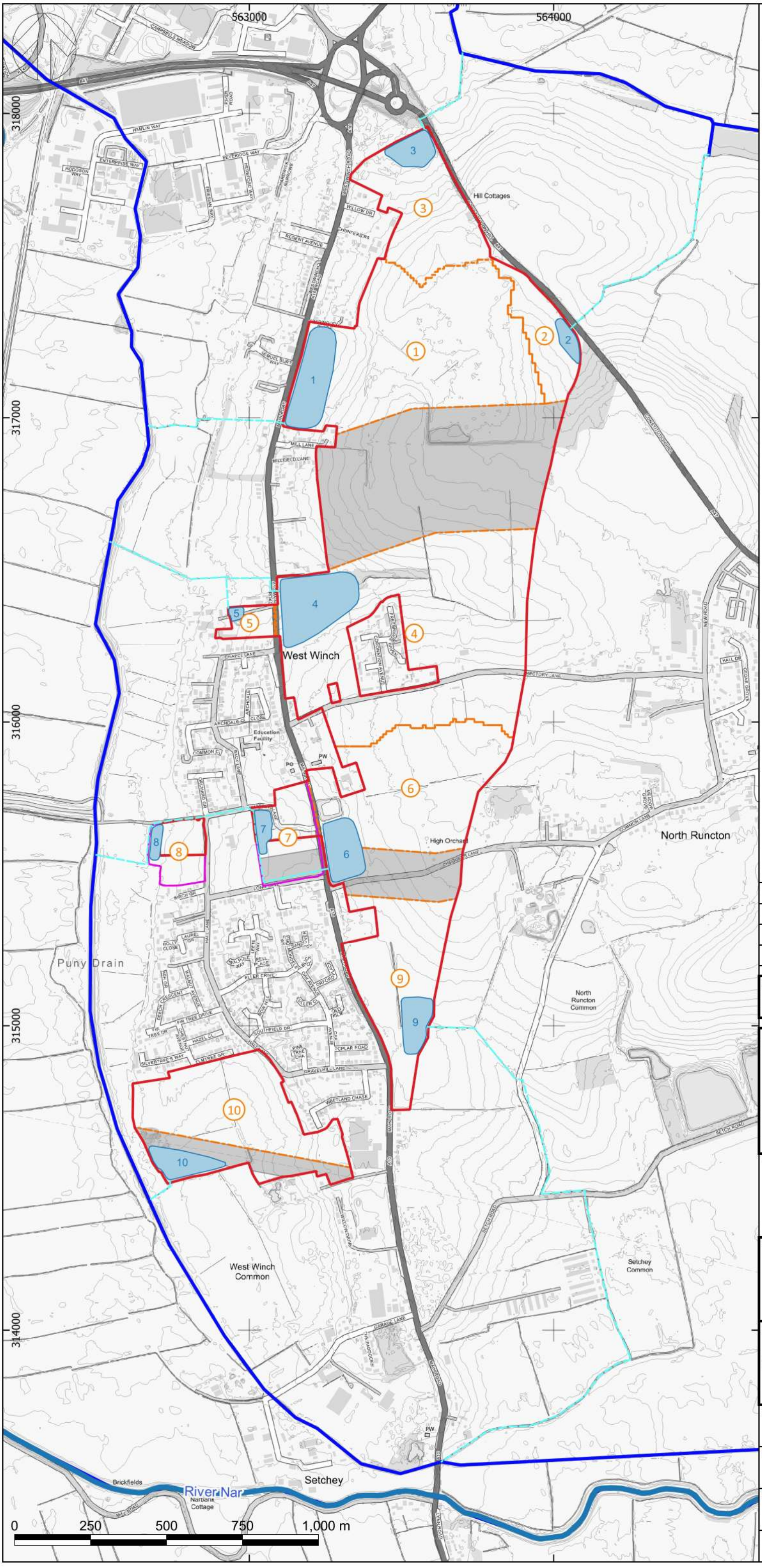
Appendix

Catchment descriptors

Name	Value	User-defined value used?
BFIHOST	0.72	No
BFIHOST19	0.79	No
PROPWET (mm)	0.23	No
SAAR (mm)	613	No

Appendix D.2

CONCEPTUAL SURFACE WATER DRAINAGE STRATEGY PLAN



Do not scale - Use only figured dimensions
The contractor is to check all dimensions on site and report any discrepancies to the site Supervisor
This drawing is to be read in conjunction with other standard documentation

Note:
This plan is furnished as a general guide only and the Statutory Undertakers concerned state that no warranty as to its correctness is given or implied. It must not be relied upon in the excavations or other works made in the vicinity of each utilities service.

Key:

- Local Plan Allocation Boundary
- Additional Development Areas
- Main River
- Ordinary Watercourse
- Existing Ground Levels (1m Contours)
- Existing Easements
- Proposed Catchments
- Proposed Attenuation Basins
- Assumed Off-Site Connectivity

Note: The proposed site-control attenuation basins shown on this drawing are indicative and subject to detailed investigations at the planning stage in consultation with the LLFA

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	24/04/2023	SEK	FIRST ISSUE	JH	

DRAWING STATUS:
S1 - FOR COORDINATION

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CLIENT:
BOROUGH COUNCIL OF KING'S LYNN AND WEST NORFOLK

PROJECT:
WEST WINCH GROWTH AREA

TITLE:
CONCEPTUAL SURFACE WATER DRAINAGE STRATEGY

DRAWN:	CHECKED:	APPROVED:
SEK	JH	

PROJECT No:	SCALE @A3:	DATE:
70071439	1:12,500	27/04/2023

DRAWING No: 70071439-D-001 REV: P01

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Basingstoke, Hampshire
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