FLOOD RISK ASSESSMENT

Land East of Claydon Road, Cropredy

Prepared for: Obsidian Strategic Asset Management Limited
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Appendices

1.0 Introduction

1.1 This Flood Risk Assessment has been prepared by Glanville Consultants on behalf of Obsidian Strategic Asset Management to accompany an Outline planning application for a proposed development of up to 60 dwellings and a community facility on land east of Claydon Road, Cropredy, Oxfordshire, OX17 1JP, herein referred to as 'the site'. The description of development is as follows:

Outline planning application (except for access) for residential development of up to 60 dwellings (Use Class C3) including a community facility, new vehicular and pedestrian access off Claydon Road, public open space and associated landscaping, earthworks, parking, engineering works and infrastructure.

1.2 The purpose of this document is to assess the existing level of flood risk to the site and its surroundings within the context of the development proposals and to demonstrate suitable strategies for the disposal of surface water run-off and foul water effluent from the development can be provided.

1.3 This assessment has been prepared in accordance with the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) to the NPPF. Local policy concerning flood risk and drainage has been considered, in compliance with the guidance set out in the Cherwell District Council Strategic Flood Risk Assessment, published in May 2017.

1.4 This assessment has been undertaken with reference to information provided and/or published by the following bodies:

- Ordnance Survey;
- British Geological Survey;
- Oxfordshire County Council;
- Cherwell District Council; and
- Environment Agency.

1.5 This report concludes that the proposed development is not at risk of flooding and that the site can be developed safely without increasing flood risk elsewhere. The development proposals therefore comply with relevant planning policy concerning flood risk. The report also demonstrates that suitable arrangements for the disposal of surface water run-off and foul water effluent from the development can be provided.

2.0 Site Description and Development Proposals

Site Description

2.1 The site is located in the village of Cropredy, 6.4km to the north of Banbury. The site is currently used for agricultural purposes, with a field access from Clayton Road in its south-western corner. A site location plan is provided at Appendix A.

2.2 The site extends to approximately 5Ha in area and is bound to the east by the Oxford Canal, to the south by residential properties in Cropredy, to the west by Claydon Road and to the north by Cropredy Marina and further agricultural land.

Topographical Survey

2.3 A topographical survey of the site and surrounding land was carried out by Greenhatch Group in March 2022. A copy of the topographical survey is included in Appendix B. Levels on-site were found to fall sharply from the highpoint in the southwestern corner in a general north-easterly direction towards Cropredy Marina and the Oxford Canal. A highpoint of 109.99m Above Ordnance Datum (AOD) was recorded at the existing field access in the south-west corner of the site, with a low point of 100.59m AOD noted adjacent to the canal.

2.4 The survey also recorded the presence of an existing ditch running through the east of the site. This ditch runs beyond the application boundary and across the entire western edge of the Cropredy Marina. Both 150mm diameter and 300mm diameter pipes were noted within the ditch to the north of the site. It is believed that the 150mm pipe is a land drain from the site and agricultural field, while the 300mm pipe is an outfall from the ditch to the marina.

2.5 The western boundary of the site with Claydon Road is formed by a hedgerow and ditch, with ditches shown on both the eastern and western sides of the highway.

Geological Mapping

2.6 Geological maps published by the British Geological Survey (BGS) indicate that the site is entirely underlain by bedrock geology comprising mudstone from the Charmouth Mudstone Formation. The BGS mapping shows no superficial deposits underlying the vast majority of the site, with superficial deposits of alluvium, consisting of clay, silt, sand and gravel, shown to potentially underlie a narrow strip along the site's eastern boundary with the Oxford Canal. An extract of the BGS mapping is included in Appendix C.

2.7 Soilscapes mapping published by Cranfield University on behalf of DEFRA shows that the proposed development falls mostly on HOST soil class 18, characterised as slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils. The drainage of these soils described as impeded with run-off draining towards ditch networks. The possible alluvium soils along the eastern edge of the site are indicated to fall on HOST soil class 20, characterised as loamy and clayey floodplain soils with naturally high groundwater. The use of infiltration drainage on-site is therefore not considered to be feasible. An extract from the Soilscapes mapping is also included in Appendix C.

Hydrological and Hydrogeological Context

2.8 The closest watercourse designated as a main river by the Environment Agency (EA) is Highfurlong Brook, which is located beyond the Oxford Canal and approximately 75m to the east of the site.

2.9 An unnamed, ordinary watercourse is located approximately 210m north of the site. The watercourse runs from east to west around the agricultural land and discharges to the Oxford Canal. This watercourse is fed by multiple watercourses, with the ditches along Claydon Road and a series of field ditches to the north-east of the site discharging to the canal via this watercourse. The watercourse can also be seen on the topographical survey in Appendix B, with two 650mm diameter culverts beneath Claydon Road also shown.

2.10 The Oxford Canal is linked to the Cropredy Marina, which is formed of three artificial basins built within the past decade. The most recent of which was constructed as part of works approved by Cherwell District Council (CDC) under planning application reference 16/01119/F. Furthermore, the site is located downstream of Clattercote, Wormleighton and Boddington Reservoirs which are approximately 2km, 4.5km and 5.75km respectively from site.

2.11 The EA defines Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The SPZs mapping indicates that the site is not located within an SPZ.

2.12 A Nitrate Vulnerable Zone (NVZ) is a conservative designation for areas of land that drain to nitrate polluted waters or waters which could become polluted by nitrates. The NVZs mapping indicates that the site is located within surface water and groundwater NVZs.

2.13 The EA defines Drinking Water Safeguard Zones (SgZs) and Drinking Water Protected Areas (DWPAs) for water sources used for public drinking water supply. SgZs define areas where pollution control measures are needed to avoid deterioration in water quality. DWPAs are areas where water sources need to be protected to prevent pollution. The majority of site is not located within a DWPA, however a small area to the south-east is located within a surface water DWPA. Additionally, the entirety of the site is located within a surface water SgZ.

2.14 Groundwater vulnerability mapping published by the EA indicates the risk to groundwater from any potential pollutants on-site reaching the underlying aquifer. The mapping shows the majority of the site within an area of medium groundwater vulnerability, with an area in the south-east of the site shown in an area of low vulnerability.

2.15 The Bedrock Aquifer Designation Map published by the EA indicates that the bedrock underlying the site is classed as a Secondary (undifferentiated) Aquifer. Secondary (undifferentiated) Aquifers have variable characteristics of rock layers or drift deposits, meaning that they cannot be attributed to a category A or B Secondary Aquifer. Therefore, water permeability and storage vary across the deposits.

2.16 None of the above designations are considered an issue that would prevent the development of the site. However, given the DWPA, SgZ and NVZ designations, careful consideration will be required to the surface water drainage strategy and pollution control measures.

Development Proposals

2.17 Outline planning with all matters reserved, except for access, is sought for a development of up to 60 dwellings (Use Class C3) including a community facility, new vehicular and pedestrian access off Claydon Road, public open space and associated landscaping, earthworks, parking, engineering works and infrastructure. An illustrative masterplan is provided at Appendix D.

3.0 Planning Policy and Guidance

3.1 Set out below is a summary of the national and local planning policy and guidance relating to flood risk and surface water management that are relevant to the site and any future developments.

National Policy

3.2 At a national level, the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) to the NPPF ensure flood risk is taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development towards areas at lowest flood risk. The NPPF retains a risk-based approach to the planning process and defines four Flood Zones to be used as the basis for applying the sequential test, as well as Flood Risk Vulnerability Classifications, which define the type of development that is considered appropriate within each zone.

3.3 The NPPF establishes the Flood Zones as the starting point for assessment with the overarching aim to steer new development to areas with the lowest probability of flooding. The Flood Zones are defined as follows:

- Flood Zone 1 (Low Probability) comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)
- Flood Zone 2 (Medium Probability) comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
- Flood Zone 3a (High Probability) comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- Flood Zone 3b (The Functional Floodplain) comprises land where water has to flow or be stored in times of flood. Cherwell District Council, as Local Planning Authority, is responsible for identifying the extents of the functional floodplain.

Local Policy and Guidance

Cherwell District Council (CDC) Strategic Flood Risk Assessment (SFRA), May 2017

3.4 The CDC Level 1 SFRA provides a reference and policy document to advise and inform developers of their obligations under the NPPF and local policies. The mapping and accompanying report provide guidance and a sound framework enabling consistent and sustainable choices to be made when making future planning decisions.

3.5 The SFRA includes summaries and mapping of the assessed flood risk, as well as historic events, for CDCs entire administrative area. The report has considered flooding from all sources including fluvial, pluvial, groundwater and sewers and provides to planners and developers on producing site specific Flood Risk Assessments and drainage proposals.

Oxfordshire County Council (OCC) Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire, (V1.2) December 2021

3.6 This guidance document provides advice from OCC in its role as Lead Local Flood Authority (LLFA) and statutory consultee on planning applications on the implementation of Sustainable Drainage systems within developments, as well as setting out specific standards and policies to be applied in Oxfordshire.

4.0 Source of Potential Flooding

4.1 Flood risk to the site is considered from all likely sources of flooding, as defined in the NPPF and the PPG to the NPPF. These include tidal/coastal, fluvial, surface water, artificial sources, groundwater, and sewer. The following paragraphs consider flood risk to the site from all these sources.

Tidal/Coastal

4.2 The watercourses referenced in Section 2 are not subject to tidal influences. The site is therefore not at risk from tidal or coastal flooding.

Fluvial

4.3 The EA publishes flood zone mapping on the GOV.UK website which shows the modelled extents of fluvial flooding. An extract from the EA's Flood Map for Planning is included in Appendix E. The flood zone mapping indicates that the vast majority of the site is located within Flood Zone 1, which is land at the lowest risk of fluvial flooding (<1 in 1,000 year return period).

4.4 The eastern boundary of the site is located adjacent to the Oxford Canal and is shown to be in a combination of Flood Zone 2 (between 1 in 1,000 and 1 in 100 annual probability of river flooding), and Flood Zone 3 (1 in 100 or greater annual probability of river flooding). However, the area at risk of fluvial flooding covers a very small area.

Surface Water

4.5 The EA publishes a Flood Risk from Surface Water map on the GOV.UK website which indicates the predicted risk of surface water flooding if rainwater does not drain away through normal drainage systems or soak into the ground. The mapping indicates that the vast majority of the site is shown to be at "very low" risk of surface water flooding, with an annual probability of flooding of less than 1 in 1,000.

4.6 The mapping also shows two areas at "low" risk of flooding, which is land with an annual probability of flooding between 1 in 1,000 and 1 in 100. These two areas are consistent with the ditches along the site's western boundary with Claydon Road and the ditch through the east of the site. These ditches will remain unchanged with the development, so it is considered that the site is at very low risk of flooding from surface water and no mitigation measures are necessary.

Artificial Sources

Reservoir

4.7 The EA publishes Reservoir Flood Risk mapping on the GOV.UK website which shows the maximum extent of flooding that may result from the failure of engineering installations such as flood defence, land drainage pumps, sluice gates and floodgates.

4.8 The mapping shows the maximum extent of flooding from reservoir failure is beyond the site boundary within the Oxford Canal and land to the north of the site. The site is therefore at very low risk of reservoir flooding.

Oxford Canal

4.9 The site is bound to the east by Cropredy Marina and the Oxford Canal. The CDC SFRA states that any development sites adjacent to the Oxford Canal should assess the residual risk of an overtopping or breach event. Historic mapping of recorded instances of canal overtopping shows no incidents along the site boundary, however there are instances recorded both upstream and downstream of the site at nearby locks.

4.10 The water level in the canal is higher than Highfurlong Brook due to Cropredy Lock to the south-east of the site. Should water levels in the canal rise above the design level, water is allowed to overflow in the first instance via weirs to the adjacent Highfurlong Brook. Given the site rises sharply from the canal, and the general topography of the local area, the risk of water encroaching onto the site following a canal breach is not considered to present any greater risk than flooding from fluvial or surface water sources. As such, no additional measures are considered necessary to mitigate against this risk. The risk of flooding from the Oxford Canal is therefore considered to be low.

Groundwater

4.11 The Level 1 SFRA includes the EA's Areas Susceptible to Groundwater Flooding (AStGWF) map for the Cherwell area. This mapping indicates most of the site is not susceptible to groundwater emergence, with the northern part of the site having a susceptibility of 0-25%. Given the expected impermeability of the underlying soils and general topography, the risk of groundwater emergence on-site is not considered to be an issue which should constrain or prevent the proposed development.

Sewer

4.12 As sewerage undertaker for the area, the SFRA includes a map of the Historical Sewer Flooding Events in CDCs administrative area reported to Thames Water in their DG5 Sewer Flooding Incident Register. This mapping indicates that the site is located within a postcode area with 0 to 5 sewer flooding incidents registered. These records do not necessarily indicate the current or future sewer flood risk situation as maintenance work or upgrades to the network may have been undertaken since the flooding incidents were registered.

4.13 Sewer records obtained from Thames Water indicate there to be no foul or surface water sewers within the development site's boundaries, with the closest sewer being a surface water sewer outfall to the ditch located on the western side of Claydon Road. While anecdotal evidence from consultation with the local community suggests flooding from sewers may have occurred elsewhere within Cropredy, these are understood not to have occurred on or near the site itself. Given the absence of sewers on-site, the proposed development is therefore considered to be at low risk of sewer flooding. Sewer records for the area are included in Appendix F.

Summary

4.14 The site is located within Flood Zone 1, which is land at the lowest risk of fluvial flooding and is considered to be at a negligible to low risk of flooding from all sources identified.

5.0 Flood Risk Assessment

5.1 The NPPF encourages a sequential, risk-based approach to determine the suitability of land for development. This document advises that the development of sites within Flood Zone 1 should be given preference where available.

5.2 Table 2 of the PPG to the NPPF categorises different types of development into five flood risk vulnerability classifications:

- Essential Infrastructure;
- Highly Vulnerable;
- More Vulnerable;
- Less Vulnerable;
- and Water Compatible Development.

5.3 The NPPF classifies the proposed residential use of the site as being 'More Vulnerable' with the proposed community use classed as 'Less Vulnerable'. Table 3 of the PPG states that 'More Vulnerable' development is compatible with Flood Zones 1 and 2, with 'Less Vulnerable' development compatible even in Flood Zone 3a, both without the need to apply the Exception Test.

5.4 As discussed in Section 4 of this report, the vast majority of the site is located within Flood Zone 1. The eastern boundary of the site is shown to be in a combination of Flood Zones 2 and 3. However, the part of the site at risk of fluvial flooding is to be an area of public open space associated with the development and is at a much lower level than the built development.

5.5 Notwithstanding this, a more detailed assessment of flood risk has been carried out that includes the future effect of climate change.

5.6 Flood levels associated with the extent of Flood Zones 2 and 3, as well as ground levels on the site have been derived using data obtained from the topographical survey of the site and surrounding land that is included at Appendix B.

5.7 An overlay of the flood extents from the EA's Flood Map for Planning on the topographical survey is provided at Appendix G. Flood Zones 2 and 3 correlate very closely to the same extent, indicating that flood levels would not be very different during these flood events. On this basis, to provide a robust assessment, it has been concluded that flood levels that define the extent of Flood Zones 2 and 3, adjacent to the eastern site boundary, would peak at a level no higher than 101.0m AOD.

5.8 The built development is located some 130m to the west of the extent of Flood Zones 2 and 3 and a much higher level. The overlay drawing at Appendic G shows that built development will be located at a minimum ground level of approximately 103.5m AOD, which is no less than 2.5m above the anticipated Flood Zone 2/3 level. As such, built development is conclusively to be located within Flood Zone 1 and will not be at risk of fluvial flooding.

Climate Change

5.9 The future effect of climate change in so far as it impacts on fluvial flooding has been considered in accordance with the Environment Agency's latest guidance – Thames Area Climate Change Guidance v1.1 (Feb 2019).

5.10 In this case, in the absence of modelled flood levels, a basic approach to technical assessment is considered appropriate whereby an allowance is added to the 'design flood' (i.e. 1% AEP) peak levels to account for potential climate change impacts.

5.11 In July 2021 the EA updated its guidance on the application of climate change allowances in flood risk assessments[1]. This guidance provides contingency allowances for potential increases in peak river flows based on percentiles. The allowances are also subject to the vulnerability classification of the proposed use.

5.12 The updated EA guidance advises that the Central climate change allowance should be considered for both Less and More Vulnerable developments in Flood Zones 2 and 3a and a local allowance for potential climate change impacts has been considered for the proposed development.

5.13 The EA's Thames Area Climate Change Guidance suggests an allowance of 500mm for the 'Central' local allowance category. On this basis, considering a 500mm allowance for the potential climate change impacts associated with the 'Central' category for the Oxford Canal, would result in a maximum 1% AEP plus climate change flood level of 101.5m AOD (i.e. 101.0m AOD + 500mm).

5.14 It can be seen from the drawing provided at Appendix G that the flood outline defined by the 101.5m AOD contour is still located within the proposed public open space area, well away from the built development on site. The built development is located approximately 2.0m above the maximum 1% AEP plus climate change flood level. As such, when considering the potential climate change impacts, the proposed built development is not at risk of fluvial flooding.

5.15 Table 3 of the PPG states that all uses are appropriate for Flood Zone 1. Therefore, the residential and community use proposed is compatible with the flood zone of the site and developing the site for its intended purpose is considered appropriate in terms of flood risk. As such, no mitigation measures are required in respect of fluvial flooding, and the Sequential and Exception Tests do not need to be applied to this development.

5.16 The site is at very low risk from all other sources of flooding. As such, flood risk is not a constraint to development.

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

6.0 Surface Water Drainage

6.1 This section outlines the proposals for the surface water drainage strategy for the development. This will be designed in-line with all relevant national and local standards and guidance, including CIRIA C753 (The SuDS Manual), Oxfordshire County Council's Local Standards and Guidance for Surface Water Drainage, and Defra's Non-Statutory Technical Standards for Sustainable Drainage Systems.

Sustainable Drainage

6.2 The PPG recommends that priority should be given to the use of sustainable drainage systems (SuDS) as they are designed to control surface water run-off where it falls and mimic natural drainage as closely as possible. SuDS also provide opportunities for the following:

- reduce the causes and impacts of flooding;
- remove pollutants from urban run-off at source; and
- combine water management with green space with benefits for amenity, recreation and wildlife.

6.3 SuDS encompass a wide range of drainage techniques intended to minimise the rate of discharge, volume and environmental impact of run-off. Infiltration based techniques are high up in the hierarchy of techniques available due to the ability for close to source dispersion of surface water. These techniques are considered the closest solution to mimic the natural drainage of undeveloped sites.

6.4 The Building Regulations part H3 stipulates that rainwater from roofs and paved areas is carried away from surface to discharge to one of the following, listed in order of priority:

a) an adequate soakaway or some other adequate infiltration system; or, where that is not practical;
b) a watercourse; or, where that is not practical
c) a sewer.

Surface Water Drainage Strategy

6.5 As discussed in Section 2, infiltration drainage on-site is not considered practicable due to ground conditions. An intrusive site investigation will be carried out at the appropriate design stage which will, amongst other things, include infiltration testing to confirm the lack of soakage on-site and this could be secured by a suitably worded planning condition.

6.6 The proposed surface water drainage strategy seeks to mimic the existing drainage regime as closely as possible. The existing ditch in the east of the site currently intercepts run-off from the agricultural land and directs it via an outfall to the north of the application site to the Cropredy Marina. The proposed strategy will therefore retain the existing ditch in place and attenuate surface water run-off and provide storage on on-site that will discharge at a restricted rate to the ditch.

6.7 The site location plan in Appendix A shows the extent of land controlled by Obsidian Strategic Asset Management outlined in blue. This plan confirms that whilst the drainage outfall falls outside of the application red boundary, it is located within the ownership boundary and therefore does not cross third party land.

6.8 The proposed strategy strives to utilise sustainable drainage techniques in accordance with the guidance described in CIRIA document C753 "Ths SuDS Manual" (2015) to accommodate run-off from all rainfall events up to and including the 1 in 100 year event, with a 40% allowance for the future effects of climate change.

6.9 Attenuation will be provided within ponds in the north- and south-east of the site, with a flow control restricting flows from the north-eastern pond to the ditch down to the QBAR value for the development area on-site, which has been calculated at 21.8 l/s. Greenfield run-off rate calculations have been included at Appendix I.

6.10 Individual and private drives on-site will be constructed using permeable paving to provide additional attenuation and interception of flows on-site as well as water quality treatment. However, in the interests of providing a robust strategy (given their possible removal by future residents), these permeable paved areas have only been shown illustratively and are not included within the strategy calculations at this stage.

6.11 The community facility will provide attenuation on-plot and will utilise permeable paving within car parking areas, with additional storage provided by geocellular crates. Discharge from the community facility to the wider surface water network will be via flow control at the QBAR value for the catchment.

6.12 Permeable paving proposed within the community facility parking area has been utilised for surface water treatment and conveyance to the attenuation tank. At the appropriate design stage sub-base depths will be confirmed and the attenuation volume provided by the voids in the sub-base of the permeable paving will be utilised to subsequently resize the attenuation tank.

6.13 MicroDrainage calculations provided within Appendix I show the proposed SuDS features have been sized to accommodate run-off from all storms up to, and including, the 1 in 100 +40% climate change allowance storm event without flooding from surface water, with FEH rainfall data utilised to calculate storage volumes.

6.14 Given the illustrative nature of the site layout at this stage, contributing impermeable areas have included the highway network as drawn, as well as the proposed community facility and associated car park. The developable areas designated for residential development have assumed an impermeable area of 60%, with an additional allowance for urban creep of 10%. This is therefore considered a suitably robust and conservative approach, with exact contributing areas and catchments to be confirmed at the appropriate stage, most likely when an application is submitted for the approval of Reserved Matters.

Pollution Control Measures

6.15 Pollution control measures are designed to minimise the transmittal of any pollutants collected by run-off flowing over hard paved areas to the receiving attenuation features.

6.16 Table 26.2 of 'The SuDS Manual' indicates the minimum treatment indices for contributing pollution hazards for different land use classifications. The treatment indices for the proposed land uses are shown in Table 1, overleaf.

6.17 The pollution indices in Table 1 should be compared with the mitigation indices in Table 2 (both overleaf) and the following formulae applied.

Total SuDS Mitigation Index ≥ Pollution Hazards Index (for each contaminant type)

Total SuDS Mitigation Index = 1st Stage Mitigation Index + 0.5 (2nd Stage Mitigation Index)

6.18 Run-off from the proposed highway network will drain via the pond in the north-east of the site, with surface water from the proposed community facility draining via permeable paving before being discharged to the pond in the north-east of the site. These features, in combination with catchpits upstream, will be effective at removing pollutants, such as hydrocarbons and sediment, from surface water. Table 2 shows that the mitigation indices for the proposed SuDS exceed the individual hazard indices in Table 1, therefore it is considered that adequate pollution control can be provided on-site.

Table 1: Pollution Hazard Indices for Different Land Use Classifications (Table 26.2, CIRIA C753)

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Suspended Solids	Metals	Hydro-carbons
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices)	Low	0.5	0.4	0.4
Residential Roofs	Very Low	0.2	0.2	0.05
Commercial/Industrial Roofs	Low	0.3	0.2	0.05

Table 2: SuDS Mitigation Indices (Table 26.3, CIRIA C753)

SuDS Component	Mitigation Indices		
	Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Pond	0.7	0.7	0.5

Maintenance and Adoption

6.19 All new surface water infrastructure will be designed in accordance with current Building Regulations, Appendix C of the Sewerage Sector Guidance, and current best practice, as appropriate. Thames Water, as sewerage undertaker, do not currently adopt SuDS features such as ponds, therefore the proposed SuDS features will remain under private ownership and be maintained by a management company. The on-site surface water sewer network could nonetheless be offered to Thames Water for adoption, with gullies serving the adoptable highway to be maintained by Oxfordshire County Council as highway authority.

6.20 Suitable adoption and maintenance regimes for drainage features, incorporating advice from system manufacturers and installers, will be developed by the site management company and implemented prior to occupation of the development. A summary of typical items to be included within a maintenance schedule is given in Table 3.

Table 3: SuDS Maintenance Schedule

Drainage Feature	Inspection and Maintenance	Frequency
Permeable pavements	Brushing and vacuuming of surface to remove detrimental materials such as debris, dirt and sediment	Annually
	Stabilise / mow adjacent verges and remove weeds from pavement surface	Occasional (as required)
	Ensure paving dewaters after rain and between storms: check joints for sedimentation; mechanically clean or jet wash and sweep surface free from silt, etc; refill joints with sealing grit	As required
	Inspect and repair any rutting and cracked or broken blocks and replace lost jointing material	Occasional (as required)
	Rehabilitate surface and upper substructure	Occasional (as required)
Pond	Inspect for signs of clogging and remove any litter / debris found	Annually, or as required
	Inspect and clear inlets and outlets of any blockages	
	Inspect banksides for evidence of physical damage and repair as appropriate	
	Check sediment level and remove any excess from forebay	
	Cut vegetated areas/aquatic planting back	
Hardstanding areas	Sweep regularly to prevent silt being washed off the surface	Regularly, as required
Gullies	Inspect and remove any sediment / debris	Annually
Flow control structure (Hydrobrake or similar)*	Inspect and remove any sediment / debris	Annually
	Inspect flows controls and repair as necessary	Annually (as required)
	Inspect for evidence of uneven surfacing or erosion and relevel/repair as appropriate	Annually

* Refer to manufacturer's guidance for specific maintenance instructions

7.0 Foul Water Drainage

7.1 This section identifies the existing foul water drainage infrastructure on and in the vicinity of the site to assess the impact of the development on the existing infrastructure, and how the development could dispose of foul effluent.

Existing Foul Water Drainage

7.2 Thames Water is the statutory sewerage undertaker for Cropredy. As noted in Section 4, sewer records obtained from Thames Water do not show any foul water infrastructure on or in the immediate vicinity of the site, with the closest foul water sewer being in Claydon Road at the junction with Kyetts Corner, to the south of the site.

7.3 The records show only those sewers that are known to be maintained by Thames Water. Other privately-owned sewers may be present within the vicinity of the site that are not shown on public records, such as those owned by the neighbouring dwellings or those which were vested into Thames Water's control but have yet to be mapped following the 2011 Transfer of Private Sewers to sewerage undertakers.

Foul Water Drainage Strategy

7.4 Thames Water's records provide cover and invert levels for certain manholes shown on the mapping. Based on this information, it is anticipated that a gravity connection from the south-western corner of the site to manhole 7892 at Kyetts Corner will be feasible.

7.5 Given the topography of the site is generally lower than Claydon Road and falls towards the north-east, a pumped solution will be required on-site. Flows from individual dwellings will therefore drain via a gravity network to a new pump station, with a rising main discharging pumped flows through the site to the point at which a gravity connection to the Thames Water sewer can be made. A pump station compound, sized and located in accordance with Thames Water's local standards for pump stations, has been shown on the proposed site layout and highlighted within the drainage strategy drawing included in Appendix H.

7.6 A pre-planning enquiry has been submitted to Thames Water to establish if there is capacity available in the local sewerage network to accommodate flows from the development. While a response is awaited at the time of writing, it is understood from preliminary discussions with Thames Water that capacity within the local sewerage network may be limited and that upgrades, or reinforcement work may be required to accommodate flows from the development.

7.7 Notwithstanding the above, current infrastructure charging arrangements mean that Thames Water, as sewerage undertaker, is obliged to accept foul water flows generated by committed development and fund any network improvements that may be required to provide the necessary capacity via infrastructure charges received from the developer. As such, foul water capacity will not ultimately be a constraint to development, although the timing of any network improvement may influence the development programme.

Maintenance and Adoption

7.8 All new foul water infrastructure constructed to serve the development will be designed in accordance with Building Regulations Part H, Appendix C of the Sewerage Sector Guidance and current best practice, as appropriate. The foul water network serving multiple dwellings, including the foul water pump station, and rising main, will be designed with the intention to offer it for adoption by Thames Water. All foul water drainage serving a single property and located within private areas will be responsibility of the property owner.

7.9 A typical management and maintenance plan detailing the type and frequency of maintenance activities for the drainage features is provided below. A more detailed plan incorporating advise from system manufacturers and installers will be developed at the appropriate design stage.

Table 4: Pump Station – Typical Maintenance Activities*

Schedule	Maintenance Activity	Inspection Frequency
Monitoring / Maintenance	Inspection by supplier. Maintenance activities to be identified and carried out by supplier	Three interim visits, followed by annual inspections, or as required
Remedial Actions	Remedial work and/or replacement of pump or tank units or supporting infrastructure	As required

**Maintenance to be in accordance with the specifications of the pump supplier.*

Table 5: Conventional Pipe Network – Typical Maintenance Activities

Schedule	Maintenance Activity	Inspection Frequency
Regular Maintenance	CCTV survey to inspect pipework for blockages, root ingress, displaced joints, or other signs of differential settlement	As required
Remedial Actions	Clear pipework of blockages, root ingress, repair joints or repair other signs of differential settlement	As required
	Replacement of pipe system	As required

8.0 Summary and Conclusion

Summary

8.1 This Flood Risk Assessment has been prepared by Glanville Consultants to accompany an Outline planning application for a development of up to 60 dwellings and a community facility, on land east of Claydon Road on land East of Claydon Road, Cropredy, Oxfordshire, OX17 1JP.

8.2 This assessment has been prepared in accordance with the requirement of National Planning Policy Framework, Planning Practice Guidance, and with reference to the relevant Strategic Flood Risk Assessment and national and local drainage standards.

8.3 The vast majority of the site is located within Flood Zone 1. The eastern boundary of the site is shown to be in a combination of Flood Zones 2 and 3. However, the part of the site at risk of fluvial flooding is to be an area of public open space associated with the development and is at a much lower level than the built development. As such, the proposed development is at low risk from all sources of flooding, including allowance for the potential effects of climate change. Flood risk to the site and surrounding area will not increase as a result of the development.

8.4 Given the underlying geological context of the site, infiltration drainage techniques are not considered feasible. As such, a surface water drainage strategy has been prepared which proposes the discharge of run-off generated by the proposed development to an existing watercourse at a restricted rate with attenuation storage provided on-site through multiple SuDS features.

8.5 The proposed SuDS features have been sized to accommodate all flows up to the 1 in 100 year +40 % climate change storm event without flooding from surface water. Appropriate pollution control and maintenance measures have also been proposed.

8.6 Foul water flows generated by the proposed development will discharge via an on-site pump station to the existing Thames Water network in Claydon Road. Thames Water is obliged to accept foul water flows generated by committed development and fund any network improvements that may be required to provide the necessary capacity via infrastructure charges received from the developer.

Conclusion

8.7 In conclusion, this report has demonstrated that the proposed development:

- is in accordance with the National Planning Policy Framework;
- will not be at an unacceptable risk from surface water flooding or other sources;
- will not increase flood risk elsewhere;
- will employ a surface water drainage strategy based on the principles of sustainable drainage;
- will employ a suitable foul water drainage strategy.

8.8 The proposals are therefore considered to fully comply with national, regional and local planning policy.

Appendices

Appendix A

Site Location Plan

PROJECT TITLE

OBSIDIAN STRATEGIC LAND AT CROPREDY MARINA

DRAWING TITLE

RED AND BLUE LINE LOCATION PLAN

DWG. NO. J0043785_009

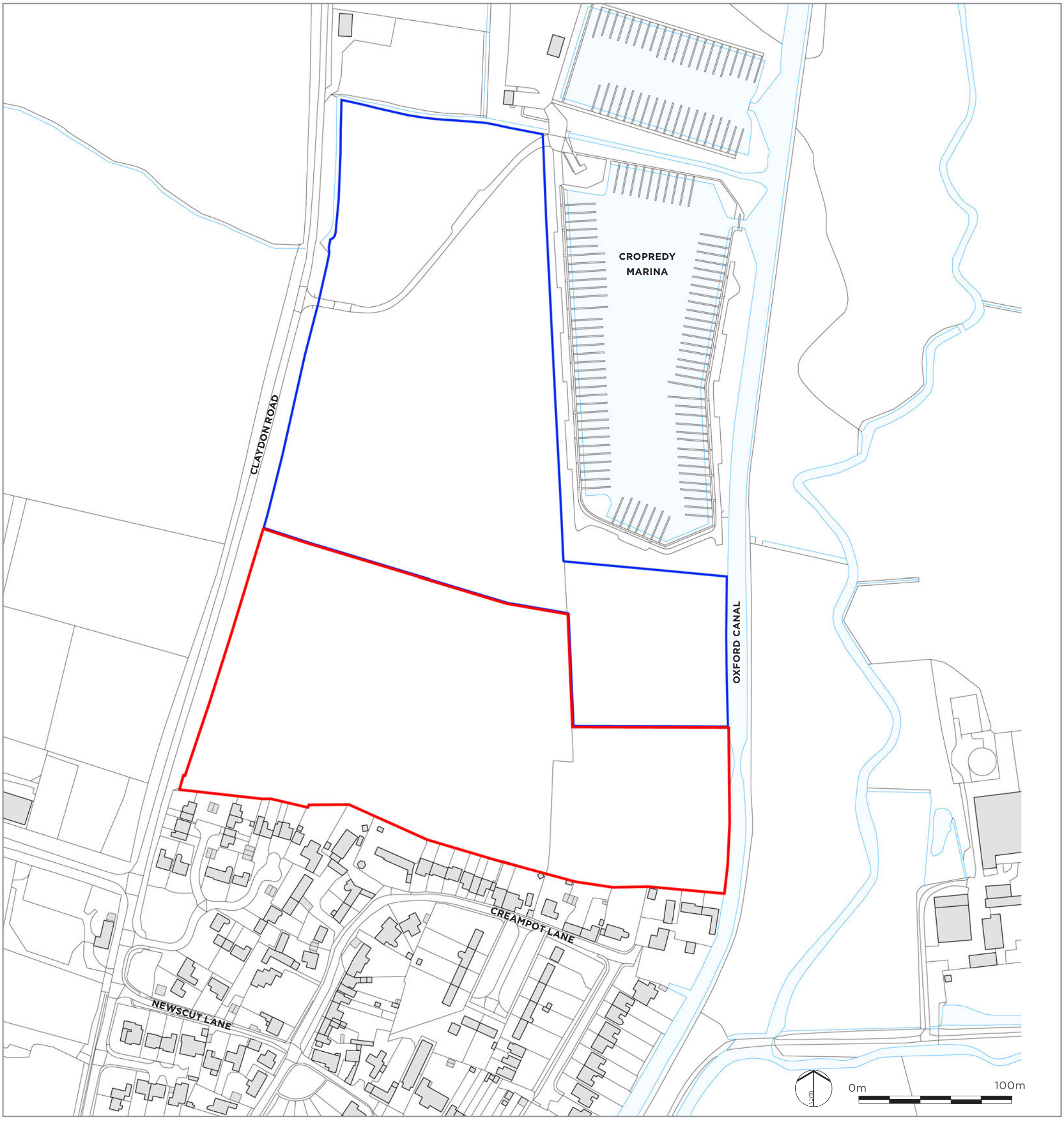
ISSUED BY	London	T: 020 7016 0720	
DATE	July 2023	**DRAWN**	MH
SCALE@A3	1:2500	**CHECKED**	JC
STATUS	Draft	**APPROVED**	JC

OBSIDIAN STRATEGIC

Carter Jonas

No dimensions are to be scaled from this drawing.
All dimensions are to be checked on site.
Area measurements for indicative purposes only.

Source: Ordnance Survey



LEGEND

Site boundary (4.96 Ha)

Land in client's ownership

Appendix B

Topographical Survey

N

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
GH1	446787.465	247168.375	104.397
GH2	446759.822	247071.856	108.600
GH3	446734.852	246972.403	110.162
GH4	446709.441	246902.194	109.210
GH6	446819.143	247288.129	101.741
GH7	446910.675	247323.922	100.691

OS Note:

This survey has been orientated to the Ordnance Survey (O.S) National Grid OSGB36(15) via Global Navigation Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGM15GB transformation models.

The survey has been correlated to this point and a further one or more OSGB36 (15) points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:

Buildings, Wall, Kerb line, Line marking, Drop kerb, Centre line, Top of bank, Overhead Cable, Concrete edge, Tarmac edge, Grass verge, Canopy/Overhang, Verge, Bottom of bank, Station and Name, Station Level, Tree / Bush / Sapling, Area of Undergrowth, Woodland, R: Ridge Level, E: Eaves Level, F: Flat Roof Level, Gate

Fence types: FW Interwoven, FR Iron Railings, WM Wire Mesh, PR Post & Rail, PW Post & Wire, CL Chain Link, WP Wooden Panels, CB Close Boarded, SP Steel Palisade

IC	Inspection chamber	Bo	Bollard		
PInv	Pipe invert	IB	Illuminated bollard		
Gy	Gully	Bin	Rubbish bin		
Bg	Back gully	Vp	Vent pipe		
Dp	Down pipe	Grl	Ground light		
Pipe	Pipe above ground	Lbox	Letter box		
MH	Manhole	Stmp	Tree Stump		
WL	Water level	Sty	Stile		
Fl	Flood light	IFL	Internal floor level		
Lp	Lamp post	THL	Threshold level		
Tp	Telegraph post	Sp	Sign post		
Ep	Electricity post	TH	Trialhole		
Ti	Traffic light	BH	Borehole		
Bus	Bus stop	ELC	Electric		
Sv	Stop valve	BT	British Telecom		
St	Stop tap	C'box	Control box		
Er	Earth rod	TT	Tactile		
Wm	Water meter	BP	Brick paved		
Gas	Gas valve	CPS	Concrete paving slabs		
Av	Air valve	CVR	Cover		
ICU	Unidentified inspection	R/wall	Retaining wall		
Wo	Wash out	TWL	Top of Wall Level		
Re	Rodding eye	TCL	Tree canopy level		
BB	Belisha beacon	G:	Girth		
CTV	Cable tv	MG	Multi girth		
Mkr	Marker post	IC	Inspection chamber		
Gmkr	Gas marker post	CL:	Cover level		
So	Soffit	IL:	Invert level		
Fh	Fire hydrant	UTR	Unable to raise		

Rev	Date	Description	Drawn	Q. Ref.

greenhatch group

- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

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London: 27, Cornwall Terrace Mews, Regents Park, London, NW1 5LL, t. (02072) 241806

CLIENT
Obsidian Strategic

PROJECT
Land at Cropredy Marina, Cherwell, Oxfordshire. OX17 1JP

TITLE
Topographical Survey

SCALE	DATE
A1@ 1: 1000	14.03.22
DRAWN: DH	QUALITY REF: GH13254

Level datum	See note
Grid orientation	See note
Job number	43382

Drawing No.	Rev.
43382_T	0

Comments
This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

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

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

Appendix C

Geological Mapping Extracts

KEY

Approximate site boundary

Superficial Geology

Alluvium - Clay, Silt, Sand and Gravel

Bedrock Geology

Charmouth Mudstone Formation - Mudstone

Dyrham Formation - Siltstone and Mudstone, Interbedded

Soilscape

HOST Soil Class 18 - Slowly Permeable Seasonally Wet Slightly Acid but Base-Rich Loamy and Clayey Soils

HOST Soil Class 20 - Loamy and Clayey Floodplain with naturally high groundwater

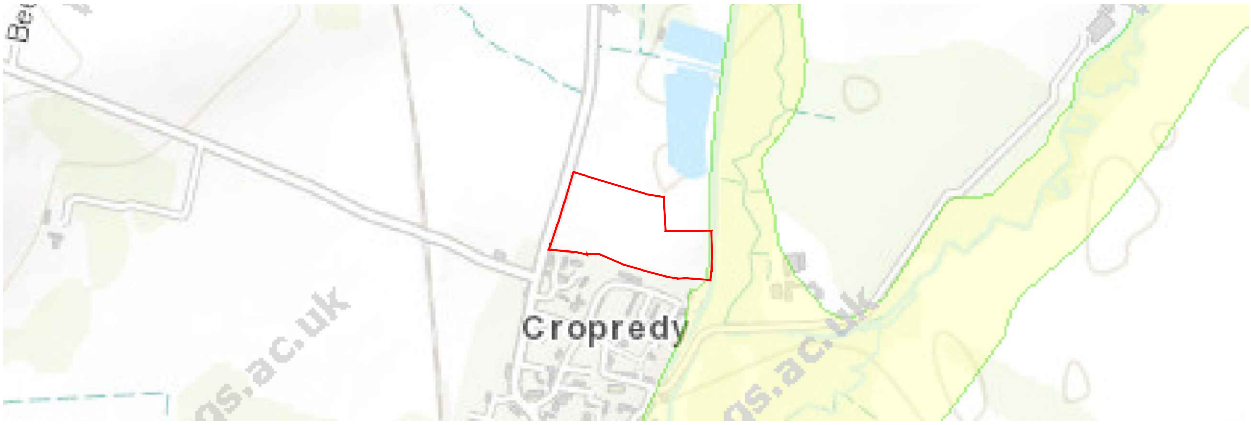
HOST Soil Class 8 - Slightly Acid Loamy and Clayey Soils with Impeded Drainage

NOTES

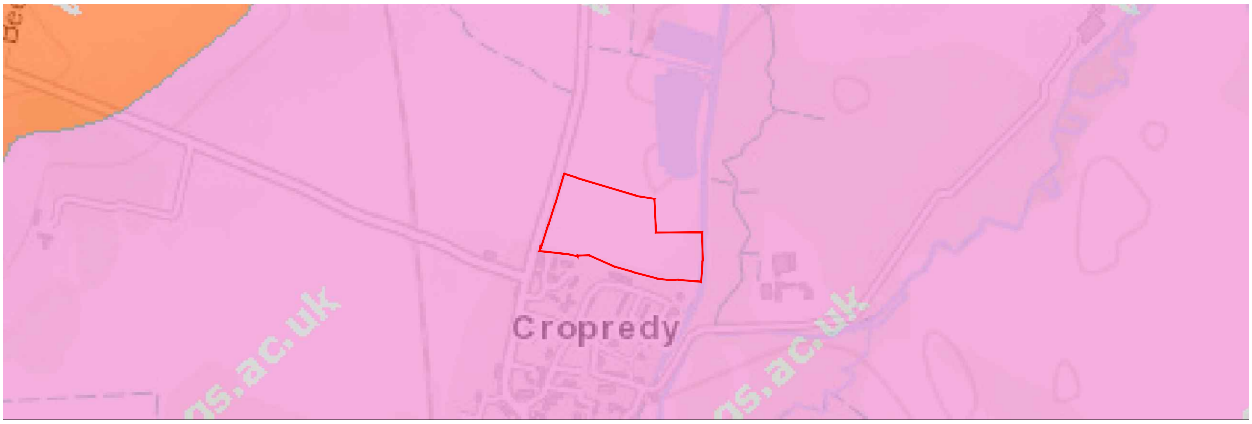
1. This drawing is to be read in conjunction with all other documents and specifications
2. Dimensions not to be scaled from drawing

N

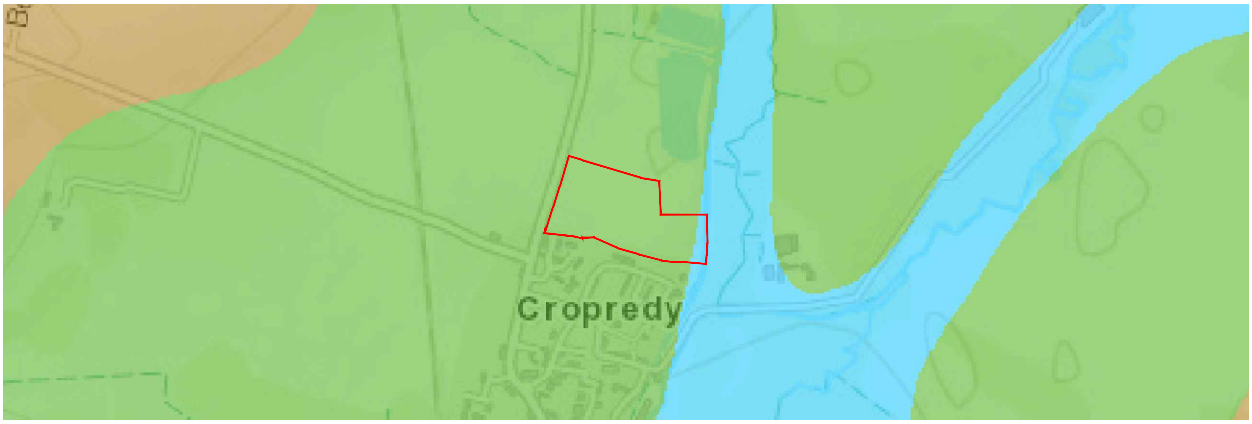
Superficial Geology



Bedrock Geology



Soilscape



Glanville
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Tel: (01235) 515550 Fax: (01235) 817799
postbox@glanvillegroup.com www.glanvillegroup.com

Project :	Land East of Claydon Road, Cropredy				
Title :	Geological Mapping Extracts				
Project Engineer :	S McNair	Scale :	NTS	Drawing No. 8210439 - SK02	Rev -
Project Director :	J Birch	Date :	March 2023		

Appendix D

Proposed Site Layout

LEGEND

- Site boundary (4.96 Ha)
- Vehicular access
- Pedestrian access

1. Proposed community facility and associated car parking
2. Primary tree-lined street
3. Drainage basin location
4. Recreational walking trail
5. Local Equipped Area of Play (LEAP)
6. Local Area of Play (LAP)
7. 10m tree buffer
8. Pumping station location
9. Public open space
10. Community orchard

NB1: The layout illustrates a proposed housing development of 60 homes at a net density of 30 DpH

NB2: Policy compliant housing mix meeting or exceeding Nationally Described Space Standards

North

0 50m

Carter Jonas

OBSIDIAN STRATEGIC

PROJECT TITLE

OBSIDIAN STRATEGIC LAND AT CROPREDY MARINA

DRAWING TITLE

ILLUSTRATIVE PLAN, 60 UNITS

ISSUED BY	London	T: 020 7016 0720	
DATE	April 2023	**DRAWN**	MH
SCALE@A3	1:1250	**CHECKED**	JC
STATUS	Planning	**APPROVED**	JC

DWG. NO. J0050867_008A

No dimensions are to be scaled from this drawing.
All dimensions are to be checked on site.
Area measurements for indicative purposes only.

Source: Ordnance Survey

Appendix E

Environment Agency Flood Map for Planning Extract

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**446922/247024**	**11 Aug 2023 9:21**

Your selected location is in flood zone 3, an area with a high probability of flooding.

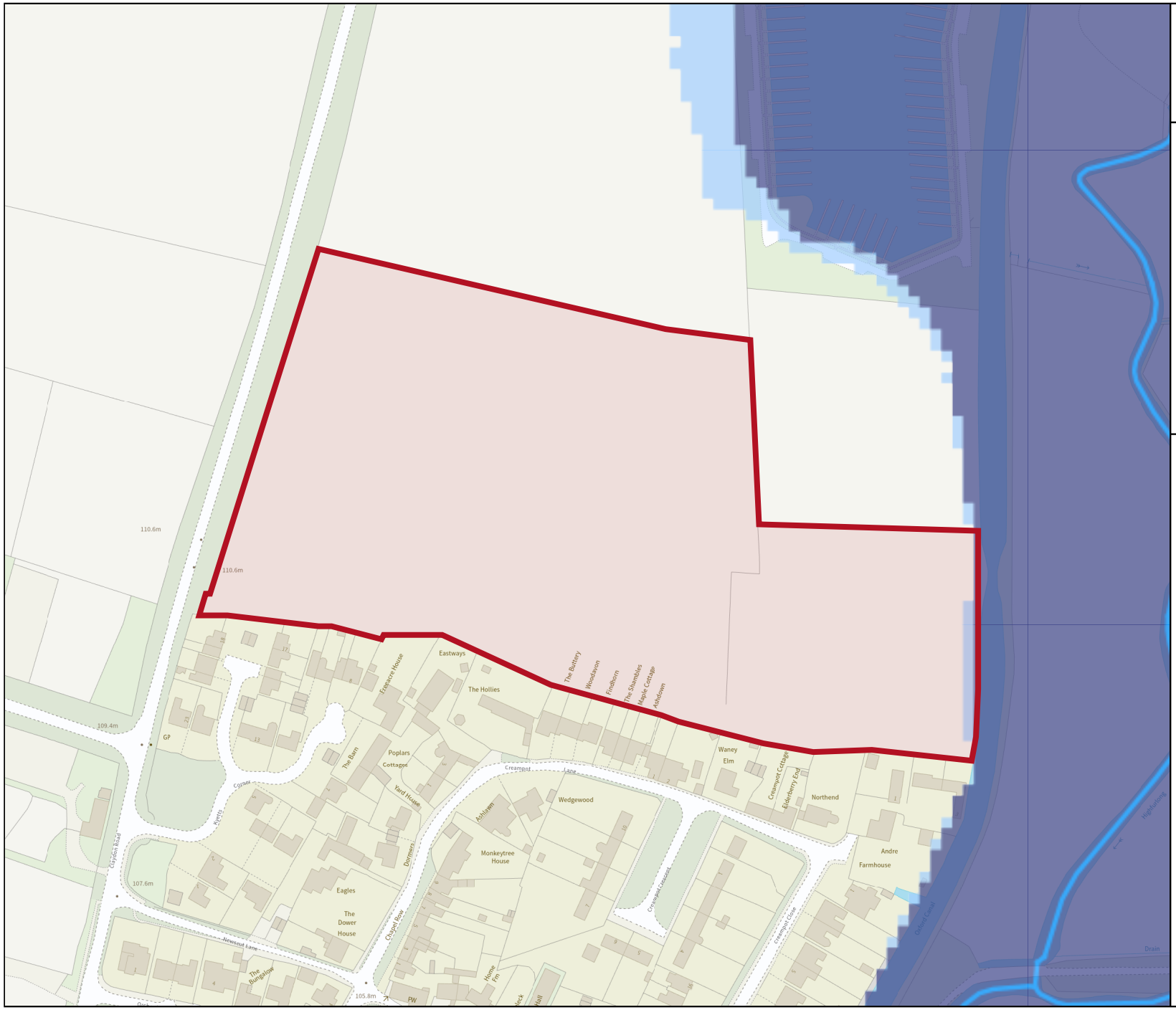
This means:

- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see www.gov.uk/guidance/flood-risk-assessment-standing-advice)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
446922/247024

Scale
1:2500

Created
11 Aug 2023 9:21

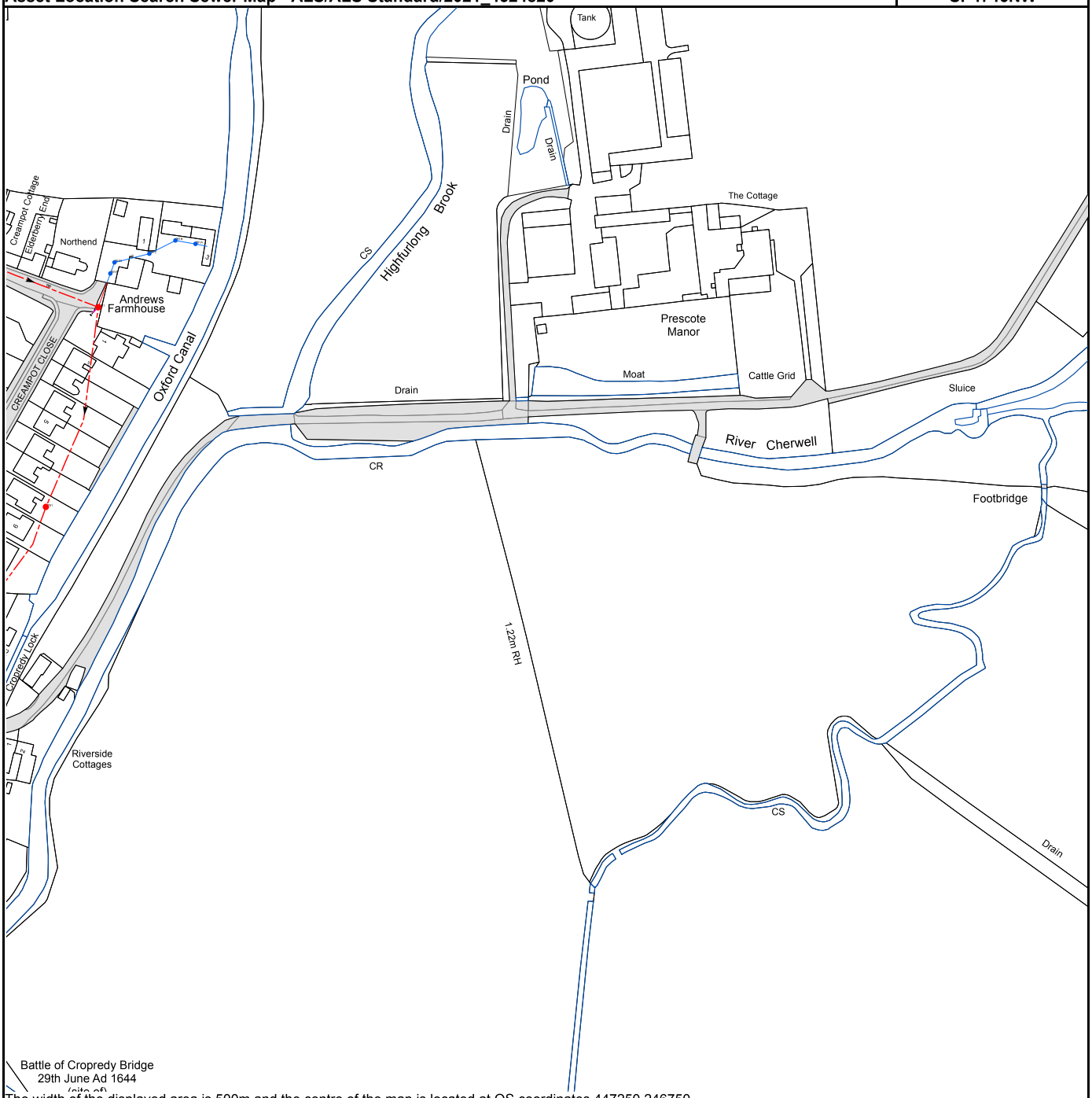
- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

Appendix F

Thames Water Sewer Records

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4524820	SP4746NW



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 447250,246750

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0801	100.58	99.91
081E	n/a	n/a
081D	n/a	n/a
081C	n/a	n/a
081A	n/a	n/a
081B	n/a	n/a
0791	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4524820	SP4647SE

The width of the displayed area is 500m and the centre of the map is located at OS coordinates 446750,247250

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
7001	109.28	104.93
7104	105.05	103.82
7101	105.22	103.93

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4524820	SP4646NE

The width of the displayed area is 500m and the centre of the map is located at OS coordinates 446750,246750

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
8703	105.34	103.96
8751	105.33	104.48
9791	n/a	n/a
9705	101.96	101.22
8702	105.63	104.16
9704	103.88	102.22
9802	104.33	102.39
9803	105.03	102.7
9806	105.32	103.28
9804	104.43	102.61
9807	105.36	103.41
9811	104.32	102.72
9805	104.14	102.97
9808	105.43	103.88
8802	105.34	103.93
9809	105.44	104.04
9810	105.24	104.48
8801	105.44	104.09
9801	103.3	101.85
9901	104.33	102.98
8901	105.48	103.77
9605	99.97	97.94
8605	103.32	101.82
8608	103.61	102.39
8607	103.71	102.56
8604	103.52	102.1
8606	103.99	102.91
9604	100.12	98.08
8603	104.59	103.52
8602	104.93	103.9
8601	104.93	104.03
9603	100.6	98.45
9602	102.39	100.76
9601	103.41	101.34
8609	104.74	103.25
871E	n/a	n/a
871D	n/a	n/a
9703	104.09	102.04
871J	n/a	n/a
871C	n/a	n/a
9792	n/a	n/a
9702	104.01	102.7
871I	n/a	n/a
871H	n/a	n/a
9701	103.77	103.07
871G	n/a	n/a
871K	n/a	n/a
8554	99.31	98.55
8553	99.76	99.05
8507	99.87	98.96
8505	99.81	98.63
8552	100.57	99.61
8504	100.62	99.24
8503	100.86	99.42
8506	100.77	99.51
8502	101.4	99.87
951C	n/a	n/a
9501	99.52	97.57
8501	102.15	100.69
8551	102.1	101.21
951B	n/a	n/a
961A	n/a	n/a
951A	99.63	98.4
8610	105.18	103.88
7601	104.28	102.44
6601	104.84	103.48
761H	n/a	n/a
761A	n/a	n/a
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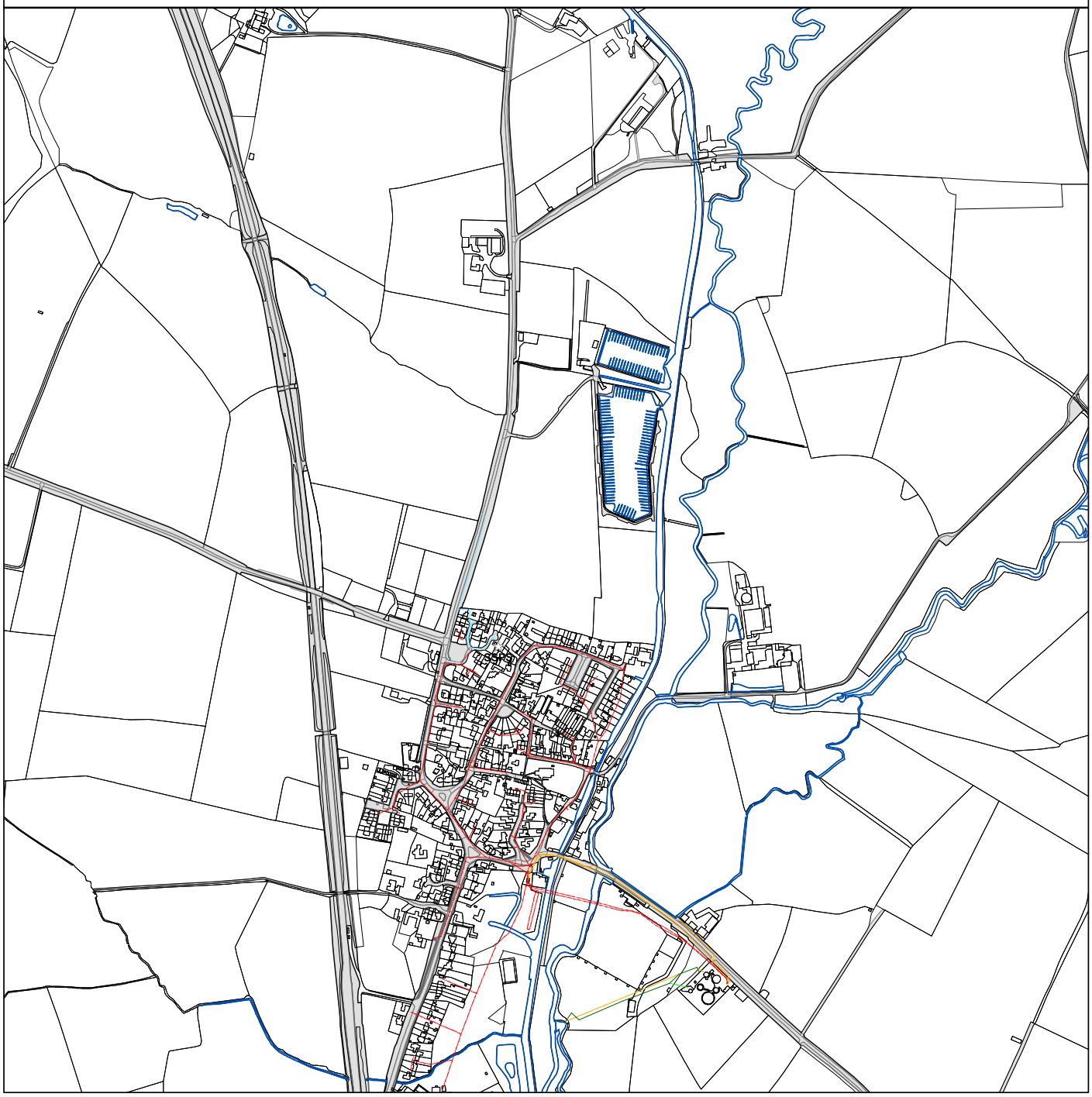
871F	n/a	n/a
871B	n/a	n/a
771B	n/a	n/a
7701	107.4	106.27
6701	106.76	105.4
8701	105.51	103.5
6801	106.78	105.38
7891	107.3	105.59
781D	n/a	n/a
781C	n/a	n/a
781A	n/a	n/a
781F	n/a	n/a
781B	n/a	n/a
7893	108.98	106.12
7897	109.03	106.94
7892	108.35	105.85
7898	108.51	107.22
7894	108.89	106.39
7895	108.68	106.88
7896	108.86	106.72
7901	108.83	106.28

Manhole Reference	Manhole Cover Level	Manhole Invert Level
8903	108.22	107.25
8508	99.4	97.47
7503	100.28	98.42
7504	101.59	98.7
7502	101.59	99.23
751F	n/a	n/a
751G	n/a	n/a
751E	n/a	n/a
5501	103.37	102.53
6501	104.95	103.12
7552	103.09	101.35
7551	103.11	101.46
7501	103.14	101.18
6604	104.21	102.49
761G	n/a	n/a
761F	n/a	n/a
6603	104.05	102.24
761C	n/a	n/a
761D	n/a	n/a
761B	n/a	n/a
761E	n/a	n/a
7602	103.72	101.82
6602	104.59	101.75
7651	104.43	102.93
7908	110.06	105.5
791D	n/a	n/a
791C	n/a	n/a
7902	109.08	106.16
7903	109.36	n/a
7904	110.18	105.77
7906	109.47	107.4
7905	109.25	107.47
8902	108.46	107.13

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2021_4524820



0 45 90 180 270 360
Meters

Scale:	1:7161
Width:	2000m
Printed By:	Rveldhur
Print Date:	19/10/2021
Map Centre:	446899,247080
Grid Reference:	SP4647SE

Comments:

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

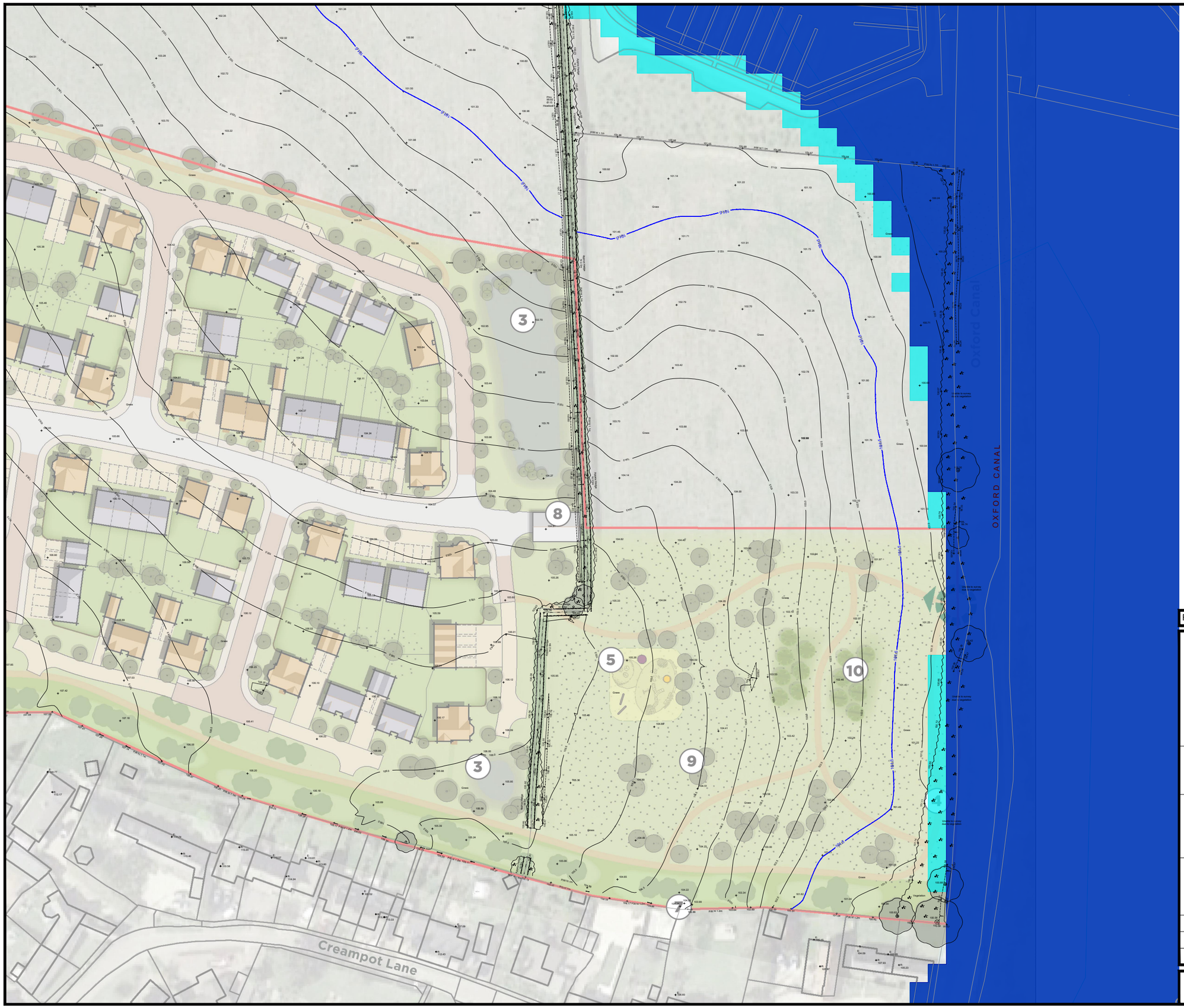
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0800 009 4540.

Appendix G

Topographical Survey & Flood Zones Overlay



NOTES

1. This drawing to be read in conjunction with all other drawings and specifications.
2. Dimensions not to be scaled for construction purposes.
3. Topographical survey from Greenhatch Group (ref: 43382_T; date: March 2022).
4. Illustrative site layout from Carter Jonas (ref: J0050867_008, date: April 2023).

KEY

- Site Boundary
- Flood Zone 2
- Flood Zone 3
- 1%AEP + climate change: 101.5m AOD

N

Rev.	Description	Date	Chkd

Glanville
Cornerstone House
62 Foxhall Road, Didcot
Oxon, OX11 7AD
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Client :
Obsidian Strategic Asset Management Limited

Project :
Land East of Claydon Road,
Cropredy

Title :
Topographical Survey & Flood Zones

Project Engineer :	A. Quigley	Scale :	1:1,000@A3
Project Director :	J. Birch	Date :	August 2023
Status :	PLANNING		

Drawing No. 8210439 - SK110 Rev P1

Appendix H

Proposed Drainage Strategy

Existing Thames Water surface water network discharges to ordinary watercourse along Claydon Road, before ultimately discharging to Oxford Canal, to the north of existing Marina.

Surface and foul water networks shown indicatively and subject to reserved matters application

Outfall to existing ditch within current landowners control. Continuous right of access to be granted for maintenance.

MicroDrainage Ref: SPond1
Max. Attenuation Volume: 1039m³
Depth of Storage - 1.20m with additional 300mm residual uncertainty allowance.

Flow control to restrict discharge from the site for all storm events up to 1:100+40%CC to 21.80 l/s (QBAR)

Adoptable foul water rising main to be constructed up to highpoint in South-west corner of the site. Break chamber to be provided before gravity connection to the existing Thames Water network. Location and Extent of break chamber and gravity network to be confirmed at appropriate design stage following confirmation of site layout and existing network details.

Community facility to provide attenuation within car park area and restrict discharge to wider network to 1.20 l/s (QMED for catchment).

MicroDrainage Ref: SCrates
Max. Attenuation Volume: 241m³
Geocellular Crate Dims: 21.50m x 10m x 1.20m

Adoptable foul water pump station. Compound dimensions 12m x 8m, with distance from wet well to habitable rooms a minimum of 20m.

Existing Thames Water Sewer
MH Ref: 7892
CL: 108.35
IL: 105.85

Gravity sewer approximately 115m in length, therefore IL of break chamber approx. 107.35m - TBC at appropriate design stage.

Existing Thames Water foul and surface water networks drawn indicatively from Thames Water asset records - locations and details of key chambers to be confirmed at appropriate design stage.

Surface and foul water networks shown indicatively and subject to reserved matters application

MicroDrainage Ref: SPond2
Max. Attenuation Volume: 77m³
Depth of Storage - 0.90m with additional 300mm residual uncertainty allowance.
Max. discharge for design event: 7.5 l/s

Claydon Road

Creampot Lane

NOTES:

1. Dimensions not to be scaled from this drawing for construction purposes.
2. This drawing should be read in conjunction with the associated Flood Risk Assessment and all relevant standards.
3. Sewer runs and SuDS features shown in outline only and are subject to detailed design.
4. All levels shown in meters above ordnance datum (m AOD).
5. Topographical survey taken from Greenhatch group drawing number 43382_T, dated March 2022.
6. All cover and invert levels of existing drainage infrastructure and ditch bed levels to be confirmed and relayed to engineer for confirmation of design.
7. Illustrative site layout taken from Carter Jonas drawing number J0050867_008, dated April 2023.
8. Thames Water sewer records taken from asset records, reference ALS/ALS Standard/2021_452420.

KEY:

- Proposed surface water sewer
- Proposed foul water sewer
- Proposed foul water rising main
- Existing Thames Water surface water sewer
- Existing Thames Water foul water sewer
- Proposed flow control chamber
- Headwall
- Direction of flow arrow
- Geocellular Crates
- SuDS Basin/Pond
- Permeable Paving

Rev.	Description	Date	Chkd
P2	Amended Drainage Strategy.	20/7/2023 JD	JB
P1	Issued to client.	4/4/2023 SM	JB

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Client :
Obsidian Strategic Asset Management Limited

Project :
Land East of Claydon Road, Cropredy

Title :
Outline Drainage Strategy

Project Engineer :	S McNair	Scale :	1:500 @ A1
Project Director :	J Birch	Date :	April 2023
Status :	PLANNING		

Drawing No. 8210439 - SK101 Rev P2

Appendix I

MicroDrainage Calculations

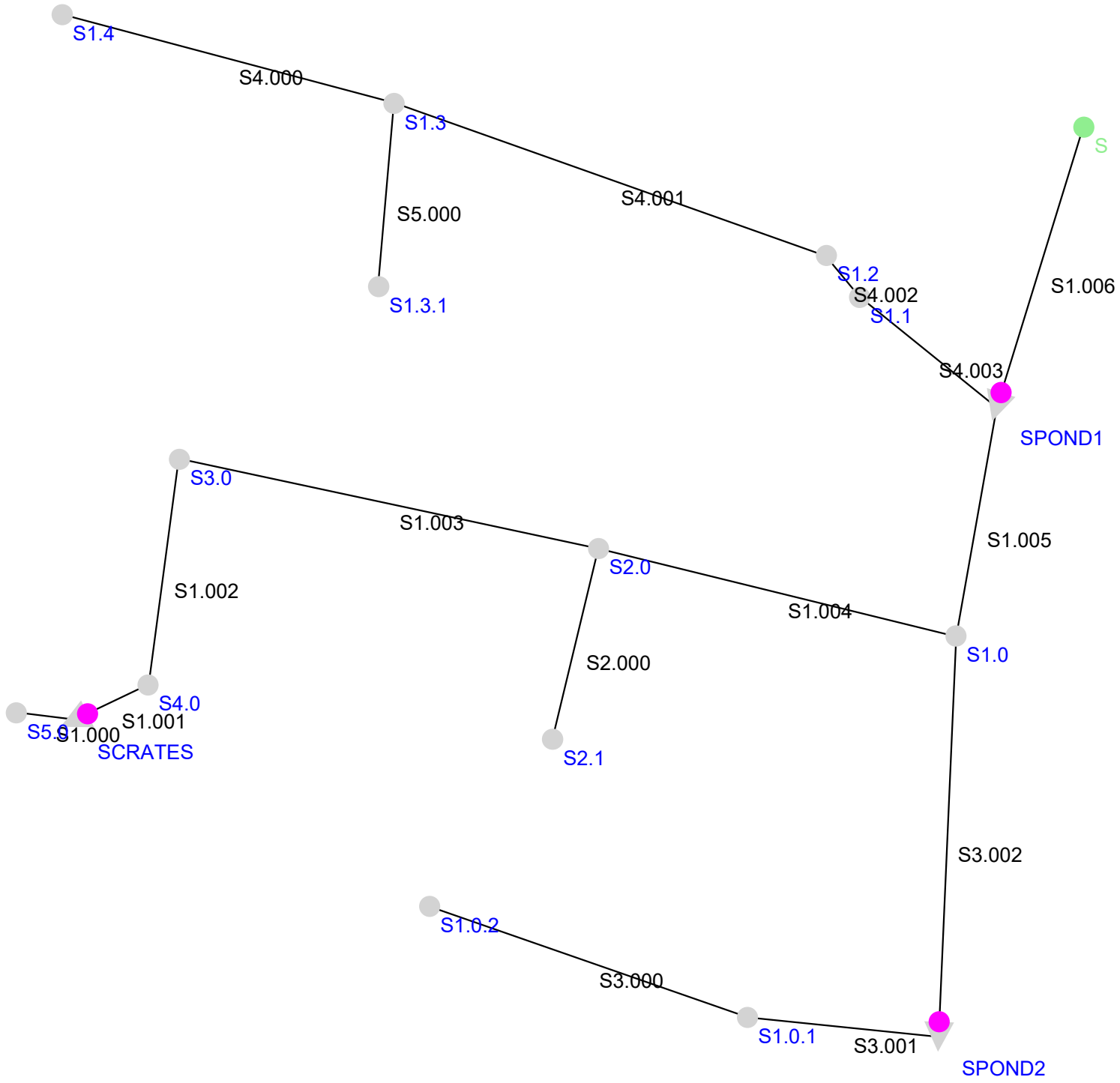
ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	4.960	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results l/s

QBAR Rural	21.8
QBAR Urban	21.8
Q2 years	19.2
Q1 year	18.5
Q30 years	49.4
Q100 years	69.5


S1.4
S4.000
S1.3
S
S4.001
S5.000
S1.2
S1.006
S1.3.1
S4.002
S1.1
S4.003
SPOND1
S3.0
S1.003
S1.005
S2.0
S1.002
S1.004
S1.0
S2.000
S4.0
S1.001
S5.0
S1.000
SCRATES
S2.1
S3.002
S1.0.2
S3.000
S1.0.1
S3.001
SPOND2

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447100 246900 SP 47100 46900
C (1km)	-0.024
D1 (1km)	0.337
D2 (1km)	0.356
D3 (1km)	0.223
E (1km)	0.295
F (1km)	2.505
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.900
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.889	4-8	0.629	8-12	0.114	12-16	0.005

Total Area Contributing (ha) = 1.638

Total Pipe Volume (m³) = 46.387

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

Network Design Table for Storm

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	9.769	2.050	4.8	0.000	10.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	13.723	0.090	152.5	0.243	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	38.152	0.535	71.3	0.065	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	71.778	0.650	110.4	0.173	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.000	32.855	0.220	149.3	0.043	10.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	61.596	0.700	88.0	0.243	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	56.380	0.335	168.3	0.059	10.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	32.175	0.215	149.7	0.101	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	67.187	1.325	50.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	38.998	2.575	15.1	0.218	0.00	0.0	0.600	o	375	Pipe/Conduit	
S4.000	57.517	1.025	56.1	0.131	10.00	0.0	0.600	o	225	Pipe/Conduit	
S5.000	30.796	0.375	82.1	0.057	10.00	0.0	0.600	o	225	Pipe/Conduit	
S4.001	76.761	0.940	81.7	0.128	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.002	8.950	0.060	149.2	0.128	0.00	0.0	0.600	o	375	Pipe/Conduit	
S4.003	29.370	1.250	23.5	0.049	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	10.04	107.400	0.000	0.0	0.0	0.0	4.65	82.1	0.0
S1.001	50.00	10.32	105.350	0.243	0.0	0.0	0.0	0.81	14.3«	39.5
S1.002	50.00	10.85	105.260	0.308	0.0	0.0	0.0	1.19	21.1«	50.0
S1.003	50.00	11.54	104.500	0.481	0.0	0.0	0.0	1.72	190.4	78.2
S2.000	50.00	10.67	104.295	0.043	0.0	0.0	0.0	0.82	14.5	7.0
S1.004	50.00	12.08	103.850	0.767	0.0	0.0	0.0	1.93	213.4	124.6
S3.000	50.00	10.94	105.250	0.059	0.0	0.0	0.0	1.00	40.0	9.6
S3.001	50.00	11.44	104.915	0.160	0.0	0.0	0.0	1.07	42.4	26.0
S3.002	50.00	12.23	104.700	0.160	0.0	0.0	0.0	1.42	25.0«	26.0
S1.005	50.00	12.37	103.150	1.145	0.0	0.0	0.0	4.68	516.5	186.1
S4.000	50.00	10.55	104.000	0.131	0.0	0.0	0.0	1.75	69.6	21.3
S5.000	50.00	10.36	103.350	0.057	0.0	0.0	0.0	1.44	57.4	9.3
S4.001	50.00	11.28	102.900	0.316	0.0	0.0	0.0	1.74	123.1	51.3
S4.002	50.00	11.38	101.885	0.444	0.0	0.0	0.0	1.48	163.6	72.1
S4.003	50.00	11.51	101.900	0.493	0.0	0.0	0.0	3.75	414.4	80.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.006	49.050	0.325	150.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.006	50.00	12.86	100.500	1.638	0.0	0.0	0.0	1.65	262.8«	266.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdro (mm)
S5.0	108.000	0.600	Open Manhole	1200	S1.000	107.400	150				
SCRATES	107.750	2.400	Open Manhole	1200	S1.001	105.350	150	S1.000	105.350	150	
S4.0	107.250	1.990	Open Manhole	1500	S1.002	105.260	150	S1.001	105.260	150	
S3.0	106.100	1.600	Open Manhole	1500	S1.003	104.500	375	S1.002	104.725	150	
S2.1	105.695	1.400	Open Manhole	1500	S2.000	104.295	150				
S2.0	105.250	1.400	Open Manhole	1500	S1.004	103.850	375	S1.003	103.850	375	
								S2.000	104.075	150	
S1.0.2	106.650	1.400	Open Manhole	1500	S3.000	105.250	225				
S1.0.1	106.315	1.400	Open Manhole	1500	S3.001	104.915	225	S3.000	104.915	225	
SPOND2	105.900	1.200	Open Manhole	1200	S3.002	104.700	150	S3.001	104.700	225	
S1.0	104.750	1.600	Open Manhole	1500	S1.005	103.150	375	S1.004	103.150	375	
								S3.002	103.375	150	
S1.4	105.400	1.400	Open Manhole	1500	S4.000	104.000	225				
S1.3.1	104.750	1.400	Open Manhole	1500	S5.000	103.350	225				
S1.3	104.300	1.400	Open Manhole	1500	S4.001	102.900	300	S4.000	102.975	225	
								S5.000	102.975	225	
S1.2	103.300	1.415	Open Manhole	1500	S4.002	101.885	375	S4.001	101.960	300	
S1.1	103.300	1.475	Open Manhole	1500	S4.003	101.900	375	S4.002	101.825	375	
SPOND1	102.000	1.500	Open Manhole	1350	S1.006	100.500	450	S1.005	100.575	375	
								S4.003	100.650	375	
S	101.000	0.825	Open Manhole	150		OUTFALL		S1.006	100.175	450	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S5.0	446821.327	247002.429	446821.327	247002.429	Required	
SCRATES	446831.019	247001.201	446831.019	247001.201	Required	
S4.0	446843.404	247007.112	446843.404	247007.112	Required	
S3.0	446848.644	247044.903	446848.644	247044.903	Required	
S2.1	446911.143	246998.003	446911.143	246998.003	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S2.0	446918.845	247029.942	446918.845	247029.942	Required	
S1.0.2	446890.549	246970.034	446890.549	246970.034	Required	
S1.0.1	446943.767	246951.417	446943.767	246951.417	Required	
SPOND2	446975.780	246948.185	446975.780	246948.185	Required	
S1.0	446978.678	247015.310	446978.678	247015.310	Required	
S1.4	446829.029	247119.393	446829.029	247119.393	Required	
S1.3.1	446882.013	247073.833	446882.013	247073.833	Required	
S1.3	446884.589	247104.521	446884.589	247104.521	Required	
S1.2	446957.002	247079.053	446957.002	247079.053	Required	
S1.1	446962.562	247072.039	446962.562	247072.039	Required	
SPOND1	446985.506	247053.705	446985.506	247053.705	Required	
S	447000.115	247100.530			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S5.0	108.000	107.400	0.450	Open Manhole	1200
S1.001	o	150	SCRATES	107.750	105.350	2.250	Open Manhole	1200
S1.002	o	150	S4.0	107.250	105.260	1.840	Open Manhole	1500
S1.003	o	375	S3.0	106.100	104.500	1.225	Open Manhole	1500
S2.000	o	150	S2.1	105.695	104.295	1.250	Open Manhole	1500
S1.004	o	375	S2.0	105.250	103.850	1.025	Open Manhole	1500
S3.000	o	225	S1.0.2	106.650	105.250	1.175	Open Manhole	1500
S3.001	o	225	S1.0.1	106.315	104.915	1.175	Open Manhole	1500
S3.002	o	150	SPOND2	105.900	104.700	1.050	Open Manhole	1200
S1.005	o	375	S1.0	104.750	103.150	1.225	Open Manhole	1500
S4.000	o	225	S1.4	105.400	104.000	1.175	Open Manhole	1500
S5.000	o	225	S1.3.1	104.750	103.350	1.175	Open Manhole	1500
S4.001	o	300	S1.3	104.300	102.900	1.100	Open Manhole	1500
S4.002	o	375	S1.2	103.300	101.885	1.040	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	9.769	4.8	SCRATES	107.750	105.350	2.250	Open Manhole	1200
S1.001	13.723	152.5	S4.0	107.250	105.260	1.840	Open Manhole	1500
S1.002	38.152	71.3	S3.0	106.100	104.725	1.225	Open Manhole	1500
S1.003	71.778	110.4	S2.0	105.250	103.850	1.025	Open Manhole	1500
S2.000	32.855	149.3	S2.0	105.250	104.075	1.025	Open Manhole	1500
S1.004	61.596	88.0	S1.0	104.750	103.150	1.225	Open Manhole	1500
S3.000	56.380	168.3	S1.0.1	106.315	104.915	1.175	Open Manhole	1500
S3.001	32.175	149.7	SPOND2	105.900	104.700	0.975	Open Manhole	1200
S3.002	67.187	50.7	S1.0	104.750	103.375	1.225	Open Manhole	1500
S1.005	38.998	15.1	SPOND1	102.000	100.575	1.050	Open Manhole	1350
S4.000	57.517	56.1	S1.3	104.300	102.975	1.100	Open Manhole	1500
S5.000	30.796	82.1	S1.3	104.300	102.975	1.100	Open Manhole	1500
S4.001	76.761	81.7	S1.2	103.300	101.960	1.040	Open Manhole	1500
S4.002	8.950	149.2	S1.1	103.300	101.825	1.100	Open Manhole	1500

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S4.003	o	375	S1.1	103.300	101.900	1.025	Open Manhole	1500
S1.006	o	450	SPOND1	102.000	100.500	1.050	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S4.003	29.370	23.5	SPOND1	102.000	100.650	0.975	Open Manhole	1350
S1.006	49.050	150.9	S	101.000	100.175	0.375	Open Manhole	150

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.243	0.243	0.243
1.002	-	-	100	0.065	0.065	0.065
1.003	-	-	100	0.173	0.173	0.173
2.000	-	-	100	0.043	0.043	0.043
1.004	-	-	100	0.243	0.243	0.243
3.000	-	-	100	0.059	0.059	0.059
3.001	-	-	100	0.101	0.101	0.101
3.002	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.218	0.218	0.218
4.000	-	-	100	0.131	0.131	0.131
5.000	-	-	100	0.057	0.057	0.057
4.001	-	-	100	0.128	0.128	0.128
4.002	-	-	100	0.128	0.128	0.128
4.003	-	-	100	0.049	0.049	0.049
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.638	1.638	1.638

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.006	S	101.000	100.175	100.175	150	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.900	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447100 246900 SP 47100 46900
C (1km)	-0.024
D1 (1km)	0.337

Synthetic Rainfall Details

D2 (1km)	0.356
D3 (1km)	0.223
E (1km)	0.295
F (1km)	2.505
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.900
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SCRATES, DS/PN: S1.001, Volume (m³): 2.9

Unit Reference	MD-SHE-0049-1200-1200-1200
Design Head (m)	1.200
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	105.350
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.2
Flush-Flo™	0.215	0.9
Kick-Flo®	0.438	0.8
Mean Flow over Head Range	-	0.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	1.200	1.2	3.000	1.8	7.000	2.7
0.200	0.9	1.400	1.3	3.500	2.0	7.500	2.8
0.300	0.9	1.600	1.4	4.000	2.1	8.000	2.9
0.400	0.8	1.800	1.4	4.500	2.2	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.3	9.000	3.0
0.600	0.9	2.200	1.6	5.500	2.4	9.500	3.1
0.800	1.0	2.400	1.6	6.000	2.5		
1.000	1.1	2.600	1.7	6.500	2.6		

Hydro-Brake® Optimum Manhole: SPOND2, DS/PN: S3.002, Volume (m³): 2.6

Unit Reference	MD-SCU-0088-7500-0900-7500
Design Head (m)	0.900
Design Flow (l/s)	7.5
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	88
Invert Level (m)	104.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: SPOND2, DS/PN: S3.002, Volume (m³): 2.6

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	7.5
Flush-Flo™	0.111	3.1
Kick-Flo®	0.130	3.1
Mean Flow over Head Range	-	5.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	8.6	3.000	13.3	7.000	19.9
0.200	3.7	1.400	9.2	3.500	14.3	7.500	20.6
0.300	4.5	1.600	9.8	4.000	15.2	8.000	21.3
0.400	5.1	1.800	10.4	4.500	16.1	8.500	21.9
0.500	5.7	2.000	10.9	5.000	17.0	9.000	22.5
0.600	6.2	2.200	11.4	5.500	17.7	9.500	23.1
0.800	7.1	2.400	11.9	6.000	18.5		
1.000	7.9	2.600	12.4	6.500	19.2		

Hydro-Brake® Optimum Manhole: SPOND1, DS/PN: S1.006, Volume (m³): 9.4

Unit Reference	MD-SHE-0204-2180-1175-2180
Design Head (m)	1.175
Design Flow (l/s)	21.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	204
Invert Level (m)	100.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.175	21.8
Flush-Flo™	0.374	21.8
Kick-Flo®	0.818	18.4
Mean Flow over Head Range	-	18.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.0	0.300	21.6	0.500	21.5	0.800	18.8
0.200	19.4	0.400	21.8	0.600	21.1	1.000	20.2

Hydro-Brake® Optimum Manhole: SPOND1, DS/PN: S1.006, Volume (m³): 9.4

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	22.0	2.400	30.7	5.000	43.7	8.000	54.9
1.400	23.7	2.600	31.9	5.500	45.8	8.500	56.5
1.600	25.3	3.000	34.2	6.000	47.7	9.000	58.1
1.800	26.7	3.500	36.8	6.500	49.6	9.500	59.7
2.000	28.1	4.000	39.2	7.000	51.4		
2.200	29.4	4.500	41.5	7.500	53.2		

Storage Structures for Storm

Cellular Storage Manhole: SCRATES, DS/PN: S1.001

Invert Level (m) 105.350 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	215.0	215.0	1.300	0.0	290.6
1.200	215.0	290.6			

Infiltration Basin Manhole: SPOND2, DS/PN: S3.002

Invert Level (m) 104.700 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	44.2	1.200	169.8

Infiltration Basin Manhole: SPOND1, DS/PN: S1.006

Invert Level (m) 100.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	571.0	1.200	1031.9	1.500	1160.2

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 447100 246900 SP 47100 46900
C (1km)	-0.024
D1 (1km)	0.337
D2 (1km)	0.356
D3 (1km)	0.223
E (1km)	0.295
F (1km)	2.505
Cv (Summer)	0.950
Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S5.0	60 minute 1 year Summer I+0%	60	108.000	107.400	-0.150	0.000
S1.001	SCRATES	1440 minute 1 year Summer I+0%	1440	107.750	105.557	0.057	0.000
S1.002	S4.0	60 minute 1 year Summer I+0%	60	107.250	105.322	-0.088	0.000
S1.003	S3.0	60 minute 1 year Summer I+0%	60	106.100	104.592	-0.283	0.000
S2.000	S2.1	60 minute 1 year Summer I+0%	60	105.695	104.350	-0.095	0.000
S1.004	S2.0	60 minute 1 year Summer I+0%	60	105.250	103.980	-0.245	0.000
S3.000	S1.0.2	60 minute 1 year Summer I+0%	60	106.650	105.306	-0.169	0.000
S3.001	S1.0.1	60 minute 1 year Summer I+0%	60	106.315	105.011	-0.129	0.000
S3.002	SPOND2	120 minute 1 year Summer I+0%	120	105.900	104.908	0.058	0.000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S5.0	0.00	0.000	0.0	OK
S1.001	SCRATES	0.07	42.459	0.9	SURCHARGED
S1.002	S4.0	0.36	0.144	7.3	OK
S1.003	S3.0	0.14	0.154	24.6	OK
S2.000	S2.1	0.29	0.088	4.0	OK
S1.004	S2.0	0.26	0.439	52.2	OK
S3.000	S1.0.2	0.14	0.091	5.4	OK
S3.001	S1.0.1	0.38	0.269	15.1	OK
S3.002	SPOND2	0.15	11.561	3.8	SURCHARGED

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.005	S1.0	60 minute 1 year Summer I+0%	60	104.750	103.251	-0.274	0.000
S4.000	S1.4	60 minute 1 year Summer I+0%	60	105.400	104.064	-0.161	0.000
S5.000	S1.3.1	60 minute 1 year Summer I+0%	60	104.750	103.397	-0.178	0.000
S4.001	S1.3	60 minute 1 year Summer I+0%	60	104.300	103.002	-0.198	0.000
S4.002	S1.2	60 minute 1 year Summer I+0%	60	103.300	102.047	-0.213	0.000
S4.003	S1.1	60 minute 1 year Summer I+0%	60	103.300	101.989	-0.286	0.000
S1.006	SPOND1	360 minute 1 year Summer I+0%	360	102.000	100.735	-0.215	0.000

PN	US/MH Name	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.005	S1.0	0.16	0.251	76.9	OK
S4.000	S1.4	0.18	0.105	12.1	OK
S5.000	S1.3.1	0.10	0.075	5.3	OK
S4.001	S1.3	0.25	0.174	29.4	OK
S4.002	S1.2	0.39	0.346	41.6	OK
S4.003	S1.1	0.13	0.519	46.4	OK
S1.006	SPOND1	0.09	144.040	21.0	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 447100 246900 SP 47100 46900
C (1km)	-0.024
D1 (1km)	0.337
D2 (1km)	0.356
D3 (1km)	0.223
E (1km)	0.295
F (1km)	2.505
Cv (Summer)	0.950
Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S5.0	60 minute 30 year Summer I+0%	60	108.000	107.400	-0.150	0.000
S1.001	SCRATES	960 minute 30 year Winter I+0%	960	107.750	105.914	0.414	0.000
S1.002	S4.0	60 minute 30 year Summer I+0%	60	107.250	105.389	-0.021	0.000
S1.003	S3.0	60 minute 30 year Summer I+0%	60	106.100	104.667	-0.208	0.000
S2.000	S2.1	60 minute 30 year Summer I+0%	60	105.695	104.395	-0.050	0.000
S1.004	S2.0	60 minute 30 year Summer I+0%	60	105.250	104.100	-0.125	0.000
S3.000	S1.0.2	60 minute 30 year Summer I+0%	60	106.650	105.347	-0.128	0.000
S3.001	S1.0.1	60 minute 30 year Summer I+0%	60	106.315	105.237	0.097	0.000
S3.002	SPOND2	60 minute 30 year Winter I+0%	60	105.900	105.208	0.358	0.000

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S5.0	0.00	0.000	0.0	OK
S1.001	SCRATES	0.07	115.785	0.9	SURCHARGED
S1.002	S4.0	1.00	0.326	20.4	OK
S1.003	S3.0	0.40	0.286	72.5	OK
S2.000	S2.1	0.78	0.168	10.8	OK
S1.004	S2.0	0.77	1.382	153.9	OK
S3.000	S1.0.2	0.38	0.162	14.7	OK
S3.001	S1.0.1	0.95	1.887	37.7	SURCHARGED
S3.002	SPOND2	0.23	34.642	5.7	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.005	S1.0	60 minute 30 year Summer I+0%	60	104.750	103.333	-0.192	0.000
S4.000	S1.4	60 minute 30 year Summer I+0%	60	105.400	104.112	-0.113	0.000
S5.000	S1.3.1	60 minute 30 year Summer I+0%	60	104.750	103.429	-0.146	0.000
S4.001	S1.3	60 minute 30 year Summer I+0%	60	104.300	103.086	-0.114	0.000
S4.002	S1.2	60 minute 30 year Summer I+0%	60	103.300	102.274	0.014	0.000
S4.003	S1.1	60 minute 30 year Summer I+0%	60	103.300	102.056	-0.219	0.000
S1.006	SPOND1	240 minute 30 year Summer I+0%	240	102.000	101.110	0.160	0.000

PN	US/MH Name	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.005	S1.0	0.48	0.675	223.2	OK
S4.000	S1.4	0.49	0.188	32.9	OK
S5.000	S1.3.1	0.27	0.131	14.3	OK
S4.001	S1.3	0.68	0.451	80.9	OK
S4.002	S1.2	1.09	1.587	116.8	SURCHARGED
S4.003	S1.1	0.36	0.811	130.3	OK
S1.006	SPOND1	0.09	414.553	21.7	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 447100 246900 SP 47100 46900
C (1km)	-0.024
D1 (1km)	0.337
D2 (1km)	0.356
D3 (1km)	0.223
E (1km)	0.295
F (1km)	2.505
Cv (Summer)	0.950
Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)
S1.000	S5.0	60 minute 100 year Summer I+40%	60	108.000	107.400	-0.150
S1.001	SCRATES	1440 minute 100 year Winter I+40%	1440	107.750	106.522	1.022
S1.002	S4.0	60 minute 100 year Summer I+40%	60	107.250	106.441	1.031
S1.003	S3.0	60 minute 100 year Summer I+40%	60	106.100	105.075	0.200
S2.000	S2.1	60 minute 100 year Summer I+40%	60	105.695	105.176	0.731
S1.004	S2.0	60 minute 100 year Summer I+40%	60	105.250	104.767	0.542
S3.000	S1.0.2	60 minute 100 year Summer I+40%	60	106.650	106.220	0.745
S3.001	S1.0.1	60 minute 100 year Summer I+40%	60	106.315	106.035	0.895
S3.002	SPOND2	60 minute 100 year Winter I+40%	60	105.900	105.595	0.745

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S5.0	0.000	0.00	0.000	0.0	OK
S1.001	SCRATES	0.000	0.09	240.726	1.2	SURCHARGED
S1.002	S4.0	0.000	1.60	2.296	32.6	SURCHARGED
S1.003	S3.0	0.000	0.69	1.335	124.7	SURCHARGED
S2.000	S2.1	0.000	1.71	1.548	23.9	SURCHARGED
S1.004	S2.0	0.000	1.33	9.767	266.3	SURCHARGED
S3.000	S1.0.2	0.000	0.78	1.706	30.2	SURCHARGED
S3.001	S1.0.1	0.000	1.88	4.153	74.6	FLOOD RISK
S3.002	SPOND2	0.000	0.30	76.838	7.5	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)
S1.005	S1.0	60 minute 100 year Summer I+40%	60	104.750	103.415	-0.110
S4.000	S1.4	60 minute 100 year Summer I+40%	60	105.400	104.724	0.499
S5.000	S1.3.1	60 minute 100 year Summer I+40%	60	104.750	103.938	0.363
S4.001	S1.3	60 minute 100 year Summer I+40%	60	104.300	103.836	0.636
S4.002	S1.2	60 minute 100 year Summer I+40%	60	103.300	102.468	0.208
S4.003	S1.1	60 minute 100 year Summer I+40%	60	103.300	102.121	-0.154
S1.006	SPOND1	360 minute 100 year Winter I+40%	360	102.000	101.681	0.731

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Maximum Vol (m^3)	Pipe Flow (l/s)	Status
S1.005	S1.0	0.000	0.83	1.312	388.9	OK
S4.000	S1.4	0.000	0.97	1.271	64.8	SURCHARGED
S5.000	S1.3.1	0.000	0.56	1.030	30.0	SURCHARGED
S4.001	S1.3	0.000	1.21	4.423	143.0	SURCHARGED
S4.002	S1.2	0.000	1.94	3.020	207.8	SURCHARGED
S4.003	S1.1	0.000	0.64	1.103	235.0	OK
S1.006	SPOND1	0.000	0.09	933.563	21.8	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.413
Region	England and Wales	Cv (Summer)	0.950
M5-60 (mm)	19.800	Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)
S1.000	S5.0	15 minute 100 year Summer I+40%	15	108.000	107.400	-0.150
S1.001	SCRATES	60 minute 100 year Summer I+40%	60	107.750	105.963	0.463
S1.002	S4.0	15 minute 100 year Summer I+40%	15	107.250	107.197	1.787
S1.003	S3.0	15 minute 100 year Summer I+40%	15	106.100	105.686	0.811
S2.000	S2.1	15 minute 100 year Summer I+40%	15	105.695	105.486	1.041
S1.004	S2.0	15 minute 100 year Summer I+40%	15	105.250	105.245	1.020
S3.000	S1.0.2	15 minute 100 year Summer I+40%	15	106.650	106.147	0.672
S3.001	S1.0.1	15 minute 100 year Summer I+40%	15	106.315	106.010	0.870
S3.002	SPOND2	60 minute 100 year Winter I+40%	60	105.900	105.484	0.634
S1.005	S1.0	15 minute 100 year Summer I+40%	15	104.750	103.459	-0.066
S4.000	S1.4	15 minute 100 year Summer I+40%	15	105.400	104.699	0.474
S5.000	S1.3.1	15 minute 100 year Summer I+40%	15	104.750	104.086	0.511
S4.001	S1.3	15 minute 100 year Summer I+40%	15	104.300	104.020	0.820
S4.002	S1.2	15 minute 100 year Summer I+40%	15	103.300	102.545	0.285
S4.003	S1.1	15 minute 100 year Summer I+40%	15	103.300	102.144	-0.131
S1.006	SPOND1	60 minute 100 year Winter I+40%	60	102.000	101.355	0.405

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S5.0	0.000	0.00	0.000	0.0	OK
S1.001	SCRATES	0.000	0.07	126.002	0.9	SURCHARGED
S1.002	S4.0	0.000	1.78	3.633	36.2	FLOOD RISK
S1.003	S3.0	0.000	0.81	2.734	145.2	SURCHARGED
S2.000	S2.1	0.000	1.94	2.096	27.1	FLOOD RISK
S1.004	S2.0	0.000	1.53	10.772	305.6	FLOOD RISK
S3.000	S1.0.2	0.000	0.87	1.577	33.6	SURCHARGED
S3.001	S1.0.1	0.000	2.11	4.109	84.0	SURCHARGED
S3.002	SPOND2	0.000	0.29	63.049	7.0	SURCHARGED
S1.005	S1.0	0.000	0.99	1.694	461.5	OK
S4.000	S1.4	0.000	1.01	1.227	67.5	SURCHARGED
S5.000	S1.3.1	0.000	0.64	1.291	34.3	SURCHARGED
S4.001	S1.3	0.000	1.23	5.132	145.9	FLOOD RISK
S4.002	S1.2	0.000	2.16	3.594	231.9	SURCHARGED
S4.003	S1.1	0.000	0.73	1.194	267.5	OK
S1.006	SPOND1	0.000	0.09	621.052	21.6	SURCHARGED

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