ABLEY LETCHFORD PARTNERSHIP
Consulting Engineers

LAND AT WHITE HORSE BUSINESS PARK, NORTH BRADLEY, TROWBRIDGE

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

CASTLEWOOD PROPERTIES VENTURES LTD

20 APRIL 2020

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1.0 Introduction

Context

1.1. This report has been prepared by Abley Letchford Partnership Limited on behalf of Castlewood Properties Ventures Ltd in relation to the proposed development at the site.

1.2. The site is located circa 2.2km south of Trowbridge town centre and is accessed via a junction on the A363 Bradley Road.

1.3. This Flood Risk Assessment is to accompany the Outline planning application for up to 100 residential dwellings, and a 64 bed Care Home facility.

1.4. **Appendix 1** shows the location of the Site.

Requirement for a Flood Risk Assessment (FRA)

1.5. The requirement for a Flood Risk Assessment is set out in Section 14 of the revised National Planning Policy Framework (NPPF) published in February 2019.

1.6. The footnote accompanying Paragraph 154 (b) state:

> *"A site-specific flood risk assessment is required for proposals of 1 hectare of greater in Flood Zone 1; all purposes for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has been identified by the Environment Agency as having critical drainage problems; and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding."*

1.7. The site is a Greenfield site, extends greater than 1 hectare in total; therefore, a site-specific flood risk assessment is required.

Report Structure

1.8. This report addresses the requirements of revised NPPF and considers the following aspects:

- Section 2: Policy and Sources of Information – a review of policy relevant to the assessment and sources of information.
- Section 3: Baseline Environmental Conditions – a description of the site location, its topography and hydrology and the development proposals.
- Section 4: Flood Risk – the effect of flooding within the existing site layout from all sources.
- Section 5: Drainage Strategy – flood risk from the Site and appropriate mitigation measures to protect the site in the post development scenario including surface and foul water drainage strategies.
- Section 6: Summary and Conclusions – a review of the suitability of the development proposals in the context of site vulnerability and the requirements of the NPPF.

2.0 Policy and Sources of Information

Introduction

2.1. This chapter provides a review of policy relevant to the assessment and sources of information.

National Planning Policy

2.2. National Planning Policy in relation to Flood Risk is set out in Section 14 of the National Planning Policy Framework (NPPF) and Planning Practice Guidance ID:7 for Flood Risk and Coastal Change (PPG). Flood Risk is discussed in Paragraphs 155-165 of the NPPF.

2.3. Paragraphs 158-162 discuss the Sequential approach. Paragraph 101 refers to a Strategic Flood Risk Assessment that would form the basis of applying the Sequential Test for local authorities to allocate development, whilst Paragraph 160-162 relates to Exemption Tests.

2.4. Paragraph 163 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 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 resilient and resilient*
>
> *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."*

2.5. The development would be classed as Major development providing more than 10 homes and the site is greater than 0.5 hectares. Paragraph 165 states:

> *"Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be appropriate. The systems used should:*
>
> *a) take account of advice from the Lead Local Flood Authority;*
>
> *b) have appropriate proposed minimum operational standards*
>
> *c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
>
> *d) where possible, provide multifunctional benefits.."*

2.6. In addition, current guidance on development and flood risk is contained within CIRIA (2004) Funders Report CP/102 Development and Flood Risk – Guidance for the Construction Industry which identifies several key aims for the development to ensure it is sustainable in flood risk terms.

Environment Agency

2.7. The Flood and Water Management Act (2010) provides the Environment Agency 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 Environment Agency is a statutory consultee in relation to flood risk and planning dependent upon criteria.

2.8. Environment Agency Standing Advice has been consulted and reviewed within this Flood Risk Assessment.

Local Authorities

2.9. Planning guidance published by Wiltshire Council (WC) regarding flood risk were referred to, i.e. Wiltshire Local Plan, the Wiltshire Core Strategy (2015), Strategic Flood Risk Assessments published in 2009 and 2013 and Wiltshire Council's Betterment Policy (2019) following an update.

2.10. North Bradley falls in the Trowbridge Community Area covered by Core Policy 29 in the Wiltshire Core Strategy which states *"Development in the Trowbridge Community Area should be in accordance with the Settlement Strategy set out in Core Policy 1."*

2.11. Key outcomes from the Wiltshire Core Strategy include the following:

- The natural function of floodplains will have been maintained and enhanced and sequential approach to flood risk will have been followed, with development being located first in areas of lowest risk.
- The use of appropriate surface water management will have become a pre-requisite for development to ensure that flood risk is not increased elsewhere. Sustainable drainage systems (SuDS) will have been used in most cases.
- Proposals for new development will have reduced the overall risk of flooding through the appropriate implementation of climate change adaptation measures.

2.12. Core Policy 52: Green Infrastructure – As part of this policy functions include providing routes e.g. footpaths and cycleways which link areas of open space within settlements; providing sustainable drainage, flood storage and urban cooling.

2.13. Core Policy 67: Flood Risk – The Strategic Housing and Economic Land Availability Assessment (SHELAA) demonstrate that there is sufficient land available in Flood Zone 1, the zone of least risk, to meet the proposed housing requirement. The strategy therefore favours housing development in Flood Zone 1 over areas of higher risk as identified by the Strategic Flood Risk Assessment.

2.14. The Core Strategy supports a sustainable approach to surface water drainage, and development will be expected to incorporate Sustainable Drainage Systems (SuDS) via the use of rainwater harvesting, permeable paving, basins, wetlands and swales, wherever possible.

2.15. The provision of green infrastructure, including woodland, should also be considered as a measure to reduce surface water run-off. Prospective developers will be expected to follow the 'surface water management train' approach recommended by the Environment Agency.

2.16. This involves a three-step process, considering first reducing the quantity of run-off, then slowing velocity of run-off to allow settlement filtering and infiltration, and finally providing passive treatment to collected surface water before discharge into the groundwater to a watercourse. It is considered that all developments will be able to incorporate measures to reduce the quantity of run-off, but site-specific geological or soil conditions may mean that measures to reduce run-off velocity and provide passive treatment would not be appropriate. Where this is the case, proposals will be expected to demonstrate why the use of such measures is not appropriate on the site in question.

2.17. The Core Strategy also states that where for all new development Sustainable Drainage Systems (SuDS) are implemented, where appropriate considering current policy and good practice guidance and emerging SuDS standards. Where appropriate, SuDS should be used to help cope with intense rainfall events.

2.18. The Strategic Flood Risk Assessments (SFRA) published in June 2009 and July 2013 provided an overview of flood risk throughout the County, providing the framework within which future development planning applications are to be reviewed. The site does not fall within a Critical Drainage Area.

2.19. Proposed surface water discharges and volume controls will need to accord with WC's updated Betterment Policy published in October 2019. This policy covers the control of surface water discharges from new development requires post development discharges to provide at least 20% betterment over pre development discharges for both peak flow and volume. This aligns with national policy, as outlined in the SuDS Technical Standards, which requires the following peak flow and volume control:

Peak flow control

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer, or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

Volume control

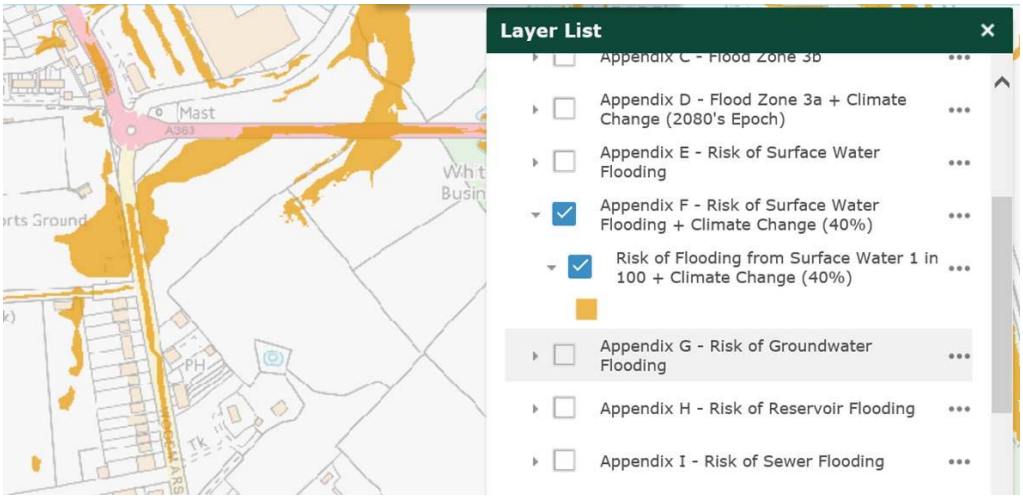
S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer, or surface water body for the 1 in 1 year rainfall event and the 1 in 100, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

2.20. As Lead Local Flood Authority, Wiltshire Council's advice was sought. WC provided the following response which is contained in **Appendix 2**:

- Development constitutes Major Development. Paragraph 165 of the NPPF applies.
- The applicant would need to evidence application of the surface water disposal hierarchy - 1st Re-use, 2nd Infiltration, 3rd watercourse/surface water body, 4th surface water sewer, 5th combined sewer.
- The drainage strategy should take account of climate change in accordance with EA guidance and urban creep.
- With regards the control of surface water discharges from greenfield sites, Wiltshire Council requires post development discharges to provide 20% betterment over pre development discharges for both peak flow and volume. For more information refer to Wiltshire Council's betterment policy.
- Wiltshire Council is the land drainage authority under the Land Drainage Act 1991. Land drainage consent is required if a development proposes to discharge flow into an ordinary watercourse or carry out work within 8m of an ordinary watercourse. An ordinary watercourse is a watercourse that does not form part of a main river. The term watercourse includes all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows.
- According to our L1 SFRA mapping the site is at risk of surface water flooding in the 100 year plus climate change scenario (see screen shot below). The current layout shows the ponds located where surface water flooding is predicted to occur. The site-specific FRA and drainage strategy should demonstrate that the ponds have sufficient capacity to accommodate the existing flooding and proposed runoff.



- The site layout should be developed following a sequential approach i.e. putting the most vulnerable development in the lowest flood risk areas.

Wessex Water

2.21. Information with regards to sewer and water main flooding contained within the SFRA has been consulted as part of this FRA. All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system and is shown on the DG5 Flood Register.

2.22. WW were contacted for development enquiry. Their response dated 14th November 2019 provided sewer records and approximate locations of WW apparatus within the vicinity of the site. In January 2020 WW was provided with the site drainage strategy for comment. Their response is provided in February 2020. See Wessex Water Responses contained within **Appendix 2**.

Foul Drainage

2.23. Wessex Water (WW) can accept foul flows from the development and there are 150mm public foul sewers located to the north east in the A363 Bradley Road and to the west in Woodmarsh. Developers may connect to the nearest public sewer on a size for size basis and WW fund any necessary capacity improvements from infrastructure charges income.

2.24. Upon granting of planning WW will need to undertake further review of the foul sewer networks as cumulative development in the catchment may exceed capacity in local systems. WW is aware of allocated residential sites to the south of this site. WW welcomes the opportunity to agree an overall drainage strategy for this area (See Strategic Planning Note below).

2.25. On review of the Drainage Strategy in February 2020, WW were content with the strategy to discharge foul flows north-east to manhole ST85558805.

Surface Water Drainage

2.26. Surface water is to be disposed of in accordance with the SuDS Hierarchy and NPPF Guidelines and should be directed to local land drainage systems.

2.27. Surface water arrangements and supporting flood risk measures to be agreed with the Lead Local Flood Authority – Wiltshire Council. There must be no surface water connections to the public foul sewer system. Land drainage run-off shall not be permitted to discharge either directly or indirectly into the public sewerage system.

2.28. On review of the Drainage Strategy in February 2020, the strategy to discharge to local watercourse at a restricted rate via attenuation basins is acceptable to WW.

Strategic Planning

2.29. Through the planning process WW will seek to promote a co-ordinated scheme of works that will deliver a strategic solution for the wider planning allocation, providing water and sewerage capacity for all allocated sites. A network capacity appraisal will be required to confirm the scope of any improvements necessary to accommodate additional loadings from multiple development applications and if WW is unable to provide this capacity in the short term WW advise agreement will need to be reached with developers and the Local Planning Authority upon the timetable for a scheme of works to meet future catchment growth, upon any grant of planning permission. WW welcome the opportunity to further discuss proposals and programme through the planning and development process so WW may review and plan any networks upgrades as necessary.

2.30. In February 2020, WW comment that they are aware of allocated development on the adjoining site to the south. WW may seek a degree of flexibility to accommodate foul flows from the adjacent site. If there is a viable option where the proposed on-site pumping station serves both sites. Under Section 112 of the Water Industry Act WW can seek to amend designs to achieve a more sustainable solution particularly if this can avoid two separate pumping stations on adjacent sites.

2.31. Changes may include increasing storage at the on-site pumping station and provided a length of foul sewer to link sites. The extra over expenses reasonably incurred in complying with an undertaker's Section 112 requirements would be repayable to the Developer.

2.32. There is scope to incorporate these changes into the Drainage Strategy if required.

Other Sources of Information

2.33. A desktop study of the Site was carried out using the Environment Agency, and the GOV.UK websites to ascertain local features, hydrology and soil characteristics.

2.34. Flood mapping and site characteristics, as published on the Environment Agency's (EA) and the GOV.uk websites, have been used as information sources. Guidance set out within the revised NPPF, the SFRA and EA Guidance has also been used as the base for this site-specific FRA.

3.0 Baseline Environmental Conditions

Introduction

3.1. This chapter provides a description of the site location, its topography and hydrology along with the development proposals.

Site Location

3.2. The site is a collection of open agricultural fields used primarily for grazing, with established hedge and tree lined boundaries.

3.3. The site area is approximately 8.37 hectares (ha).

3.4. The site lies approximately 2.2km to the south of Trowbridge, with Woodmarsh to the west and A363 Bradley Road to the north.

3.5. The site lies within the administrative area of Wiltshire Council (WC)

3.6. The site is located immediately south of Wiltshire Housing Site Allocation Site H2.1 Elm Grove Farm on the opposite side of the A363 Bradley Road.

3.7. The grid reference for the site is ST856558. The nearest postcode is BA14 0RQ.

Development Proposals

3.8. The presented development proposals comprise a change from agricultural use to up to 100 residential dwellings and a care home facility of up to 64 beds together with associated surface water attenuation features, landscaping, footways and infrastructure which includes a foul water pumping station.

3.9. The Illustrative Masterplan and Parameter Plan are included within **Appendix 1.** These show the layout and location of the proposed development.

3.10. The site is accessed via a proposed junction onto A363 Bradley Road and separate link road from a proposed development to the south. A drawing depicting the proposed site access off A363 Bradley Road is included within **Appendix 1.**

Existing Site Drainage

3.11. A site walkover identified an open field ditch within the site itself along the central hedge line and headwall for a culverted crossing beneath the A363 Bradley Road. Additional field ditches are present along the southern and eastern boundaries. The nearest open watercourse is approximately 0.2km north east beyond Drynham Lane, which is unnamed.

3.12. The unnamed watercourse progresses north eastwards, skirting around Lower Studley and Longfield, before eventually joining the River Biss.

3.13. There are no on-site surface water manholes except for inspection chambers associated with the Wessex Water water main crossing the site.

Topography

3.14. The topography of the site generally falls in a north-easterly direction towards A363 Bradley Road. The approximate site gradients towards A363 Bradley Road range between 1:35 and 1:60.

3.15. The topographical survey indicates that the low point of the site is in the north eastern corner of the site at 41.5m. The high point of the site can be located in the south western corner at 49.99m.

Geology and Hydrogeology

3.16. The British Geolgoical Survey record plans for the area indicates the site is located above the Oxford Clay Formation – Mudstone. A nearby trial identifies stiff dark grey silty Oxford Clay/weak mudstone at a depth of 6m. Groundwater was hit at 1.5m onwards.

3.17. The Cranfield University Soilscape maps indicate the site overlies slowly permeable loamy and clayey soils.

3.18. The site is underlain by Unproductive strata, i.e. rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

3.19. Environment Agency (EA) records show the site lies outside of any Groundwater Source Protection Zone, Principal aquifer designation or Groundwater Vulnerability Area.

3.20. Infiltration testing has not been undertaken at the time of writing. However, given the recorded geology of the site and flooding from pluvial sources (discussed later in the report), the use of infiltration type drainage within the site would appear to be unviable. A Phase 1 and Phase 2 Ground Investigation would confirm this position.

4.0 Flood Risk

Introduction

4.1. This chapter examines the effect of flooding within the existing site layout from all sources, including fluvial, pluvial and external sources.

Flood Risk to the Site from Fluvial Flooding Sources

4.2. According to the Flood maps for Planning– GOV.UK website, the existing site is located entirely within Flood Zone 1. This zone comprises land where flooding from rivers and the sea (fluvial) is very unlikely. There is less than a 0.1% (1 in 1000) chance of flooding occurring each year. See Appendix 1

4.3. The nearest watercourse designated as Main River by the EA is the River Biss which routes approximately 855m south east of the of the site.

Flood Risk to the Site from Pluvial Flooding Sources

4.4. In addition, the Long Term Flood Risk Maps – GOV.UK website identifies where land is subject to onsite surface water flood risk (pluvial) as depicted in Figure 1. These locations appear to coincide with an on-site open ditch and topographical low points within the site itself.

- Dark blue indicates high risk that each year has a chance of flooding of greater than 3.3%.
- Medium blue indicates medium risk that each year has a chance of flooding 1% and 3.3%.
- Light blue indicates low risk that each year this area has a chance of flooding between 0.1% and 1%.
- Areas not covered indicate a chance of flooding of less than 0.1%.

4.5. The overland flow (pluvial flooding) appears to occur when the existing road gullies on Woodmarsh are inundated in events of sustained rainfall events that there is no place for the water to go but across the site.

4.6. The same scenario occurs on the A363 Bradley Road and the pluvial flooding appears to combine to form one extent of overland flow, the majority of which follows the route of the existing surface water conveyance route. All other areas appear to be generated by the site's own catchment.

4.7. Proposed buildings and users will be located away from the existing extent of pluvial flooding, ground reprofiling will be undertaken to mitigate the risk.

4.8. In addition, the remaining greenfield areas will be managed with grass and vegetation providing a surface treatment more conducive to reductions in overland flow.

4.9. Not only will these measures assist in management of surface water on site, but also contribute to a reduction in flood risk downstream of the site, as the discharge rate from site is controlled, restricted and attenuated on site. However, cognisance will be taken to ensure downstream receptors are suitably recharged.

Figure 1 – EA Mapping for Pluvial Flooding

Flood Risk to the Site from Other Sources

4.10. The SFRA, EA and GOV.UK websites and local available documents indicate the site does not fall within the extent of flooding from reservoirs, canals or other artificial sources.

4.11. In Wessex Water's Development Enquiry there was no reference to any flood risk issues as a result of sewer flooding.

4.12. All proposed surface and foul water drainage systems will be designed to accommodate flows to modern standards and thus present negligible risk of flooding. In the unlikely event of a failure following a heavy rainfall event, flood depths would typically be restricted to very shallow depths. This would usually be contained within carriageways directing any flood water away from buildings and people.

4.13. Wiltshire Council's SFRA states that due to the nature of the underlying geology groundwater is not deemed to be a significant cause of flooding in the West Wiltshire District which Trowbridge falls within.

Sequential Test

4.14. The revised NPPF (2019) states the aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available site appropriate for the proposed development in areas with a lower risk of flooding. The Strategic Flood Risk Assessment will provide a basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

4.15. If it is not possible for development to be in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance.

4.16. The proposed development comprises a residential care home and residential dwellings. Therefore, this development has been assigned a Flood Risk Vulnerability Classification - More Vulnerable in accordance with Table 2 and 3 of PPG ID: 7.

4.17. The pre-development flood characteristics of the site has been assessed and the proposed 'More Vulnerable' development i.e. housing, is currently located within Fluvial Flood Zone 1.

Flood Risk Vulnerability classification (see Table 1 PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Table 1 – Flood Risk Vulnerability Classification

4.18. It is therefore considered that within the context of the site-specific FRA, the site passes the Sequential Test.

5.0 Drainage Strategy

Introduction

5.1. This chapter provides details on the surface water drainage strategy and measures to drain the proposed development site.

Methodology

5.2. The proposed drainage strategy has been designed to achieve the requirements of the revised NPPF this site-specific FRA will demonstrate the following 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;

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.

Management Strategy

5.3. 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.

5.4. A surface water management strategy for the development will be required to manage and reduce the flood risk posed by the surface water runoff from the site.

5.5. There are three possible options to discharge the surface water runoff in accordance with requirement H3 of the Building Regulations 2010. Rainwater shall discharge to one of the following, listed in order of priority:

- An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable
- A watercourse; or where that is not reasonably practicable
- A sewer.

5.6. 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.

5.7. From desktop study information, it is unlikely that infiltration is practicable. Therefore the surface water drainage will be designed to attenuate runoff with controlled discharge to the local watercourses i.e. the existing open field ditch on site which would be feasible point of discharge. Implementation of SuDS will ensure that flood risk downstream is not increased because of the proposed development.

5.8. Wiltshire Council has permissive rights over any ordinary watercourses/land drainage ditches. If any work is required within the watercourse then approval from WC is required.

5.9. Details of any crossings and proposed culverts will require the approval of the Land Drainage Authority as appropriate.

5.10. Timber bridges are deemed to be appropriate for footway/cycleway crossings of watercourses with oversized box culverts appropriate for road crossings, providing that it can be demonstrated that other alternatives which retain the open watercourse are not possible, thereby justifying that culverting is the only viable option.

Sustainable Drainage Systems (SuDS)

5.11. Sustainable water management measures should be used 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.

5.12. The Construction Industry Research and Information Association, CIRIA's C690

- 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.

5.13. In 2015 CIRIA published the SuDS Manual (C753) providing the best practice guidance on the planning, design, construction, operation and maintenance of SuDS.

5.14. 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 an 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.

5.15. Given that infiltration type SuDS devices are not considered feasible, the following SuDS components are applicable to the site include:

- Pervious surfacing systems – structural surfaces that allow water to penetrate into a granular layer thus providing storage and treatment, e.g. pervious paving.
- 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. 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.

Greenfield Run Off Rates

5.16. In line with national guidance, all surface water runoff from the site will be limited to annual runoff QBAR for all events up to the annual probability 1 in 100 year storm event plus 40% allowance for climate change. This provides considerable benefit in overall run-off rates both in the short and long term with an allowance for climate change.

5.17. The development site is approximately 8.37ha Greenfield site, of which 3.38ha is developed with the remainder of the site as open space, gardens and other soft landscaped areas.

5.18. The developable area has been split into 3 catchments and served by 3 proposed drainage networks.

Catchment	Developable Area (ha)	Assumed Impermeable Area (ha)	Percentage covered in Impermeable Surfaces (P_{imp})
1	0.41	0.37	90%
2	1.21	0.79	65%
3	1.63	1.06	65%
Total	**3.25**	**2.22**	

Table 2 – Catchment Areas

5.19. It is assumed that majority of rainfall currently occurs as overland flow at source routed towards the ditches on the field boundaries within the site. Some water will infiltrate into the underlying soil.

5.20. An assessment of existing surface water runoff has been undertaken, in order to determine the potential surface water options and attenuation requirements for the site.

5.21. To quantify any potential increase in surface water runoff, the existing Greenfield runoff rate from the site must initially be determined.

5.22. The following parameters have been incorporated into the runoff calculations:

- Development Catchment Area: 3.25ha
- Average Annual Rainfall (SAAR): 780mm

- Soil: 0.450
- Region No.: 8

5.23. Greenfield run-off calculations for the existing site provide the following discharge rates:

Network	1:1 Storm Event (l/s)	QBar Storm Event (l/s)	1:30 Storm Event (l/s)	1:100 Storm Event (l/s)	Greenfield Runoff Volume (m^3)
1	1.6	2.1	3.9	5.0	129.7
2	4.7	6.0	11.5	14.6	382.7
3	7.7	8.1	18.7	23.8	515.5
Development Total	12.6	16.2	30.9	39.2	

Table 3 – Greenfield Runoff Rates & Volume

Surface Water Treatment Improvements

5.24. 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 land usage and gives guidelines for appropriate treatment stages.

5.25. 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.

5.26. 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.

5.27. Historically, PPG3 documentation would recommendation that pollutants were removed utilising oil separators, but since it has been superseded, more recent guidance has shifted to the use of SuDS features to remove pollutants; thereby providing significant improvements in treatment. The use of non-mechanical features also reduces the requirements for maintenance and increase natural biodiversity.

5.28. 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 slow down and degrade these pollutants which is critical to the provision of an acceptable drainage scheme.

5.29. The final drainage solution will therefore provide a comprehensive treatment train under all events, thus providing a realistic strategy which mimics the cleansing effectiveness as the concentration of the pollutant decreases along the SuDS Management Train.

Surface Water Drainage Strategy

5.30. Based on the proposed site layout for the developed site, it has been conservatively estimated the impermeable areas for the care home facility and associated hardstanding areas in Catchment 1 will be 90% of the developable area.

5.31. For Catchments 2 and 3 impermeable areas for residential housing and associated hardstanding areas in Catchments 2 and 3 will be approximately 65% P_{imp} of the developable area.

5.32. The conservative estimates of 90% and 65% P_{imp} make allowances for urban creep allowance of 10% in accordance with The SuDS Manual (CIRIA 753) and assist with WC's Betterment Policy.

5.33. A surface water management strategy for the proposed development has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. The drainage system for the proposed development will manage and reduce the flood risk posed by the surface water runoff from the site.

5.34. To achieve the above, proposed discharge rates could be restricted to Greenfield discharge rates for all storms up to and including the 1 in 100 year storm event plus a 40% allowance for climate change. This will require on-site attenuation to hold back flows controlled by an on-site flow control device, such as a Hydrobrake manhole.

5.35. In addition to the on-site attenuation, Long Term Storage would also be required with the extra discharge volume generated by the proposed development, over and above the existing discharge volume, discharged at a low rate, such as 2.0l/s/ha. This would normally be controlled by a secondary attenuation area.

5.36. Alternatively, all discharge flows could be restricted to QBAR for all storm events up to and including the 1 in 100 year storm event plus 40% allowance for climate change. This would negate the requirement for Long Term Storage and again flows would be attenuated on site and discharged utilising an on-site flow control device such as a Hydrobrake. This normally requires a greater volume of attenuation.

5.37. For the purposes of this report and to provide a robust analysis, all attenuation requirements have been calculated utilising all discharge flows restricted to QBAR as set out above in paragraph 5.23, as this is normally the worst-case scenario. However, either method described above is viable and will be investigated further during detailed design.

5.38. An assessment of the existing flow routes and development clusters have been used to define surface water sub-catchments. These will form discrete drainage areas, each with their own drainage characteristics with the runoff from them then conveyed downstream to the drainage outfall. These will be named as Network 1, 2 and 3.

5.39. There are three attenuation basin features 1, 2 and 3, each dealing with their own catchment, shown in the Drainage Strategy that could accommodate the required storage volume calculated.

5.40. The Drainage Strategy and Microdrainage Simulation Report in **Appendix 4** demonstrates that surface water from the proposed development can be managed such that flood risk to and from the site following development is not increased in accordance with WC's Betterment Policy for both discharge rate and discharge volume.

5.41. A summary of the attenuation volumes is set out in Table 4:

Catchment	Calculated Attenuation Volume (m^3)	Provided Attenuation Volume (m^3)
1	129.7	240
2	382.7	500
3	515.5	700

Table 4 – Attenuation Volume Requirements

5.42. There is scope to utilise source control techniques and further refinements of the design which will assist with the reduction of the attenuation storage, which could be investigated at detailed design stage.

5.43. As groundwater was encountered at 1.5m deep, the bases of each basin do not exceed this level. However, site-specific ground water monitoring is recommended in order to confirm the drainage strategy. The attenuation basins are proposed to be lined with an impermeable geotextile membrane.

5.44. Surface water run-off from the development site to the existing watercourse is to be restricted to the Greenfield QBAR runoff rate. Discharge from the development features will be managed using flow controls within manholes or headwalls.

5.45. It is proposed to provide a network of trapped gullies, pipes and Sustainable Drainage (SuDS) features to collect the surface water runoff from hardstanding areas such as roads, roofs and driveways. The traditional system will work in combination with such features as pervious paving, swales and basins to provide attenuation storage and high-quality water benefits.

5.46. Sustainable water management measures will be introduced to control the surface water runoff from the proposed development site thereby, managing the flood risk to the site and surrounding areas from the surface water run-off.

Maintenance and Adoption

5.47. SuDS serving single properties, for example, pervious paved driveways to single dwellings, will be owned and maintained by the owner of that property.

5.48. SuDS within the public open space will be offered to Wiltshire Council for maintenance and adoption. Wiltshire Council is the lead drainage authority.

5.49. Any SuDS not adopted by Wiltshire Council will be maintained by a private management that will be appointed to maintain other private assets such as landscaping.

5.50. Suitable adoption and maintenance regimes for SuDS should be submitted in support of the reserved matters application.

Flood Flow Conveyance and Site Finished Floor Levels

5.51. The Illustrative Masterplan for the proposed development site provides space in the northern portion of the site for surface water attenuation basins prior to restricted discharge into the unnamed ordinary watercourse adjacent to A363 Bradley Road.

5.52. The surface water mapping shows pluvial flooding (overland) attributed to the unnamed ordinary water courses crossing the site. It is assumed in heavy rainfall events it accumulates in the northern portion of the site before it flows into the culverted section beneath A363 Bradley Road.

5.53. A wider hydraulic assessment of the watercourse that bisects the site is recommended. The conclusions of the assessment will inform how the development will affect which areas will flood in the post development scenario. The hydraulic assessment will inform on the existing flood levels where any ditch crossings/dwellings are proposed. The minimum finished floor level (FFL) would be based upon the existing flood level plus a 300mm additional allowance for freeboard.

5.54. It is envisaged that the post development scenario will reduce extent of pluvial flooding shown earlier in the report.

Safe Access and Egress

5.55. The main access road to the development is via the A363 Bradley Road to the north. A future southern link for proposed development to the south east of the development site.

5.56. Safe access and egress is to be designed to meet requirements in accordance with WC's SFRA: The development should be safe throughout its life, to achieve this dry pedestrian egress should be possible above the 1 in 100 year fluvial flood level and emergency vehicular access should be possible during times of extreme flood (an extreme flood event is an event with an annual probability of between 1% (1 in 100 year) and 0.1% (1 in 1000 year)). The site access and access road will be designed at 300mm above the 1 in 100 year fluvial flood level. Therefore, dry pedestrian egress can be afforded off A363 Bradley Road.

5.57. There is no requirement to provide safe access and egress to public open space.

Foul Water Drainage Strategy

5.58. It is intended that the foul water from the development will ultimately discharge to the existing Wessex Water 150mm diameter foul water sewer in A363 Bradley Road to the north of the site.

5.59. This will be achieved via a pumped system within the proposed development that will discharge into proposed manhole on A363 Bradley Road. From this manhole, a connection into the existing Wessex Water foul water network can be made.

5.60. Upon granting of planning Wessex Water will need to undertake further review of the foul sewer networks as cumulative development in the catchment may exceed capacity in local systems. If this is the case, Thames Water will be required to make appropriate upgrade and off-site reinforcement to serve the site. Wessex Water will need to undertake modelling work and, if required, design a solution and build the necessary improvements which will be completed at Wessex Water's cost.

5.61. The proposed foul water sewers will be designed in collaboration with Wessex Water as approving body in accordance with Sewers for Adoption 7th edition.

5.62. It is proposed to offer the proposed sewers to Wessex Water for adoption under S104 Agreement of the Water Industry Act.

5.63. Connections to existing adopted sewers will be made via a S106 Agreement with Wessex Water as part of the adoption process.

6.0 Summary and Conclusions

Introduction

6.1. This chapter summarises the previous chapters and assesses the suitability of the development proposals in the context of on and off-site vulnerability.

Summary

6.2. This report presents a Flood Risk Assessment, in accordance with the revised NPPF and PPG, in respect of the proposed development to change from its existing agricultural use to up to 100 residential dwellings and a Care Home facility comprising 64 beds on land south of Trowbridge in Wiltshire.

6.3. This report details the flood risk at the site and how this could be managed and mitigated to allow the site to be developed in support of the planning application.

Assessment of Flood Risk

6.4. The FRA has demonstrated the following:

- There are Ordinary Watercourses in the form of unnamed field ditches within the site which will not present a residual risk of flooding to the site greater than that of the existing. This will need to be confirmed by a hydraulic assessment.
- The detailed Fluvial flood map, for fluvial sources, provided by the Flood maps for Planning–GOV.UK website indicate that the site area is entirely located with Flood Zone 1; assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1%).
- Whilst the detailed flood map provided by the Long Term Flood Risk Maps – GOV.UK website indicates northern portion of the site is affected by pluvial flooding, any future risk of pluvial flooding will be mitigated by the drainage and flood attenuation features provided to the north of the development.
- Wiltshire Council's SFRA did not deem groundwater flooding to be a significant issue, it is recommended that site-specific groundwater monitoring is undertaken to inform the design of the surface water attenuation basin features.
- The detailed flood map provided by the Long Term Flood Risk Maps – GOV.UK website indicates no risk from secondary flooding sources, such as reservoirs, within the site.
- In PPG ID: 7, the appropriate uses have been identified for the Flood Zones. The proposed development is classified as 'more vulnerable'. All development types of this classification are deemed acceptable in terms of flood risk.
- The proposed development site passes the Sequential Test and the Exception Test is not required.

Site Drainage

6.5. The FRA has considered the potential impact of the development on surface water runoff rates. The surface water management strategy for the proposed development will manage and the flood risk posed by the surface water runoff from the site.

6.6. The proposed areas of hardstanding surfaces will be directed to the existing watercourses following the existing topography of the site. Attenuation will be provided with a limited discharge rate thereby mimicking the existing drainage situation as closely as practicable.

Conclusions

6.7. It is concluded that this Flood Risk Assessment demonstrates that the development satisfied the revised NPPF (February 2019) and can be justified in the proposed location. Any increase in surface water run-off can be managed using SuDS techniques like pervious paving used widely to provide source control as well as attenuation features proposed to provide storage in extreme storm events.

6.8. The above provides the minimum of two treatment stages which is in accordance with the recommendations of CIRIA C753.

6.9. All surface water drainage systems will be designed to restrict discharge rates to greenfield QBAR runoff rate and store the balance of water for all events up to and including the 1 in 100 year event including allowance for a 40% increase in rainfall intensities as a result of climate change.

6.10. This site-specific Flood Risk Assessment has

- produced an assessment that meets the criteria set out in NPPF;
- assessed the risk posed to the site from flood events;
- assessed the risk posed to the site from the site storm water generation and the site storm water runoff management; and
- assessed the risk the site poses to increase in flooding elsewhere
- included an allowance for urban creep as set in CIRIA guidance; and
- accorded with WC's Betterment policy.

Appendices

Appendix 1 - Plans

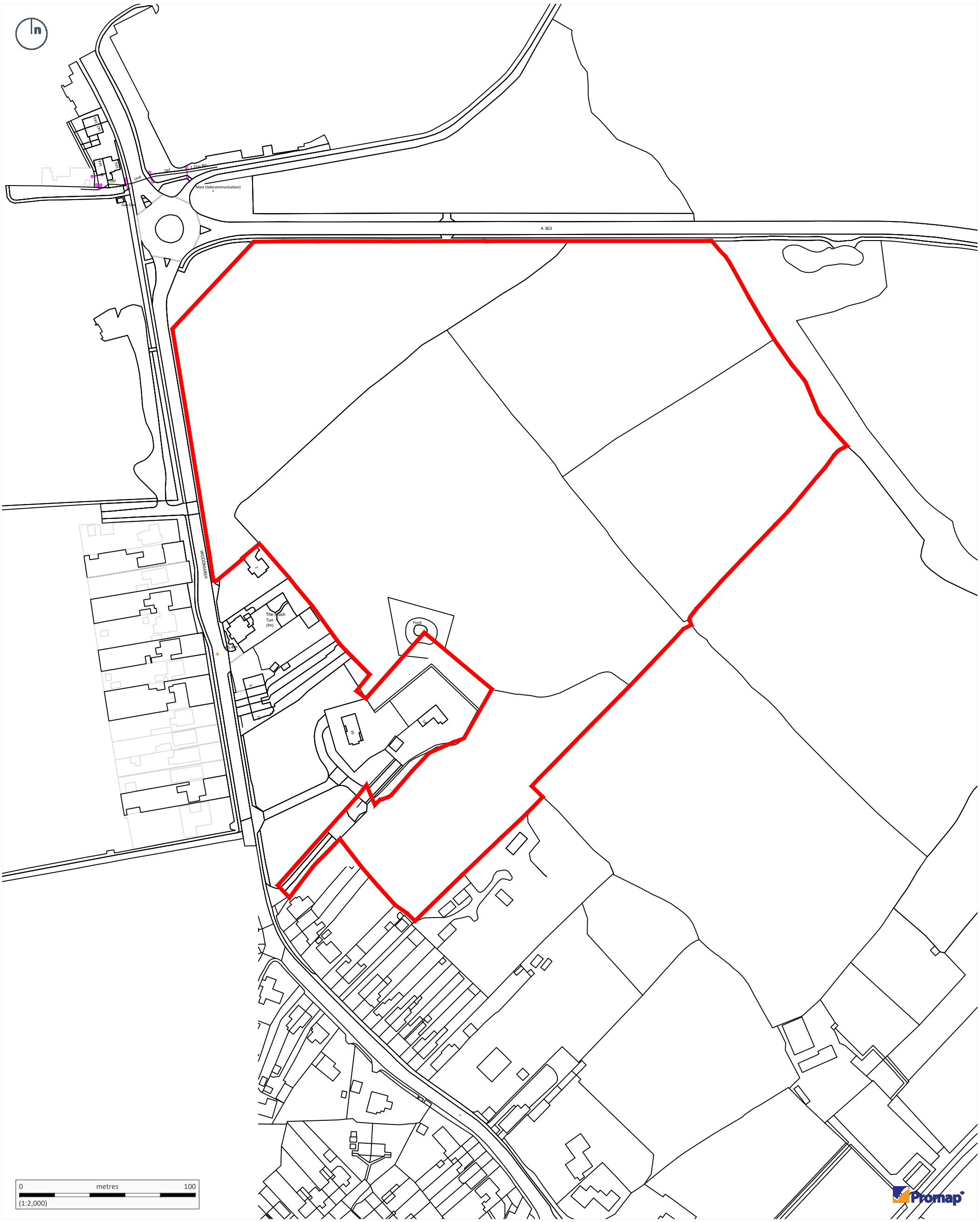
Site Location Plan

Illustrative Masterplan

Parameter Plan

Proposed Site Access

Flood Map for Planning – GOV.UK



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Land under Castlewood Ventures Properties Ltd control = 8.37ha / 20.68ac

DRAWING NUMBER: 1001	CHECKED BY: NH
PROJECT: Land south of the A363	REVISION: -
	STATUS: Draft
DRAWING: Redline Plan	DATE: February 2019
	SCALE: 1:2000 @ A3
PROJECT NUMBER: CASR3002	

Turley

0 metres 50
(1:1,250)

Key Site Plan

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Proposed Foul Water Pumping Station

CLIENT	Castlewood Property Ventures Ltd
PROJECT	Land at North Bradley
DRAWING:	Illustrative Sketch Layout water main retained and Care Home

PROJECT NO. CASR3002	STATUS Draft	
DRAWING NO. 4001.01	SCALE 1:1250 @ A3	
REVISION E	DATE February 2020	CHECKED BY JB/NH

Turley

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- Site boundary
- Residential land (Up to 2.5 storey)
- Residential land (Up to 3 storey)
- Green infrastructure
- Highways
- Indicative attenuation features
- Indicative primary highways route
- Proposed access points
- Future access points to adjacent development

CLIENT
Castlewood Properties Limited

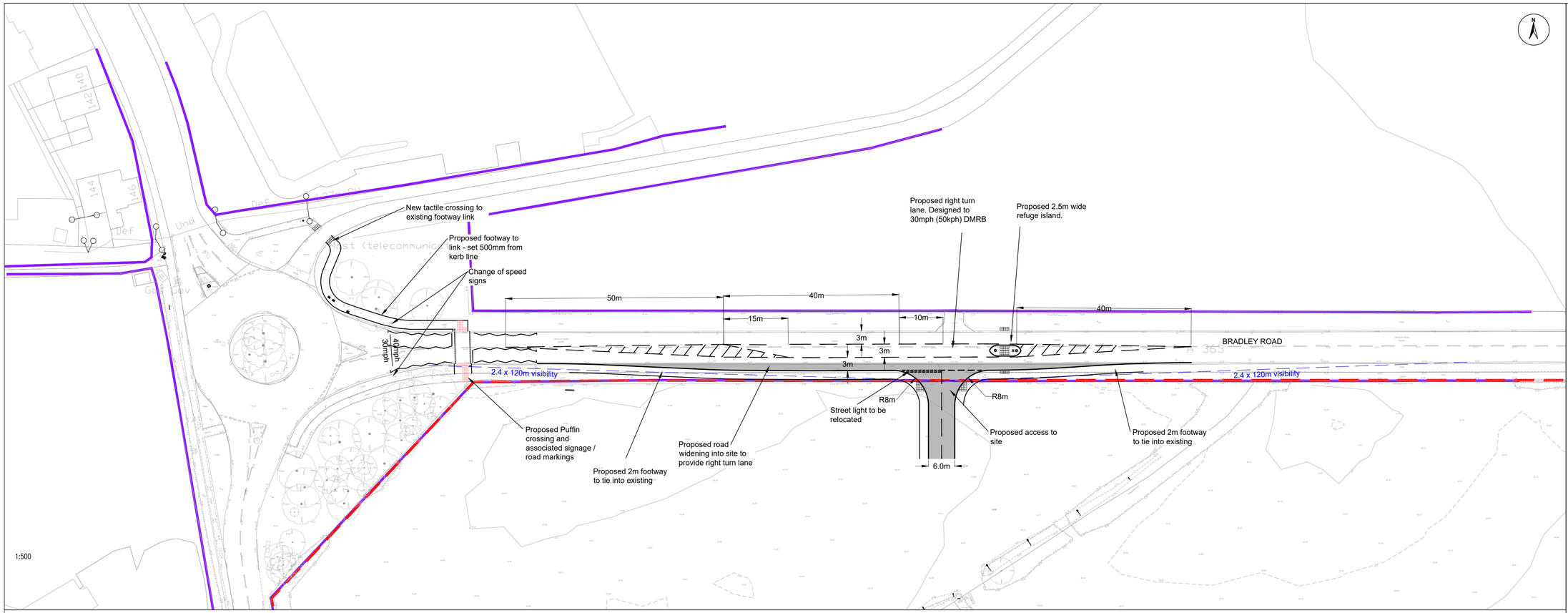
PROJECT
Land off the A363 White Horse Business Park

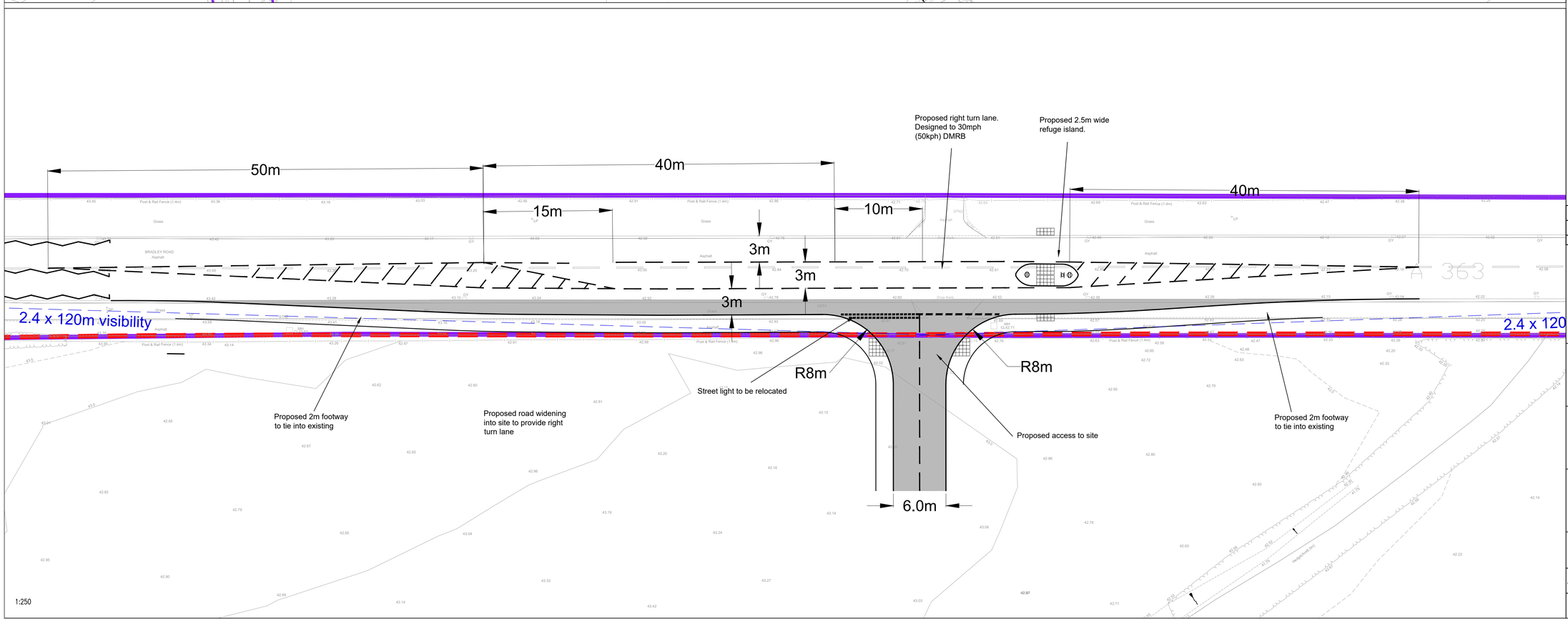
DRAWING
Parameter Plan

PROJECT NUMBER
CASR3002

DRAWING NUMBER	CHECKED BY
5000	**MR**
REVISION	STATUS
D	**DRAFT**
DATE	SCALE
March 2020	**1:2000 @ A3**

Turley





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NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY OTHERS. BADINGHAM CANNOT BE HELD RESPONSIBLE FOR ANY INACCURACIES
3. LEVELS ARE IN METRES AND RELATE TO OS GPS DATUM.

DESIGN DATA

1. DESIGN BASED UPON DMRB GUIDANCE
2. A363 40mph ROAD SPEED, WOODMARSH 30mph ROAD SPEED

KEY

- SITE BOUNDARY
- PROPOSED KERB LINE
- VISIBILITY SPLAY AS INDICATED
- TACTILE PAVING SLABS AT PEDESTRIAN CONTROLLED/UNCONTROLLED CROSSING POINTS
- TMP FLECTA OR LIT SIMMONS BOLLARDS INSTALLED ON PEDESTRIAN REFUGE ISLANDS.
- PROPOSED LOCATION OF PUFFIN CROSSING SIGNALS
- HIGHWAY BOUNDARY

Rev	Description	Drn	Chk	Date
A	Highway Boundary added	AD	AKD	26.02.20

REVISIONS

Badingham
Concept | Consult | Construct
Transport & Infrastructure Consultants
www.badinghamuk.com

Project
Bradley Road, South Trowbridge

Client
Castlewood Commercial Properties Ltd

Title
Proposed Right Turn Lane Access

Status
FOR DISCUSSION

Scale	Date	Drawn	Checked
As Shown @ A1	14.05.18	AD	AKD

Job No	Drawing No	Revision
-	002	A

Appendix 2 - Responses

Wiltshire Council Correspondence

Wessex Water Correspondence

Charles Graham

From: VanNiekerk, Carli <Carli.VanNiekerk@wiltshire.gov.uk>
Sent: 18 February 2020 15:43
To: Charles Graham
Subject: RE: A201 Land South of Bradley Road, North Bradley, Trowbridge, Wiltshire BA14 0RQ

Follow Up Flag: Follow up
Flag Status: Flagged

Mr Graham,

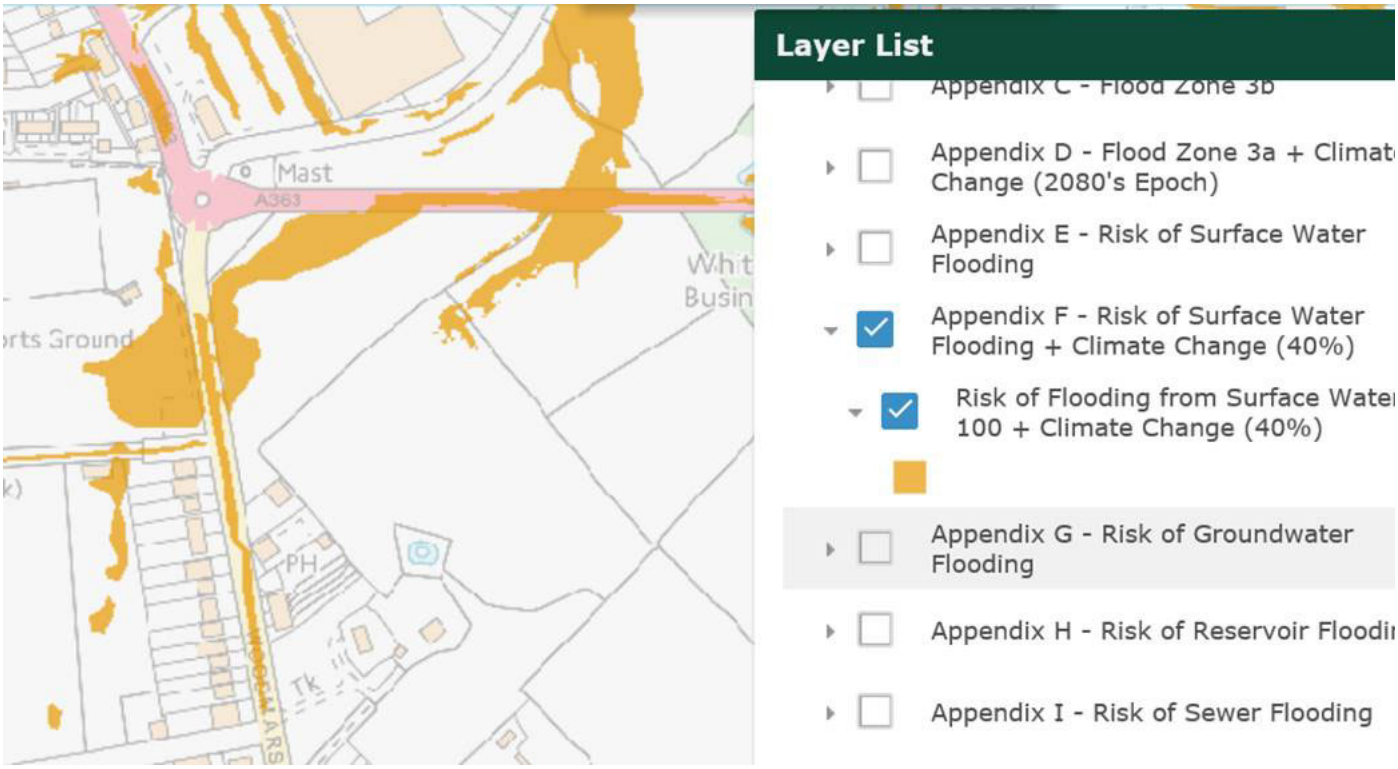
I'm happy to provide advice, but please also note that there is a formal pre-application process that you can follow to get comments from all consultees. With SuDS there is a cross over with ecology, urban design and landscape, so it would be useful to get their comments as well.

I see that there has been 2 planning applications for this site in the past, see table below. I could not find drainage or flood risk comments for either.

Reference	Proposed development	Outcome
W/02/00350/FUL	Alterations to access	Approve with Conditions
W/07/01620/FULES	New football stadium, covered pitches and clubhouse facilities, training pitch and associated facilities	Withdrawn

- The proposed development constitutes major development, therefore para 165 of the NPPF applies:
  165. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:
  a) take account of advice from the lead local flood authority;
  b) have appropriate proposed minimum operational standards;
  c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
  d) where possible, provide multifunctional benefits.
- The applicant would need to evidence application of the surface water disposal hierarchy - 1st Re-use, 2nd Infiltration, 3rd watercourse/surface water body, 4th surface water sewer, 5th combined sewer.
- The drainage strategy should take account of climate change in accordance with EA guidance and urban creep.
- With regards the control of surface water discharges from greenfield sites, Wiltshire Council requires post development discharges to provide 20% betterment over pre development discharges for both peak flow and volume. For more information refer to Wiltshire Council's betterment policy update which can be found here.
- Wiltshire Council is the land drainage authority under the Land Drainage Act 1991. Land drainage consent is required if a development proposes to discharge flow into an ordinary watercourse or carry out work within 8m of an ordinary watercourse. An ordinary watercourse is a watercourse that does not form part of a main river. The term watercourse includes all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows. Wiltshire Council's land drainage bylaws can be downloaded here. The land drainage consent application form and guidance notes can be found on our website here.
- According to our L1 SFRA mapping the site is at risk of surface water flooding in the 100 year plus climate change scenario (see screen shot below). The current layout shows the ponds located where surface water flooding is predicted to occur. The site specific FRA and drainage strategy should demonstrate that the ponds have sufficient capacity to accommodate the existing flooding and proposed runoff.

- The site layout should be developed following a sequential approach i.e. putting the most vulnerable development in the lowest flood risk areas.
- Finally, the table below outlines the level of information required at each application stage. Provision of the correct information will expedite the processing of your application by the LLFA.



Pre-app	Outline	Full	Reserved matters	Discharge of conditions	Document to be submitted
✓	✓	✓			Flood Risk Assessment / Statement
✓	✓	✓			Drainage Strategy / Statement & sketch layout plan
	✓				Preliminary layout drawings
	✓				Preliminary “Outline” hydraulic calculations
	✓				Preliminary landscape proposals
	✓				Ground investigation report (for infiltration)
	✓	✓			Evidence of third party agreement for discharge to their system (in principle/ consent to discharge)
		✓		✓	Maintenance program and on-going maintenance responsibilities
		✓	✓		Detailed development layout
		✓	✓	✓	Detailed flood & drainage design drawings
		✓	✓	✓	Full Structural, hydraulic & ground investigations

		✓	✓	✓	Geotechnical factual and interpretive reports, including infiltration results
		✓	✓	✓	Evidence of measures to prevent pollution of the receiving groundwater and/or surface waters
		✓	✓	✓	Drawings showing conveyance routes for flows exceeding the 1 in 100 year plus climate change
		✓	✓	✓	Detailed landscaping details
		✓	✓	✓	Discharge agreements (temporary and permanent)
		✓	✓	✓	Development Management & Construction Phasing Plan

Kind regards

Carli van Niekerk CEng MICE
Principal Drainage Engineer (Planning)
Weather and Drainage/Highways Asset Management and Commissioning

Wiltshire Council

Tel: 01225 713273
Email: carli.vanniekerk@wiltshire.gov.uk
Web: www.wiltshire.gov.uk
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From: Drainage <Drainage@wiltshire.gov.uk>
Sent: 11 February 2020 10:32
To: VanNiekerk, Carli <Carli.VanNiekerk@wiltshire.gov.uk>
Subject: FW: A201 Land South of Bradley Road, North Bradley, Trowbridge, Wiltshire BA14 0RQ

From: Charles Graham <cgraham@alpce.co.uk>
Sent: 27 January 2020 16:01
To: Drainage <Drainage@wiltshire.gov.uk>
Subject: A201 Land South of Bradley Road, North Bradley, Trowbridge, Wiltshire BA14 0RQ

Dear Sir or Madam,

We have been in correspondence with Wessex Water regarding the Foul water drainage of a proposed site comprising 99no residential dwellings and 1no Care Home facility south of Bradley Road, Trowbridge, BA14 0RQ.

Please could Wiltshire Council as Lead Local Flood Authority provide any advice on surface water arrangements/flood risk measures. We have devised a preliminary drainage strategy (attached) for comment.

Any advice/comments would be greatly appreciated.

Kind Regards

Mr Charles Graham
Engineer

Tel: 01488 684390

Abley Letchford Partnership Ltd
Consulting Engineers

3 Tealgate, Charnham Park
Hungerford, RG17 0YT

www.alpce.co.uk

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Charles Graham

From: Alison Kurobasa <Alison.Kurobasa@wessexwater.co.uk>
Sent: 04 February 2020 13:30
To: Charles Graham
Subject: WWDevResp ST85NE/ 406 : Prelim Drainage Strategy - Land South of Bradley Road, North Bradley, Wiltshire
Attachments: A201-005 P1 Preliminary Drainage Strategy.pdf

Hello Charles

Thank you for sending through a copy of your preliminary drainage strategy for our comment.

The site shall be served by separate systems of drainage.

Foul Sewerage
We welcome the strategy to discharge foul flows north-east to manhole ST85558805 which is our preferred point of connection.
A pumped connection would be acceptable with a break chamber as you have indicated.
Wessex Water will adopt a foul pumping station and sewers through a formal S104 agreement, subject to satisfactory engineering proposals constructed to current adoptable standards.
No dwellings within 15metres of the pumping station and satisfactory access arrangements appear achievable.
The route of the rising main will require a 6m easement (3m either side) and must not conflict with the attenuation basin earthworks.

Strategic Planning
We are aware of allocated development on an adjoining site to the south and we may seek a degree of flexibility to accommodate foul flows from the adjacent site. If there is a viable option where your single pumping station serves both sites, we would look to explore this. Under Section 112 of the Water Industry Act we can seek to amend designs to achieve a more sustainable solution particularly if this can avoid two separate pumping stations on adjacent sites.
Changes may include increasing storage at your pumping station and providing a length of foul sewer to link sites. The extra over expenses reasonably incurred in complying with an undertaker's Section 112 requirements would be repayable to the developer.

We fully appreciate the complexities of different developers and sites coming forward at different times and will continue to monitor site layouts and drainage strategies as they progress through the planning process and work with developers and the planning authority to promote a sustainable foul drainage solution.

Surface Water Drainage
The strategy to discharge to local watercourse at a restricted rate via attenuation basins is acceptable to us but will require the approval of the Lead Local Flood Authority.

I hope that you will find the above comments of use, however, please do not hesitate to contact me if you require further information or clarification.

ALISON KUROBASA
PLANNING LIAISON

Wessex Water
Claverton Down Bath BA2 7WW
wessexwater.co.uk

Direct Dial: 01225526611
Planning Liaison: 01225526288

We have recently developed a new online service for obtaining Wessex Water Asset Maps. This service allows you to quickly and easily receive a copy via email https://maps.wessexwater.co.uk/webapps/request-a-map/

From: Charles Graham <cgraham@alpce.co.uk>
Sent: 29 January 2020 15:23
To: Alison Kurobasa <Alison.Kurobasa@wessexwater.co.uk>
Subject: RE: WWDevResp ST85NE/ 406 : Land South of Bradley Road, North Bradley, Wiltshire

Hi Alison,

Thank you for the comments in your email dated 14 November 2019.
We have produced the attached preliminary drainage strategy for the site and would welcome any further comments/advice to ensure we are in line with Wessex Water's requirements with regard to the surface and foul water drainage.

We look forward to hearing from you.

Many thanks

Kind Regards

Mr Charles Graham
Engineer

Tel: 01488 684390

Abley Letchford Partnership Ltd
Consulting Engineers

From: Alison Kurobasa <Alison.Kurobasa@wessexwater.co.uk>
Sent: 14 November 2019 16:00
To: Colin Sumbler <csumbler@alpce.co.uk>
Subject: WWDevResp ST85NE/ 406 : Land South of Bradley Road, North Bradley, Wiltshire

For the attention of Mr Colin Sumbler

Site: Land South of Bradley Road, North Bradley, Wiltshire
Proposal: 149 Dwellings

Thank you for your development enquiry. Please find attached an extract from our records showing the approximate location of our apparatus within the vicinity of the site.

The manhole details are as follows:

Woodmarsh 150mm foul sewer: MH ST8555601; CL 44.639, IL 43.359. MH ST8555701; CL 44.388, IL43.198.
Bradley Road 150mm foul sewer: MH ST85559803; CL43.360, IL 42.010. MH ST85558805; CL42.890, IL 41.340. MH ST85558804; CL 43.330, IL 41.180

Bradley Road 600mm SW sewer: MH ST85558802; CL 43.050, IL 40.250. MH ST85558801: CL 44.000, IL 39.900

Proposed Sewerage

Separate systems of drainage must be provided to serve development proposals:

Foul Drainage

We can accept foul only flows from the development and there are 150mm public foul sewers located to the north east in Bradley Road and to the west in Woodmarsh. Developers may connect to the nearest public sewer on a size for size basis and Wessex Water fund any necessary capacity improvements from infrastructure charges income. Upon grant of planning Wessex Water will need to undertake further review of the foul sewer networks as cumulative development in the catchment may exceed capacity in local systems. We are aware of allocated residential sites to the south of this site and Wessex Water would welcome the opportunity to agree an overall drainage strategy for this area (see Strategic Planning note below).

Surface Water Drainage

Surface water to be disposed of in accordance with Suds Hierarchy and NPPF Guidelines and should be directed to local land drainage systems.
Surface water arrangements and supporting flood risk measures to be agreed with the Lead Local Flood Authority.
There must be no surface water connections to the public foul sewer system.
Land drainage run-off shall not be permitted to discharge either directly or indirectly to the public sewerage system

Existing Water Main Crossing the Site

There is an existing 450 Ductile Iron water main crossing the site. This is a strategic trunk main which must be accurately located on site and marked on deposited drawings. There must be no building or tree planting within 6 metres either side of this water main. Wessex Water require unrestricted access to carry out their statutory duties. Consideration must be given to maintaining ground levels above the trunk main and the developer will need to agree protection measures throughout the construction works and thereafter. Connection to this main for site supply will not be possible.

There will be significant costs involved in diverting a trunk main of this size. Diversions of public apparatus are at the developer's cost. For a high level budget cost please visit our website and use the charges calculator which has been created for developers to interactively generate a budget quotation for their project: https://www.wessexwater.co.uk/services/building-and-developing/charging-arrangementsarges
(I have attached an excel version but please be aware that this may become out of date, the online version will always be updated with the current charging arrangements).

Water Supply

A water supply is available from the local distribution mains in Woodmarsh and Bradley Road.
Wessex Water will need to undertake further review of cumulative development in the catchment may exceed capacity in local systems (see Strategic Planning note below).
A connection via development to the north of the site through to the water main in the bypass would be preferable.
Buildings above two storeys will require on site boosted storage.

Strategic Planning

Through the planning process we will seek to promote a co-ordinated scheme of works that will deliver a strategic solution for the wider planning allocation, providing water and sewerage capacity for all allocated development sites. A network capacity appraisal will be required to confirm the scope of any improvements necessary to accommodate additional loadings from multiple development applications and if we are unable to provide this capacity in the short term we advise that we will need to reach agreement with developers and the Local Planning Authority upon the timetable for a scheme of works to meet future catchment growth, upon any grant of planning permission. We welcome the opportunity to further discuss your proposals and programme throughout the planning and development process so we may review and plan any network upgrades as necessary.

I trust that you find the above of use, however please do not hesitate to contact me if you require further information or clarification.

ALISON KUROBASA
PLANNING LIAISON

Wessex Water
Claverton Down Bath BA2 7WW
wessexwater.co.uk

From: Colin Sumbler <csumbler@alpce.co.uk>
Sent: 08 November 2019 09:40
To: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Subject: RE: North Bradley, Trowbridge

Good morning Teddy,
Thanks for getting back to me.

With regards to flows from the proposed development, it is anticipated that up to 149 dwellings will be delivered.

Regards

Mr Colin Sumbler
Principal Engineer

Tel: 01488 684390
Mobile: 07719 322220

Abley Letchford Partnership Ltd
Consulting Engineers

From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 08 November 2019 08:22
To: Colin Sumbler <csumbler@alpce.co.uk>
Subject: RE: North Bradley, Trowbridge

Hello Colin,

RE : SITE AT NORTH BRADLEY

Many thanks for your email and the opportunity to work together on the above proposal . Please accept this response as an acknowledgement of receipt. I will be back in touch once I have fully reviewed your emails and attachments in detail. Are you able to confirm any potential flows for any services required in the interim ?

Kind regards,

Teddy Takyi-Amuah,

Wessex Water / Planning Liaison
Claverton Down Bath BA2 7WW
wessexwater.co.uk

From: Colin Sumbler <csumbler@alpce.co.uk>
Sent: 07 November 2019 12:53
To: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Cc: Planning Liaison <planning.liaison@wessexwater.co.uk>; Leigh Abley <labley@alpce.co.uk>
Subject: North Bradley, Trowbridge

Good afternoon Teddy,
My colleague Leigh Abley gave me your contact details suggesting you may be able to assist.

We write in connection to the above site and would welcome the opportunity to engaging with you in respect to surface and foul water disposal as well as a potential water main diversion. With your assistance the emerging master plan and forthcoming outline planning application will benefit.

Are you able to provide some information on the invert levels of the public sewers (surface and foul) clouded pink on the attached plan? With this we can assess if a foul pump station will be required.

Additionally, can you confirm the size of the water main that crosses the site and provide a high level diversion estimate for the water main diversion (circa 220m) also identified on the attached plan ?

I look forward to hearing from you

Regards

Mr Colin Sumbler
Principal Engineer

Tel: 01488 684390
Mobile: 07719 322220

Abley Letchford Partnership Ltd
Consulting Engineers

3 Tealgate, Charnham Park
Hungerford, RG17 0YT

www.alpce.co.uk

Registered in England No. 8903427
Bremhill Grove Farnmhouse, East Tytherton, Chippenham SN15 4LX

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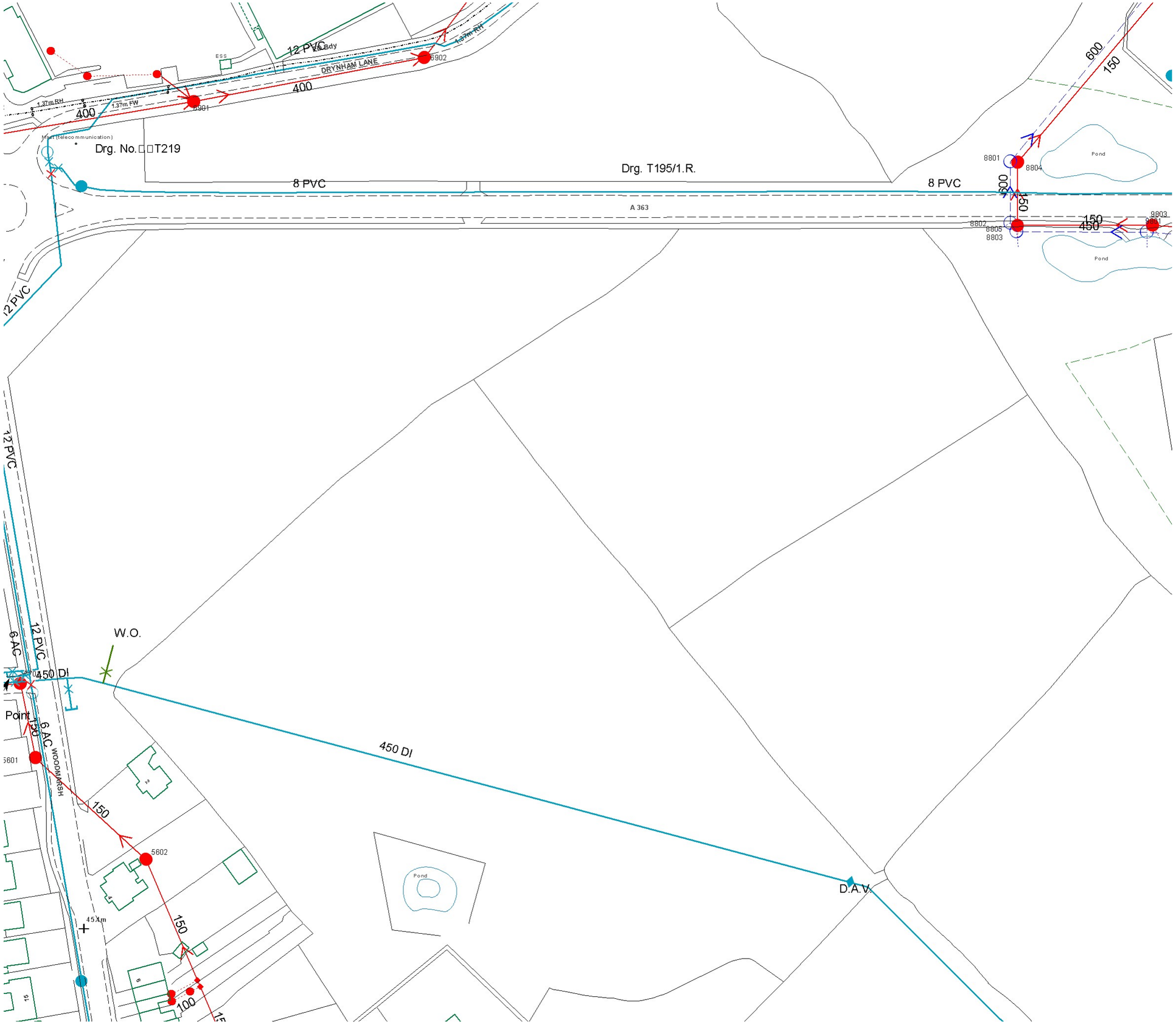

Wessex Water
YTL GROUP

Bradley Road

North Bradley

Printed on : 14/11/2019 10:25

WATER MAINS Public Private
Public
Raw Water
Abandoned
Valve Hydrant PRV Meter

SEWERS Public - Section 104 - Private
Foul
Combined
Surface
Abandoned sewers

OTHER WESSEX PIPES
Rising Mains
Effluent Disposal Main
Overflow

NON-WESSEX PIPES
Private Rising Mains
Culverted Water Course
Highway Drain

Information in this plan 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 to discuss your proposals.

Centre:385731.99 , 155772.35

Scale = 1:1250
Metres 20 40 60

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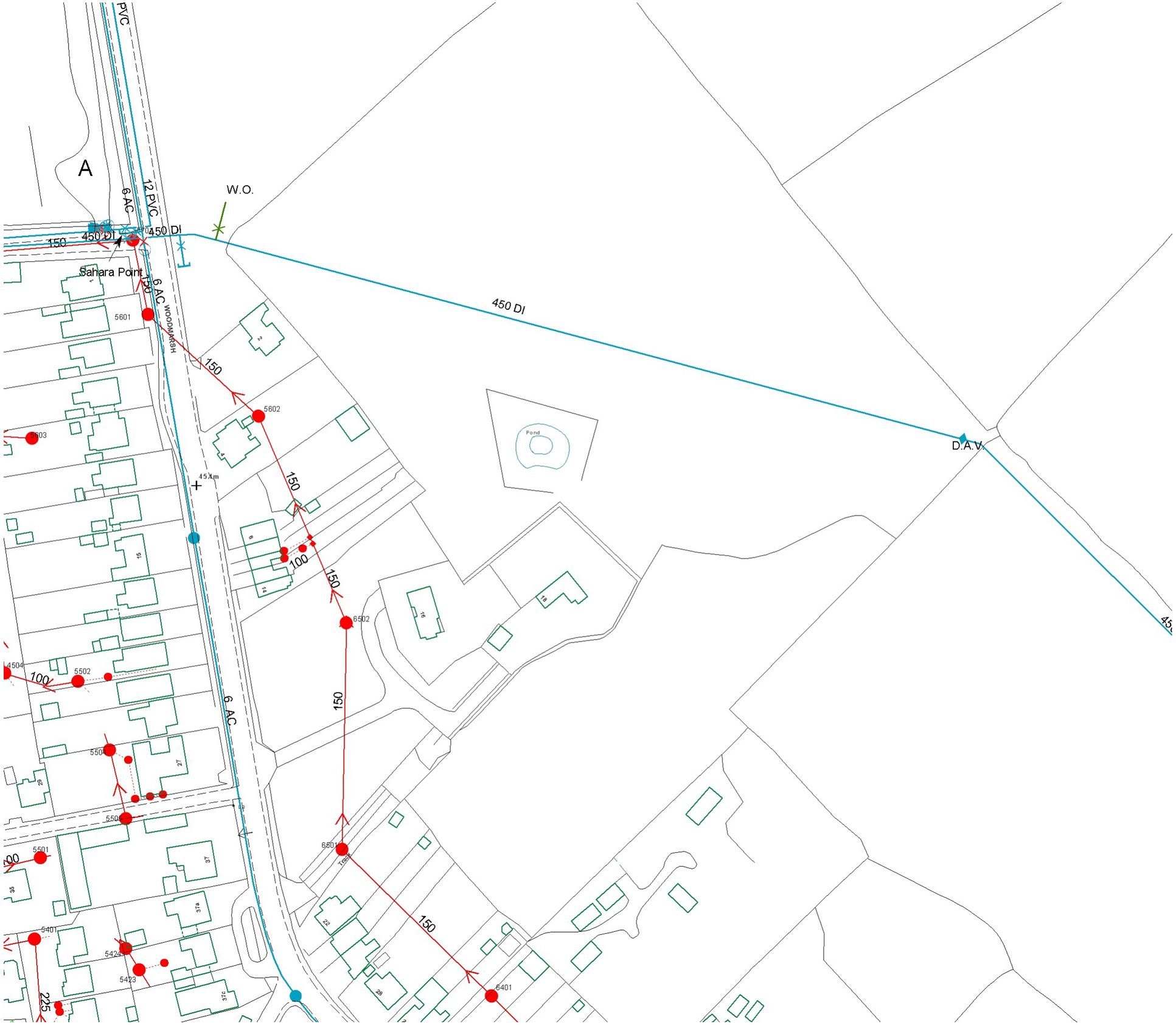

Wessex Water
YTL GROUP

Woodmarsh

North Bradley

Printed on : 14/11/2019 10:22

WATER MAINS Public Private
Public
Raw Water
Abandoned
Valve Hydrant PRV Meter

SEWERS Public - Section 104 - Private
Foul
Combined
Surface
Abandoned sewers

OTHER WESSEX PIPES
Rising Mains
Effluent Disposal Main
Overflow

NON-WESSEX PIPES
Private Rising Mains
Culverted Water Course
Highway Drain

Information in this plan 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 to discuss your proposals.

Centre:385694.29 , 155623.85

Scale = 1:1250
Metres 20 40 60

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Appendix 3 - Drainage Strategy

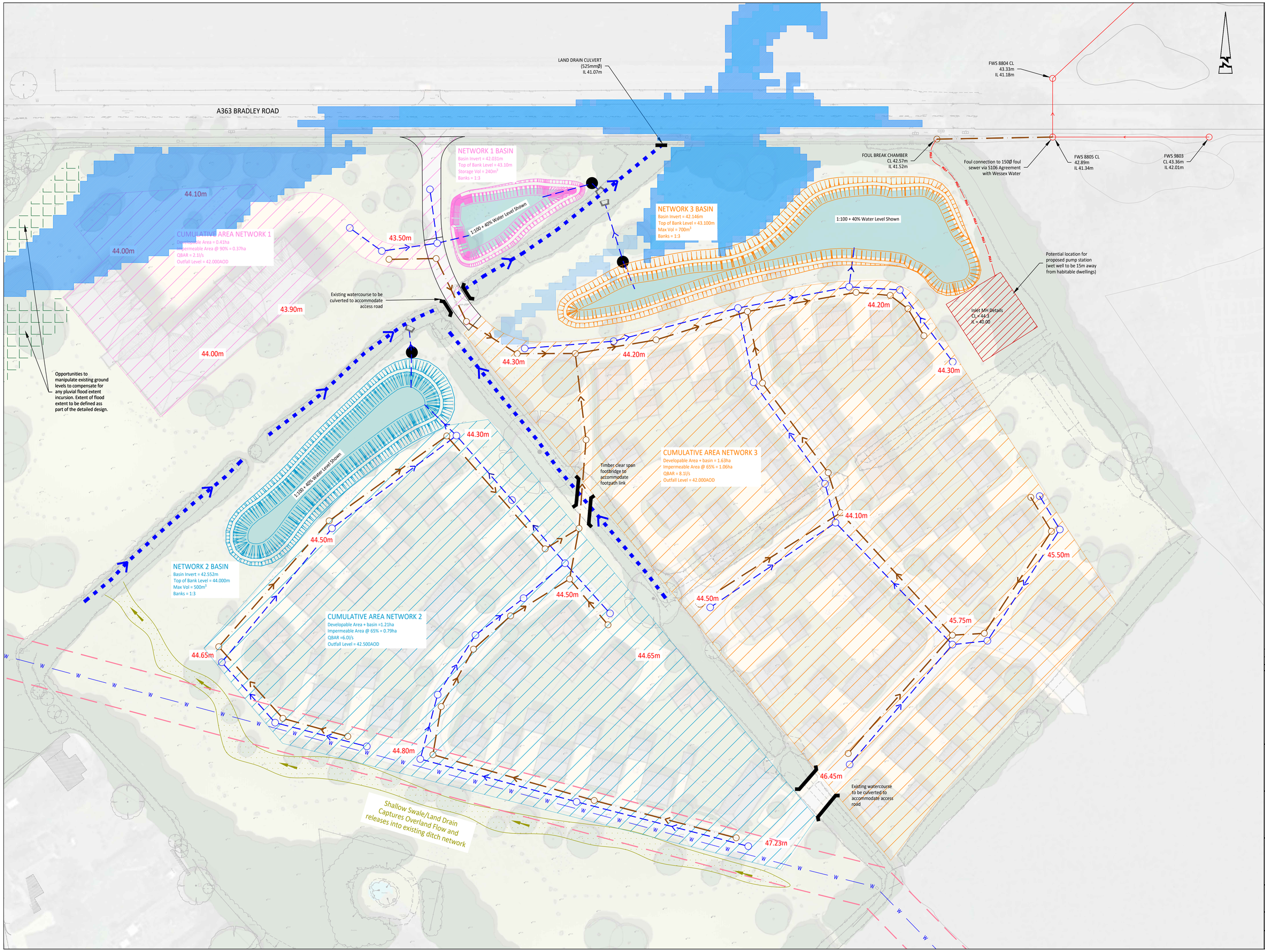
Drainage Strategy Plan

Network 1 Design Details and Storm Modelling

Network 2 Design Details and Storm Modelling

Network 3 Design Details and Storm Modelling

Microdrainage Source Control Information



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GENERAL NOTES:

1. Do not scale.
2. This drawing is to be read in conjunction with and checked against all other drawings, Engineering details, Specification and any structural, Geotechnical or other specialist document provided.
3. Any anomaly or contradiction between any of the above is to be reported to the Engineer.
4. All proposals shown are indicative pending confirmation of site layout proposals.

KEY

FOUL STORM

- Proposed sewer & MH
- Proposed Foul Rising Main
- Public Foul Water Sewer
- Control Manhole
- Basin Earthworks (colour indicates catchments)
- Existing Wessex Water Trunk Main with Easement
- Existing ditch and indicative flow direction
- 44.10m Approximate Proposed Cover Level
- Proposed Location of Foul Water Pump Station
- Environment Agency 1 in 30 year pluvial flooding
- Environment Agency 1 in 100 year pluvial flooding

Rev	Date	Description	Drawn	Checked
P2	02.20	Layout updated.	CS	LPA
P1	01.20	First Issue	FN	LPA

ABLEY LETCHFORD PARTNERSHIP
Consulting Engineers
3 Tealgate, Charnham Park
Hungerford, Berkshire RG17 0YT
www.alpce.co.uk Tel: 01488 684390

Client
CASTLEWOOD PROPERTIES VENTURES LTD

Project
LAND AT WHITE HORSE BUSINESS PARK NORTH BRADLEY

Title
PRELIMINARY DRAINAGE STRATEGY

Status

Scale	Date	Drawn	Checked
1:500 @ A1	01/20	FN	LPA

Drawing No	Revision
A201-005	P2

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SWS NETWORK 1.SWS

Pipe Sizes SWS NETWORK 1 Manhole Sizes SWS NETWORK 1

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.800	Add Flow / Climate Change (%)	0
Ratio R	0.381	Minimum Backdrop Height (m)	1.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.350
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SWS NETWORK 1.SWS

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	33.183	0.111	298.9	0.370	5.00	0.0	0.600	o	450	Pipe/Conduit	
S2.001	60.017	0.200	300.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.002	5.000#	0.020	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.003	2.725	0.011	247.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	50.00	5.47	42.342	0.370	0.0	0.0	0.0	1.17	186.2	50.1
S2.001	50.00	6.33	42.231	0.370	0.0	0.0	0.0	1.17	185.8	50.1
S2.002	50.00	6.41	42.031	0.370	0.0	0.0	0.0	0.99	70.0	50.1
S2.003	50.00	6.46	42.011	0.370	0.0	0.0	0.0	0.99	70.3	50.1

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Manhole Schedules for SWS NETWORK 1.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S3	44.124	1.782	Open Manhole	1350	S2.000	42.342	450				
S2	43.881	1.650	Open Manhole	1350	S2.001	42.231	450	S2.000	42.231	450	
S2	43.000	0.969	Open Manhole	1350	S2.002	42.031	300	S2.001	42.031	450	
S3	42.456	0.445	Open Manhole	1200	S2.003	42.011	300	S2.002	42.011	300	
S1	43.000	1.000	Open Manhole	0		OUTFALL		S2.003	42.000	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S3	385626.636	155821.213	385626.636	155821.213	Required	
S2	385658.937	155813.617	385658.937	155813.617	Required	
S2	385712.920	155839.843	385712.920	155839.843	Required	
S3	385738.409	155852.057	385738.409	155852.057	Required	
S1	385740.085	155849.908			No Entry	

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PIPELINE SCHEDULES for SWS NETWORK 1.SWS

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	o	450	S3	44.124	42.342	1.332	Open Manhole	1350
S2.001	o	450	S2	43.881	42.231	1.200	Open Manhole	1350
S2.002	o	300	S2	43.000	42.031	0.669	Open Manhole	1350
S2.003	o	300	S3	42.456	42.011	0.145	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	33.183	298.9	S2	43.881	42.231	1.200	Open Manhole	1350
S2.001	60.017	300.1	S2	43.000	42.031	0.519	Open Manhole	1350
S2.002	5.000#	250.0	S3	42.456	42.011	0.145	Open Manhole	1200
S2.003	2.725	247.7	S1	43.000	42.000	0.700	Open Manhole	0

Free Flowing Outfall Details for SWS NETWORK 1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S2.003	S1	43.000	42.000	0.000	0	0

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Online Controls for SWS NETWORK 1.SWS

Hydro-Brake® Optimum Manhole: S2, DS/PN: S2.002, Volume (m³): 10.7

Unit Reference	MD-SHE-0070-2100-0900-2100
Design Head (m)	0.900
Design Flow (l/s)	2.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	42.031
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	2.1	Kick-Flo®	0.564	1.7
Flush-Flo™	0.273	2.1	Mean Flow over Head Range	-	1.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.4
0.200	2.1	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.1	1.600	2.7	4.000	4.2	8.000	5.8
0.400	2.0	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.9	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.7	2.200	3.2	5.500	4.8	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.2		

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Storage Structures for SWS NETWORK 1.SWS

Tank or Pond Manhole: S2, DS/PN: S2.002

Invert Level (m) 42.031

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	200.0	1.000	440.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 1.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.382
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.300 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S3	15 Winter	1	+40%	100/15 Summer				42.553
S2.001	S2	15 Winter	1	+40%	100/15 Summer				42.431
S2.002	S2	480 Winter	1	+40%	30/30 Winter				42.321
S2.003	S3	480 Winter	1	+40%					42.049

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S3	-0.239	0.000	0.44		70.8	OK	
S2.001	S2	-0.250	0.000	0.40		69.0	OK	
S2.002	S2	-0.010	0.000	0.04		2.1	OK	
S2.003	S3	-0.262	0.000	0.04		2.1	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.382
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.300 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S3	15 Winter	30	+0%	100/15 Summer				42.645
S2.001	S2	15 Winter	30	+0%	100/15 Summer				42.514
S2.002	S2	480 Winter	30	+0%	30/30 Winter				42.483
S2.003	S3	360 Winter	30	+0%					42.050

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S3	-0.147	0.000	0.77		124.1	OK	
S2.001	S2	-0.167	0.000	0.70		119.7	OK	
S2.002	S2	0.152	0.000	0.05		2.1	SURCHARGED	
S2.003	S3	-0.261	0.000	0.04		2.1	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.382
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.300 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S3	15 Winter	100	+40%	100/15 Summer				42.994
S2.001	S2	960 Winter	100	+40%	100/15 Summer				42.841
S2.002	S2	960 Winter	100	+40%	30/30 Winter				42.839
S2.003	S3	960 Summer	100	+40%					42.050

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S3	0.202	0.000	1.35		219.3	SURCHARGED	
S2.001	S2	0.160	0.000	0.08		14.4	SURCHARGED	
S2.002	S2	0.508	0.000	0.05		2.1	FLOOD RISK	
S2.003	S3	-0.261	0.000	0.04		2.1	OK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SWS NETWORK 2.SWS

Pipe Sizes SWS NETWORK 2 Manhole Sizes SWS NETWORK 2

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.500	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	1.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.350
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SWS NETWORK 2.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	36.325	0.148	245.4	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	91.635	0.374	245.0	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S3.001	64.194	0.262	245.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	54.204	0.221	245.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	46.792	0.191	245.0	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S4.001	42.600	0.174	244.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.002	21.872	0.059	370.7	0.790	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	50.00	5.61	43.130	0.000	0.0	0.0	0.0	1.00	70.6	0.0
S3.000	50.00	6.53	43.618	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S3.001	50.00	7.60	43.244	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S2.001	50.00	8.50	42.982	0.000	0.0	0.0	0.0	1.00	70.6	0.0
S4.000	50.00	5.78	43.126	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S4.001	50.00	6.49	42.935	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S2.002	50.00	8.85	42.611	0.790	0.0	0.0	0.0	1.05	167.0	107.0

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Network Design Table for SWS NETWORK 2.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.003	6.876	0.028	245.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.004	5.995	0.024	249.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.003	50.00	8.96	42.552	0.790	0.0	0.0	0.0	1.00	70.6«	107.0
S2.004	50.00	9.06	42.524	0.790	0.0	0.0	0.0	0.99	70.0«	107.0

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Manhole Schedules for SWS NETWORK 2.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	44.630	1.500	Open Manhole	1200	S2.000	43.130	300				
S2	45.118	1.500	Junction		S3.000	43.618	300				
S2	44.800	1.556	Open Manhole	1200	S3.001	43.244	300	S3.000	43.244	300	
S2	44.500	1.518	Open Manhole	1200	S2.001	42.982	300	S2.000	42.982	300	
								S3.001	42.982	300	
S5	44.626	1.500	Open Manhole	1200	S4.000	43.126	300				
S6	44.500	1.565	Open Manhole	1200	S4.001	42.935	300	S4.000	42.935	300	
S4	44.261	1.650	Open Manhole	1350	S2.002	42.611	450	S2.001	42.761	300	
								S4.001	42.761	300	
S3	44.000	1.448	Open Manhole	1350	S2.003	42.552	300	S2.002	42.552	450	
S2	44.000	1.476	Open Manhole	1200	S2.004	42.524	300	S2.003	42.524	300	
S1	43.300	0.800	Open Manhole	0		OUTFALL		S2.004	42.500	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	385761.261	155716.280	385761.261	155716.280	Required	
S2	385781.762	155661.494			No Entry	
S2	385693.897	155687.509	385693.897	155687.509	Required	
S2	385732.661	155738.677	385732.661	155738.677	Required	
S5	385633.598	155719.553	385633.598	155719.553	Required	
S6	385664.092	155755.044	385664.092	155755.044	Required	
S4	385698.224	155780.536	385698.224	155780.536	Required	
S3	385688.863	155800.304	385688.863	155800.304	Required	

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Manhole Schedules for SWS NETWORK 2.SWS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S2	385686.844	155806.877	385686.844	155806.877	Required	
S1	385685.064	155812.601			No Entry	

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PIPELINE SCHEDULES for SWS NETWORK 2.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	o	300	S1	44.630	43.130	1.200	Open Manhole	1200
S3.000	o	300	S2	45.118	43.618	1.200	Junction	
S3.001	o	300	S2	44.800	43.244	1.256	Open Manhole	1200
S2.001	o	300	S2	44.500	42.982	1.218	Open Manhole	1200
S4.000	o	300	S5	44.626	43.126	1.200	Open Manhole	1200
S4.001	o	300	S6	44.500	42.935	1.265	Open Manhole	1200
S2.002	o	450	S4	44.261	42.611	1.200	Open Manhole	1350
S2.003	o	300	S3	44.000	42.552	1.148	Open Manhole	1350
S2.004	o	300	S2	44.000	42.524	1.176	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	36.325	245.4	S2	44.500	42.982	1.218	Open Manhole	1200
S3.000	91.635	245.0	S2	44.800	43.244	1.256	Open Manhole	1200
S3.001	64.194	245.0	S2	44.500	42.982	1.218	Open Manhole	1200
S2.001	54.204	245.3	S4	44.261	42.761	1.200	Open Manhole	1350
S4.000	46.792	245.0	S6	44.500	42.935	1.265	Open Manhole	1200
S4.001	42.600	244.8	S4	44.261	42.761	1.200	Open Manhole	1350
S2.002	21.872	370.7	S3	44.000	42.552	0.998	Open Manhole	1350
S2.003	6.876	245.6	S2	44.000	42.524	1.176	Open Manhole	1200
S2.004	5.995	249.8	S1	43.300	42.500	0.500	Open Manhole	0

Free Flowing Outfall Details for SWS NETWORK 2.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S2.004	S1	43.300	42.500	42.060	0	0

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Online Controls for SWS NETWORK 2.SWS

Hydro-Brake® Optimum Manhole: S3, DS/PN: S2.003, Volume (m³): 5.3

Unit Reference	MD-SHE-0112-6000-1200-6000
Design Head (m)	1.200
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	42.552
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	6.0	Kick-Flo®	0.754	4.8
Flush-Flo™	0.357	6.0	Mean Flow over Head Range	-	5.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.0	3.000	9.2	7.000	13.8
0.200	5.7	1.400	6.4	3.500	9.9	7.500	14.2
0.300	5.9	1.600	6.8	4.000	10.5	8.000	14.7
0.400	6.0	1.800	7.2	4.500	11.1	8.500	15.1
0.500	5.9	2.000	7.6	5.000	11.7	9.000	15.5
0.600	5.7	2.200	7.9	5.500	12.3	9.500	15.9
0.800	5.0	2.400	8.3	6.000	12.8		
1.000	5.5	2.600	8.6	6.500	13.3		

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Storage Structures for SWS NETWORK 2.SWS

Tank or Pond Manhole: S3, DS/PN: S2.003

Invert Level (m) 42.552

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	331.0	1.448	1010.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 2.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.383
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S1	60 Winter	1	+40%	100/240 Winter				43.130
S3.000	S2	60 Winter	1	+40%					43.618
S3.001	S2	60 Winter	1	+40%					43.244
S2.001	S2	60 Winter	1	+40%	100/15 Summer				42.982
S4.000	S5	60 Winter	1	+40%	100/240 Winter				43.126
S4.001	S6	15 Winter	1	+40%	100/15 Summer				42.935
S2.002	S4	15 Winter	1	+40%	30/15 Summer				42.938
S2.003	S3	360 Winter	1	+40%	1/120 Winter				42.888
S2.004	S2	360 Winter	1	+40%					42.593

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S1	-0.300	0.000	0.00		0.0	OK	
S3.000	S2	-0.300	0.000	0.00		0.0	OK*	
S3.001	S2	-0.300	0.000	0.00		0.0	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SWS NETWORK 2.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.001	S2	-0.300	0.000	0.00		0.0	OK	
S4.000	S5	-0.300	0.000	0.00		0.0	OK	
S4.001	S6	-0.300	0.000	0.00		0.0	OK	
S2.002	S4	-0.123	0.000	0.87		119.8	OK	
S2.003	S3	0.036	0.000	0.12		5.9	SURCHARGED	
S2.004	S2	-0.231	0.000	0.12		5.9	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 2.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.383
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S1	60 Winter	30	+0%	100/240 Winter				43.130
S3.000	S2	60 Winter	30	+0%					43.618
S3.001	S2	60 Winter	30	+0%					43.244
S2.001	S2	15 Winter	30	+0%	100/15 Summer				43.112
S4.000	S5	60 Winter	30	+0%	100/240 Winter				43.126
S4.001	S6	15 Winter	30	+0%	100/15 Summer				43.121
S2.002	S4	15 Winter	30	+0%	30/15 Summer				43.127
S2.003	S3	360 Winter	30	+0%	1/120 Winter				43.079
S2.004	S2	60 Winter	30	+0%					42.593

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S1	-0.300	0.000	0.00		0.0	OK	
S3.000	S2	-0.300	0.000	0.00		0.0	OK*	
S3.001	S2	-0.300	0.000	0.00		0.0	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 2.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.001	S2	-0.170	0.000	0.05		3.6	OK	
S4.000	S5	-0.300	0.000	0.00		0.0	OK	
S4.001	S6	-0.114	0.000	0.06		3.8	OK	
S2.002	S4	0.066	0.000	1.56		213.4	SURCHARGED	
S2.003	S3	0.227	0.000	0.12		6.0	SURCHARGED	
S2.004	S2	-0.231	0.000	0.12		6.0	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 2.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.383
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S1	480 Winter	100	+40%	100/240 Winter				43.479
S3.000	S2	60 Winter	100	+40%					43.618
S3.001	S2	480 Winter	100	+40%					43.479
S2.001	S2	480 Winter	100	+40%	100/15 Summer				43.479
S4.000	S5	480 Winter	100	+40%	100/240 Winter				43.479
S4.001	S6	480 Winter	100	+40%	100/15 Summer				43.479
S2.002	S4	480 Winter	100	+40%	30/15 Summer				43.479
S2.003	S3	480 Winter	100	+40%	1/120 Winter				43.477
S2.004	S2	960 Winter	100	+40%					42.593

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S1	0.049	0.000	0.00		0.0	SURCHARGED	
S3.000	S2	-0.300	0.000	0.00		0.0	OK*	
S3.001	S2	-0.065	0.000	0.00		0.1	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 2.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.001	S2	0.197	0.000	0.00		0.3	SURCHARGED	
S4.000	S5	0.053	0.000	0.00		0.0	SURCHARGED	
S4.001	S6	0.244	0.000	0.00		0.1	SURCHARGED	
S2.002	S4	0.418	0.000	0.38		52.0	SURCHARGED	
S2.003	S3	0.625	0.000	0.12		6.0	SURCHARGED	
S2.004	S2	-0.231	0.000	0.12		6.0	OK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SWS NETWORK 3.SWS

Pipe Sizes SWS NETWORK 3 Manhole Sizes SWS NETWORK 3

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.500	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	1.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.350
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SWS NETWORK 3.SWS

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.000	52.525	0.214	245.4	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	42.926	0.175	245.3	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S3.001	44.527	0.182	244.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	44.775	0.183	244.7	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S3.002	69.814	0.285	245.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S6.000	27.556	0.112	246.0	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	50.00	5.88	43.153	0.000	0.0	0.0	0.0	1.00	70.6	0.0
S4.000	50.00	5.72	43.114	0.000	0.0	0.0	0.0	1.00	70.6	0.0
S3.001	50.00	6.62	42.939	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S5.000	50.00	5.75	42.940	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S3.002	50.00	7.78	42.757	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S6.000	50.00	5.46	42.769	0.000	0.0	0.0	0.0	1.00	70.5	0.0

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Network Design Table for SWS NETWORK 3.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S6.001	45.344	0.185	245.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S7.000	31.931	0.130	245.6	0.000	5.00	0.0	0.600	o	300	Pipe/Conduit	
S7.001	46.703	0.191	244.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.003	19.467	0.026	748.7	1.060	0.00	0.0	0.600	o	600	Pipe/Conduit	
S3.004	12.625	0.052	242.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.005	22.981	0.094	244.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S6.001	50.00	6.22	42.657	0.000	0.0	0.0	0.0	1.00	70.7	0.0
S7.000	50.00	5.53	42.793	0.000	0.0	0.0	0.0	1.00	70.6	0.0
S7.001	50.00	6.31	42.663	0.000	0.0	0.0	0.0	1.00	70.8	0.0
S3.003	50.00	8.15	42.172	1.060	0.0	0.0	0.0	0.88	249.4	143.5
S3.004	50.00	8.36	42.146	1.060	0.0	0.0	0.0	1.00	71.0«	143.5
S3.005	50.00	8.74	42.094	1.060	0.0	0.0	0.0	1.00	70.8«	143.5

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Manhole Schedules for SWS NETWORK 3.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	46.474	3.321	Open Manhole	1200	S3.000	43.153	300				
S2	45.401	2.287	Open Manhole	1200	S4.000	43.114	300				
S2	45.528	2.589	Open Manhole	1200	S3.001	42.939	300	S3.000	42.939	300	
								S4.000	42.939	300	
S3	44.440	1.500	Open Manhole	1200	S5.000	42.940	300				
S3	44.404	1.647	Open Manhole	1200	S3.002	42.757	300	S3.001	42.757	300	
								S5.000	42.757	300	
S6	44.269	1.500	Open Manhole	1200	S6.000	42.769	300				
S7	44.157	1.500	Open Manhole	1200	S6.001	42.657	300	S6.000	42.657	300	
S8	44.300	1.507	Open Manhole	1200	S7.000	42.793	300				
S9	44.163	1.500	Open Manhole	1200	S7.001	42.663	300	S7.000	42.663	300	
S4	43.300	1.128	Open Manhole	1500	S3.003	42.172	600	S3.002	42.472	300	
								S6.001	42.472	300	
								S7.001	42.472	300	
S3	43.100	0.954	Open Manhole	1500	S3.004	42.146	300	S3.003	42.146	600	
S2	43.100	1.006	Open Manhole	1200	S3.005	42.094	300	S3.004	42.094	300	
S1	42.421	0.421	Open Manhole	0		OUTFALL		S3.005	42.000	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	385811.546	155681.934	385811.546	155681.934	Required	
S2	385881.613	155745.348	385881.613	155745.348	Required	
S2	385845.692	155721.845	385845.692	155721.845	Required	
S3	385775.182	155731.379	385775.182	155731.379	Required	
S3	385814.207	155753.331	385814.207	155753.331	Required	
S6	385845.692	155801.446	385845.692	155801.446	Required	

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Manhole Schedules for SWS NETWORK 3.SWS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S7	385829.950	155824.062	385829.950	155824.062	Required	
S8	385708.343	155811.632	385708.343	155811.632	Required	
S9	385739.766	155805.959	385739.766	155805.959	Required	
S4	385785.187	155816.828	385785.187	155816.828	Required	
S3	385777.313	155834.632	385777.313	155834.632	Required	
S2	385767.679	155842.791	385767.679	155842.791	Required	
S1	385750.118	155857.615			No Entry	

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PIPELINE SCHEDULES for SWS NETWORK 3.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.000	o	300	S1	46.474	43.153	3.021	Open Manhole	1200
S4.000	o	300	S2	45.401	43.114	1.987	Open Manhole	1200
S3.001	o	300	S2	45.528	42.939	2.289	Open Manhole	1200
S5.000	o	300	S3	44.440	42.940	1.200	Open Manhole	1200
S3.002	o	300	S3	44.404	42.757	1.347	Open Manhole	1200
S6.000	o	300	S6	44.269	42.769	1.200	Open Manhole	1200
S6.001	o	300	S7	44.157	42.657	1.200	Open Manhole	1200
S7.000	o	300	S8	44.300	42.793	1.207	Open Manhole	1200
S7.001	o	300	S9	44.163	42.663	1.200	Open Manhole	1200
S3.003	o	600	S4	43.300	42.172	0.528	Open Manhole	1500
S3.004	o	300	S3	43.100	42.146	0.654	Open Manhole	1500
S3.005	o	300	S2	43.100	42.094	0.706	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.000	52.525	245.4	S2	45.528	42.939	2.289	Open Manhole	1200
S4.000	42.926	245.3	S2	45.528	42.939	2.289	Open Manhole	1200
S3.001	44.527	244.7	S3	44.404	42.757	1.347	Open Manhole	1200
S5.000	44.775	244.7	S3	44.404	42.757	1.347	Open Manhole	1200
S3.002	69.814	245.0	S4	43.300	42.472	0.528	Open Manhole	1500
S6.000	27.556	246.0	S7	44.157	42.657	1.200	Open Manhole	1200
S6.001	45.344	245.1	S4	43.300	42.472	0.528	Open Manhole	1500
S7.000	31.931	245.6	S9	44.163	42.663	1.200	Open Manhole	1200
S7.001	46.703	244.5	S4	43.300	42.472	0.528	Open Manhole	1500
S3.003	19.467	748.7	S3	43.100	42.146	0.354	Open Manhole	1500
S3.004	12.625	242.8	S2	43.100	42.094	0.706	Open Manhole	1200
S3.005	22.981	244.5	S1	42.421	42.000	0.121	Open Manhole	0

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Free Flowing Outfall Details for SWS NETWORK 3.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S3.005	S1	42.421	42.000	41.250	0	0

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Online Controls for SWS NETWORK 3.SWS

Hydro-Brake® Optimum Manhole: S3, DS/PN: S3.004, Volume (m³): 6.8

Unit Reference	MD-SHE-0137-8100-0700-8100
Design Head (m)	0.700
Design Flow (l/s)	8.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	137
Invert Level (m)	42.146
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	8.1	Kick-Flo®	0.504	6.9
Flush-Flo™	0.233	8.1	Mean Flow over Head Range	-	6.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	1.200	10.4	3.000	16.1	7.000	24.2
0.200	8.1	1.400	11.2	3.500	17.3	7.500	24.9
0.300	8.0	1.600	12.0	4.000	18.5	8.000	25.8
0.400	7.7	1.800	12.6	4.500	19.6	8.500	26.6
0.500	7.0	2.000	13.3	5.000	20.6	9.000	27.3
0.600	7.5	2.200	13.9	5.500	21.5	9.500	28.1
0.800	8.6	2.400	14.5	6.000	22.5		
1.000	9.6	2.600	15.1	6.500	23.4		

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Storage Structures for SWS NETWORK 3.SWS

Tank or Pond Manhole: S3, DS/PN: S3.004

Invert Level (m) 42.146

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	942.0	0.954	1715.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 3.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.383
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S3.000	S1	60 Winter	1	+40%					43.153
S4.000	S2	60 Winter	1	+40%					43.114
S3.001	S2	60 Winter	1	+40%					42.939
S5.000	S3	60 Winter	1	+40%					42.940
S3.002	S3	60 Winter	1	+40%					42.757
S6.000	S6	60 Winter	1	+40%					42.769
S6.001	S7	15 Winter	1	+40%	100/15 Winter				42.711
S7.000	S8	60 Winter	1	+40%					42.793
S7.001	S9	15 Winter	1	+40%	100/15 Winter				42.708
S3.003	S4	15 Winter	1	+40%	30/15 Summer				42.724
S3.004	S3	480 Winter	1	+40%	30/240 Winter				42.345
S3.005	S2	480 Winter	1	+40%					42.162

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for SWS NETWORK 3.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S1	-0.300	0.000	0.00		0.0	OK	
S4.000	S2	-0.300	0.000	0.00		0.0	OK	
S3.001	S2	-0.300	0.000	0.00		0.0	OK	
S5.000	S3	-0.300	0.000	0.00		0.0	OK	
S3.002	S3	-0.300	0.000	0.00		0.0	OK	
S6.000	S6	-0.300	0.000	0.00		0.0	OK	
S6.001	S7	-0.246	0.000	0.01		0.8	OK	
S7.000	S8	-0.300	0.000	0.00		0.0	OK	
S7.001	S9	-0.255	0.000	0.01		0.7	OK	
S3.003	S4	-0.048	0.000	1.03		138.4	OK	
S3.004	S3	-0.101	0.000	0.13		7.5	OK	
S3.005	S2	-0.232	0.000	0.12		7.5	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 3.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.383
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S3.000	S1	60 Winter	30	+0%					43.153
S4.000	S2	60 Winter	30	+0%					43.114
S3.001	S2	60 Winter	30	+0%					42.939
S5.000	S3	60 Winter	30	+0%					42.940
S3.002	S3	15 Winter	30	+0%					42.770
S6.000	S6	15 Winter	30	+0%					42.775
S6.001	S7	15 Winter	30	+0%	100/15 Winter				42.783
S7.000	S8	60 Winter	30	+0%					42.793
S7.001	S9	15 Winter	30	+0%	100/15 Winter				42.783
S3.003	S4	15 Winter	30	+0%	30/15 Summer				42.785
S3.004	S3	360 Winter	30	+0%	30/240 Winter				42.459
S3.005	S2	960 Summer	30	+0%					42.165

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 3.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S1	-0.300	0.000	0.00		0.0	OK	
S4.000	S2	-0.300	0.000	0.00		0.0	OK	
S3.001	S2	-0.300	0.000	0.00		0.0	OK	
S5.000	S3	-0.300	0.000	0.00		0.0	OK	
S3.002	S3	-0.287	0.000	0.00		0.2	OK	
S6.000	S6	-0.294	0.000	0.00		0.0	OK	
S6.001	S7	-0.174	0.000	0.03		1.8	OK	
S7.000	S8	-0.300	0.000	0.00		0.0	OK	
S7.001	S9	-0.180	0.000	0.03		1.7	OK	
S3.003	S4	0.013	0.000	2.25		303.0	SURCHARGED	
S3.004	S3	0.013	0.000	0.14		8.1	SURCHARGED	
S3.005	S2	-0.229	0.000	0.13		8.1	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 3.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.383
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.400 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 40, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S3.000	S1	60 Winter	100	+40%					43.153
S4.000	S2	60 Winter	100	+40%					43.114
S3.001	S2	15 Winter	100	+40%					42.942
S5.000	S3	15 Winter	100	+40%					42.949
S3.002	S3	15 Winter	100	+40%					42.960
S6.000	S6	15 Winter	100	+40%					42.990
S6.001	S7	15 Winter	100	+40%	100/15 Winter				42.990
S7.000	S8	15 Winter	100	+40%					42.989
S7.001	S9	15 Winter	100	+40%	100/15 Winter				42.989
S3.003	S4	15 Winter	100	+40%	30/15 Summer				42.995
S3.004	S3	480 Winter	100	+40%	30/240 Winter				42.728
S3.005	S2	960 Winter	100	+40%					42.165

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SWS NETWORK 3.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S3.000	S1	-0.300	0.000	0.00		0.0	OK	
S4.000	S2	-0.300	0.000	0.00		0.0	OK	
S3.001	S2	-0.297	0.000	0.00		0.0	OK	
S5.000	S3	-0.291	0.000	0.00		0.1	OK	
S3.002	S3	-0.097	0.000	0.13		9.1	OK	
S6.000	S6	-0.079	0.000	0.01		0.9	OK	
S6.001	S7	0.033	0.000	0.12		8.0	SURCHARGED	
S7.000	S8	-0.104	0.000	0.01		0.8	OK	
S7.001	S9	0.026	0.000	0.13		8.6	SURCHARGED	
S3.003	S4	0.223	0.000	3.88		523.1	SURCHARGED	
S3.004	S3	0.282	0.000	0.14		8.1	SURCHARGED	
S3.005	S2	-0.229	0.000	0.13		8.1	OK	

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Rural Runoff Calculator

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (Years)	100
Area (ha)	0.410
SAAR (mm)	785
Soil	0.450
Growth Curve	(None)

Map

Partly Urbanised Catchment (QBAR)

Urban	0.000
Region	Region 8

Calculate

Results

QBAR rural (l/s): 2.1

QBAR urban (l/s): 2.1

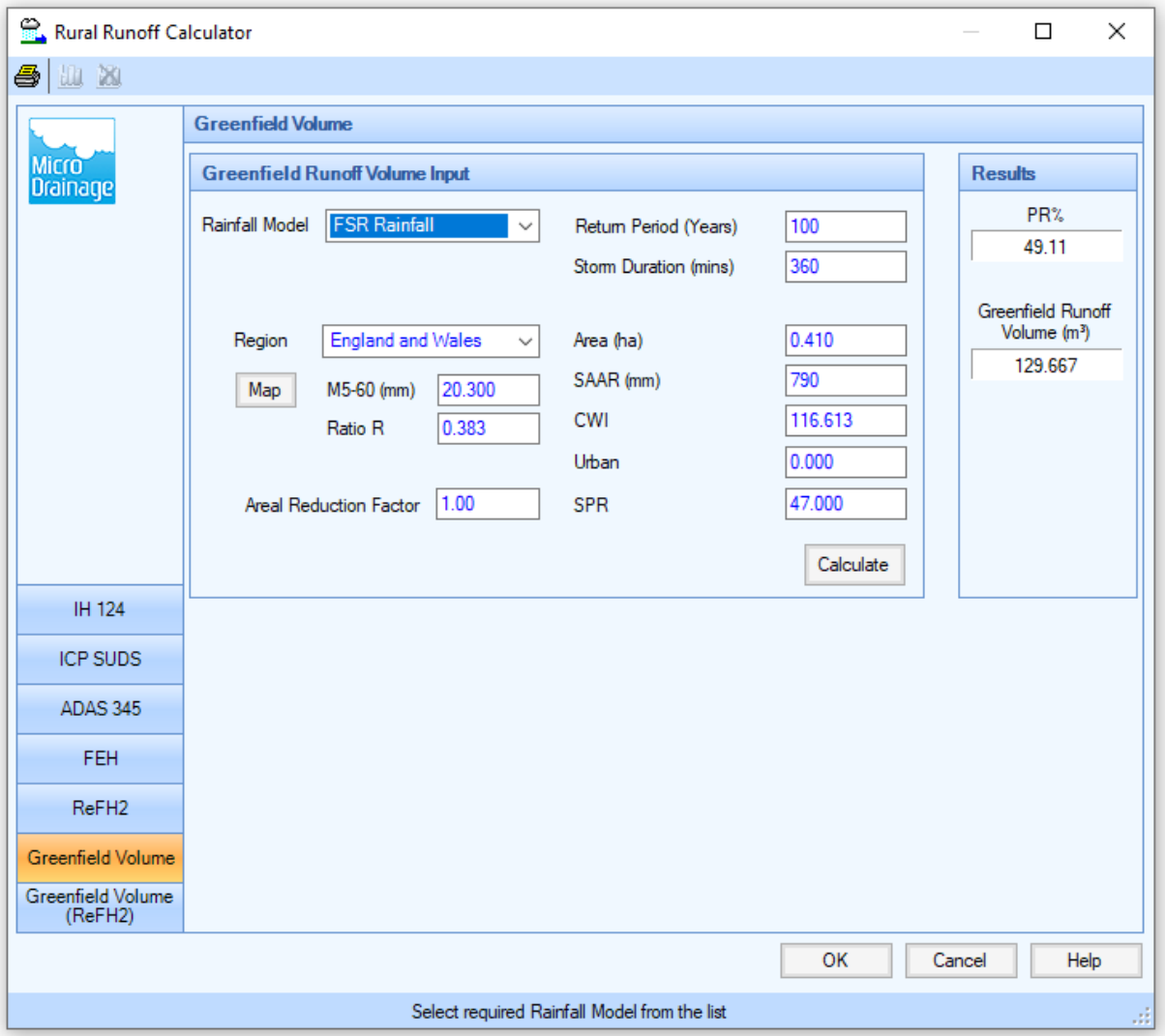
Return Period Flood

Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	2.1	5.1	1.8	3.9	5.1
Region 2	2.1	5.4	1.8	3.9	5.4
Region 3	2.1	4.3	1.8	3.6	4.3
Region 4	2.1	5.3	1.7	4.0	5.3
Region 5	2.1	7.3	1.8	4.9	7.3
Region 6/Region 7	2.1	6.6	1.8	4.7	6.6
Region 8	2.1	5.0	1.6	3.9	5.0
Region 9	2.1	4.5	1.8	3.6	4.5
Region 10	2.1	4.3	1.8	3.5	4.3

IH 124
ICP SUDS
ADAS 345
FEH
ReFH2
Greenfield Volume
Greenfield Volume (ReFH2)

OK Cancel Help

Enter Return Period between 1 and 1000


Rural Runoff Calculator
Micro Drainage
Greenfield Volume
Greenfield Runoff Volume Input
Rainfall Model
FSR Rainfall
Return Period (Years)
100
Storm Duration (mins)
360
Region
England and Wales
Area (ha)
0.410
Map
M5-60 (mm)
20.300
SAAR (mm)
790
Ratio R
0.383
CWI
116.613
Urban
0.000
Areal Reduction Factor
1.00
SPR
47.000
Calculate
Results
PR%
49.11
Greenfield Runoff Volume (m³)
129.667
IH 124
ICP SUDS
ADAS 345
FEH
ReFH2
Greenfield Volume
Greenfield Volume (ReFH2)
OK
Cancel
Help
Select required Rainfall Model from the list

Rural Runoff Calculator

IH 124
ICP SUDS
ADAS 345
FEH
ReFH2
Greenfield Volume
Greenfield Volume (ReFH2)

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (Years): 100
Area (ha): 1.210
SAAR (mm): 780
Soil: 0.450
Map
Growth Curve: (None)

Partly Urbanised Catchment (QBAR)

Urban: 0.000
Region: Region 8 ...

Calculate

Results

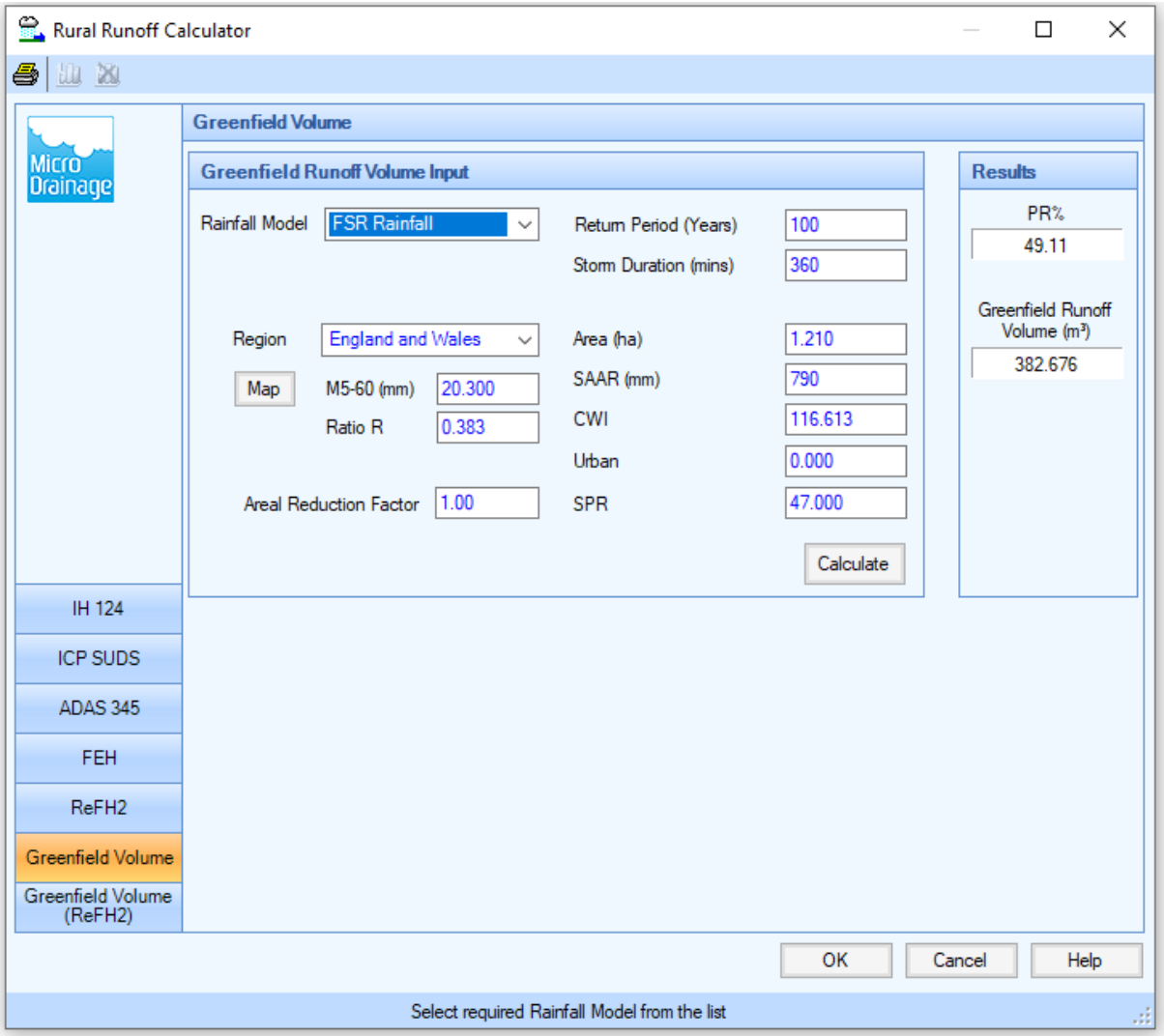
QBAR rural (l/s): 6.0
QBAR urban (l/s): 6.0

Return Period Flood

Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	6.0	15.0	5.1	11.4	15.0
Region 2	6.0	15.9	5.2	11.4	15.9
Region 3	6.0	12.5	5.2	10.6	12.5
Region 4	6.0	15.5	5.0	11.8	15.5
Region 5	6.0	21.5	5.2	14.5	21.5
Region 6/Region 7	6.0	19.2	5.1	13.7	19.2
Region 8	6.0	14.6	4.7	11.5	14.6
Region 9	6.0	13.2	5.3	10.6	13.2
Region 10	6.0	12.5	5.2	10.2	12.5

OK Cancel Help

Enter Return Period between 1 and 1000


Rural Runoff Calculator
Micro Drainage
Greenfield Volume
Greenfield Runoff Volume Input
Rainfall Model
FSR Rainfall
Return Period (Years)
100
Storm Duration (mins)
360
Region
England and Wales
Area (ha)
1.210
Map
M5-60 (mm)
20.300
SAAR (mm)
790
Ratio R
0.383
CWI
116.613
Urban
0.000
Areal Reduction Factor
1.00
SPR
47.000
Calculate
Results
PR%
49.11
Greenfield Runoff Volume (m³)
382.676
IH 124
ICP SUDS
ADAS 345
FEH
ReFH2
Greenfield Volume
Greenfield Volume (ReFH2)
OK
Cancel
Help
Select required Rainfall Model from the list

Rural Runoff Calculator

IH 124
ICP SUDS
ADAS 345
FEH
ReFH2
Greenfield Volume
Greenfield Volume (ReFH2)

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (Years): 100
Area (ha): 1.630
SAAR (mm): 780
Soil: 0.450
Map
Growth Curve: (None)
Calculate

Partly Urbanised Catchment (QBAR)

Urban: 0.000
Region: Region 8

Results

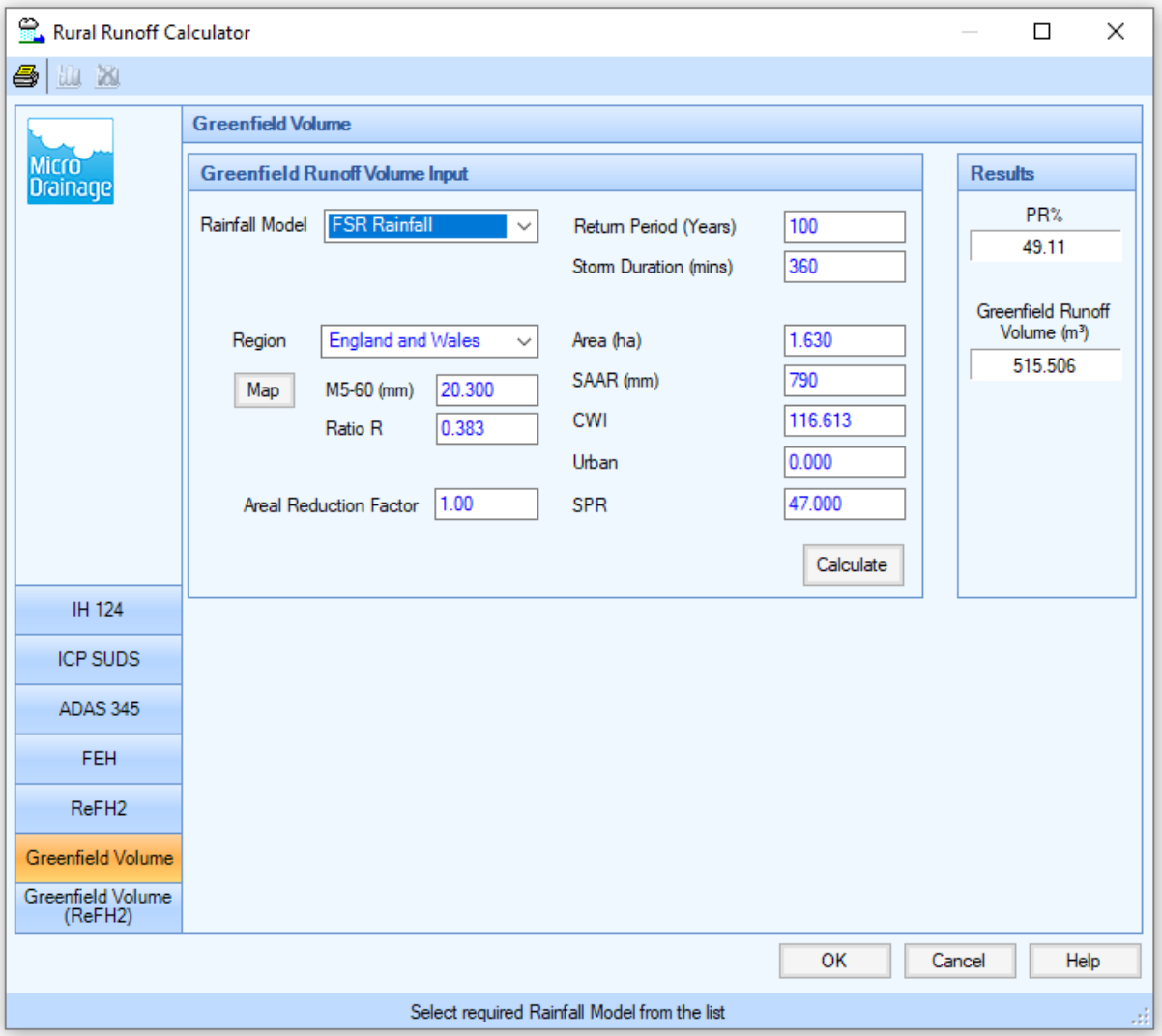
QBAR rural (l/s): 8.1
QBAR urban (l/s): 8.1

Return Period Flood

Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	8.1	20.2	6.9	15.4	20.2
Region 2	8.1	21.4	7.1	15.4	21.4
Region 3	8.1	16.9	7.0	14.3	16.9
Region 4	8.1	20.9	6.7	15.9	20.9
Region 5	8.1	28.9	7.1	19.5	28.9
Region 6/Region 7	8.1	25.9	6.9	18.4	25.9
Region 8	8.1	19.7	6.3	15.5	19.7
Region 9	8.1	17.7	7.2	14.3	17.7
Region 10	8.1	16.9	7.1	13.8	16.9

OK Cancel Help

Enter Return Period between 1 and 1000


Rural Runoff Calculator
Micro Drainage
Greenfield Volume
Greenfield Runoff Volume Input
Rainfall Model
FSR Rainfall
Return Period (Years)
100
Storm Duration (mins)
360
Region
England and Wales
Area (ha)
1.630
Map
M5-60 (mm)
20.300
SAAR (mm)
790
Ratio R
0.383
CWI
116.613
Urban
0.000
Areal Reduction Factor
1.00
SPR
47.000
Calculate
Results
PR%
49.11
Greenfield Runoff Volume (m³)
515.506
IH 124
ICP SUDS
ADAS 345
FEH
ReFH2
Greenfield Volume
Greenfield Volume (ReFH2)
OK
Cancel
Help
Select required Rainfall Model from the list

development planning
infrastructure design
transport
HIGHWAYS
drainage
CIVIL ENGINEERING
site appraisal
flood risk assessment
travel plans
masterplanning

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