



LAND NORTH OF WHYCHURCH FARM AND WEST OF CRUDWELL ROAD
FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

GLEESON LAND LTD

17 February 2026





Abley Letchford
3 Tealgate
Charnham Park
Hungerford
RG17 0YT

t: 01488 684390
e: contact@ableyletchford.co.uk
w: www.ableyletchford.co.uk

Quality Management:

Prepared by:	J Arrowsmith/G Roinas
Authorised by:	E Philpott/S Ihle
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1.0 Introduction

1.1 Context

- 1.1.1 This Flood Risk Assessment (FRA) has been prepared by Abley Letchford, on behalf of Gleeson Land Ltd to support an Outline planning permission for residential development of 149 dwellings, including the creation of new vehicular access with footways, public open space, children's play areas, allotments, community orchard, landscape planting, surface water attenuation, and associated infrastructure on land south of Filands and to the north of Whychurch Farm, Malmesbury.

1.2 Development Proposals

- 1.2.1 The proposals are for an Outline planning application (with all matters reserved except access) for a residential development, including the construction of up to 149 dwellings, new vehicular access with footways and cycleways, public open space, landscape and associated infrastructure. An Illustrative Masterplan is included within **Appendix A**.

1.3 Requirement for a Flood Risk Assessment

- 1.3.1 The requirement for a FRA is set out in Section 14 of the revised National Planning Policy Framework (NPPF) as revised in December 2024 and last updated in February 2025.

- 1.3.2 The footnote accompanying Paragraph 181 states:

'A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use..'

- 1.3.3 The site is a greenfield site that comprises of farmland with established hedges. The area of the site is approximately 12.5 hectares. As the site area extends greater than 1 hectare, a site-specific flood risk assessment is required. To comply with the requirements of the NPPF, matters related to flood risk and drainage are addressed within this report.

1.4 Report Aim and Format

- 1.4.1 The principal aims of this report are to demonstrate that the proposed development complies with national and local planning policy in respect to flood risk and to demonstrate that a suitable drainage strategy can be provided as part of development.
- 1.4.2 This report will also summarise the impacts the development could have on flood risk to the surrounding area and outlines the mitigation strategies, where required, that will be implemented to address this risk.
- 1.4.3 The drainage design embraces the guiding principles of Sustainable Drainage Systems (SuDS) which are central to the design of the surface water drainage strategy for the proposed development.



1.5 Report Structure

1.5.1 This report addresses the requirements of NPPF and is set out as follows:

- **Section 2: Policy and Sources of Information** – a review of policy relevant to the assessment and summary of the sources of information used to inform the assessment.
- **Section 3: Site Setting** – a description of the site location, topography, geology and hydrology.
- **Section 4: Overview of Flood Risk** – a review of data for flooding from all sources to determine the baseline flood risk to the site and an assessment of the impacts of the development on flood risk.
- **Section 5: Sequential Test and Exception Test** – a description of the proposed development and a classification of the vulnerability in the context of the Sequential Test and Exception Test.
- **Section 6: Flood Risk Mitigation** – a summary of the mitigation measures, where required, to suitably manage the potential flood risk to or arising from the development.
- **Sections 7 and 8: Drainage Strategy** – a summary of appropriate strategies to manage the surface water and foul water from the site in the post development scenario.
- **Section 9: Conclusion** – a summary of the flood risk considerations for the proposed development, drainage strategies and conclusion on how the proposed scheme meets the requirements of the NPPF, local policy and site specific requirements.



2.0 Policy and Sources of Information

2.1 Introduction

- 2.1.1 This chapter provides an overview of policy relevant to the assessment and the available information on all sources of flood risk.

2.2 National Planning Policy

- 2.2.1 National Policy in relation to flood risk is set out in Section 14 of the National Planning Policy Framework (NPPF), December 2024 (last updated February 2025) and Planning Practice Guidance (PPG) ID: 7 for Flood Risk and Coastal Change, September 2025.

- 2.2.2 Flood Risk is discussed at Paragraphs 170 to 182 of the NPPF. Paragraphs 172 to 177 discuss the sequential approach with respect to individual applications. Paragraph 174 refers to the Strategic Flood Risk Assessment (SFRA) that would form the basis of applying the Sequential Test for local authorities to allocate developments, whilst Paragraphs 178 to 179 relate to Exception Tests.

- 2.2.3 Paragraph 181 discusses the determination of planning applications stating:

'When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- a) Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location.*
- b) The development is appropriately flood resistant and resilient, such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment.*
- c) It incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.*
- d) Any residual risk can be safely managed; and*
- e) Safe access and escape routes are included where appropriate, as part of an agreed emergency plan.'*

- 2.2.4 The proposed development is for residential use at the site which covers approximately 12.5 hectares and would, therefore, be classed as a Major development because *'the number of dwelling houses to be provided is 10 or more; or the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within 10 dwelling houses.'*

- 2.2.5 Paragraph 182 states:

'Sustainable drainage systems provided as part of proposals for major development should:

- *Take account of advice from the Lead Local Flood Authority.*
- *Have appropriate proposed minimum operational standards; and*
- *Have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development.'*



- 2.2.6 The PPG sets out more specific guidance on how to apply and implement the NPPF policies. This includes guidance on when a Sequential Test is required and considerations on how to apply the test. In Paragraph 023 of the PPG the aim of the sequential approach is clarified and includes the following:

'The approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk.'

- 2.2.7 In applying the Sequential Test to planning applications, NPPF Paragraph 175 confirms specific development cases when the test is not applicable:

'The sequential test should be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk).'

- 2.2.8 The PPG goes on to state when and how to apply the Sequential Test to planning applications and in Paragraph 027 states:

'...In applying paragraph 175 a proportionate approach should be taken. Where a site-specific flood risk assessment demonstrates clearly that the proposed layout, design and mitigation measures would ensure that occupiers and users would remain safe from current and future surface water flood risk for the lifetime of the development (therefore addressing the risks identified e.g. by Environment Agency flood risk mapping), without increasing flood risk elsewhere, then the Sequential Test need not be applied...'

2.3 Environment Agency

- 2.3.1 The Flood and Water Management Act (2010) provides the Environment Agency (EA) a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. The EA is a statutory consultee in relation to flood risk and planning.
- 2.3.2 Data has been obtained from the EA Flood Map for Planning, EA Long Term Flood Risk Mapping and the Catchment Data Explorer websites as appropriate to inform this FRA.

2.4 Local Authorities

- 2.4.1 The site lies within the administrative area of Wiltshire Council (WC). WC is both the Local Planning Authority (LPA) and the Lead Local Flood Authority (LLFA).
- 2.4.2 Planning guidance published by WC regarding flood risk was referred to in order to assess the methodology best suited to this FRA. The following key documents were reviewed:
- WC Core Strategy (adopted January 2015);
 - WC Core Strategy, Core Policy 67 'Flood Risk' (adopted January 2015);
 - WC Local Flood Risk Management Strategy (dated April 2015);
 - WC Preliminary Flood Risk Assessment (PFRA) (dated May 2011) and PFRA addendum (dated 2017);
 - WC Level 1 Strategic Flood Risk Assessment (SFRA) (dated November 2024); and



- WC Level 2 SFRA (dated February 2025).

- 2.4.3 WC became the LLFA under the Flood and Water Management Act 2010. WC provide guidance to assess, manage and inform flood risk.
- 2.4.4 As LLFA, WC provides a guidance note for developers called 'Drainage Betterment Strategy', dated June 2024 to assist developers seeking planning permission for new sites by setting criteria to be met as part of the design of the drainage strategy and a list of documentation to be presented in the associated FRA.
- 2.4.5 WC has permissive rights over any Ordinary Watercourses including land drainage ditches. If any work is required within an Ordinary Watercourse (improvements or crossings) then approval from the LLFA is required under the Flood and Water Management Act 1991.

2.5 Local Water Authority

- 2.5.1 Wessex Water is responsible for the supply of clean water and the disposal of wastewater in the for the Malmesbury area.
- 2.5.2 Information with regards to sewer and water main flooding contained within the SFRA has been reviewed as part of this FRA. All Water Companies have a statutory obligation to maintain a register of properties and areas which are at risk of flooding from the public sewerage system and is shown on the DG5 Flood Register.

2.6 Other Sources of Information

- 2.6.1 A desktop study of the site was carried out using the following websites to ascertain local features, hydrology and soil characteristics:
- DEFRA's Magic Map portal;
 - British Geological Survey (BGS) 'Geology of Britain' online viewer; and
 - Cranfield University 'Soilscapes' portal.
- 2.6.2 A site walkover was carried out on 18/10/2024 which allowed observations of the surface water flow routes, highway ditches, and ditches within the site boundary.
- 2.6.3 Guidance with respect to Sustainable Drainage Systems (SuDS) is contained within DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, Construction Industry Research and Information Association (CIRIA) C753 The SuDS Manual and within the NPPF PPG – 'Flood Risk and Coastal Change'.
- 2.6.4 Additional guidance on development and flood risk is contained within CIRIA C624 Development and Flood Risk – Guidance for the Construction Industry which identifies several key aims for a development to ensure it is sustainable in flood risk terms.

3.1 Introduction

3.2 Site Location

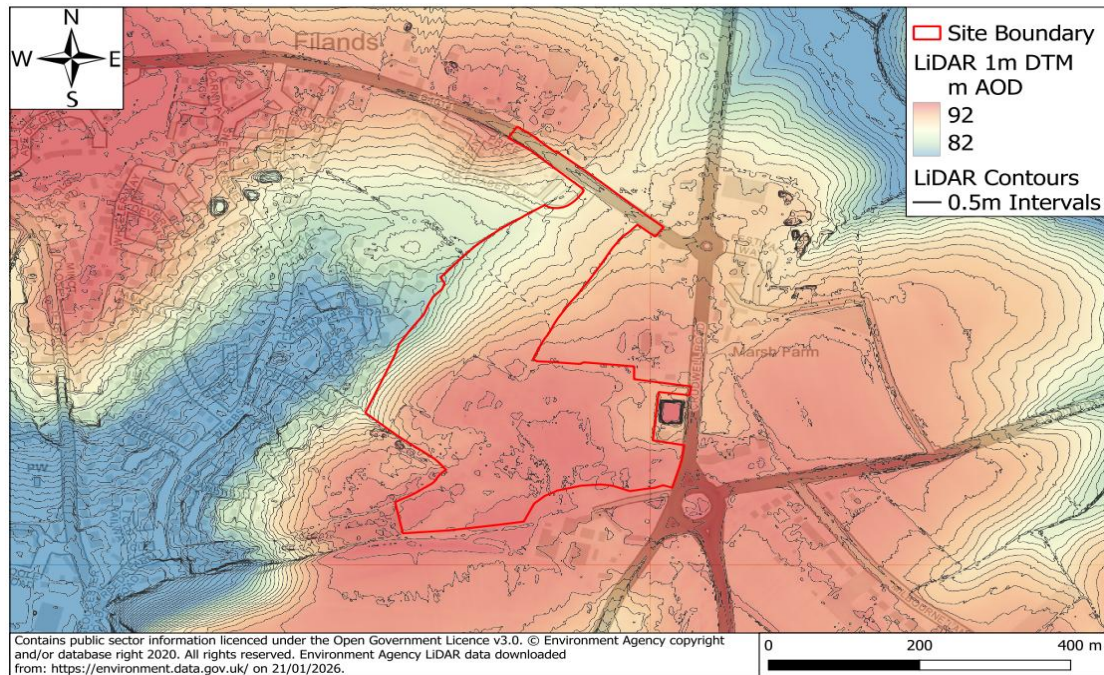
Figure 3.1: Site Location



3.3 Topography

3.3.1 The ground levels across the site are shown by LiDAR in **Figure 3.2**.

Figure 3.2: Site Topography



3.3.2 The LiDAR data presented in **Figure 3.2** shows that the ground levels slope upwards from northwest to southeast. Ground levels across the site range between 83.2m AOD and 91.7m AOD. The highest ground levels are at the south of the site, at 91.7m AOD. The lowest ground levels are along the western boundary of the site, at 83.2m AOD.

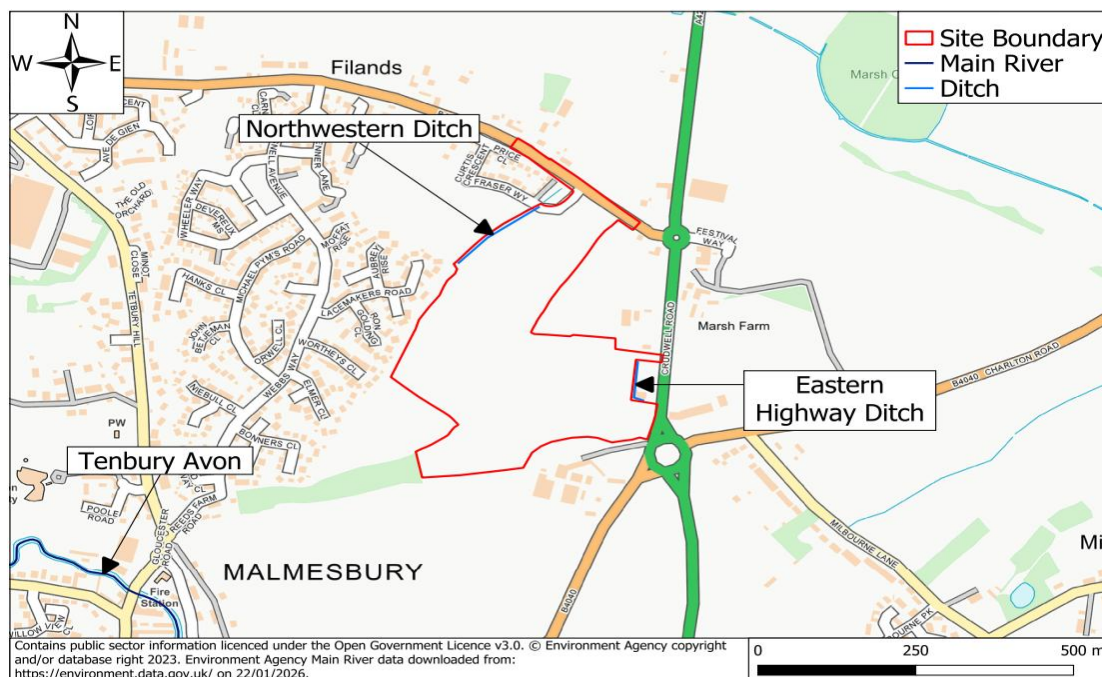
3.3.3 A topographical survey of the site has been carried out. A copy of the topographical survey is included in **Appendix A**. The topographical survey data generally agrees with the LiDAR data.

3.4 Hydrology: Watercourses and Sewers

Watercourses

3.4.1 The nearest Main River is the Tenbury Avon, which is located 700m to the southwest of the site. Ditches were observed within the northwestern part of the site and just outside the site boundary along Crudwell Road (highway ditch). The location of the ditches are shown in **Figure 3.3**.

Figure 3.3: Ditch Locations



3.4.2 **Figure 3.4** and **Figure 3.5** show photographs of the ditches within and surrounding the site boundary taken during the site walkover which was carried out on 18/10/2024.

Figure 3.4: Photograph of the Northwestern Ditch



3.4.4 **Figure 3.4** shows a vegetated ditch within a hedgerow. The ditch is approximately 40cm in width and 1m in depth.

Figure 3.5: Photograph of the Eastern Highway Ditch



3.4.5 **Figure 3.5** shows a shallow vegetated ditch. The ditch is approximately 0.5m in width and 30cm in depth.

Surface and Foul Water Sewers

3.4.6 Sewer asset records obtained from Wessex Water shows that there is a public foul sewer within the northwestern part of the site, running from Filand's Road to the adjacent housing estate. There



is a water mains distribution within the site originating at the water tower at the eastern site boundary. The road network at the southeast of the site contains foul manholes, public foul sewers, water mains distribution, and highway drains.

- 3.4.7 A copy of the Wessex Water sewer asset plan is included within **Appendix A**.

3.5 Geology and Hydrogeology

- 3.5.1 The British Geological Survey (BGS) 'Geology of Britain' online viewer indicates that the geology underlying the site is the northwestern part of the site is Kellaway Clay Member-Mudstone. The majority of the southeastern part of the site is underlain by Oxford Clay Formation – Mudstone. The site is not shown to be underlain by any superficial geology.
- 3.5.2 The Cranfield University 'Soilscapes' online viewer indicates that the site is underlain by slowly impermeable, seasonally wet, slightly acidic but base-rich loamy and clayey soils.
- 3.5.3 An intrusive ground investigation report was produced by Card Geotechnics Ltd on March 2025 and infiltration testing was carried out in four locations. All the tests failed in accordance with BRE365 guidance. On this basis, soakaway drainage is considered unlikely to be feasible within the underlying natural soils.
- 3.5.4 The DEFRA Magic Map online viewer indicates that the site does not lie within either a bedrock aquifer designation or a superficial drift aquifer designation.

4.0 Overview of Flood Risk

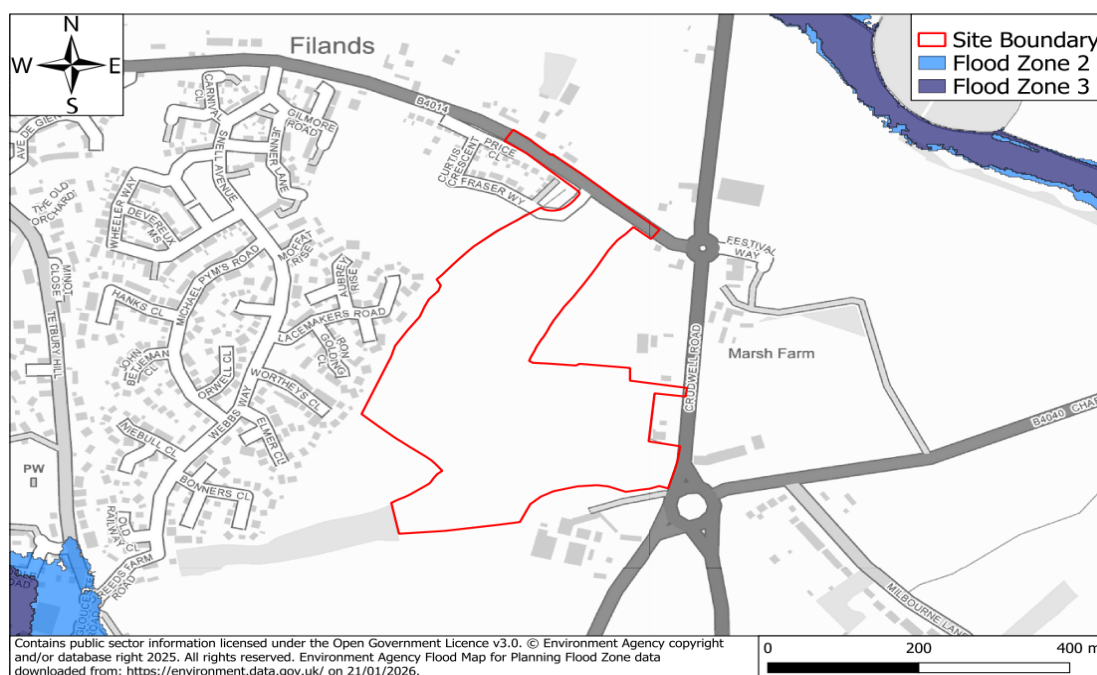
4.1 EA Flood Zone Map

4.1.1 The EA Flood Map for Planning provides an initial indication of the extent of Flood Zones. In the PPG Table 1, Flood Zones are defined as follows:

- Flood Zone 1 'Low Probability' – Land having less than 0.1% annual probability of river or sea flooding.
- Flood Zone 2 'Medium Probability' – Land having between a 1% and 0.1% annual probability of river flooding, or between a 0.5% and 0.1% annual probability of sea flooding.
- Flood Zone 3a 'High Probability' – Land having a 1% or greater annual probability of river flooding, or land having a 0.5% or greater annual probability of sea flooding.

4.1.2 **Figure 4.1** shows the EA Flood Zone mapping.

Figure 4.1: EA Flood Map for Planning



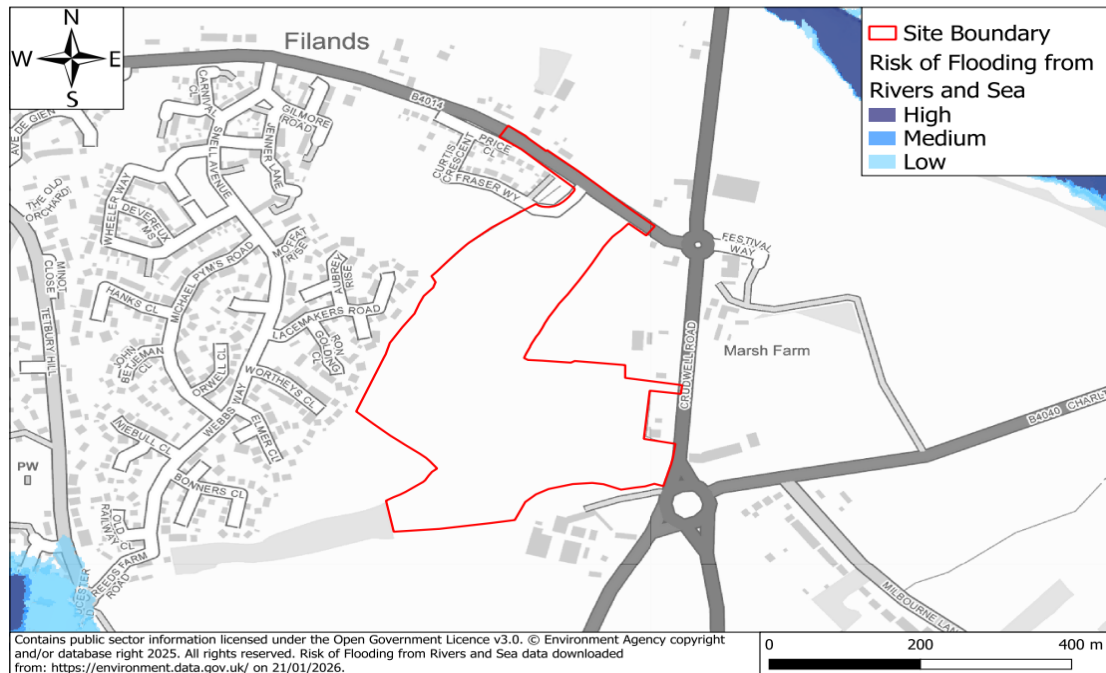
4.1.3 **Figure 4.1** confirms that the site is located entirely within Flood Zone 1.

4.2 Flood Risk from Fluvial Sources

EA Mapping of Risk of Flooding from Rivers and Sea

4.2.1 The EA produces mapping of flooding from river and sea as part of the NaFRA project, as shown in **Figure 4.2**.

Figure 4.2: EA Risk of Flooding from Rivers and Sea



4.2.2 The EA NaFRA Risk of Flooding from Rivers and Sea mapping shown in **Figure 4.2** indicates that the site is not at risk of flooding from rivers and sea.

4.2.3 The site is therefore at a low risk of flooding from rivers and sea.

4.3 Flood Risk from Surface Water

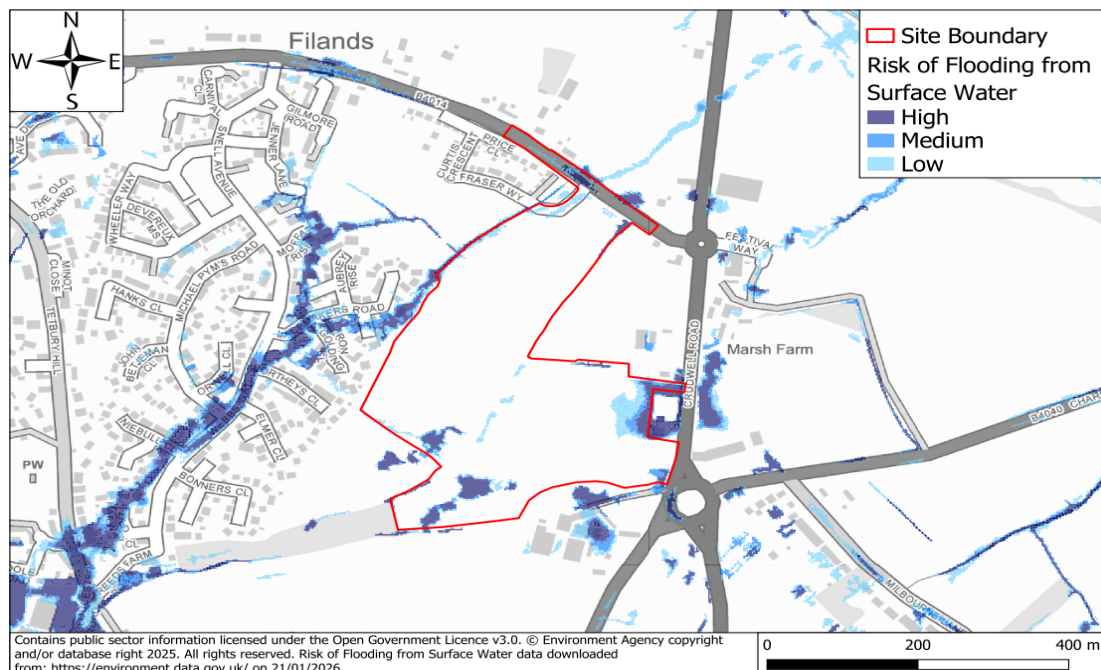
4.3.1 The EA's Risk of Flooding from Surface Water mapping indicates areas that could be susceptible to surface water flooding during extreme rainfall events. The EA surface water mapping defines rainfall events based on the following:

- 1 in 30 (3.3%) annual probability 'High Risk'
- 1 in 100 (1%) annual probability 'Medium Risk'
- 1 in 1,000 (0.1%) annual probability 'Low Risk'.

4.3.2 The NPPF PPG – 'Flood Risk and Coastal Change' includes the 1 in 100 annual probability of surface water flood (including climate change) within the definition of the design flood event to be used to inform a FRA.

4.3.3 **Figure 4.3** shows the potential flood risk from surface water.

Figure 4.3: EA Risk of Flooding from Surface Water



- 4.3.4 The EA NaFRA Risk of Flooding from Surface Water mapping shown in **Figure 4.3** indicates that the majority of the site is not at risk of surface water flooding. A surface water flow route is evident along the western site boundary, of 'Low', 'Medium' and 'High' risk of surface water flooding, however this is outside the area of proposed development.
- 4.3.5 There are several areas of isolated surface water ponding at the west of the site adjacent to Crudwell Road, of 'High', 'Medium' and 'Low' risk of surface water flooding. Observations from the site visit confirms that this is associated with a highway ditch system.
- 4.3.6 There are also several areas of surface water ponding at the southwest corner of the site which correspond with localised topographical low points.
- 4.3.7 Therefore, the entire site is deemed to be at low risk of surface water flooding as the majority of the surface water flooding is located outside the proposed development.

4.4 Flood Risk from Groundwater

- 4.4.1 In general, groundwater flooding may occur after prolonged periods of unusually high rainfall. During such periods, more water than usual infiltrates through the ground, raising the water table above its normal depth below the surface. Where the water table is at a shallow depth in any case, the water table can reach the surface. This can cause groundwater to merge with rainfall and cause localised flooding.
- 4.4.2 The EA Long Term Flood Risk for groundwater states that 'this location is outside of a groundwater flood alert area'.
- 4.4.3 The WC Level 1 SFRA assesses the area for susceptibility to groundwater flooding, which has been undertaken using Appendix G (BGS Groundwater Emergence Map) and Appendix R (Groundwater



Flood Zone for Application of a Sequential Test Map). The relevant mapping is included within **Appendix A**.

- 4.4.4 The BGS Groundwater Emergence Map shows that the entire site is 'deemed as having negligible risk from groundwater flooding due to the nature of the local geological deposits'.
- 4.4.5 The Groundwater Flood Zone for Application of a Sequential Test Map shows that the site lies outside of a groundwater flood zone.
- 4.4.6 An intrusive ground investigation report was produced by Card Geotechnics Ltd on March 2025 and ground water monitoring was included as part of this investigation. The ground water monitoring lasted between October 2020 and March 2021 and included five windowless sampling boreholes (WS01 to WS05) to a maximum depth of 5m below ground level (bgl), together with the installation of combined ground gas and groundwater monitoring wells.
- 4.4.7 Groundwater was not recorded during the investigation, with only a slow seepage recorded within a borehole at depths of below 4m. This is considered to be associated with the boreholes acting as a sump to surface water rather than groundwater.
- 4.4.8 Therefore, the site is deemed to be at low risk of groundwater flooding and groundwater flooding is no basis of the Sequential Test.

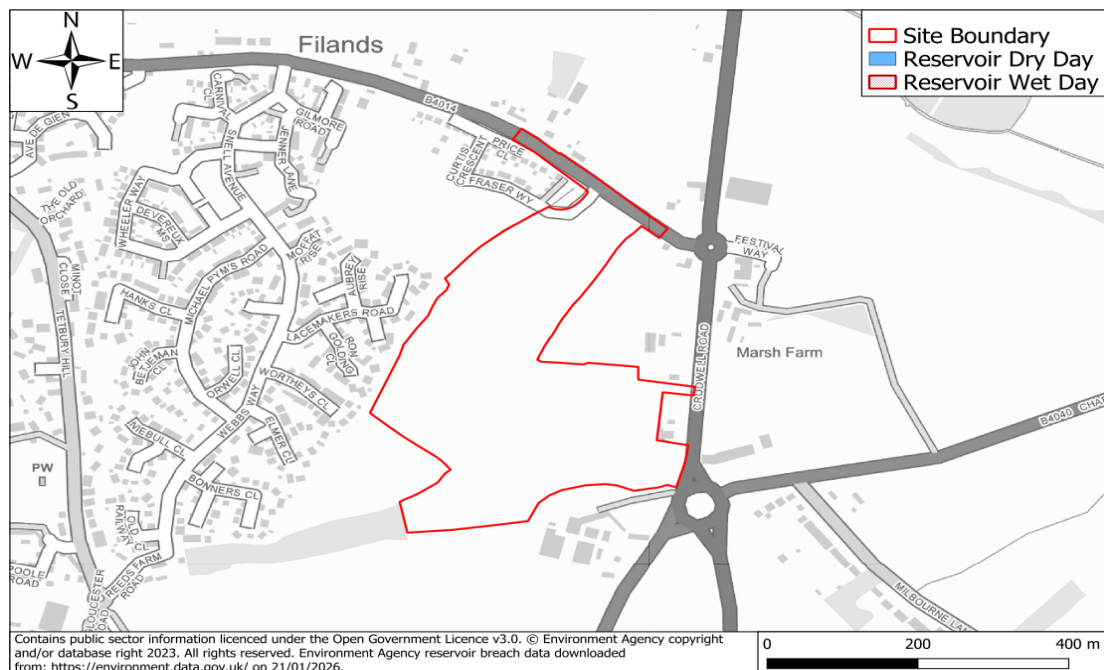
4.5 Flood Risk from Sewers

- 4.5.1 In general, when exceeded, surcharged sewer networks can lead to flooding from backed up manholes and gully connections.
- 4.5.2 WC Asset Location Plans (produced on 28/10/2024) shows that there is a public foul sewer within the site boundary. A copy of the WC Asset Plans is included within **Appendix A**.
- 4.5.3 The WC Level 1 SFRA includes a record of sewer flooding for Wiltshire covering a period between 2015 to 2019. The sewer record from the nearest postcode of SN16 9 shows that there have been 6 recorded incidents of sewer flooding. However, there is no specific indication that the site itself has been affected.
- 4.5.4 Overall, the site is deemed to be at low risk of sewer flooding.

4.6 Flood Risk from Reservoirs

- 4.6.1 The EA Risk of Flooding from Reservoirs mapping indicates areas that would be at risk of flooding in the event of a reservoir breach. The flood extents are shown for both the 'dry day' scenario and the 'wet day' scenario.
- 4.6.2 'Dry day' is defined by the EA as '*...the individual flood extent for all large, raised reservoirs in the event that they were to fail and release the water on a 'dry day' when local rivers are at normal levels. It represents a prediction of a credible worst case scenario, however it's unlikely that any actual flood would be this large*'.
- 4.6.3 'Wet day' is defined by the EA as '*...the individual flood extents for all large, raised reservoirs in the event that they were to fail and release the water help on a 'wet day' when local rivers had already overflowed their banks. It represents a prediction of a credible worst case scenario, however it's unlikely that any actual flood would be this large*'.
- 4.6.4 **Figure 4.4** shows the flood risk from reservoirs.

Figure 4.4: EA Risk of Flooding from Reservoirs



4.6.5 The mapping indicates that the site is not at risk of flooding in the event of a reservoir breach. The site is at low risk of flooding from reservoirs.

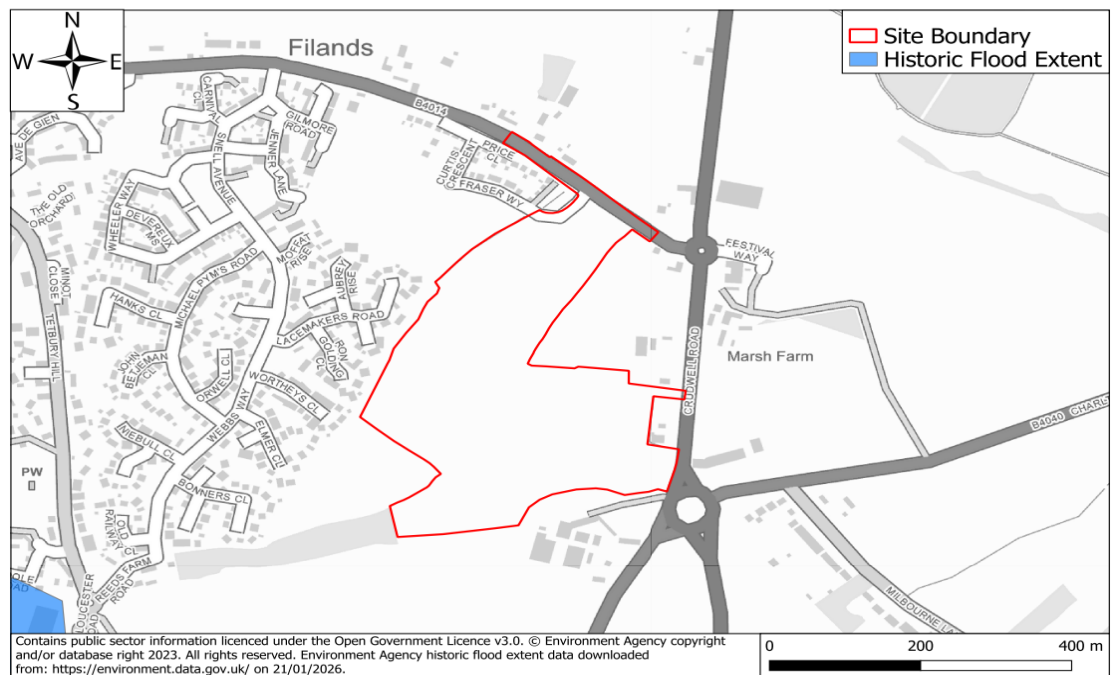
4.7 Flood Risk from Other Sources

4.7.1 The EA flood risk maps and the 2019 and 2024 Level 1 SFRAs show that the site is not at risk of flooding from canals or other artificial sources.

4.8 Historic Flooding

4.8.1 **Figure 4.5** shows the historic flood extent records held by the EA. The EA Historic Flood Map shows the maximum extent of recorded flood events.

Figure 4.5: EA Historic Flood Extents



- 4.8.2 The EA historic flood outline dataset shows that the site and surrounding area has no record of historic flooding. The site is therefore at low risk of historic flooding.



4.9 Flood Risk Summary

4.9.1 A summary of flooding from all sources is provided in **Table 4.1**.

Table 4.1 : Summary of Flood Risk

Source of Flooding	High	Medium	Low	Comments
Fluvial			✓	The EA Flood Zone mapping shows that the site is located entirely within Flood Zone 1. The EA NaFRA Risk of Flooding from Rivers and Sea mapping shows that the site is not at risk of flooding from rivers and sea. The WC Level 1 SFRA flood map confirms the EA Flood Zones. Fluvial flood risk for the site is therefore low.
Pluvial			✓	The EA NaFRA Risk of Flooding from Surface Water mapping shows that the majority of the site is not at risk of surface water flooding. A surface water flow route is evident along the western site boundary but is outside the area of proposed development. There are several areas of isolated surface water ponding. However the majority of these areas are located of the proposed development areas. Therefore, the entire site is deemed to be at low risk of surface water flooding.
Groundwater			✓	The WC Level 1 SFRA BGS Groundwater Emergence mapping shown shows that the entire site is 'deemed as having negligible risk from groundwater flooding due to the nature of the local geological deposits'. The WC Level 1 SFRA Groundwater Flood Zone for application of a Sequential Test Map shows that the site lies outside the groundwater flood zone. Therefore, the site is deemed to be at low risk of groundwater flooding.
Sewers			✓	The Wessex Water asset map show that there is a public sewer near the northwestern site boundary. The WC Level 1 SFRA includes records of sewer flooding. The DG5 sewer record from the nearest postcode area (SN16 9) shows that there has been 6 records of sewer flooding in the postcode area. There is no indication that these incidents have impacted the site. Flood risk from sewers is therefore deemed to be low.
Reservoirs, canals and other artificial sources.			✓	The EA flood risk maps, WC PFRA and WC Level 1 and Level 2 SFRA do not indicate the site to be at risk of flooding from reservoirs or other sources. Flood risk from these sources is subsequently low.



5.0 Sequential Test and Exception Test

5.1 NPPF Sequential Test

- 5.1.1 The NPPF states that Local Planning Authorities allocating land for development should apply the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- 5.1.2 The entire site is located within Flood Zone 1.
- 5.1.3 The majority of the site is located within an area with no risk of surface water flooding.
- 5.1.4 The entire site lies outside of the groundwater flood zone for application of the Sequential Test.
- 5.1.5 The site is deemed to be at low risk of sewer flooding.
- 5.1.6 The flood risk from other sources is low.
- 5.1.7 The proposed development is for residential use. It is classed within the NPPF as a 'More Vulnerable' development.
- 5.1.8 The WC Level 1 SFRA states that *'Developers are required to apply the Sequential Test to all development sites, unless a development is within fluvial flood zone 1 and other flooding issues within the area of development (i.e. surface water, groundwater, sewer flooding) are at low risk.'*
- 5.1.9 The WC Level 1 SFRA states that *'If a Sequential Test is not required, the Exception Test is not required'*.
- 5.1.10 Therefore, the Sequential Test and Exception Test are not required.



6.0 Flood Mitigation Strategy

6.1 Sequential Approach

- 6.1.1 The NPPF encourages a 'sequential approach' in master planning for new development: locating the more vulnerable uses of the development in the areas of lowest flood risk from all sources.
- 6.1.2 The masterplan reflects this sequential approach with all proposed residential development located in Flood Zone 1 and areas of low flood risk from other sources.

6.2 Ground Floor Levels

- 6.2.1 The requirements for setting ground floor levels for new developments are set out in BS8533:2017 'Assessing and Managing Flood Risk in New Developments – Code of Practice'. A finished floor level of at least 150mm above the modelled level for the 1 in 100 annual probability plus climate change allowance is recommended in the WC Level 1 SFRA.
- 6.2.2 In addition, ground floor levels should be set a minimum of 150mm above the surrounding ground level to mitigate the residual flood risk from surface water runoff events. It is recommended that surrounding ground levels are appropriately contoured to direct surface water away from the development.

6.3 Floodplain Storage and Flow Routing

- 6.3.1 The proposed residential development areas are located outside of the fluvial flood extents for the design event. There is therefore no impact on fluvial floodplain storage or conveyance as a result of the proposed built residential development.
- 6.3.2 Some parts of the site area located within areas of 'High', 'Medium' and 'Low' risk of surface water flooding. Rainfall and runoff on these areas will be managed within the surface water drainage strategy and therefore not negatively impact the surface water flow routes, or conveyance once the drainage strategy is implemented.

6.4 Safe Access

- 6.4.1 The residential development areas are located outside of the potential flood risk areas. Continuous safe access for the development is available via the B4014.

6.5 Residual Risk

- 6.5.1 The NPPF PPG – 'Flood Risk and Coastal Change' defines residual risk as coming from '*flood risk management infrastructure*' and the '*residual risk to a development once any site-specific flood mitigation measures are taken into account*'.
- 6.5.2 Residual risk to the site includes a breach in the raised flood defences, the failure of a reservoir and a flood event greater than the designed standards.
- 6.5.3 The residual risk to the site is low. The EA AIMS dataset which contains information of flood defences indicates that the site does not benefit from raised flood defences. The EA mapping for reservoir breaches indicates that the site is not located within an area at risk of flooding in the event of a reservoir breach in both a 'wet day' and 'dry day' scenario. The 'Less Vulnerable' residential development is located outside of the 1 in 1,000 annual probability flood extent.



7.0 Surface Water Drainage

7.1 Introduction

- 7.1.1 This chapter provides details on the surface drainage strategy and includes measures to drain the proposed development site.

7.2 Overall Strategy

- 7.2.1 The proposed drainage strategy has been designed to the requirements of the NPPF by providing a comprehensive drainage system which embraces the SuDS philosophy and key principals. The utilisation of Sustainable Drainage Systems (SuDS) not only provides the benefit of controlling waters at source and online treatment of collected surface water but also allows enhanced aesthetics through improved landscaping, biodiversity, and ecological opportunities.
- 7.2.2 These features offer a holistic treatment train and management system to the benefit of new residents, members of the wider community, downstream receptors and the environment.
- 7.2.3 The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. Changes of land uses can have significant downstream impacts where existing drainage systems may not have sufficient capacity for any additional surface water flow.
- 7.2.4 A surface water management strategy is therefore required to manage and reduce the flood risk posed by the surface water runoff from the site. The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates to the pre-development scenario, unless specific off-site arrangements are made and result in the same net effect.
- 7.2.5 Sustainable water management measures (SuDS) should be introduced to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from the surface water runoff.
- 7.2.6 The Construction Industry Research and Information Association, CIRIA's C690 states the following:
- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing surfaces)
 - **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting)
 - **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one or several soakaways for the entire site)
 - **Regional Control** – management of runoff from several sites, typically in a detention basin or wetland.
- 7.2.7 The SuDS Manual 2015 (C753) provides best practice guidance on the planning, design, construction, operation and maintenance of SuDS. This document provides guidance to ensure that SuDS are planned and designed to maximise the opportunities and benefits of surface water management.



- 7.2.8 The four main categories of benefits that can be achieved by SuDS, referred to as the four pillars of SuDS design, are:
- **Water quantity** – control the quantity of runoff to support the management of flood risk, and maintain and protect the natural water cycle;
 - **Water quality** – manage the quality of the runoff to prevent pollution
 - **Amenity** – create and sustain better places for people
 - **Biodiversity** – create and sustain better places for nature.
- 7.2.9 The National Standards for Sustainable Drainage Systems (SuDS) released in July 2025 sets out five possible options to discharge surface water runoff. Runoff from the development shall be discharged to the following final destinations, to the maximum extent practicable, in accordance with the below hierarchy:
- **Priority 1:** Collected for non-potable use
 - **Priority 2:** Infiltrated to ground
 - **Priority 3:** Discharged to an above ground surface water body
 - **Priority 4:** Discharged to a surface water sewer, or another piped surface water drainage system
 - **Priority 5:** Discharged to a combined sewer
- 7.2.10 Rainwater harvesting has been considered in accordance with the National Standards for Sustainable Drainage Systems (SuDS). However, it is not proposed due to the high maintenance requirements and limited non-potable demand for individual dwellings, which would reduce system efficiency and long-term reliability.
- 7.2.11 Infiltration testing was completed as part of an intrusive ground investigation (Ref: Para 3.5.3 above) and all the tests failed in accordance with BRE 365 guidance. On this basis, infiltration to the ground is not considered a viable option of surface water runoff disposal, due to the existence of Mudstone and Clay Formation (Ref: Para 3.5.1 & 3.5.2 above). Therefore, the surface water drainage proposals will be designed to attenuate runoff with controlled discharge to the existing local watercourses i.e. the existing open field ditch on site which would be feasible point of discharge.
- 7.2.12 Site investigations and infiltration testing have demonstrated that infiltration is not feasible across the site due to ground conditions, meaning discharge to the nearest watercourse is the most practical and sustainable option for managing surface water runoff. The proposed drainage strategy includes appropriately sized attenuation features to control runoff rates and volumes, ensuring that peak flows are managed in accordance with the National Standards for Sustainable Drainage Systems (SuDS), while also mitigating flood risk downstream. Given the constraints of the site and the need for a technically feasible and maintainable solution, discharge to the watercourse represents the most appropriate approach, and the strategy is designed to comply with relevant SuDS requirements and to be acceptable to the LLFA.



7.2.13 Implementation of SuDS will ensure that flood risk downstream is not increased due to the proposed development. These features will also provide positive improvements to the quality of surface water runoff.

7.2.14 The following SuDS components are deemed applicable to the site:

- Conveyance systems – components that convey flows to downstream storage systems, e.g. swales and filter drains.
- Storage systems – components that control flow, and possibly volumes, by storing water and releasing it slowly, e.g. geocellular units, attenuation basins and wetlands.
- Treatment systems – components that remove or facilitate the degradation of contaminants present in runoff, e.g. filter strips and proprietary treatment systems.

7.3 Pre and Post Development Areas/Rates

7.3.1 The overall site is approximately 12.477ha and the developable area, which is also the natural catchment that slopes towards the north-west ditch is 6.468ha. The impermeable area of this catchment is 4.613ha. It is classified as a greenfield site and it is considered 100% permeable.

7.3.2 Given the underlying geology, it is assumed part of the rainfall infiltrates to the ground and the rest occurs as overland flow at source towards the lower parts of the site.

7.3.3 In order to quantify any potential increase in surface water runoff, the existing Greenfield runoff rate from the site must initially be determined. The rates of runoff have been determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS. The recommended methodology for sites up to 200 hectares in area is the IH124 method.

7.3.4 An assessment of existing surface water runoff has been undertaken, to determine the potential surface water options and attenuation requirements for the site utilising the following parameters.

- Average Annual Rainfall (SAAR): 763mm/year
- Soil: 0.37
- Region No.: 8

Pre-Development Discharge Areas & Rates

7.3.5 With an overall site area of 12.477ha, a natural catchment area of 6.468ha and an impermeable area of 4.613ha, the calculated Greenfield runoff discharge rates and volumes are as presented in **Table 7.1**. The corresponding runoff outputs created with the use of HR Wallingford and FLOW software can be found within **Appendix B**.



Table 7.1 – Pre-Development Runoff Rates/Volumes per Hectare

Annual Probability	Greenfield/Pre-Development Runoff Rate per hectare (l/s)	Greenfield/Pre-Development Runoff Rate for the natural catchment of 6.468ha (l/s)	Greenfield/Pre-Development Volume 360 minute storm for the impermeable area of 4.613ha(m ³)
1 in 1 year event(100% AEP)	2.5	16.2	-
1 in 2 year event(50% AEP)	-	-	375
QBar(44% AEP)	3.2	20.7	-
1 in 30 year event(3.3% AEP)	6.2	40.1	799
1 in 100 year event(1% AEP)	7.7	49.8	1,071

- 7.3.6 The proposed development splits into three distinct catchments(A, B and C) and can be seen in the Drainage Strategy drawing in **Appendix B**. A previous Reserved Matters application has been submitted for Catchment A and B and the exact impermeable areas for these two catchments are 2.419ha. For Catchment C, based on the Illustrative Masterplan, it has been conservatively estimated that the impermeable surfaces will be approximately 65% of the developable area. The use of 65% therefore provides for a robust assessment which allows for fluctuations in residential density, and future urban creep of up to 10% on private curtilage areas, which typically results in approximately 5% of the total area, in accordance with The SuDS Manual (CIRIA 753).
- 7.3.7 The post development impermeable area of the dwellings for Catchment C has been calculated to approximately 2.858ha and this accounts for future urban creep of 10% in accordance with The SuDS Manual (CIRIA 753). Therefore, the total impermeable area of Catchments A, B and C is 4.613ha and this includes the dwellings with including urban creep, the roads, the basins and general infrastructure.
- 7.3.8 In order to comply with best practice as stipulated in EA Report SC030219 'Rainfall Runoff Management for Developments', proposed discharge rates should be restricted to one of two methods for all storms up to and including the 1 in a 100 year storm event plus a 45% allowance for climate change.

Post-Development Discharge Areas & Rates

- 7.3.9 All discharge flows could be restricted to 30% betterment of the existing greenfield runoff rates QBar. This negates the requirement for Long Term Storage and again flows would be attenuated on site and discharged utilising an onsite control device, such as a vortex control device. This normally requires a greater volume of attenuation.
- 7.3.10 The site naturally splits towards two different directions; to the west and to the east. Refer to drawing HD009-006 in **Appendix B** for the catchments and the proposed drainage strategy.
- 7.3.11 Catchment A and B naturally slope to the west and their topography will be maintained. Part of Catchment C naturally slopes towards the west, which is also the outfall of Catchment B and the



rest of Catchment C towards the east. The eastern portion of Catchment C does not have an outfall, such as a ditch, watercourse or a public sewer and therefore, it is proposed to transfer flows of that area towards the west and discharge to the outfall that Catchment B utilizes.

- 7.3.12 The part of Catchment C that slopes to the west towards the same outfall as Catchment B is 2.920ha. The part of Catchment C that slopes towards the east is relatively flat and causes localised flooding on the site, mostly towards the boundary, due to the lack of an outfall.
- 7.3.13 All the flows from the part of Catchment C that is relatively flat will be restricted to 30% betterment of the greenfield runoff QBar of the natural Catchment C that slopes towards the west and utilizes the same outfall as Catchment B.
- 7.3.14 The proposed development's discharge rates are designed to be restricted to the natural catchment areas, which cover 6.468ha(Catchment A:1.897ha; Catchment B:1.651ha; Catchment C:2.920ha) and equates to 14.4 l/s for all storm events. This represents a 30% reduction compared to the existing greenfield runoff rate (QBAR). The calculated runoff discharge rates are presented in **Table 7.2**.

Table 7.2 – Post-Development Runoff Rates

Catchment	Catchment Area (ha)	Impermeable Area (ha)	QBAR (l/s/ha)	Discharge Rates Based on QBAR(l/s)	Discharge Rates with 30% betterment on QBAR(l/s)	Proposed Discharge Rates (l/s)	Attenuation Volume Provided (m3)
A	1.897	1.180	3.2	6.1	4.2	3.1	1,424
B	1.651	0.949		5.3	3.7	2.4	1,063
C	2.920*	2.858		9.3	6.5	8.9	2,838
Total	-	4.987	-	20.7	14.4	14.4	5,325

*The 2.920ha is the area of Catchment C that positively drains towards the west.

7.4 Surface Water Proposals

- 7.4.1 It is proposed to provide a network of trapped gullies, pipes and Sustainable Drainage (SuDS) features to collect the surface water runoff from impermeable areas such as roads, roofs and driveways. The traditional system could work in combination with such features such as permeable pavement, roadside swales and filter drains, to filtrate, store and transport water to attenuation basins to provide attenuation storage and high-quality water benefits.
- 7.4.2 The final attenuation basins will drain, with a controlled discharge into the existing ordinary watercourse to the west, via gravity. Due to the topography in Catchment C a foul pumping station is proposed to pump foul to the Wessex Water foul sewer on Crudwell Road.
- 7.4.3 In Catchment C the end point attenuation basin will not provide the full storage requirements on its own to attenuate the flows at the proposed discharge rate. It will therefore be necessary two basins and form a treatment train.
- 7.4.4 Drawing HD009-006, a copy of which is included within **Appendix B**, provides a high level overview of the drainage proposals together with the estimated requirements for the required storage and SuDS features for the parcels within the various catchments of the proposed development.



- 7.4.5 The banks of the SuDS basins will be designed in accordance with the SuDS Manual C753 guidance and a side slope gradient between 1 in 3 and 1 in 4. An appropriate freeboard of 300mm above the maximum water level is also proposed. This allows landscaping of both wetland and wildflower mixes to provide an appropriate landscape context in the vicinity of the features through the provision of permanent water pools in parts of the proposed basins.
- 7.4.6 Open SuDS features will be designed so as not to compromise the safety of residents, visitors and their property. Generally open boundaries are provided, and perimeter planting could be utilised to define the extents of the features.
- 7.4.7 Proposed discharge rates will be restricted to a rate that is 30% reduced than the QBAR (refer to Para.7.27 and **Table 3**) for all storm events up to and including the 1 in 100 year storm event plus 45% allowance for climate change. This would negate the requirement for Long Term Storage and flows would be attenuated on site and discharged utilising an on-site flow control device such as a Hydrobrake.
- 7.4.8 All conveyance systems will be designed to cater for the 1:30 year storm event, in accordance with industry standard, with all attenuation features designed to allow for the 1 in 100 year storm event plus 45% climate change allowance. All the drainage modelling calculations can be found in **Appendix B**. The drainage calculations for Catchment A and B incorporate full networks as they have progressed under a separate planning application and more information are available. The calculations for Catchment C, do not incorporate an entire network, but an outline quick storage estimate to determine the attenuation volume and flow control.
- 7.4.9 The proposals draw reference to the DEFRA document Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems March 2015, as well as CIRIA C753 The SuDS Manual.
- 7.4.10 Current uncontrolled pluvial runoff exhibited onsite during high rainfall events will be mitigated as a result of the Development and flooding near the Wessex Water water tower and relevant equipment close to the eastern boundary of Catchment C will be significantly reduced. This will occur by virtue of the change in surface from greenfield to positively drained impermeable areas, which will serve to capture, attenuate and delay surface water runoff. This will be a benefit to downstream receptors, especially towards Crudwell Road.
- 7.4.11 This proposal identifies the principal components of the surface water strategy and is subject to further detailed localised investigations as part of the subsequent Reserved Matters applications. These assumptions are subject to evolution as the design develops and the individual parcels are further realised.
- 7.4.12 There is scope to utilise source control techniques (such as swales, granular strips and permeable paving) which will assist with the reduction of larger attenuation storage features. This should be embraced and investigated as the project progresses.
- 7.4.13 Subject to the provision of additional geotechnical information, the attenuation basins may require partial lining to protect against the ingress of natural groundwater. Such lining provides the ability to create localised, small permanent bodies of water which adds landscaping and biodiversity opportunities to the scheme.



7.5 Exceedance Flood Routing

- 7.5.1 Flows in excess of the above design storms, which may flood from the network for storms in excess of the 1 in 100 year storm plus 45% climate change, will be kept within the internal road network, until such time as they can be directed into adjacent landscaping areas or existing vegetation/woodland. This ensures that no onsite or offsite residential units are afforded an increased level of protection from flood waters until such time as the rain events become significant. Refer to drawing HD009-006, in **Appendix B** for exceedance flow routes.
- 7.5.2 The attenuation basins of the Development are designed to provide 300mm freeboard and therefore can accept additional flood water from manholes upstream.

7.6 Water Quality Improvements

- 7.6.1 CIRIA report C753 The SuDS Manual outlines the methodology for assessing water quality risks associated with new development. This is a simple index approach which provides a high level scoping analysis of the land usage and gives guidelines for appropriate treatment stages.
- 7.6.2 This process identifies features necessary to provide adequate substance removal in line with Environment Agency requirements. This is a three step process of Allocation, Mitigation and Review.
- 7.6.3 Surfaces generating runoff are 'graded' on their potential to contribute to various harmful pollutants and gives each surface a risk of pollution from each element. An extract of Table 26.2 within the SuDS Manual is set out below in **Table 7.3**.

Table 7.3 – Extract from Table 26.2 SuDS Manual

Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Other Roofs	Low	0.3	0.2-0.8	0.05
Low traffic residential roads and non-residential parking with infrequent change.	Low	0.5	0.4	0.4
Commercial yard, parking with frequent change, other roads,	medium	0.7	0.6	0.7
Sites with heavy pollution	High	0.8	0.8	0.9

- 7.6.4 Historically, PPG3 documentation would recommend that pollutants were removed utilising oil separators, but since its superseding, more recent guidance has shifted to the use of SuDS features to remove pollutants; thereby providing significant improvements in treatment.
- 7.6.5 The use of non-mechanical features decreases the requirements for maintenance and increase natural biodiversity. That said, the SuDS Manual does not remove the possibility of utilising separators, so long as they are considered in partnership with a comprehensive overall SuDS regime.
- 7.6.6 Without adequate treatment, the pollutants would cause damage if they were to enter the watercourse or water table in large volumes. The use of SuDS features to slow down and degrade these pollutants is critical to the provision of an acceptable discharge.



- 7.6.7 The respective cleansing abilities of common SuDS features are given by corresponding mitigation indices within the SuDS Manual. An extract of Table 26.3 within the SuDS Manual is set out below in **Table 7.4**.

Table 7.4 – Extract from Table 26.3 SuDS Manual

Type of SuDS component	Total Suspended Solids	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable Paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8

- 7.6.8 The individual pollution indices are totalled, with the first SuDS component utilising its full value and subsequent downstream SuDS features acting with 50% efficiency. This provides a realistic strategy which mimics the reduced cleansing effectiveness as the concentration of a pollutant decreases along the SuDS train.
- 7.6.9 The proposed detention basins and swales provide adequate pollution mitigation to the pollution hazard levels that the proposed development will create, in accordance with **Table 7.3 and 7.4**.
- 7.6.10 In line with Environment Agency guidance, before the design phase is concluded, the proposals are reviewed and analysed in order to identify potential shortcomings and to ensure that adequate volume of SuDS features are provided to mitigate the risk of pollution from each source.

7.7 SuDS Maintenance Strategy

- 7.7.1 For the water treatment effects of SuDS features to remain effective, a comprehensive maintenance strategy should be implemented.
- 7.7.2 During construction, maintenance of SuDS features should be undertaken by the Contractor. Upon completion, the assets should be passed over to the Management Company, statutory authority, or community group commissioned to maintain the features in perpetuity.
- 7.7.3 As part of the strategy, a regular maintenance regime will be created, which consists of several primary measures required to ensure the longevity of the system. These should be undertaken on a regular basis to ensure consistent performance. Typical maintenance activities consist of:
- Inspecting and reporting; relatively regular review of the condition identifying issues and providing resolutions. Periodic review from the maintenance contractor;
 - Litter and debris removal;
 - Grass trimming, overall cutting and localised strimming preventing blockages;
 - Weed and evasive plant control;
 - Shrub management;
 - Aquatic and shoreline vegetation management;
 - Sweeping pervious surfaces; and



- Oil removal from proprietary systems.
- 7.7.4 A remedial maintenance schedule would be recommended as part of the handover of the SuDS features, remedial maintenance is required to provide repairs to the system and monitor long term damage ensuring the system remains consistently productive. The schedule could consist of;
- Structure rehabilitation and repair;
 - Infiltration surface rehabilitation;
 - Scarifying to remove “Thatch”;
 - Spiking or Tining the soil;
 - Air pressure treatment.
- 7.7.5 The maintenance schedule contents and timing will depend upon multiple factors including usage, contents of water utilising the system, location and biology. To this end, it is suggested that the schedule be finalised as part of detailed design; ensuring the most comprehensive maintenance schedule is incorporated for the phase in hand.
- 7.7.6 Community outreach can be undertaken as part of the development, which will raise awareness on the importance of SuDS to both flood risk and water quality in the local area. Imparting the new residents with knowledge on the risks associated with pollution to the surface water drainage system is key, as is the direct effect their actions may have on water quality and biodiversity in the area.
- 7.8 Adoption and Ownership**
- 7.8.1 The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and the requirement of the National Planning Policy Framework.
- 7.8.2 The intention of adoption and ownership of drainage and SuDS is as follows:
- 7.8.3 Surface water sewers within development parcels and the foul pumping station to be offered for adoption to Wessex Water under the Section 104 process of the Water Industry Act.
- 7.8.4 Surface water highway drains, gullies and leads within adopted roads to be maintained by the Highway Authority.
- 7.8.5 Above ground attenuation (i.e. swales and basins) to be maintained by a private maintenance company funded by residential properties or subject to agreement with the Local Authority.
- 7.8.6 SuDS features serving single properties, for example, permeable paved driveways to single dwellings, will be owned and maintained by the owner of that property.
- 7.8.7 Suitable adoption and maintenance regimes for SuDS should be submitted in support of the Reserved Matters application.



8.0 Foul Water Drainage

8.1 Introduction

- 8.1.1 This chapter provides details on the proposed foul water drainage strategy and measures to convey effluent.

8.2 Overall Strategy

- 8.2.1 A Wessex Water public foul sewer is crossing Catchment A and B and therefore it is proposed each of these two catchments to connect to the existing foul sewer. Refer to Drawing HD009-006 in **Appendix B** for the proposed foul drainage strategy.
- 8.2.2 Due to the topography of the site and location of the existing foul sewer point of connection for Catchment C, wastewater from Catchment C will require pumping to the receiving public sewer.
- 8.2.3 There is currently a public sewer located within Crudwell Road that borders the site. The foul sewer records from Wessex Water can be seen in **Appendix B**.
- 8.2.4 Discussions are currently ongoing with Wessex Water, but Wessex Water has confirmed that they would accept a connection from a 150mm diameter sewer from Catchment C to the foul public sewer within Crudwell Road.
- 8.2.5 The topography of the Site and the location and invert of the existing foul sewers will require wastewater from Catchment C only to be pumped as it cannot drain by gravity.
- 8.2.6 Discussions are ongoing with Wessex Water regarding the exact location(s) and specifications of the pump station that will be required to provide sufficient capacity to service the development.
- 8.2.7 Notwithstanding this, the delivery of the proposed on-site foul water sewers will be designed in collaboration with Wessex Water as approving body in accordance with the new Sewerage Sector Guidance (SSG) and will be offered to Wessex Water for adoption under S104 Agreement of the Water Industry Act. The connection to the existing public sewer system will be made via a S106 Agreement of the Water Industry Act with Wessex Water as part of the overall adoption process.

8.3 Adoption and Ownership

- 8.3.1 The drainage system is designed to the appropriate standards including the new Sewerage Sector Guidance (SSG), the Building Regulations and British Standards.
- 8.3.2 Foul water sewers within development parcels and offsite to the point of connection are to be offered for adoption to Wessex Water under the Section 104 process of the Water Industry Act.



9.0 Conclusion

9.1 Flood Risk

9.1.1 The EA Flood Risk mapping has been reviewed alongside the Wiltshire Council (WC) Preliminary Flood Risk Assessment (PFRA) and Wiltshire Council (WC) Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA).

9.1.2 This Flood Risk Assessment (FRA) concludes that:

- The entire site is located within Flood Zone 1 according to the EA Flood Map for Planning and WC Level 1 SFRA mapping.
- The EA Risk of Flooding from Rivers and Sea mapping shows the entire site is at Very Low risk of flooding from rivers and sea.
- The EA NaFRA Risk of Flooding from Surface Water mapping shows that most of the site is not at risk of surface water flooding. A surface water flow route is evident along the western site boundary but is outside the area of proposed development. There are several areas of isolated surface water ponding which correspond with localised topographical low points. Areas of surface water ponding are to be managed appropriately within the surface water drainage strategy. The proposed development area is deemed to be at low risk of surface water flooding.
- The WC Level 1 SFRA BGS Groundwater Emergence mapping shown shows that the entire site is 'deemed as having negligible risk from groundwater flooding due to the nature of the local geological deposits'. The WC Level 1 SFRA Groundwater Flood Zone for application of a Sequential Test Map shows that the site lies outside the groundwater flood zone. Therefore, the site is deemed to be at low risk of groundwater flooding.
- Wessex Water asset map shows sewer asset records. They show a public four sewer near the northwestern boundary of the site. The WC Level 1 SFRA includes records of sewer flooding for Wiltshire covering a period of between 2015 and 2019. The sewer record from the nearest postcode (SN16 9) shows that there have been 6 records of sewer flooding. There is no indication that these have impacted the site. Overall, the site is deemed to be at low risk of sewer flooding.
- The site is not at risk of flooding in the event of a reservoir breach.

9.1.3 In summary the proposed development is at a low risk of flooding from all sources.

9.2 Sequential Test and Exception Test

9.2.1 The site is located within Flood Zone 1.

9.2.2 The surface water flood risk across the site is considered to be low.

9.2.3 The entire site lies outside the Groundwater Flood Zone for the application of the Sequential Test.

9.2.4 The WC Level 1 SFRA states that '*Developers are required to apply the Sequential Test to all development sites, unless a development is within fluvial flood zone 1 and other flooding issues within the area of development (i.e. surface water, groundwater, sewer flooding) are at low risk.*'

9.2.5 The residential development is classed as 'More Vulnerable'. The WC Level 1 SFRA states that '*If a Sequential Test is not required, the Exception Test is not required.*'



9.2.6 Therefore, the Sequential Test and Exception Test are not required.

9.3 Mitigation Strategy

9.3.1 Finished ground floor levels should be set a minimum of 150mm above the surrounding ground level to mitigate the residual flood risk from surface water runoff events. Surrounding ground levels should also be appropriately contoured to direct surface water away from houses.

9.3.2 The proposed surface water drainage strategy will manage the flood risk posed by uncontrolled surface water runoff from the Site. Any increase in surface water run-off can be managed using SuDS source control techniques as well as attenuation features to provide storage in extreme storm events. All surface water drainage systems will be designed to provide 30% betterment to the existing QBAR runoff rate and store the balance of water for all events up to and including the 1 in 100 year event including an allowance for a 45% increase in rainfall intensities as a result of climate change and urban creep.

9.4 Summary

9.4.1 This FRA demonstrates that the proposed development complies with national and local planning policy with respect to flood risk and drainage. The risk of flooding is adequately managed, and, with the implementation of a suitable surface water drainage strategy, the offsite flood risk is not increased.



APPENDICES



Appendix A – Plans

Illustrative Masterplan

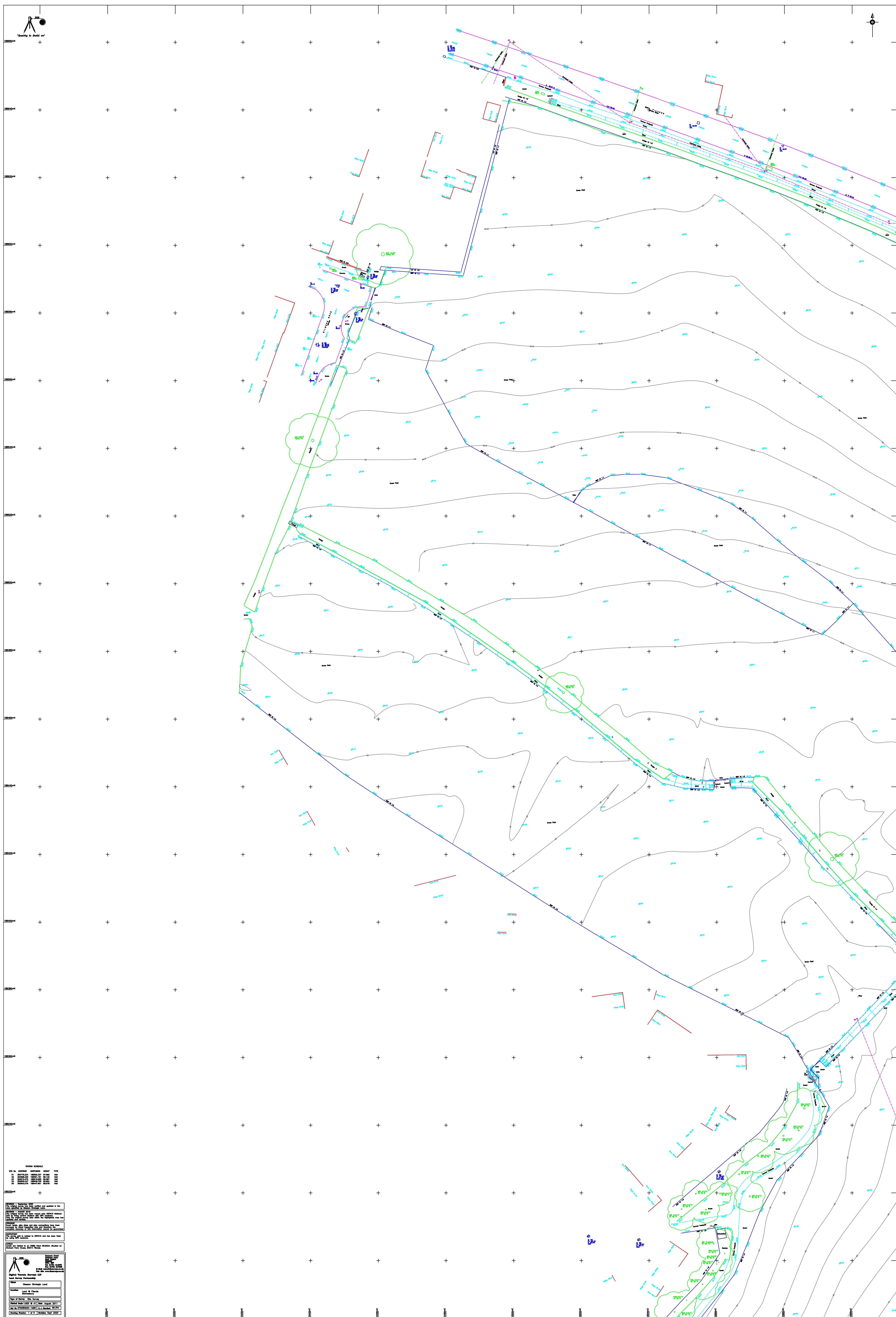
Topographical Survey

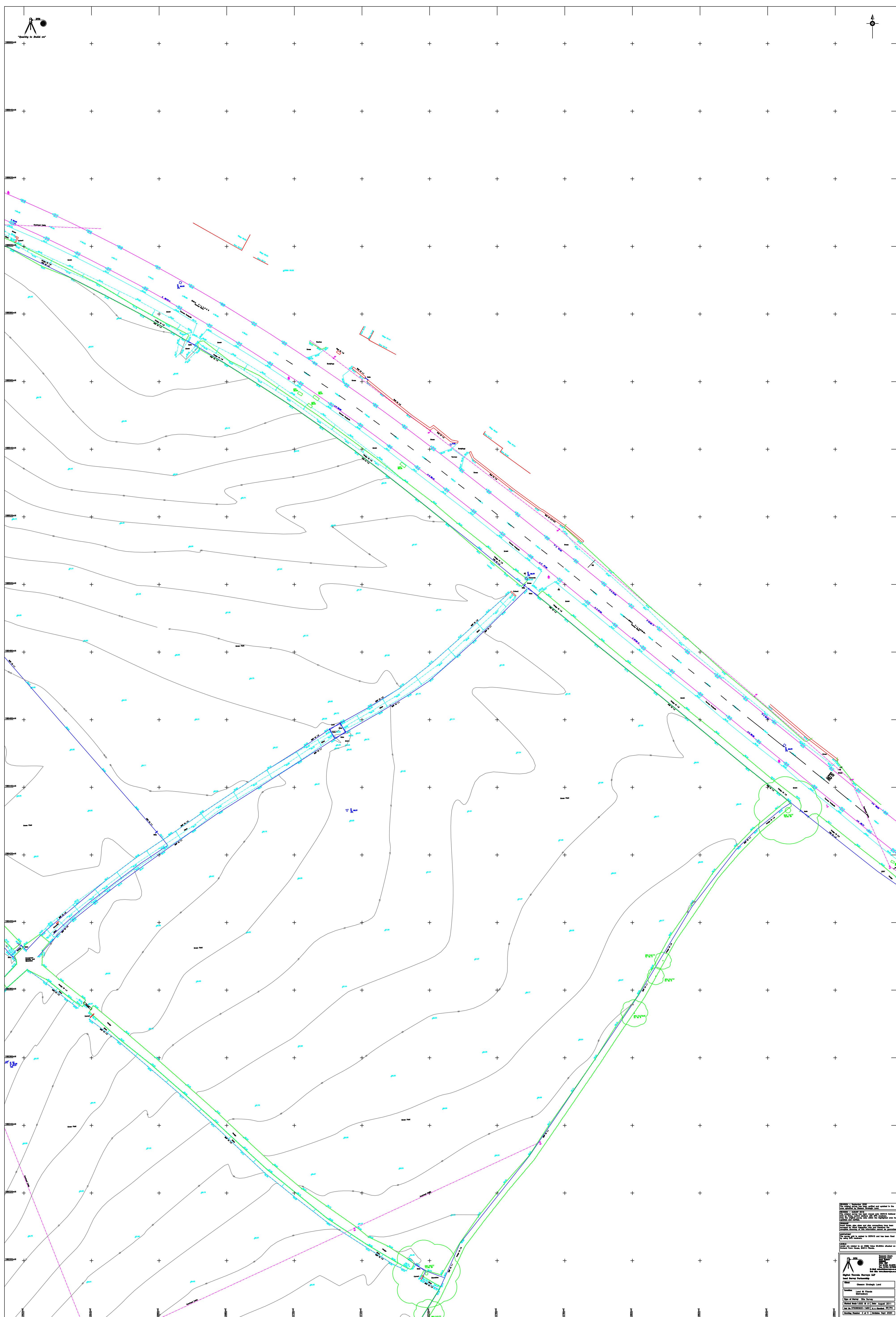
Wessex Water Sewer Asset Plan

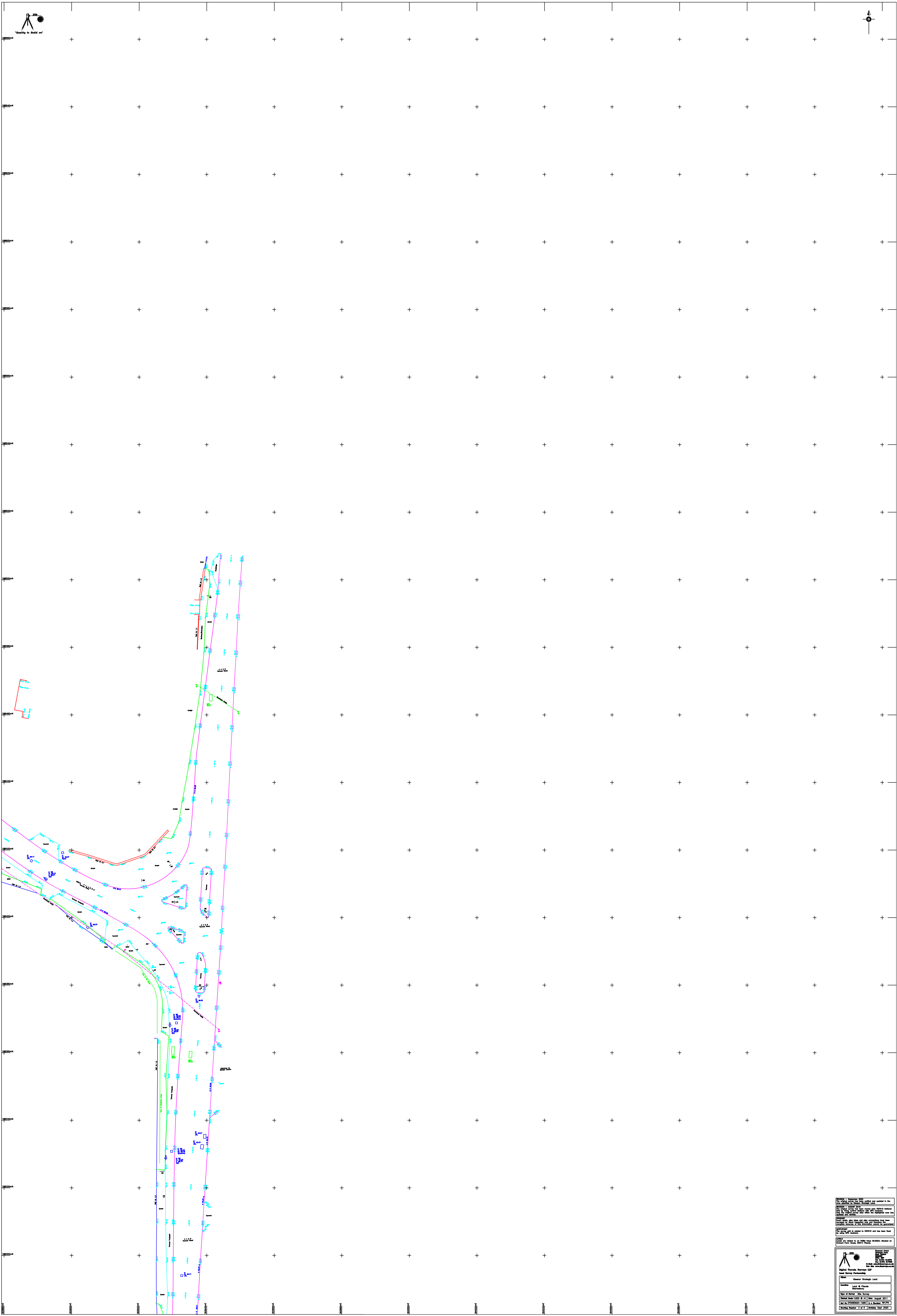
WC Groundwater Emergence Map

WC Groundwater Flood Zone for Application of the Sequential Test

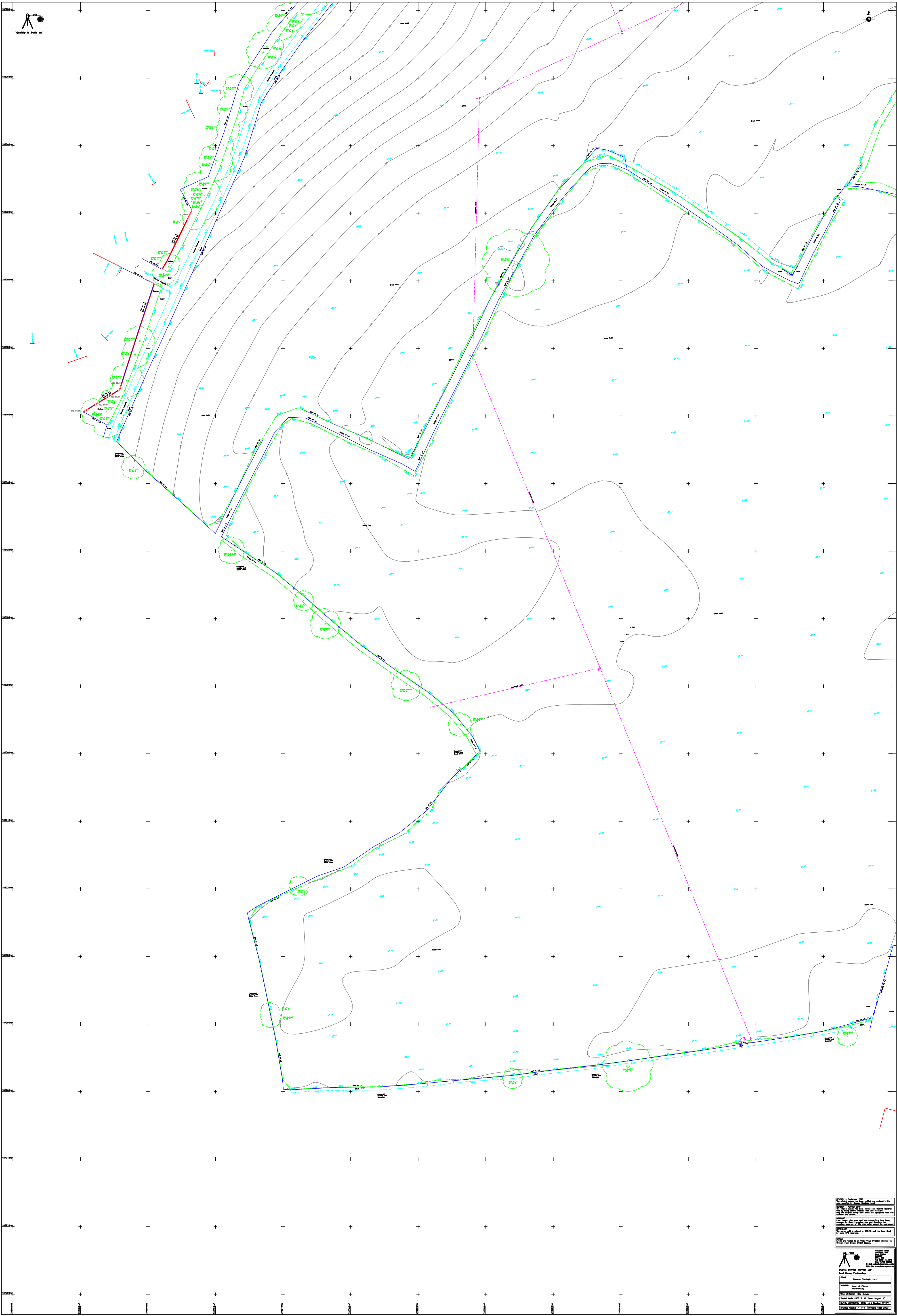








REVISIONS	
NO.	DESCRIPTION
1	Issue for approval
PROJECT INFORMATION	
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Location	Green Valley Road
Scale	1:1000
Date	10/10/2011
Drawn by	J. Smith
Checked by	M. Jones
Project Manager	P. Brown
Client	ABC Ltd
Drawing Number	1 of 1
Revision	Rev 1.0



REVISIONS

NO.	DESCRIPTION	DATE
1	Initial Design	10/10/2011
2	Revised Design	11/10/2011
3	Final Design	12/10/2011

PROJECT INFORMATION

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Client: [Client Name]
Location: [Location]
Scale: [Scale]
Drawing Number: [Drawing Number]

DESIGNER

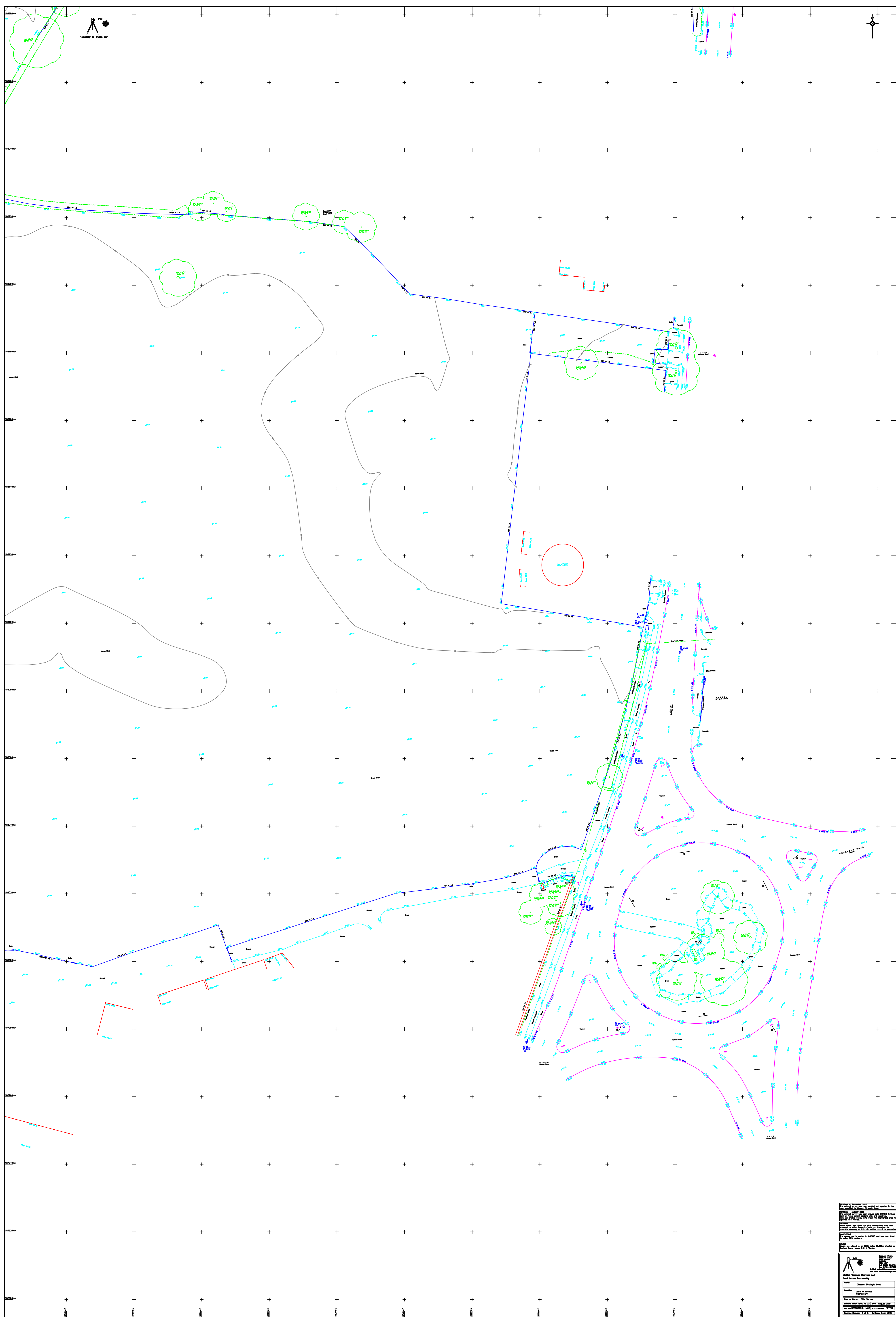
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Design Number: [Design Number]
Design Date: [Design Date]

APPROVED

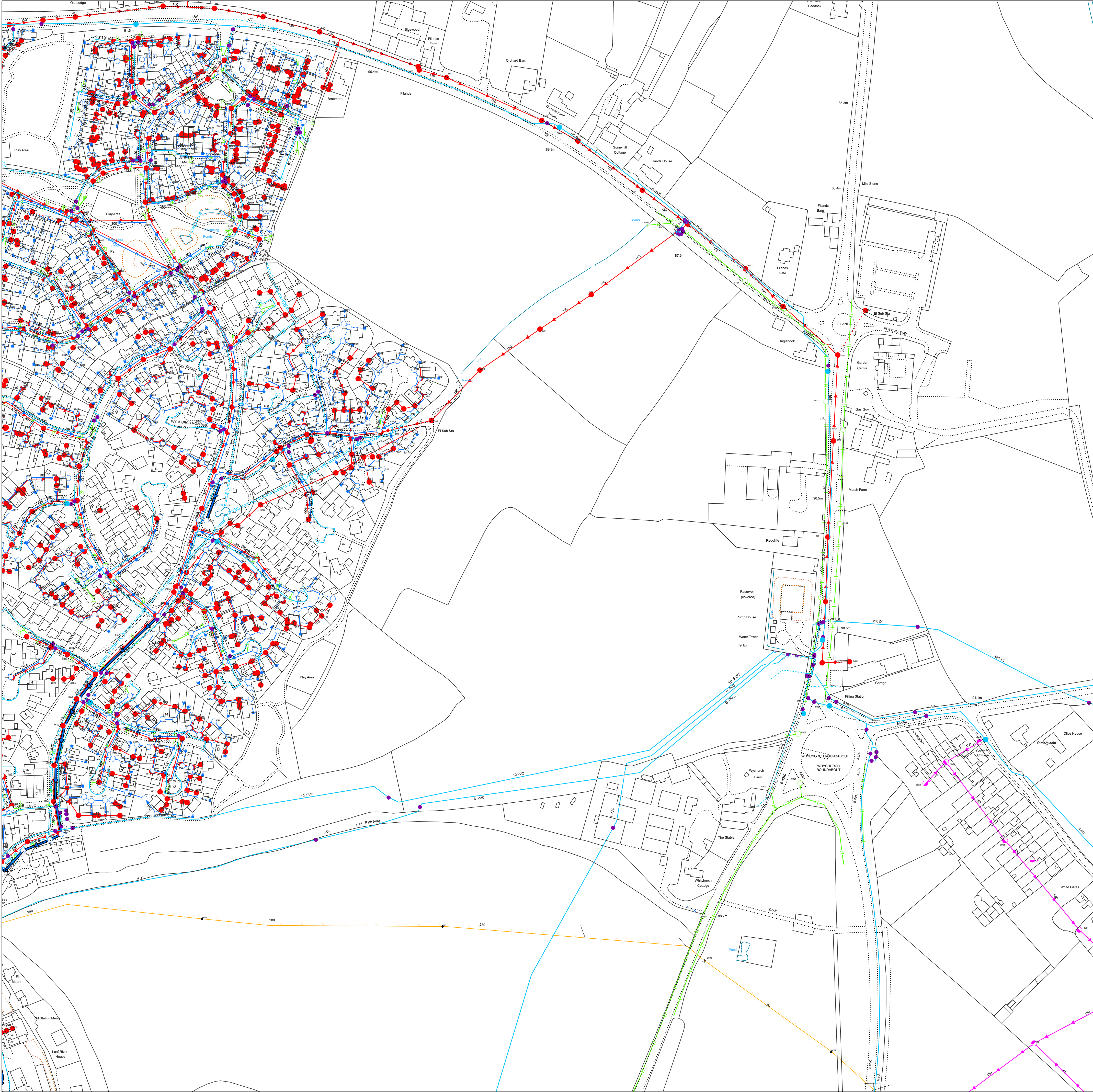
Approved Name: [Approved Name]
Approved Date: [Approved Date]

NOTES

1. All dimensions are in meters.
2. All elevations are in meters above sea level.
3. The design is based on the latest available data.



Wessex Water Web Map



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WATER MAINS	SEWERS	STRATEGIC	PUBLIC	PRIVATE	SECTION 104	OTHER WESSEX PIPES	NON-WESSEX / UNKNOWN
Distribution	Foul	Surface	Combined	Abandoned	Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow).	Rising Mains	Private Rising Mains
Washout	Surface	Combined	Abandoned	Abandoned	Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow).	Standby Rising Mains	Culverted Watercourse
Raw Water	Surface	Combined	Abandoned	Abandoned	Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow).	Effluent Disposal	Highway Drain
Abandoned	Surface	Combined	Abandoned	Abandoned	Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow).	Overflow	Use Unknown
Private	Surface	Combined	Abandoned	Abandoned	Colours generally indicate the use of the sewer/drain (i.e Red - Foul, Dark Blue - Surface, Magenta - Combined/Dual Use, Light Green - Highway Drain, Mid Green - Overflow).	Syphon	Status Unknown
FITTINGS	STRUCTURES	OTHER STRUCTURES	OTHER STRUCTURES	OTHER STRUCTURES	OTHER STRUCTURES	OTHER STRUCTURES	OTHER STRUCTURES
Hydrant	Manhole - Foul	Attenuation Tank	Storage Tank	Chamber	Tunnel	Interceptor	
Other	Manhole - Surface						
	Manhole - Combined						
	Inlet						
	Outfall						
	Lamphole						
	Bifurcation - Foul						
	Bifurcation - Surface						
	Bifurcation - Combined						
	Combined Sewage Overflow						
	Pumping Station - Surface						
	Pumping Stn - Foul/Combined						
	Gully						
	Vent Column						
	Rodding Eye						
	Catchpit						
	Flushing Chamber						
	Soakaway						
	Non Return Valve						
	Air Valve						
	Hatch Box						
	Washout						

Information in this map is provided for identification purposes only. No warranty as to accuracy is given or implied. The precise route of pipe work may not exactly match that shown. Wessex Water does not accept liability for inaccuracies. Sewers and lateral drains adopted by Wessex Water under the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 are to be plotted over time and may not yet be shown. In carrying out any works, you accept liability for the cost of any repairs to Wessex Water apparatus damaged as a result of your works. You are advised to commence excavations using hand tools only. Mechanical digging equipment should not be used until pipe work has been precisely located. If you are considering any form of building works and pipe work is shown within the boundary of your property or a property to be purchased (or very close by) a surveyor should plot its exact position prior to commencing works or purchase. If you are proposing to build over or near Wessex Water's apparatus you should contact the Developer Services Team, tel: 01225 526333 or e-mail: developer.enquiries@wessexwater.co.uk to discuss your proposals. Details of assets within Wessex Water's land ownership are unavailable through this service.

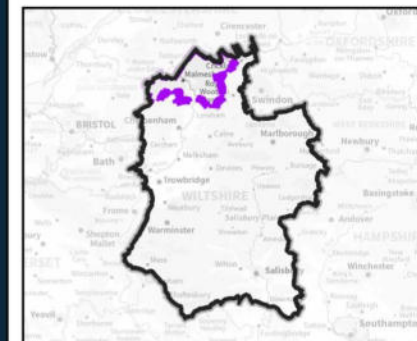
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Scale: 1:1,768
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Arlington House
Park Five
Harrier Way
Sowton
Exeter
EX2 7HU
+44 (0)1392 706050
info@jbaconsulting.com

JBA
consulting

Wiltshire Council



Groundwater Emergence: Malmesbury

Legend

- Wiltshire boundary
- Community Partnership Area

Groundwater Emergence

- This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
- Flooding from groundwater is not likely.
- There is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely.
- Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
- Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.

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Site



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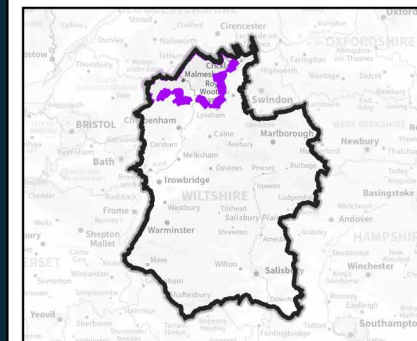




Arlington House
Park Five
Harrier Way
Sowton
Exeter
EX2 7HU
+44 (0)1392 706050
info@jbaconsulting.com

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Groundwater Flood Zone for application of the Sequential Test: Malmesbury

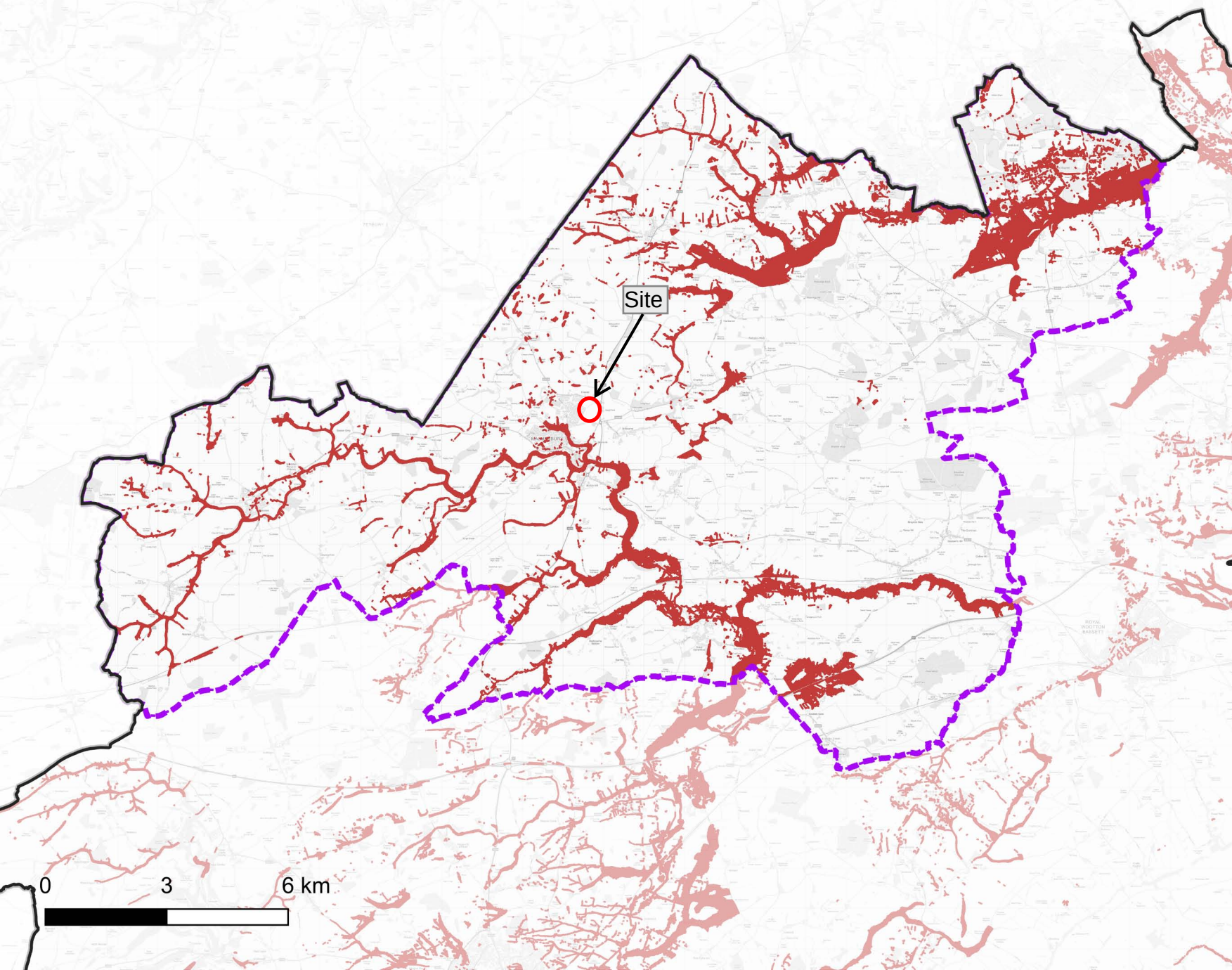
Legend

- Wiltshire boundary
- Community Partnership Area
- Groundwater Sequential Test area

The analyses performed to prepare the mapping are all for a 1 in 100-year (1% AEP) event and so provide a risk of groundwater flooding to the surface as they are based on predicted difference between groundwater level and the ground surface.

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Appendix B – Drainage Strategy

Greenfield Runoff Rates

Greenfield Volumes

Proposed Drainage Modelling Calculations

Proposed Drainage Strategy Layout

Calculated by:	GEORGIOS ROINAS
Site name:	HD009 Filands Road, Malmesbury
Site location:	Filands Road, Malmesbury

Site Details

Latitude:	51.59386° N
Longitude:	2.09262° W
Reference:	1641170261
Date:	Sep 27 2023 16:59

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1

Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Hydrological characteristics

	Default	Edited
SAAR (mm):	763	763
Hydrological region:	8	8
Growth curve factor 1 year:	0.78	0.78
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.43	2.43
Growth curve factor 200 years:	2.78	2.78

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	3.18	3.18
1 in 1 year (l/s):	2.48	2.48
1 in 30 years (l/s):	6.2	6.2
1 in 100 year (l/s):	7.72	7.72
1 in 200 years (l/s):	8.83	8.83

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Greenfield Volume

50% AEP Greenfield Volume

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	4.613
Soil Index	3
SPR	0.37
Catchment Wetness Index	114.370
Return Period (years)	2
Climate Change (%)	0
Storm Duration (mins)	360
Betterment (%)	0
	Calc
PR	0.343
Runoff Volume (m ³)	375

3.3% AEP Greenfield Volume

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	4.613
Soil Index	3
SPR	0.37
Catchment Wetness Index	114.370
Return Period (years)	30
Climate Change (%)	0
Storm Duration (mins)	360
Betterment (%)	0
	Calc
PR	0.362
Runoff Volume (m ³)	799

1% AEP Greenfield Volume

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	4.613
Soil Index	3
SPR	0.37
Catchment Wetness Index	114.370
Return Period (years)	100
Climate Change (%)	0
Storm Duration (mins)	360
Betterment (%)	0
	Calc
PR	0.381
Runoff Volume (m ³)	1071

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.600
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	550.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
8	0.116	5.00	89.968	1350	393769.143	188345.091	2.212	87.756
7	0.046	5.00	90.047	1350	393766.214	188336.107	2.261	87.786
1	0.102	5.00	90.526	1350	393717.853	188272.596	1.564	88.962
2	0.067	5.00	90.141	1350	393726.372	188313.575	2.077	88.064
20	0.060	5.00	89.282	1200	393693.069	188331.720	1.425	87.857
35	0.128	5.00	88.018	1200	393702.485	188370.937	1.749	86.269
35_OUT			86.500		393685.891	188376.870	1.454	85.046
14	0.062	5.00	87.464	600	393762.848	188448.568	1.708	85.756
15	0.043	5.00	87.557	1200	393750.556	188444.298	1.878	85.679
16	0.050	5.00	87.342	1200	393736.056	188442.536	1.892	85.450
11	0.138	5.00	89.179	1350	393790.386	188381.776	1.879	87.300
12	0.052	5.00	88.197	1350	393755.731	188404.207	2.097	86.100
17	0.091	5.00	87.305	1350	393723.298	188416.174	2.143	85.162
18_OUT			86.500		393706.282	188412.728	1.454	85.046
21	0.053	5.00	89.256	1350	393685.785	188328.313	1.447	87.809
22	0.093	5.00	90.183	1350	393657.396	188263.177	1.436	88.747
23	0.114	5.00	89.687	1350	393666.012	188286.329	3.526	86.161
24	0.083	5.00	87.709	1350	393659.054	188346.916	1.600	86.109
25			85.800	1200	393632.948	188362.654	1.184	84.616
27	0.030	5.00	86.055	1350	393607.165	188323.320	1.914	84.141
28	0.108	5.00	86.571	1350	393610.599	188309.383	2.466	84.105
29	0.128	5.00	90.767	1350	393662.281	188229.956	1.721	89.046
30	0.010	5.00	90.253	1200	393644.648	188243.720	1.653	88.600
32	0.065	5.00	89.626	1350	393619.267	188246.891	1.552	88.074
33	0.045	5.00	87.509	1500	393587.452	188256.660	3.621	83.888
33_OUT			85.261		393571.992	188264.378	1.455	83.806
13	0.085	5.00	87.381	600	393778.528	188462.705	1.425	85.956
36	0.162	5.00	86.500		393658.394	188380.133	1.500	85.000
37			86.500	1200	393654.711	188382.020	1.575	84.925
37_OUT			85.500		393627.720	188383.425	0.750	84.750
38	0.160	5.00	85.261		393588.971	188307.401	1.501	83.760
39_OUT			85.000		393590.173	188326.861	1.323	83.677
39			85.260	1350	393589.079	188313.214	1.527	83.733
4			90.397	1200	393738.795	188313.520	2.385	88.012
10			89.381	1350	393791.602	188371.951	1.733	87.648
34	0.044	5.00	88.594	1350	393697.824	188353.322	1.425	87.169
19		5.00	89.862	1350	393715.412	188318.693	1.435	88.427
5			90.409	1200	393748.858	188317.060	2.441	87.968
6			90.232	1200	393758.751	188325.527	2.318	87.914

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	41.855	0.600	88.962	88.139	0.823	50.9	225	5.38	48.0
1.001	2	4	12.423	0.600	88.064	88.012	0.052	238.9	300	5.58	45.9
1.002	4	5	10.668	0.600	88.012	87.968	0.044	242.4	300	5.76	46.5
1.003	5	6	13.022	0.600	87.968	87.914	0.054	241.1	300	5.98	45.6
1.004	6	7	12.947	0.600	87.914	87.861	0.053	244.3	300	6.19	44.9
1.005	7	8	9.449	0.600	87.786	87.756	0.030	315.0	375	6.35	44.4
1.006	8	10	35.012	0.600	87.756	87.648	0.108	324.2	375	6.93	42.4
1.007	10	11	9.900	0.600	87.648	87.300	0.348	28.4	375	6.98	42.3
1.008	11	12	41.281	0.600	87.300	86.100	1.200	34.4	375	7.20	41.6
1.009	12	17	34.570	0.600	86.100	85.237	0.863	40.1	375	7.40	41.1
2.000	13	14	21.112	0.600	85.956	85.831	0.125	168.9	225	5.35	48.1
2.001	14	15	13.013	0.600	85.756	85.679	0.077	169.0	300	5.53	47.4
2.002	15	16	14.607	0.600	85.679	85.450	0.229	63.8	300	5.65	46.9
2.003	16	17	29.291	0.600	85.450	85.312	0.138	212.3	300	6.11	45.1
1.010	17	18_OUT	17.361	0.600	85.162	85.119	0.043	403.7	450	7.69	40.7
3.000	19	20	25.863	0.600	88.427	87.857	0.570	45.4	225	5.22	48.6
3.001	20	21	8.041	0.600	87.857	87.809	0.048	167.5	225	5.35	48.1
3.002	21	23	46.407	0.600	87.809	87.535	0.274	169.4	225	6.13	45.1
4.000	22	23	24.703	0.600	88.747	88.262	0.485	50.9	225	5.22	48.6
3.003	23	28	60.017	0.600	86.161	84.107	2.054	29.2	450	6.39	44.2
5.000	24	25	30.483	0.600	86.109	84.616	1.493	20.4	300	5.15	48.9
5.001	25	27	14.305	0.600	84.616	84.292	0.324	44.2	300	5.25	48.4
5.002	27	28	14.354	0.600	84.141	84.105	0.036	398.7	450	5.48	47.6
3.004	28	33	57.580	0.600	84.105	83.963	0.142	405.5	450	7.35	41.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.838	73.1	17.7	1.339	1.777	0.102	0.0	75	1.521
1.001	1.013	71.6	28.1	1.777	2.085	0.169	0.0	130	0.953
1.002	1.005	71.0	28.4	2.085	2.141	0.169	0.0	132	0.950
1.003	1.008	71.2	27.9	2.141	2.018	0.169	0.0	130	0.949
1.004	1.001	70.8	27.4	2.018	1.886	0.169	0.0	130	0.940
1.005	1.015	112.1	34.4	1.886	1.837	0.215	0.0	142	0.897
1.006	1.001	110.5	50.7	1.837	1.358	0.331	0.0	178	0.980
1.007	3.408	376.4	50.5	1.358	1.504	0.331	0.0	92	2.400
1.008	3.098	342.1	70.6	1.504	1.722	0.469	0.0	115	2.457
1.009	2.870	317.0	77.4	1.722	1.693	0.521	0.0	126	2.386
2.000	1.003	39.9	14.9	1.200	1.408	0.085	0.0	95	0.933
2.001	1.206	85.3	25.2	1.408	1.578	0.147	0.0	112	1.055
2.002	1.971	139.4	32.3	1.578	1.592	0.190	0.0	98	1.612
2.003	1.075	76.0	39.3	1.592	1.693	0.241	0.0	153	1.084
1.010	1.005	159.9	125.5	1.693	0.931	0.853	0.0	301	1.108
3.000	1.947	77.4	0.0	1.210	1.200	0.000	0.0	0	0.000
3.001	1.007	40.0	10.5	1.200	1.222	0.060	0.0	79	0.852
3.002	1.002	39.8	18.4	1.222	1.927	0.113	0.0	108	0.983
4.000	1.837	73.0	16.4	1.211	1.200	0.093	0.0	73	1.492
3.003	3.771	599.8	51.2	3.076	2.014	0.320	0.0	87	2.335
5.000	3.495	247.0	14.6	1.300	0.884	0.083	0.0	49	1.939
5.001	2.372	167.7	14.4	0.884	1.463	0.083	0.0	59	1.467
5.002	1.012	160.9	19.4	1.464	2.016	0.113	0.0	105	0.692
3.004	1.003	159.5	80.7	2.016	3.096	0.541	0.0	226	1.006

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
6.000	29	30	22.369	0.600	89.046	88.600	0.446	50.2	300	5.17	48.8
6.001	30	32	25.578	0.600	88.600	88.074	0.526	48.6	300	5.36	48.1
6.002	32	33	33.281	0.600	88.074	85.800	2.274	14.6	300	5.49	47.5
3.005	33	33_OUT	17.279	0.600	83.888	83.853	0.035	493.7	525	7.44	41.0
7.000	34	35	18.221	0.600	87.169	86.269	0.900	20.2	225	5.10	49.1
7.001	35	35_OUT	17.623	0.600	86.269	85.055	1.214	14.5	225	5.19	48.8
8.000	36	37	16.848	0.600	85.000	84.930	0.070	240.7	300	5.28	48.4
8.001	37	37_OUT	17.008	0.600	84.925	84.750	0.175	97.2	300	5.46	47.6
9.000	38	39	6.436	0.600	83.760	83.733	0.027	238.4	300	5.11	49.0
9.001	39	39_OUT	13.691	0.600	83.733	83.677	0.056	244.5	300	5.33	48.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
6.000	2.225	157.3	22.6	1.421	1.353	0.128	0.0	76	1.596
6.001	2.260	159.7	23.9	1.353	1.252	0.138	0.0	78	1.642
6.002	4.130	291.9	34.8	1.252	1.409	0.202	0.0	69	2.811
3.005	3.202	693.2	116.8	3.096	0.883	0.789	0.0	145	2.412
7.000	2.921	116.1	7.9	1.200	1.524	0.044	0.0	39	1.674
7.001	3.452	137.2	30.4	1.524	1.220	0.173	0.0	72	2.788
8.000	1.009	71.3	28.3	1.200	1.270	0.162	0.0	132	0.953
8.001	1.595	112.7	27.9	1.275	0.450	0.162	0.0	101	1.327
9.000	1.014	71.7	28.4	1.201	1.227	0.160	0.0	131	0.956
9.001	1.001	70.7	27.8	1.227	1.023	0.160	0.0	130	0.942

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	41.855	50.9	225	ADOPTABLE	90.526	88.962	1.339	90.141	88.139	1.777
1.001	12.423	238.9	300	ADOPTABLE	90.141	88.064	1.777	90.397	88.012	2.085
1.002	10.668	242.4	300	ADOPTABLE	90.397	88.012	2.085	90.409	87.968	2.141
1.003	13.022	241.1	300	ADOPTABLE	90.409	87.968	2.141	90.232	87.914	2.018
1.004	12.947	244.3	300	ADOPTABLE	90.232	87.914	2.018	90.047	87.861	1.886
1.005	9.449	315.0	375	ADOPTABLE	90.047	87.786	1.886	89.968	87.756	1.837
1.006	35.012	324.2	375	ADOPTABLE	89.968	87.756	1.837	89.381	87.648	1.358
1.007	9.900	28.4	375	ADOPTABLE	89.381	87.648	1.358	89.179	87.300	1.504
1.008	41.281	34.4	375	ADOPTABLE	89.179	87.300	1.504	88.197	86.100	1.722
1.009	34.570	40.1	375	ADOPTABLE	88.197	86.100	1.722	87.305	85.237	1.693

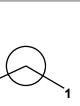
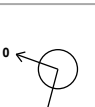
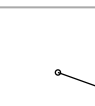
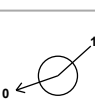
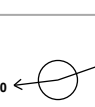
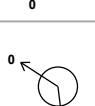
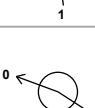
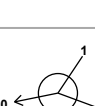
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1350	Manhole	Adoptable	2	1350	Manhole	Adoptable
1.001	2	1350	Manhole	Adoptable	4	1200	Manhole	Adoptable
1.002	4	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
1.003	5	1200	Manhole	Adoptable	6	1200	Manhole	Adoptable
1.004	6	1200	Manhole	Adoptable	7	1350	Manhole	Adoptable
1.005	7	1350	Manhole	Adoptable	8	1350	Manhole	Adoptable
1.006	8	1350	Manhole	Adoptable	10	1350	Manhole	Adoptable
1.007	10	1350	Manhole	Adoptable	11	1350	Manhole	Adoptable
1.008	11	1350	Manhole	Adoptable	12	1350	Manhole	Adoptable
1.009	12	1350	Manhole	Adoptable	17	1350	Manhole	Adoptable

Pipeline Schedule

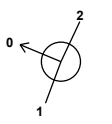
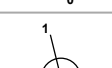
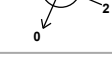
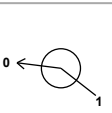
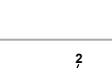
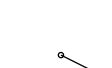
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.000	21.112	168.9	225	ADOPTABLE	87.381	85.956	1.200	87.464	85.831	1.408
2.001	13.013	169.0	300	ADOPTABLE	87.464	85.756	1.408	87.557	85.679	1.578
2.002	14.607	63.8	300	ADOPTABLE	87.557	85.679	1.578	87.342	85.450	1.592
2.003	29.291	212.3	300	ADOPTABLE	87.342	85.450	1.592	87.305	85.312	1.693
1.010	17.361	403.7	450	ADOPTABLE	87.305	85.162	1.693	86.500	85.119	0.931
3.000	25.863	45.4	225	ADOPTABLE	89.862	88.427	1.210	89.282	87.857	1.200
3.001	8.041	167.5	225	ADOPTABLE	89.282	87.857	1.200	89.256	87.809	1.222
3.002	46.407	169.4	225	ADOPTABLE	89.256	87.809	1.222	89.687	87.535	1.927
4.000	24.703	50.9	225	ADOPTABLE	90.183	88.747	1.211	89.687	88.262	1.200
3.003	60.017	29.2	450	ADOPTABLE	89.687	86.161	3.076	86.571	84.107	2.014
5.000	30.483	20.4	300	ADOPTABLE	87.709	86.109	1.300	85.800	84.616	0.884
5.001	14.305	44.2	300	ADOPTABLE	85.800	84.616	0.884	86.055	84.292	1.463
5.002	14.354	398.7	450	ADOPTABLE	86.055	84.141	1.464	86.571	84.105	2.016
3.004	57.580	405.5	450	ADOPTABLE	86.571	84.105	2.016	87.509	83.963	3.096
6.000	22.369	50.2	300	ADOPTABLE	90.767	89.046	1.421	90.253	88.600	1.353
6.001	25.578	48.6	300	ADOPTABLE	90.253	88.600	1.353	89.626	88.074	1.252
6.002	33.281	14.6	300	ADOPTABLE	89.626	88.074	1.252	87.509	85.800	1.409
3.005	17.279	493.7	525	ADOPTABLE	87.509	83.888	3.096	85.261	83.853	0.883
7.000	18.221	20.2	225	ADOPTABLE	88.594	87.169	1.200	88.018	86.269	1.524
7.001	17.623	14.5	225	ADOPTABLE	88.018	86.269	1.524	86.500	85.055	1.220
8.000	16.848	240.7	300	ADOPTABLE	86.500	85.000	1.200	86.500	84.930	1.270
8.001	17.008	97.2	300	ADOPTABLE	86.500	84.925	1.275	85.500	84.750	0.450
9.000	6.436	238.4	300	ADOPTABLE	85.261	83.760	1.201	85.260	83.733	1.227
9.001	13.691	244.5	300	ADOPTABLE	85.260	83.733	1.227	85.000	83.677	1.023

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.000	13	600	Manhole	Adoptable	14	600	Manhole	Adoptable
2.001	14	600	Manhole	Adoptable	15	1200	Manhole	Adoptable
2.002	15	1200	Manhole	Adoptable	16	1200	Manhole	Adoptable
2.003	16	1200	Manhole	Adoptable	17	1350	Manhole	Adoptable
1.010	17	1350	Manhole	Adoptable	18_OUT		Junction	
3.000	19	1350	Manhole	Adoptable	20	1200	Manhole	Adoptable
3.001	20	1200	Manhole	Adoptable	21	1350	Manhole	Adoptable
3.002	21	1350	Manhole	Adoptable	23	1350	Manhole	Adoptable
4.000	22	1350	Manhole	Adoptable	23	1350	Manhole	Adoptable
3.003	23	1350	Manhole	Adoptable	28	1350	Manhole	Adoptable
5.000	24	1350	Manhole	Adoptable	25	1200	Manhole	Adoptable
5.001	25	1200	Manhole	Adoptable	27	1350	Manhole	Adoptable
5.002	27	1350	Manhole	Adoptable	28	1350	Manhole	Adoptable
3.004	28	1350	Manhole	Adoptable	33	1500	Manhole	Adoptable
6.000	29	1350	Manhole	Adoptable	30	1200	Manhole	Adoptable
6.001	30	1200	Manhole	Adoptable	32	1350	Manhole	Adoptable
6.002	32	1350	Manhole	Adoptable	33	1500	Manhole	Adoptable
3.005	33	1500	Manhole	Adoptable	33_OUT		Junction	
7.000	34	1350	Manhole	Adoptable	35	1200	Manhole	Adoptable
7.001	35	1200	Manhole	Adoptable	35_OUT		Junction	
8.000	36		Junction		37	1200	Manhole	Adoptable
8.001	37	1200	Manhole	Adoptable	37_OUT		Junction	
9.000	38		Junction		39	1350	Manhole	Adoptable
9.001	39	1350	Manhole	Adoptable	39_OUT		Junction	

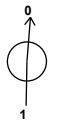
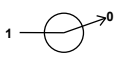
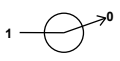
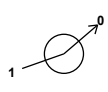
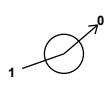
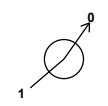
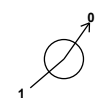
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
8	393769.143	188345.091	89.968	2.212	1350		1	1.005	87.756	375
7	393766.214	188336.107	90.047	2.261	1350		1	1.004	87.861	300
							0	1.005	87.786	375
1	393717.853	188272.596	90.526	1.564	1350		0	1.000	88.962	225
2	393726.372	188313.575	90.141	2.077	1350		1	1.000	88.139	225
20	393693.069	188331.720	89.282	1.425	1200		0	1.001	88.064	300
							1	3.000	87.857	225
35	393702.485	188370.937	88.018	1.749	1200		0	3.001	87.857	225
							1	7.000	86.269	225
35_OUT	393685.891	188376.870	86.500	1.454			0	7.001	86.269	225
							1	7.001	85.055	225
14	393762.848	188448.568	87.464	1.708	600		1	2.000	85.831	225
15	393750.556	188444.298	87.557	1.878	1200		0	2.001	85.756	300
							1	2.001	85.679	300
16	393736.056	188442.536	87.342	1.892	1200		0	2.002	85.679	300
							1	2.002	85.450	300
11	393790.386	188381.776	89.179	1.879	1350		0	2.003	85.450	300
							1	1.007	87.300	375
12	393755.731	188404.207	88.197	2.097	1350		0	1.008	87.300	375
							1	1.008	86.100	375
17	393723.298	188416.174	87.305	2.143	1350		0	1.009	86.100	375
							1	2.003	85.312	300
							2	1.009	85.237	375
							0	1.010	85.162	450

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
18_OUT	393706.282	188412.728	86.500	1.454		 1	1.010	85.119	450
21	393685.785	188328.313	89.256	1.447	1350	 1	3.001	87.809	225
22	393657.396	188263.177	90.183	1.436	1350	 0	3.002	87.809	225
23	393666.012	188286.329	89.687	3.526	1350	 0	4.000	88.747	225
24	393659.054	188346.916	87.709	1.600	1350	 1	4.000	88.262	225
25	393632.948	188362.654	85.800	1.184	1200	 2	3.002	87.535	225
27	393607.165	188323.320	86.055	1.914	1350	 0	3.003	86.161	450
28	393610.599	188309.383	86.571	2.466	1350	 0	5.000	86.109	300
29	393662.281	188229.956	90.767	1.721	1350	 1	5.000	84.616	300
30	393644.648	188243.720	90.253	1.653	1200	 0	5.001	84.616	300
32	393619.267	188246.891	89.626	1.552	1350	 1	5.001	84.292	300
33	393587.452	188256.660	87.509	3.621	1500	 0	5.002	84.141	450
33_OUT	393571.992	188264.378	85.261	1.455		 1	5.002	84.105	450
						 2	3.004	84.105	450
						 0	3.004	84.105	450
						 0	6.000	89.046	300
						 1	6.000	88.600	300
						 0	6.001	88.600	300
						 1	6.001	88.074	300
						0	6.002	88.074	300
						1	6.002	85.800	300
						2	3.004	83.963	450
						0	3.005	83.888	525
						1	3.005	83.853	525

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
13	393778.528	188462.705	87.381	1.425	600	 0	0	2.000	85.956	225
36	393658.394	188380.133	86.500	1.500		 0	0	8.000	85.000	300
37	393654.711	188382.020	86.500	1.575	1200	 01	1	8.000	84.930	300
37_OUT	393627.720	188383.425	85.500	0.750		 1	0	8.001	84.925	300
						 1	1	8.001	84.750	300
38	393588.971	188307.401	85.261	1.501		 0	0	9.000	83.760	300
39_OUT	393590.173	188326.861	85.000	1.323		 1	1	9.001	83.677	300
39	393589.079	188313.214	85.260	1.527	1350	 01	1	9.000	83.733	300
						 1	0	9.001	83.733	300
4	393738.795	188313.520	90.397	2.385	1200	 10	1	1.001	88.012	300
						 0	0	1.002	88.012	300
10	393791.602	188371.951	89.381	1.733	1350	 01	1	1.006	87.648	375
						 1	0	1.007	87.648	375
34	393697.824	188353.322	88.594	1.425	1350	 0	0	7.000	87.169	225
19	393715.412	188318.693	89.862	1.435	1350	 0	0	3.000	88.427	225
5	393748.858	188317.060	90.409	2.441	1200	 01	1	1.002	87.968	300
						 1	0	1.003	87.968	300
6	393758.751	188325.527	90.232	2.318	1200	 01	1	1.003	87.914	300
						 1	0	1.004	87.914	300

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		

Storm Durations

60	180	360	600	960	2160	4320	7200	10080
120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
30	40	0	0
100	0	0	0
100	45	0	0

Node 35_OUT Online Orifice Control

Flap Valve	x	Invert Level (m)	85.046	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.450		

Node 36 Online Orifice Control

Flap Valve	x	Invert Level (m)	85.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.300		

Node 18_OUT Online Orifice Control

Flap Valve	x	Invert Level (m)	85.046	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.450		

Node 33_OUT Online Orifice Control

Flap Valve	x	Invert Level (m)	83.806	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.525		

Node 38 Online Orifice Control

Flap Valve	x	Invert Level (m)	83.760	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.300		

Node 37 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	84.925	Product Number	CTL-SHE-0079-3000-1200-3000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

Node 39 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	83.733	Product Number	CTL-SHE-0070-2400-1230-2400
Design Depth (m)	1.230	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.4	Min Node Diameter (mm)	1200

Node 38 Pond Storage Structure

Invert Level (m)	83.760	Analyse flow through structure	✓	Main Channel Slope (1:X)	1000.0
Time to half empty (mins)		Main Channel Length (m)	46.000	Main Channel n	0.035

Inlets

33_OUT

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	447.5	1.500	1599.0

Node 36 Pond Storage Structure

Invert Level (m)	85.000	Analyse flow through structure	✓	Main Channel Slope (1:X)	1000.0
Time to half empty (mins)		Main Channel Length (m)	46.000	Main Channel n	0.035

Inlets

18_OUT | 35_OUT

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	816.0	1.500	1622.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	8	33	87.899	0.143	33.8	0.2043	0.0000	OK
60 minute summer	7	34	87.919	0.133	22.0	0.1898	0.0000	OK
60 minute summer	1	33	89.021	0.059	10.6	0.0838	0.0000	OK
60 minute summer	2	33	88.173	0.109	17.6	0.1565	0.0000	OK
60 minute summer	20	33	87.921	0.064	6.3	0.0725	0.0000	OK
60 minute summer	35	33	86.324	0.055	17.9	0.0619	0.0000	OK
720 minute winter	35_OUT	675	85.303	0.257	4.3	0.0000	0.0000	OK
60 minute summer	14	33	85.846	0.090	15.3	0.0255	0.0000	OK
60 minute summer	15	33	85.757	0.078	19.8	0.0877	0.0000	OK
60 minute summer	16	33	85.572	0.122	25.0	0.1380	0.0000	OK
60 minute summer	11	34	87.395	0.095	47.5	0.1353	0.0000	OK
60 minute summer	12	34	86.202	0.102	52.8	0.1465	0.0000	OK
60 minute summer	17	34	85.391	0.229	86.7	0.3274	0.0000	OK
60 minute summer	18_OUT	34	85.310	0.264	87.0	0.0000	0.0000	OK
60 minute summer	21	33	87.893	0.084	11.8	0.1204	0.0000	OK
60 minute summer	22	33	88.804	0.057	9.7	0.0809	0.0000	OK
60 minute summer	23	33	86.232	0.071	33.0	0.1012	0.0000	OK
60 minute summer	24	33	86.147	0.038	8.6	0.0546	0.0000	OK
60 minute summer	25	33	84.664	0.048	8.6	0.0537	0.0000	OK
60 minute summer	27	34	84.291	0.150	11.8	0.2143	0.0000	OK
60 minute summer	28	34	84.289	0.184	55.5	0.2636	0.0000	OK
60 minute summer	29	33	89.106	0.060	13.3	0.0853	0.0000	OK
60 minute summer	30	33	88.663	0.063	14.3	0.0711	0.0000	OK
60 minute summer	32	33	88.129	0.055	21.0	0.0790	0.0000	OK
720 minute winter	33	690	84.127	0.239	13.6	0.4230	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	8	1.006	10	33.7	1.236	0.305	0.9713	
60 minute summer	7	1.005	8	22.1	0.602	0.197	0.3464	
60 minute summer	1	1.000	2	10.6	1.307	0.145	0.3388	
60 minute summer	2	1.001	4	17.6	0.752	0.245	0.2902	
60 minute summer	20	3.001	21	6.3	0.554	0.157	0.0918	
60 minute summer	35	7.001	35_OUT	17.9	1.664	0.130	0.1962	
60 minute summer	35_OUT	Pond	36	59.9	0.063	0.002		
60 minute summer	14	2.001	15	15.3	0.953	0.179	0.2093	
60 minute summer	15	2.002	16	19.8	0.968	0.142	0.3015	
60 minute summer	16	2.003	17	24.8	0.954	0.327	0.7638	
60 minute summer	11	1.008	12	47.6	2.065	0.139	0.9515	
60 minute summer	12	1.009	17	52.9	1.629	0.167	1.1558	
60 minute summer	17	1.010	18_OUT	87.0	1.153	0.544	1.3106	
60 minute summer	18_OUT	Pond	36	59.9	0.063	0.002		
60 minute summer	21	3.002	23	11.6	0.870	0.291	0.6182	
60 minute summer	22	4.000	23	9.7	1.266	0.133	0.1893	
60 minute summer	23	3.003	28	32.9	0.937	0.055	2.2757	
60 minute summer	24	5.000	25	8.6	1.405	0.035	0.1880	
60 minute summer	25	5.001	27	8.6	1.234	0.051	0.0996	
60 minute summer	27	5.002	28	11.3	0.223	0.070	0.7687	
60 minute summer	28	3.004	33	53.7	0.971	0.336	3.1998	
60 minute summer	29	6.000	30	13.3	1.291	0.085	0.2305	
60 minute summer	30	6.001	32	14.3	1.464	0.090	0.2505	
60 minute summer	32	6.002	33	21.0	2.397	0.072	0.2915	
60 minute summer	33	3.005	33_OUT	78.6	1.062	0.113	1.2796	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.87%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	33_OUT	690	84.128	0.322	13.5	0.0000	0.0000	OK
60 minute summer	13	33	86.030	0.074	8.9	0.0210	0.0000	OK
720 minute winter	36	690	85.300	0.300	12.8	247.0421	0.0000	SURCHARGED
720 minute winter	37	690	85.299	0.374	3.4	0.4233	0.0000	SURCHARGED
60 minute summer	37_OUT	1	84.750	0.000	2.9	0.0000	0.0000	OK
720 minute winter	38	690	84.127	0.367	9.3	200.1593	0.0000	SURCHARGED
60 minute summer	39_OUT	1	83.677	0.000	2.2	0.0000	0.0000	OK
720 minute winter	39	690	84.127	0.394	3.2	0.5638	0.0000	SURCHARGED
60 minute summer	4	33	88.122	0.110	17.6	0.1249	0.0000	OK
60 minute summer	10	34	87.727	0.079	33.7	0.1137	0.0000	OK
60 minute summer	34	33	87.200	0.031	4.6	0.0437	0.0000	OK
60 minute summer	19	1	88.427	0.000	0.0	0.0000	0.0000	OK
60 minute summer	5	33	88.076	0.108	17.5	0.1226	0.0000	OK
60 minute summer	6	34	88.021	0.107	17.4	0.1215	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	33_OUT	Pond	38	34.5	0.054	0.002		
60 minute summer	13	2.000	14	8.9	0.799	0.223	0.2351	
240 minute winter	36	Orifice	37	4.6				
360 minute summer	37	Hydro-Brake®	37_OUT	2.9				92.4
240 minute winter	38	Orifice	39	4.1				
240 minute winter	39	Hydro-Brake®	39_OUT	2.2				55.6
60 minute summer	4	1.002	5	17.5	0.754	0.246	0.2477	
60 minute summer	10	1.007	11	33.8	1.747	0.090	0.1918	
60 minute summer	34	7.000	35	4.6	0.882	0.040	0.0970	
60 minute summer	19	3.000	20	0.0	0.000	0.000	0.1202	
60 minute summer	5	1.003	6	17.4	0.769	0.245	0.2964	
60 minute summer	6	1.004	7	17.5	0.809	0.247	0.2801	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.10%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	8	33	87.997	0.241	88.4	0.3443	0.0000	OK
60 minute summer	7	33	88.025	0.239	57.3	0.3415	0.0000	OK
60 minute summer	1	33	89.057	0.095	27.6	0.1363	0.0000	OK
60 minute summer	2	33	88.267	0.203	45.7	0.2906	0.0000	OK
60 minute summer	20	33	87.979	0.122	16.2	0.1375	0.0000	OK
60 minute summer	35	33	86.359	0.090	46.5	0.1016	0.0000	OK
1440 minute winter	35_OUT	1380	85.654	0.608	10.8	0.0000	0.0000	OK
60 minute summer	14	32	85.909	0.153	39.7	0.0433	0.0000	OK
60 minute summer	15	32	85.811	0.132	51.4	0.1498	0.0000	OK
60 minute summer	16	34	85.784	0.334	65.1	0.3782	0.0000	SURCHARGED
60 minute summer	11	33	87.460	0.160	124.6	0.2296	0.0000	OK
60 minute summer	12	34	86.270	0.170	138.3	0.2439	0.0000	OK
60 minute summer	17	34	85.664	0.502	224.7	0.7182	0.0000	SURCHARGED
1440 minute winter	18_OUT	1410	85.654	0.608	17.2	0.0000	0.0000	OK
60 minute summer	21	33	87.959	0.150	30.3	0.2146	0.0000	OK
60 minute summer	22	33	88.842	0.095	25.2	0.1358	0.0000	OK
60 minute summer	23	33	86.274	0.113	85.8	0.1621	0.0000	OK
60 minute summer	24	33	86.170	0.061	22.3	0.0866	0.0000	OK
60 minute summer	25	33	84.689	0.073	22.3	0.0830	0.0000	OK
1440 minute winter	27	1440	84.474	0.333	2.3	0.4769	0.0000	OK
1440 minute winter	28	1440	84.472	0.367	11.0	0.5251	0.0000	OK
60 minute summer	29	33	89.145	0.099	34.5	0.1411	0.0000	OK
60 minute summer	30	33	88.704	0.104	37.1	0.1173	0.0000	OK
60 minute summer	32	33	88.164	0.090	54.6	0.1294	0.0000	OK
1440 minute winter	33	1380	84.473	0.585	16.0	1.0337	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	8	1.006	10	87.9	1.580	0.795	1.9505	
60 minute summer	7	1.005	8	57.3	0.776	0.511	0.7024	
60 minute summer	1	1.000	2	27.6	1.526	0.378	0.8223	
60 minute summer	2	1.001	4	45.6	0.902	0.637	0.6307	
60 minute summer	20	3.001	21	16.1	0.650	0.402	0.2009	
60 minute summer	35	7.001	35_OUT	46.5	1.763	0.339	0.4699	
60 minute summer	35_OUT	Pond	36	120.5	0.073	0.005		
60 minute summer	14	2.001	15	39.7	1.249	0.466	0.4304	
60 minute summer	15	2.002	16	51.5	1.121	0.369	0.7170	
60 minute summer	16	2.003	17	63.5	1.040	0.836	2.0627	
60 minute summer	11	1.008	12	124.2	2.654	0.363	1.9325	
60 minute summer	12	1.009	17	137.8	1.624	0.435	2.7480	
60 minute summer	17	1.010	18_OUT	225.4	1.423	1.410	2.7392	
60 minute summer	18_OUT	Pond	36	120.5	0.073	0.005		
60 minute summer	21	3.002	23	29.9	1.093	0.750	1.2727	
60 minute summer	22	4.000	23	25.2	1.635	0.345	0.3809	
60 minute summer	23	3.003	28	85.6	1.107	0.143	4.8507	
60 minute summer	24	5.000	25	22.3	1.911	0.090	0.3573	
60 minute summer	25	5.001	27	22.3	1.441	0.133	0.3739	
60 minute summer	27	5.002	28	29.2	0.266	0.182	1.7947	
60 minute summer	28	3.004	33	140.7	1.082	0.882	7.5662	
60 minute summer	29	6.000	30	34.5	1.654	0.219	0.4666	
60 minute summer	30	6.001	32	37.1	1.883	0.232	0.5045	
60 minute summer	32	6.002	33	54.6	3.133	0.187	0.5803	
60 minute summer	33	3.005	33_OUT	203.9	1.125	0.294	3.1627	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.10%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	33_OUT	1410	84.474	0.668	19.1	0.0000	0.0000	OK
60 minute summer	13	33	86.085	0.129	23.1	0.0365	0.0000	OK
1440 minute winter	36	1410	85.649	0.649	19.0	616.7876	0.0000	SURCHARGED
1440 minute winter	37	1410	85.649	0.724	3.5	0.8189	0.0000	SURCHARGED
60 minute summer	37_OUT	1	84.750	0.000	2.9	0.0000	0.0000	OK
1440 minute winter	38	1410	84.469	0.709	10.6	488.2700	0.0000	SURCHARGED
60 minute summer	39_OUT	1	83.677	0.000	2.2	0.0000	0.0000	OK
1440 minute winter	39	1410	84.469	0.736	3.2	1.0530	0.0000	SURCHARGED
60 minute summer	4	33	88.215	0.203	45.6	0.2298	0.0000	OK
60 minute summer	10	34	87.786	0.138	87.9	0.1979	0.0000	OK
60 minute summer	34	33	87.217	0.048	11.9	0.0694	0.0000	OK
60 minute summer	19	1	88.427	0.000	0.0	0.0000	0.0000	OK
60 minute summer	5	33	88.164	0.196	45.5	0.2219	0.0000	OK
60 minute summer	6	34	88.101	0.187	45.4	0.2118	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	33_OUT	Pond	38	86.1	0.072	0.005		
60 minute summer	13	2.000	14	23.1	1.017	0.579	0.4795	
60 minute summer	36	Orifice	37	6.8				
60 minute summer	37	Hydro-Brake®	37_OUT	2.9				49.5
60 minute summer	38	Orifice	39	6.1				
8640 minute summer	39	Hydro-Brake®	39_OUT	2.2				842.2
60 minute summer	4	1.002	5	45.5	0.914	0.641	0.5312	
60 minute summer	10	1.007	11	88.0	2.160	0.234	0.4046	
60 minute summer	34	7.000	35	11.9	1.151	0.102	0.1917	
60 minute summer	19	3.000	20	0.0	0.000	0.000	0.2828	
60 minute summer	5	1.003	6	45.4	0.955	0.637	0.6186	
60 minute summer	6	1.004	7	45.4	1.056	0.641	0.5560	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	8	33	88.053	0.297	122.4	0.4247	0.0000	OK
60 minute summer	7	34	88.086	0.300	79.2	0.4295	0.0000	OK
60 minute summer	1	33	89.077	0.115	38.6	0.1651	0.0000	OK
60 minute summer	2	33	88.339	0.275	63.9	0.3941	0.0000	OK
60 minute summer	20	34	88.031	0.174	22.7	0.1972	0.0000	OK
60 minute summer	35	33	86.377	0.108	65.1	0.1227	0.0000	OK
2160 minute winter	35_OUT	2100	85.921	0.875	11.4	0.0000	0.0000	OK
60 minute summer	14	34	86.369	0.613	54.0	0.1734	0.0000	SURCHARGED
60 minute summer	15	34	86.325	0.646	68.7	0.7303	0.0000	SURCHARGED
60 minute summer	16	34	86.245	0.795	86.0	0.8990	0.0000	SURCHARGED
60 minute summer	11	33	87.489	0.189	173.1	0.2706	0.0000	OK
60 minute summer	12	34	86.376	0.276	192.7	0.3943	0.0000	OK
60 minute summer	17	34	86.027	0.865	308.1	1.2382	0.0000	SURCHARGED
2160 minute winter	18_OUT	2160	85.920	0.874	17.4	0.0000	0.0000	OK
60 minute summer	21	34	88.014	0.205	42.0	0.2933	0.0000	OK
60 minute summer	22	33	88.863	0.116	35.3	0.1660	0.0000	OK
60 minute summer	23	33	86.295	0.134	119.1	0.1916	0.0000	OK
60 minute summer	24	33	86.181	0.072	31.2	0.1024	0.0000	OK
2160 minute winter	25	2100	84.715	0.099	1.8	0.1114	0.0000	OK
2160 minute winter	27	2100	84.712	0.571	2.3	0.8168	0.0000	SURCHARGED
2160 minute winter	28	2160	84.710	0.605	11.1	0.8664	0.0000	SURCHARGED
60 minute summer	29	33	89.165	0.119	48.3	0.1705	0.0000	OK
60 minute summer	30	33	88.725	0.125	51.9	0.1415	0.0000	OK
60 minute summer	32	33	88.183	0.109	76.3	0.1553	0.0000	OK
2160 minute winter	33	2160	84.710	0.822	15.6	1.4528	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	8	1.006	10	121.9	1.692	1.103	2.4874	
60 minute summer	7	1.005	8	79.6	0.850	0.710	0.8888	
60 minute summer	1	1.000	2	38.6	1.529	0.528	1.2108	
60 minute summer	2	1.001	4	63.2	0.946	0.883	0.8356	
60 minute summer	20	3.001	21	22.1	0.668	0.552	0.2855	
60 minute summer	35	7.001	35_OUT	65.1	1.930	0.474	0.5173	
60 minute summer	35_OUT	Pond	36	158.9	0.080	0.006		
60 minute summer	14	2.001	15	52.5	1.262	0.615	0.9164	
60 minute summer	15	2.002	16	67.7	1.131	0.486	1.0286	
60 minute summer	16	2.003	17	85.4	1.213	1.124	2.0627	
60 minute summer	11	1.008	12	173.0	2.723	0.506	2.9189	
60 minute summer	12	1.009	17	189.9	1.794	0.599	3.4069	
60 minute summer	17	1.010	18_OUT	306.9	1.937	1.920	2.7507	
60 minute summer	18_OUT	Pond	36	158.9	0.080	0.006		
60 minute summer	21	3.002	23	41.2	1.168	1.034	1.6289	
60 minute summer	22	4.000	23	35.3	1.775	0.483	0.4915	
60 minute summer	23	3.003	28	118.9	1.148	0.198	5.9391	
60 minute summer	24	5.000	25	31.2	2.104	0.126	0.4537	
60 minute summer	25	5.001	27	31.2	1.442	0.186	0.6247	
60 minute summer	27	5.002	28	41.9	0.294	0.260	2.2743	
60 minute summer	28	3.004	33	198.0	1.250	1.241	9.1232	
60 minute summer	29	6.000	30	48.3	1.794	0.307	0.6024	
60 minute summer	30	6.001	32	51.9	2.046	0.325	0.6494	
60 minute summer	32	6.002	33	76.3	3.424	0.261	0.7421	
60 minute summer	33	3.005	33_OUT	290.6	1.362	0.419	3.7140	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	33_OUT	1440	84.715	0.909	21.2	0.0000	0.0000	OK
60 minute summer	13	34	86.459	0.503	32.3	0.1424	0.0000	SURCHARGED
2160 minute winter	36	2100	85.917	0.917	13.6	944.4980	0.0000	SURCHARGED
2160 minute winter	37	2100	85.916	0.991	4.5	1.1209	0.0000	SURCHARGED
60 minute summer	37_OUT	1	84.750	0.000	2.9	0.0000	0.0000	OK
2160 minute winter	38	2100	84.710	0.950	10.3	744.9204	0.0000	SURCHARGED
60 minute summer	39_OUT	1	83.677	0.000	2.2	0.0000	0.0000	OK
2160 minute winter	39	2100	84.709	0.976	3.1	1.3969	0.0000	SURCHARGED
60 minute summer	4	34	88.282	0.270	63.2	0.3057	0.0000	OK
60 minute summer	10	34	87.819	0.171	121.9	0.2444	0.0000	OK
60 minute summer	34	33	87.226	0.057	16.7	0.0822	0.0000	OK
60 minute summer	19	1	88.427	0.000	0.0	0.0000	0.0000	OK
60 minute summer	5	34	88.228	0.260	62.8	0.2943	0.0000	OK
60 minute summer	6	34	88.163	0.249	62.7	0.2818	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	33_OUT	Pond	38	123.7	0.082	0.007		
60 minute summer	13	2.000	14	30.7	1.064	0.770	0.8396	
60 minute summer	36	Orifice	37	7.5				
60 minute summer	37	Hydro-Brake®	37_OUT	2.9				47.9
60 minute summer	38	Orifice	39	6.2				
8640 minute summer	39	Hydro-Brake®	39_OUT	2.2				934.7
60 minute summer	4	1.002	5	62.8	0.957	0.884	0.7027	
60 minute summer	10	1.007	11	122.2	2.369	0.325	0.5158	
60 minute summer	34	7.000	35	16.7	1.258	0.144	0.2451	
60 minute summer	19	3.000	20	0.0	0.000	0.000	0.4271	
60 minute summer	5	1.003	6	62.7	0.984	0.879	0.8298	
60 minute summer	6	1.004	7	62.9	1.090	0.889	0.7721	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.52%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	8	33	88.037	0.281	113.2	0.4022	0.0000	OK
60 minute summer	7	33	88.069	0.283	73.3	0.4048	0.0000	OK
60 minute summer	1	33	89.072	0.110	35.6	0.1574	0.0000	OK
60 minute summer	2	33	88.316	0.252	58.9	0.3604	0.0000	OK
60 minute summer	20	33	88.012	0.155	21.0	0.1754	0.0000	OK
60 minute summer	35	33	86.373	0.104	60.1	0.1172	0.0000	OK
1440 minute winter	35_OUT	1380	85.848	0.802	8.4	0.0000	0.0000	OK
60 minute summer	14	34	86.208	0.452	51.4	0.1279	0.0000	SURCHARGED
60 minute summer	15	34	86.170	0.491	63.1	0.5552	0.0000	SURCHARGED
60 minute summer	16	34	86.101	0.651	79.6	0.7358	0.0000	SURCHARGED
60 minute summer	11	33	87.483	0.183	160.0	0.2615	0.0000	OK
60 minute summer	12	34	86.331	0.231	178.1	0.3311	0.0000	OK
60 minute summer	17	34	85.911	0.749	286.7	1.0723	0.0000	SURCHARGED
1440 minute winter	18_OUT	1410	85.849	0.803	22.1	0.0000	0.0000	OK
60 minute summer	21	33	87.995	0.186	39.1	0.2660	0.0000	OK
60 minute summer	22	33	88.857	0.110	32.5	0.1578	0.0000	OK
60 minute summer	23	33	86.290	0.129	110.4	0.1842	0.0000	OK
60 minute summer	24	33	86.178	0.069	28.8	0.0983	0.0000	OK
60 minute summer	25	33	84.699	0.083	28.8	0.0944	0.0000	OK
1440 minute winter	27	1410	84.651	0.510	3.0	0.7296	0.0000	SURCHARGED
1440 minute winter	28	1410	84.650	0.545	14.2	0.7801	0.0000	SURCHARGED
60 minute summer	29	33	89.160	0.114	44.6	0.1629	0.0000	OK
60 minute summer	30	33	88.720	0.120	48.0	0.1353	0.0000	OK
60 minute summer	32	33	88.178	0.104	70.6	0.1488	0.0000	OK
1440 minute winter	33	1410	84.650	0.762	20.0	1.3462	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	8	1.006	10	112.7	1.668	1.020	2.3455	
60 minute summer	7	1.005	8	73.7	0.831	0.657	0.8401	
60 minute summer	1	1.000	2	35.6	1.522	0.487	1.1042	
60 minute summer	2	1.001	4	58.4	0.934	0.816	0.7811	
60 minute summer	20	3.001	21	20.7	0.664	0.516	0.2584	
60 minute summer	35	7.001	35_OUT	60.1	1.827	0.438	0.5076	
60 minute summer	35_OUT	Pond	36	148.4	0.079	0.006		
60 minute summer	14	2.001	15	48.7	1.187	0.571	0.9164	
60 minute summer	15	2.002	16	63.0	1.121	0.452	1.0286	
60 minute summer	16	2.003	17	79.6	1.131	1.048	2.0627	
60 minute summer	11	1.008	12	159.9	2.719	0.467	2.5565	
60 minute summer	12	1.009	17	176.9	1.755	0.558	3.1400	
60 minute summer	17	1.010	18_OUT	286.1	1.806	1.789	2.7507	
60 minute summer	18_OUT	Pond	36	148.4	0.079	0.006		
60 minute summer	21	3.002	23	38.4	1.158	0.964	1.5350	
60 minute summer	22	4.000	23	32.5	1.740	0.445	0.4614	
60 minute summer	23	3.003	28	110.2	1.140	0.184	5.8760	
60 minute summer	24	5.000	25	28.8	2.057	0.117	0.4285	
60 minute summer	25	5.001	27	28.8	1.411	0.172	0.6149	
60 minute summer	27	5.002	28	38.0	0.288	0.236	2.2743	
60 minute summer	28	3.004	33	183.3	1.157	1.149	9.0828	
60 minute summer	29	6.000	30	44.6	1.760	0.284	0.5670	
60 minute summer	30	6.001	32	48.0	2.007	0.301	0.6121	
60 minute summer	32	6.002	33	70.6	3.354	0.242	0.7008	
60 minute summer	33	3.005	33_OUT	265.3	1.258	0.383	3.6351	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.52%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	33_OUT	2100	84.649	0.843	15.3	0.0000	0.0000	OK
60 minute summer	13	34	86.286	0.330	29.8	0.0933	0.0000	SURCHARGED
1440 minute winter	36	1410	85.844	0.844	18.1	851.7440	0.0000	SURCHARGED
1440 minute winter	37	1410	85.844	0.919	4.6	1.0389	0.0000	SURCHARGED
60 minute summer	37_OUT	1	84.750	0.000	2.9	0.0000	0.0000	OK
1440 minute winter	38	1410	84.646	0.886	14.6	672.3755	0.0000	SURCHARGED
60 minute summer	39_OUT	1	83.677	0.000	2.2	0.0000	0.0000	OK
1440 minute winter	39	1410	84.645	0.912	3.2	1.3055	0.0000	SURCHARGED
60 minute summer	4	33	88.261	0.249	58.4	0.2821	0.0000	OK
60 minute summer	10	34	87.810	0.162	112.7	0.2321	0.0000	OK
60 minute summer	34	33	87.224	0.055	15.4	0.0789	0.0000	OK
60 minute summer	19	1	88.427	0.000	0.0	0.0000	0.0000	OK
60 minute summer	5	34	88.209	0.241	58.1	0.2720	0.0000	OK
60 minute summer	6	34	88.145	0.231	57.9	0.2615	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	33_OUT	Pond	38	114.9	0.079	0.006		
60 minute summer	13	2.000	14	29.9	1.048	0.751	0.8396	
60 minute summer	36	Orifice	37	5.7				
60 minute summer	37	Hydro-Brake®	37_OUT	2.9				48.6
60 minute summer	38	Orifice	39	5.0				
600 minute winter	39	Hydro-Brake®	39_OUT	2.2				94.0
60 minute summer	4	1.002	5	58.1	0.946	0.818	0.6560	
60 minute summer	10	1.007	11	112.9	2.305	0.300	0.4884	
60 minute summer	34	7.000	35	15.4	1.232	0.133	0.2311	
60 minute summer	19	3.000	20	0.0	0.000	0.000	0.3775	
60 minute summer	5	1.003	6	57.9	0.976	0.813	0.7736	
60 minute summer	6	1.004	7	58.2	1.089	0.823	0.7143	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	8	34	88.204	0.448	159.1	0.6408	0.0000	SURCHARGED
60 minute summer	7	34	88.252	0.466	103.5	0.6670	0.0000	SURCHARGED
60 minute summer	1	34	89.112	0.150	51.7	0.2140	0.0000	OK
60 minute summer	2	34	88.666	0.602	84.7	0.8613	0.0000	SURCHARGED
60 minute summer	20	34	88.273	0.416	30.4	0.4701	0.0000	SURCHARGED
60 minute summer	35	33	86.398	0.129	87.2	0.1463	0.0000	OK
2160 minute winter	35_OUT	2100	86.202	1.156	11.2	0.0000	0.0000	OK
60 minute summer	14	34	87.163	1.407	71.1	0.3983	0.0000	SURCHARGED
60 minute summer	15	34	87.085	1.406	89.9	1.5907	0.0000	SURCHARGED
60 minute summer	16	34	86.944	1.494	113.4	1.6898	0.0000	SURCHARGED
60 minute summer	11	35	87.793	0.493	224.2	0.7062	0.0000	SURCHARGED
60 minute summer	12	35	87.204	1.104	241.8	1.5791	0.0000	SURCHARGED
60 minute summer	17	35	86.579	1.417	389.9	2.0273	0.0000	SURCHARGED
60 minute summer	18_OUT	35	86.250	1.204	389.7	0.0000	0.0000	OK
60 minute summer	21	34	88.233	0.424	55.0	0.6074	0.0000	SURCHARGED
60 minute summer	22	33	88.887	0.140	47.2	0.2007	0.0000	OK
60 minute summer	23	33	86.316	0.155	157.2	0.2213	0.0000	OK
60 minute summer	24	33	86.192	0.083	41.7	0.1185	0.0000	OK
60 minute summer	25	34	85.213	0.597	41.7	0.6753	0.0000	SURCHARGED
60 minute summer	27	34	85.188	1.047	52.4	1.4978	0.0000	SURCHARGED
60 minute summer	28	34	85.181	1.076	259.5	1.5397	0.0000	SURCHARGED
60 minute summer	29	33	89.188	0.142	64.6	0.2027	0.0000	OK
60 minute summer	30	33	88.749	0.149	69.5	0.1682	0.0000	OK
60 minute summer	32	33	88.202	0.128	102.2	0.1834	0.0000	OK
2160 minute winter	33	2100	84.962	1.074	21.5	1.8981	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	8	1.006	10	159.0	1.725	1.439	3.2436	
60 minute summer	7	1.005	8	103.4	0.938	0.922	1.0422	
60 minute summer	1	1.000	2	50.9	1.512	0.696	1.4186	
60 minute summer	2	1.001	4	81.7	1.161	1.142	0.8748	
60 minute summer	20	3.001	21	28.8	0.724	0.719	0.3198	
60 minute summer	35	7.001	35_OUT	87.2	2.452	0.635	0.5586	
60 minute summer	35_OUT	Pond	36	207.7	0.089	0.008		
60 minute summer	14	2.001	15	69.2	1.226	0.811	0.9164	
60 minute summer	15	2.002	16	89.3	1.268	0.641	1.0286	
60 minute summer	16	2.003	17	113.1	1.607	1.489	2.0627	
60 minute summer	11	1.008	12	216.0	2.730	0.631	4.5532	
60 minute summer	12	1.009	17	239.2	2.169	0.755	3.8130	
60 minute summer	17	1.010	18_OUT	389.7	2.460	2.437	2.7507	
60 minute summer	18_OUT	Pond	36	207.7	0.089	0.008		
60 minute summer	21	3.002	23	53.9	1.365	1.354	1.7606	
60 minute summer	22	4.000	23	47.2	1.891	0.646	0.6164	
60 minute summer	23	3.003	28	156.9	1.281	0.262	6.2006	
60 minute summer	24	5.000	25	41.7	2.187	0.169	1.3141	
60 minute summer	25	5.001	27	39.1	1.423	0.233	1.0073	
60 minute summer	27	5.002	28	53.4	0.337	0.332	2.2743	
60 minute summer	28	3.004	33	253.2	1.598	1.587	9.1232	
60 minute summer	29	6.000	30	64.6	1.913	0.411	0.7555	
60 minute summer	30	6.001	32	69.5	2.189	0.435	0.8125	
60 minute summer	32	6.002	33	102.2	3.688	0.350	0.9226	
60 minute summer	33	3.005	33_OUT	372.9	1.726	0.538	3.7328	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	33_OUT	2160	84.968	1.162	21.4	0.0000	0.0000	OK
60 minute summer	13	34	87.322	1.366	43.2	0.3867	0.0000	FLOOD RISK
2160 minute winter	36	2100	86.197	1.197	17.9	1329.4040	0.0000	SURCHARGED
2160 minute winter	37	2100	86.197	1.272	4.0	1.4382	0.0000	SURCHARGED
60 minute summer	37_OUT	1	84.750	0.000	2.9	0.0000	0.0000	OK
2160 minute winter	38	2100	84.959	1.199	13.8	1058.0910	0.0000	SURCHARGED
60 minute summer	39_OUT	1	83.677	0.000	2.2	0.0000	0.0000	OK
2160 minute winter	39	2100	84.959	1.226	3.0	1.7539	0.0000	SURCHARGED
60 minute summer	4	34	88.562	0.550	81.7	0.6217	0.0000	SURCHARGED
60 minute summer	10	35	87.889	0.241	159.0	0.3455	0.0000	OK
60 minute summer	34	33	87.236	0.067	22.4	0.0955	0.0000	OK
60 minute summer	19	1	88.427	0.000	0.0	0.0000	0.0000	OK
60 minute summer	5	34	88.467	0.499	81.7	0.5647	0.0000	SURCHARGED
60 minute summer	6	34	88.360	0.446	81.6	0.5039	0.0000	SURCHARGED

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	33_OUT	Pond	38	160.0	0.090	0.009		
60 minute summer	13	2.000	14	40.2	1.064	1.009	0.8396	
180 minute summer	36	Orifice	37	6.4				
2160 minute winter	37	Hydro-Brake®	37_OUT	3.1				388.5
120 minute summer	38	Orifice	39	6.4				
2160 minute winter	39	Hydro-Brake®	39_OUT	2.4				297.1
60 minute summer	4	1.002	5	81.7	1.160	1.149	0.7512	
60 minute summer	10	1.007	11	158.0	2.364	0.420	0.9172	
60 minute summer	34	7.000	35	22.4	1.350	0.193	0.3048	
60 minute summer	19	3.000	20	0.0	0.000	0.000	0.5143	
60 minute summer	5	1.003	6	81.6	1.159	1.145	0.9170	
60 minute summer	6	1.004	7	81.5	1.158	1.152	0.9117	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.600
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	550.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Basin C1	2.038	5.00	90.740	393720.188	188098.489	1.500	89.240
Basin C2	0.439		90.500	393644.519	188152.354	1.500	89.000

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Basin C1	Basin C2	63.851	0.600	89.240	89.000	0.240	266.0	800	5.60	47.1

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.781	895.1	347.0	0.700	0.700	2.038	0.0	345	1.673

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	63.851	266.0	800	ADOPTABLE	90.740	89.240	0.700	90.500	89.000	0.700

Link	US Node	Node Type	DS Node	Node Type
1.000	Basin C1	Junction	Basin C2	Junction

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Connections	Link	IL (m)	Dia (mm)
Basin C1	393720.188	188098.489	90.740	1.500	0 ↖			
					0	1.000	89.240	800
Basin C2	393644.519	188152.354	90.500	1.500	1 ↘	1.000	89.000	800

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	10080	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		

Storm Durations

60	180	360	600	960	2160	4320	7200	10080
120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
30	40	0	0
100	0	0	0
100	45	0	0

Node Basin C2 Offline Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Loop to Node		Sump Available	✓
Invert Level (m)	89.000	Product Number	CTL-SHE-0135-8900-1200-8900
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.9	Min Node Diameter (mm)	1200

Node Basin C1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	89.240	Product Number	CTL-SHE-0129-8000-1200-8000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.0	Min Node Diameter (mm)	1200

Node Basin C1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	89.240
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	2400

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1149.0	1149.0	1.500	3007.0	3021.9

Node Basin C2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	89.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	2700

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	242.0	242.0	1.500	923.0	933.9

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	Basin C1	675	89.561	0.321	43.1	432.2057	0.0000	OK
1440 minute summer	Basin C2	1080	89.302	0.302	14.2	93.7667	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	Basin C1	1.000	Basin C2	7.9	0.186	0.009	6.0174	
1440 minute summer	Basin C2	Hydro-Brake®		8.8				877.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	Basin C1	1140	89.871	0.631	61.8	970.8746	0.0000	OK
1440 minute summer	Basin C2	1440	89.602	0.602	20.8	227.8714	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	Basin C1	1.000	Basin C2	9.7	0.181	0.011	8.2654	
60 minute summer	Basin C2	Hydro-Brake®		8.9				700.1

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Basin C1	1380	90.117	0.877	58.1	1484.9380	0.0000	SURCHARGED
2880 minute summer	Basin C2	2880	89.899	0.899	18.4	400.7564	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	Basin C1	1.000	Basin C2	15.6	0.178	0.017	13.2564	
60 minute summer	Basin C2	Hydro-Brake®		8.9				982.4

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Basin C1	1380	90.053	0.813	53.7	1343.4750	0.0000	SURCHARGED
2160 minute summer	Basin C2	2220	89.831	0.831	19.5	358.0495	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	Basin C1	1.000	Basin C2	13.6	0.179	0.015	11.9282	
60 minute summer	Basin C2	Hydro-Brake®		8.9				906.1

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Basin C1	1410	90.387	1.147	77.9	2132.2900	0.0000	SURCHARGED
2880 minute winter	Basin C2	2820	90.097	1.097	17.2	538.3150	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	Basin C1	1.000	Basin C2	19.4	0.175	0.022	18.7766	
60 minute summer	Basin C2	Hydro-Brake®		8.9				1316.2

N/11/04126/OUT
Consented development

ISSUES

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NOTES:

- 1) The basins have been designed to drain 65% impermeable area of the total area of each catchment and 100% impermeable area from the basins.

KEY:

- Red Line Boundary
- Catchment A (Total Area:1.897ha)
- Catchment B (Total Area:1.651ha)
- Catchment C (Total Area:4.160ha)
- Part of Catchment C that naturally slopes towards the outfall of Catchment B (Total Area:2.920ha)
- Proposed Foul Rising Main
- Proposed Surface Water Sewer and Manhole
- Proposed Foul Sewer and Manhole
- Existing Foul Sewer and Manhole
- Exceedance Flow Routes
- Flow Control (Hydrobrake or similar)
- Proposed Headwall

Catchment A
Total Developable Area: 1.897ha

Foul from the dwellings of
Catchment A to connect to the
existing Wessex Water foul sewer
that crosses the site.A new
manhole chamber to be provided.

Attenuation Basin A
Approximate Volume = 1,224m³
Side Slopes = 1:3 & 1:4
Depth = 1.5m
Top of the Bank:85.50m
IL:85.00m

Hydrobrake to restrict flows and
offer 30% betterment on the Qbar
Flow discharge rate: 3.1l/s

Foul from the dwellings of
Catchment B to connect to the
existing Wessex Water foul sewer
that crosses the site.A new
manhole chamber to be provided.

Hydrobrake to restrict flows and
offer 30% betterment on the Qbar
Flow discharge rate: 2.4l/s

Attenuation Basin B
Approximate Volume = 1,063m³
Side Slopes = 1:3 & 1:4
Depth = 1.5m
Top of the Bank:85.25m
IL:83.75m

Catchment B
Total Developable
Area: 1.651ha

Gravity connection to Wessex Water
Foul Manhole chamber 9201,
subject to detailed design.

Conveyance Vegetated Swale

Hydrobrake to restrict flows and
offer 30% betterment on the Qbar
Flow discharge rate: 8.9l/s

Attenuation Basin C2(Western Basin)
Approximate Volume = 592m³
Side Slopes = 1:4
Depth = 1.5m
Top of the Bank:80.50m
IL:80.00m

Vegetated Swale
Gradient 1 in 300

Proposed Foul
Pumping Station

Flow Control 8.0l/s

Attenuation Basin C3(Eastern Basin)
Approximate Volume = 2,246m³
Side Slopes = 1:4
Depth = 1.5m
Top of the Bank:90.74m
IL:89.24m

Catchment C
Total Developable Area: 4.160ha
Catchment C is restricted to the natural catchment
area(2.920ha) that naturally slopes towards the outfall
of Catchment B

Easement for existing water mains

PA	02/20	Layout Updated	GR	SI
PA	02/20	Layout Updated	GR	SI
PA	02/20	Layout Updated	GR	SI
PA	02/20	Layout Updated	GR	SI



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DRAINAGE STRATEGY
LAYOUT

PRELIMINARY

Scale	1:500 @ A0	Date	DEC	Drawn	GR	Checked	LA
Project	HD009-008	Sheet	P4				

Rev Description

Date Au Ch

Project Land north of Whychurch Farm



Transport Planning | Flood & Water Management | Civil Engineering

Hungerford Office

3 Tealgate, Charnham Park,
Hungerford RG17 0YT

01488 684 390

Reading Office

6th Floor, Reading Bridge House,
George Street, Reading, RG1 8LS

0118 237 1736

www.ableyletchford.co.uk