ARDENT
CONSULTING ENGINEERS

Land South of Henham Road, Elsenham

FLOOD RISK ASSESSMENT
& DRAINAGE STRATEGY

REPORT REF NO. 2008170-05A
PROJECT NO. 2008170
JUNE 2022

HEAD OFFICE: 3rd Floor, The Hallmark Building, 52-56 Leadenhall Street, London, EC3M 5JE T | 020 7680 4088
ESSEX: 1 - 2 Crescent Court, Billericay, Essex, CM12 9AQ T | 01277 657 677
KENT: Suite 10, Building 40, Churchill Business Centre, Kings Hill, Kent, ME19 4YU T | 01732 752 155
MIDLANDS: Office 3, The Garage Studios, 41-43 St Mary's Gate, Nottingham, NG1 1PU T | 0115 697 0940
SOUTH WEST: City Point, Temple Gate, Bristol, BS1 6PL T | 0117 456 4994
SUFFOLK: Suite 110, Suffolk Enterprise Centre, 44 Felaw Street, Ipswich, IP2 8SJ T | 01473 407 321

Email: enquiries@ardent-ce.co.uk

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-	FOR PLANNING	AW	AW	BB	APRIL 2022
A	FOR PLANNING	AW	AW	BB	JUNE 2022

1. INTRODUCTION

1.1. Ardent Consulting Engineers (hereafter referred to as "Ardent") has been commissioned by Countryside Partnerships PLC to undertake a Flood Risk Assessment (FRA) for the Land South of Henham Road, Elsenham (hereafter referred to as 'the Site').

1.2. The Site is 5.34ha in area and the EA Flood Map shows that the majority of the Site is within Flood Zone 1. There is a small amount of the site, in the southeast corner along the boundary, that is within Flood Zone 2. However, as the development is over 1ha, shows some surface water flooding along the southern boundary and a small section of the development is within Flood Zone 2, a Flood Risk Assessment (FRA) is therefore required to support the planning application for this Site.

1.3. The contents of this FRA assess the implications of flood risk on the proposed development. This FRA has been prepared with specific reference to the requirements of National Planning Policy Framework (NPPF) released in July 2021 and the Planning Practice Guidance (PPG), which superseded the Technical Guidance to the NPPF, in March 2014. This report also takes into consideration the requirements within the Non-statutory technical standards for sustainable drainage systems (March 2015) and its Practice Guidance (July 2015).

1.4. This FRA has been prepared to support a planning application to be submitted to Uttlesford District Council (UDC).

Site Location

NEAREST POSTCODE	NGR	AREA(ha)	LLFA
CM22 6DG	TL539262	5.34	ECC

1.5. The application site is bound by Henham Road to the north, Hall Road to the west, the EA Main River Stansted Brook to the south and a ditch to the east.

1.6. The site is located on the eastern edge of the town of Elsenham, as shown in **Figure 1-1**.

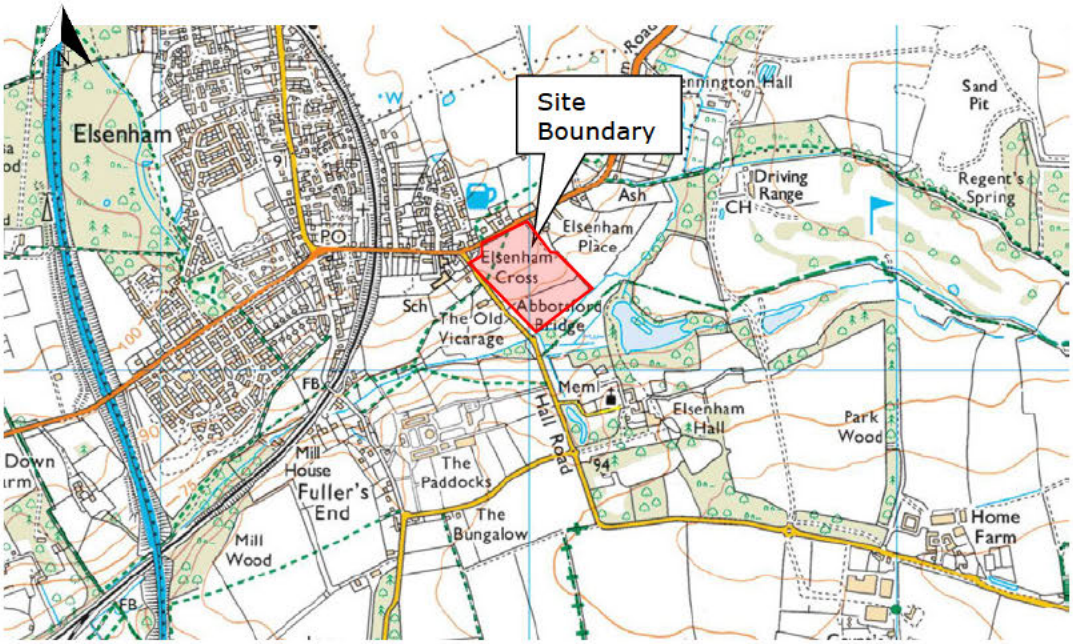

Figure 1-1: Site Location Plan

Development Proposals

1.7. The proposal includes the development of the greenfield site south of Henham Road, for 130 residential dwellings with associated parking, landscaping and infrastructure works.

1.8. The proposed development is illustrated in **Figure 1-2**; refer to **Appendix A** for the full development proposals.

Figure 1-2: Proposed layout

2. POLICY CONTEXT

National Planning Policy Framework

2.1. The National Planning Policy Framework (NPPF) was introduced on 27 March 2012. It was then revised in July 2018, February 2019 and most recently in July 2021; where paragraphs 159 to 169 inclusive establish the Planning Policy relating to flood risk management. The Technical Guide to the NPPF has been superseded by the Planning Practice Guidance (PPG) in March 2014.

2.2. It states all plans should apply a sequential, risk-based approach to the location of development – considering all sources of flood risk and the current and future impacts of climate change – to avoid where possible, flood risk to people and property. They should do this and manage residual risk, by:

- applying the sequential test and then, if necessary, the exception test as set out below;
- safeguarding land from development that is required, or likely to be required, for current or future flood management;
- using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and
- where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

2.7. The Planning Practice Guidance (PPG) provides the methodology required to undertake the Sequential and Exception Tests.

Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems (March 2015)

2.8. The Non-statutory technical standards for sustainable drainage systems were published in March 2015. They should be used in conjunction with the Planning Practice Guidance. In addition, the Best Practice Guidance for the Non-statutory technical standards was published in July 2015 by LASOO.

2.9. The Local Planning Authority (LPA) may set local requirements for planning permission that have the effect of more stringent requirements than these non-statutory technical standards.

2.10. In addition, SuDS should be designed in accordance with CIRIA 753 SuDS Manual, which represents current best practice.

Sequential Test Requirements

2.11. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the 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. As only a very small part of the site is located in Flood Zone 2, it is considered that the Sequential Test is not required. However, this should be confirmed with the Local Planning Authority.

Exception Test Requirements

2.1. Table 2 (Flood risk vulnerability classification) of the Planning Practice Guidance (PPG) classes the residential use as More Vulnerable. According to Table 3 (refer to **Table 2-1** below) of the PPG, the developable area of the Site, which is located in Flood Zone 1/2, is not required to undergo the Sequential and Exception Tests and is appropriate for the development.

Table 2-1: Extract from the PPG - Table 3: Flood Risk Vulnerability

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

3. BASELINE CONDITIONS

Hydrology

3.1. There is an existing Main River, as identified by the Environment Agency, along the southern boundary of the site. The EA Main River is identified as the Stansted Brook.

Topography

3.2. A topographical survey of the site was carried out in March 2021 and is included in **Appendix B**. Elevations across the Site are in the order of 94.42 – 80.95 mAOD. With a relatively steep slope generally falling from north to south, at a gradient of approximately 1 in 20.

Ground Conditions

3.3. A review of the British Geological Survey (BGS) mapping indicates that the bedrock geology of the site consists of Thanet Formation and Lambeth Group (clay, silt and sand) with superficial deposits of Kesgrave Catchment Subgroup (sand and gravel) in the northern part of the site and Head Clay in the southern area of the site. Refer to **Figure 3-1** for an extract of the mapping.

3.4. Nearby borehole records indicate (approximately 35m northwest of the site) that that the site is underlain by Kesgrave Sands and Gravels, as suggested by the BGS mapping, up to a depth of 5.7m BGL, then by Red Grag to a depth of 6.7m BGL and then London Clay beyond this for the depth of the borehole at 8m deep. Water was struck at 92.1mAOD, 2.7m below ground levels.

3.5. At this stage a site investigation has not been undertaken, and therefore based upon the BGS mapping information and the underlying geology, it has been assumed that infiltration is not viable. At detail design stage a site investigation will be undertaken and if infiltration is deemed appropriate, the drainage strategy will be amended to suit.

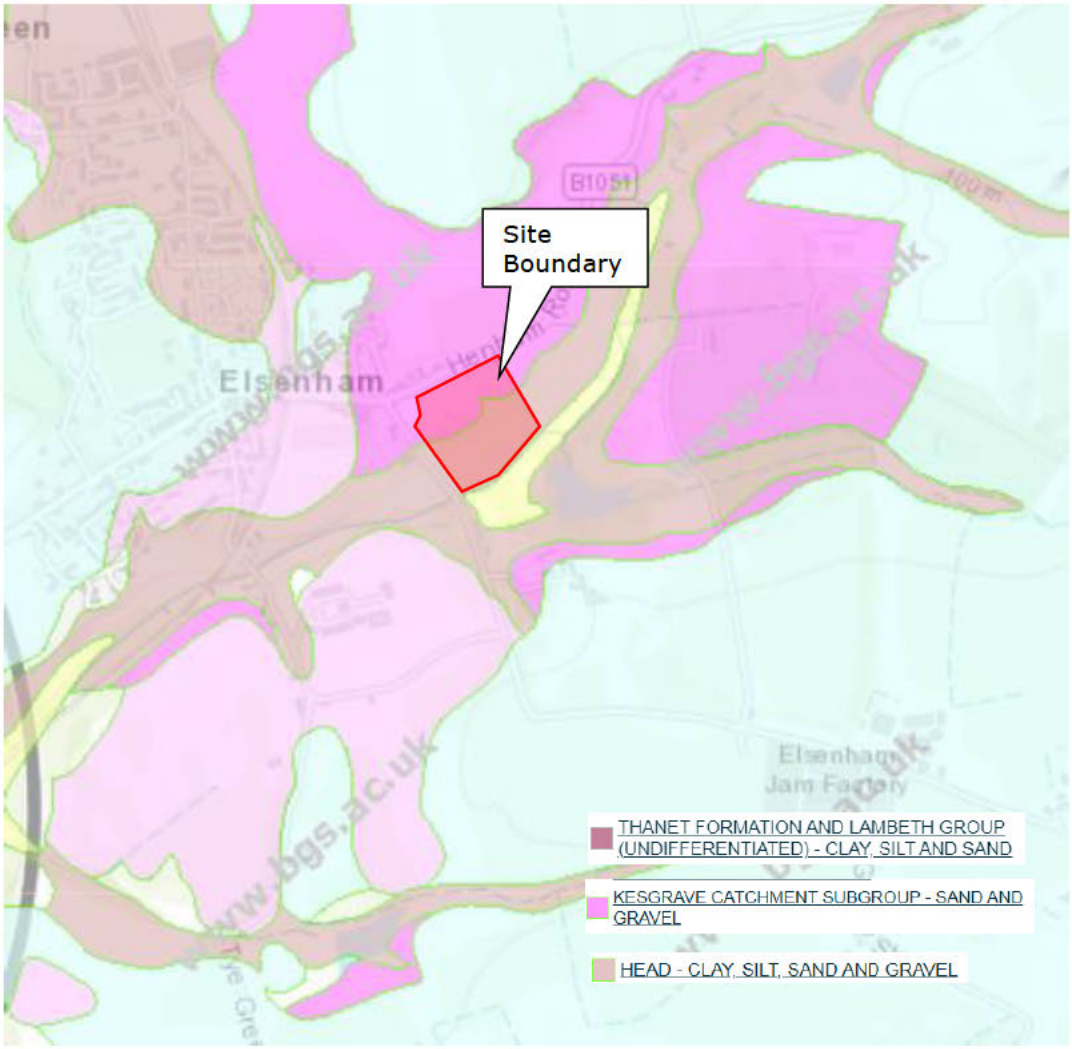

Figure 3-1: BGS Online Geology Mapping

Existing Sewer Infrastructure

3.6. Thames Water asset plans have confirmed that there is a 150mm dia. Foul sewer running east to west within the southern half of the site boundary. This sewer then connects into a 225mm dia. Foul sewer located within Hall Road. There is also a 150mm dia. Foul sewer north of the site within Henham Road. There is also a foul water rising main located along the western boundary of the site along the edge of Hall Road. The nearest surface water sewer is located to the northwest of the site, approximately 125m from the site boundary, within the junction of Hailes Wood. A survey of the drainage has also been undertaken to confirm the location of the sewers within the site. The full Thames Water asset plans and drainage surveys are provided in

Appendix C.

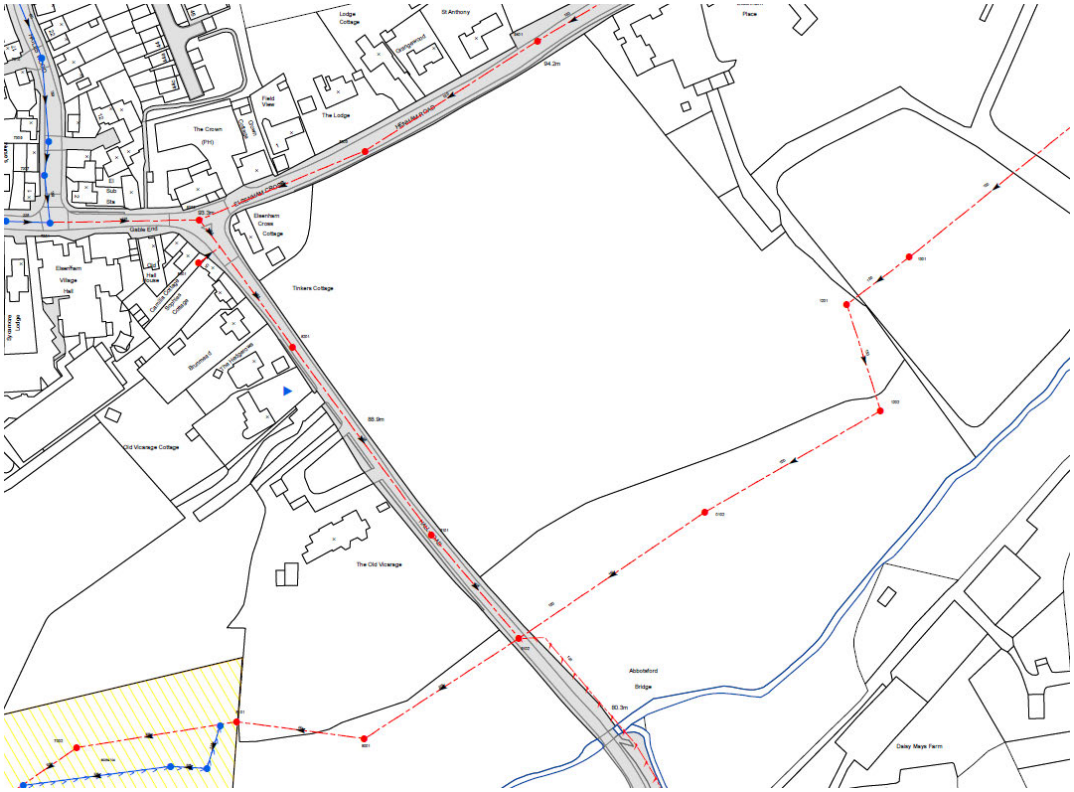

Figure 3-2: Thames Water Sewers

4. SOURCES OF FLOODING

4.1. The NPPF requires flood risk from the following sources to be assessed, each of which are assessed separately below:

- Fluvial sources (river flooding);
- Tidal sources (flooding from the sea);
- Sewer Flooding;
- Groundwater sources;
- Pluvial sources (flooding resulting from overland flows);
- Artificial sources, canals, reservoirs etc.; and,
- It also requires the risk from increases in surface water discharge to be assessed (surface water management).

Flood Zone Designation

4.2. Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. The NPPF Planning Practice Guidance defines Flood Zones as follows:

- **Flood Zone 1: Low Probability**. Land having a less than 1 in 1,000 annual probability of river or sea flooding.
- **Flood Zone 2: Medium Probability**. Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
- **Flood Zone 3a: High Probability**. Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
- **Flood Zone 3b: The Functional Floodplain**. This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency

Fluvial / Tidal Flooding

4.3. Based on the Environment Agency's (EA) Flood map for planning, the vast majority of the Site is located in Flood Zone 1. A small part immediately adjacent to the Stansted Brook is located in Flood Zone 2.

4.4. In line with the NPPF, developments must consider the impact of climate change extents to inform flood mitigation measures and safe access and egress levels. Climate change allowances are based on peak river flow by management catchment and the latest climate change allowances were released in July 2021. The guidance states that the central estimate should be used for 'More Vulnerable' development and at the site this is 10%.

4.5. On review of correspondence undertaken with the EA on a nearby scheme (UTT/19/0462/FUL), it was identified that the EA does not have flood level datum or updated climate change outlines for this area.

4.6. In the absence of updated climate change outlines, it is proposed to assess the impact of climate change using the guidance in the EA's Thames Area Climate Change Allowances (TACCA) (2017). As per Table A in the TACCA, an 'Intermediate/Basic' approach for Large-Major 'more vulnerable' developments is appropriate.

4.7. As the Site sits broadly in Flood Zone 1, the 'Basic' approach of assessment is proposed. This approach was accepted on the nearby scheme (UTT/19/0462/FUL) which was for a full planning application of a residential development for 130 residential dwellings. The site rises steeply away from the watercourse, keeping any developable area higher than the flood levels. Acceptance of this approach from the EA is currently pending review.

4.8. The 'Basic' approach involves the addition of an allowance to the 'design flood' (i.e. 1% annual probability) peak levels to account for potential climate change impacts. As per Table B in the TACCA, an allowance of 500mm is applied to the Central event.

4.9. Flood water levels during the 1% annual probability have been estimated from comparing the flood extents with Lidar data. The increased depth has been added to these values to provide an approximate flood level for the 1% annual probability plus climate change event. A Climate Change Flood Level Plan identifying the climate change flood outline underlaid by the proposed development is included in **Appendix I**. As is shown by the plan, the proposed development is outside of the flood outline. Based on this assessment, the maximum 1 in 100 year, including climate change, flood level at the site is 81.6m AOD.

4.10. To give further confidence that development can be situated above the climate change levels, further assessment of the flood plain was undertaken by reviewing Lidar cross-sections along the Stansted Brook. The cross sections identify that the land to the south of the Stansted Brook are considerably lower than the proposed development Site. This will result in flood water naturally flowing to the south of the site utilising the available flood plain and minimising the rise of water onto the Site. It is therefore considered that the development has a low risk of fluvial flooding due to the impacts of climate change.

4.11. The location of the cross-sections are shown on the Climate Change Flood Level Plan in **Appendix I** with the cross-sections shown below in **Figure 4-1** and **Figure 4-2**.

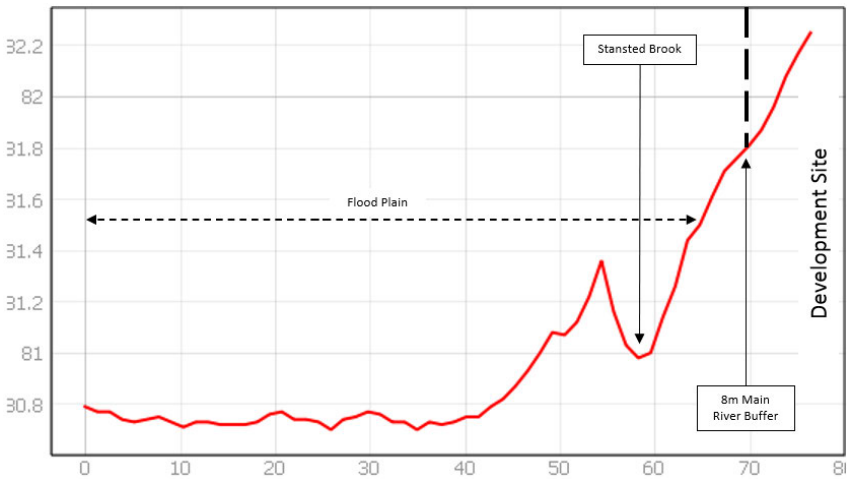

Figure 4-1: Cross-Section A-A

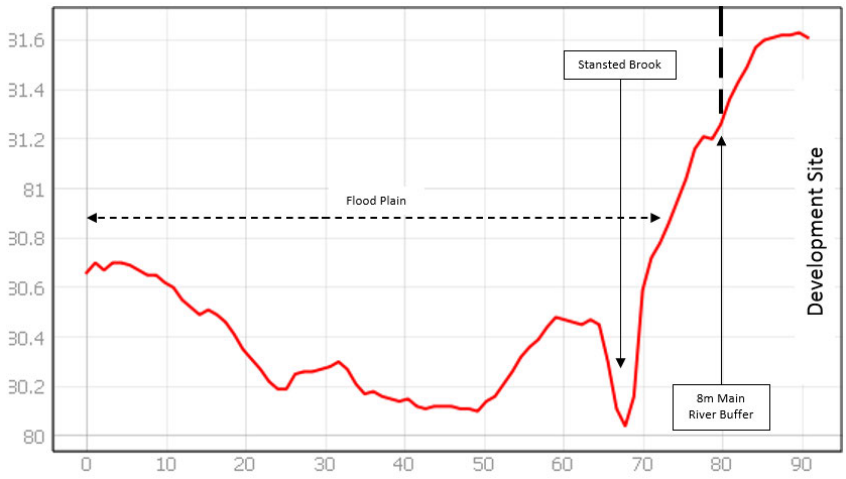

Figure 4-2: Cross-Section B-B

Pluvial Flooding

4.12. The Environment Agency surface water flood maps show that the majority of the development site is in an area that has a 'very low' risk of surface water flooding, meaning that there is less than a 0.1% chance of flooding from surface water flooding each year.

4.13. There are areas of 'low' to 'medium' risk of surface water flooding along the southern boundary of the site, which is assumed to be associated with the EA Main River. Refer to **Figure 4-2** below.

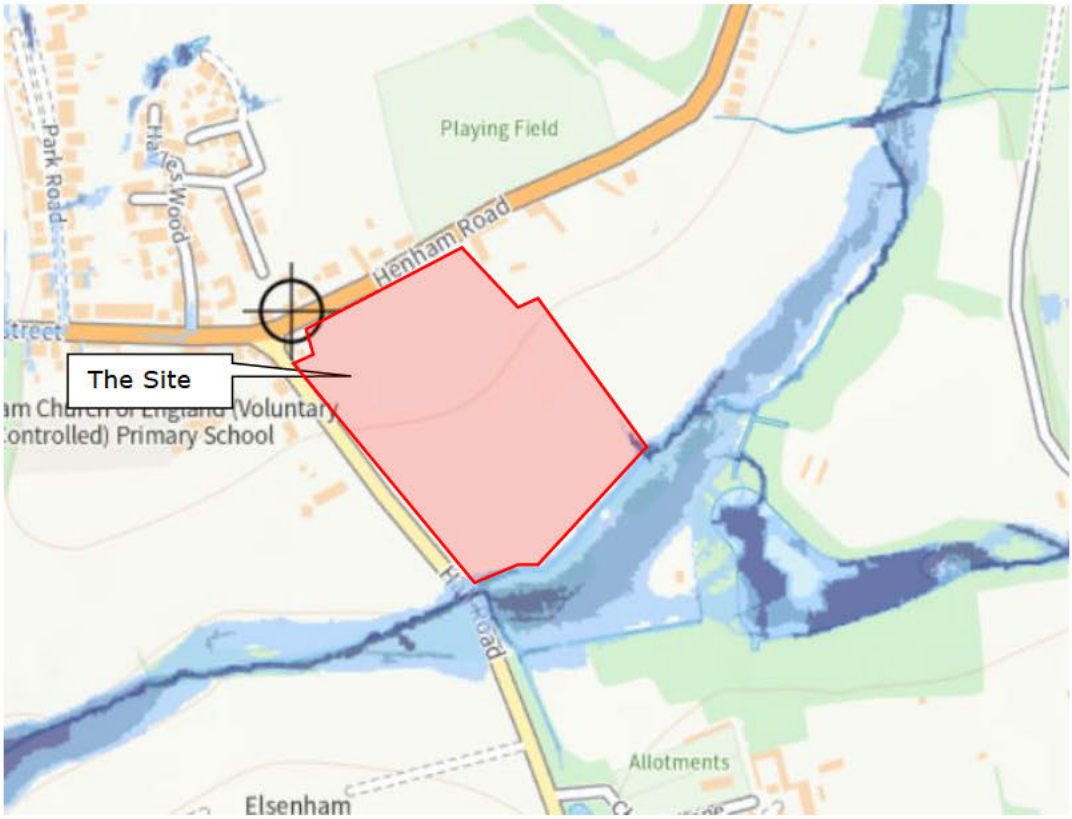

Figure 4-1: Environment Agency Flood Map for Surface Water

Groundwater Flooding

4.14. Local boreholes located approximately 35m to the northwest of the site showed ground water at a depth of approximately 2.5m below ground levels. Reinforcing that ground water may only pose a risk to sub ground level development. Any risk of groundwater flooding can be quantified following the site investigation and groundwater monitoring proposed at detail design stage. However, the risk can be mitigated by providing suitable conveyance routes and lined above ground SuDS such as swales and basins which will capture and convey and localised run-off.

Sewer Flooding

4.15. There is no record of sewer flooding within the vicinity of the Site based on the Essex County Council Historic Sewer Flooding Records 2012.

4.16. The risk of sewer flooding is therefore assessed as low.

Artificial Sources

4.17. According to the Environment Agency's Flood risk from reservoir map, the Site is not in an area at risk of flooding from artificial sources.

4.18. The site is therefore considered to be at a 'very low' risk of flooding from artificial sources.

5. FLOOD MITIGATION MEASURES

Finished Floor Levels

5.1. The vast majority of the site is located within Flood Zone 1 and there is low/negligible risk of flooding from other sources discussed in this report.

5.2. Finished ground floor levels of the proposed properties will be set 300mm above the 1 in 100 year, including climate change, flood level. The maximum flood level is 81.6m AOD. Therefore, finished floor levels will be set at a minimum of 81.9m AOD.

Main river buffer

5.3. To allow access to the watercourse for maintenance, no development is proposed within 8m of the Stansted Brook.

6. SURFACE WATER DRAINAGE STRATEGY

6.1. DEFRA's Non-statutory technical guidance for Sustainable Drainage Systems and CIRIA Guidance C753 "The SuDS Manual" have been used to determine the appropriate SuDS Strategy, which considers the spatial and environmental constraints of the Site.

6.2. Under the NPPF an allowance of 40% for the effects of climate change will achieve the policy requirements for the proposed development.

Surface Water Drainage Options Consideration

6.3. In line with CIRIA guidance C753 (The SuDS manual), the drainage hierarchy needs to be considered and is listed below in order of preference:

- Store rainwater for later use;
- Use infiltration techniques, such as porous surfaces in non-clay areas;
- Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse;
- Discharge rainwater direct to a watercourse;
- Discharge rainwater to a surface water drain; and
- Discharge rainwater to the combined sewer.

Store rainwater for later use

6.4. There is potential to reuse a percentage of the rainwater within the site by installing water butts on houses. However, this only accounts for a small proportion of the runoff during a storm event and therefore other options need to be considered in parallel.

Use infiltration techniques, such as porous surfaces in non-clay areas

6.5. BGS mapping and nearby borehole records indicates the presence of Lambeth Group and Thanet Formation (clay, sand, silt), which is considered to have poor infiltration qualities. Therefore, infiltration potential is assumed negligible and has be discounted as an option.

Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse

6.6. The surface water drainage strategy for the proposed development will mimic the existing greenfield drainage, with gradual release of surface water runoff to the Main River to the south of the Site. This is achieved through flow restrictions prior to discharging to the river.

6.7. Attenuation will be provided upstream of the flow control devices by a combination of swales and attenuation basins.

6.8. Discharge will be restricted to the greenfield rates, with surface water attenuation provided up to the 1 in 100 year climate change event.

Sustainable Drainage Systems (SuDS) Hierarchy

6.9. **Table 5-1** below appraises the constraints and opportunities for the use of SuDS techniques within the site and it adopts the management train approach outlined in CIRIA C753 'The SuDS Manual'.

Table 6-1: Existing and Proposed Areas

Type:	**Infiltration Devices** (Source Control)
Constraints:	Underlying geology is assumed not compatible with infiltration systems.
Opportunities:	No opportunities due to ground conditions.
Type:	**Lined Permeable Paving** (Source Control)
Constraints:	It is not possible to provide infiltrating permeable paving/permavoid due to site characteristics (as per infiltration devices above). Can only be provided within private areas (e.g. private car parks or private drives) due to adoption issues.
Opportunities:	Permeable paving wrapped in geo-membrane could be used within private areas to provide surface water attenuation and a stage of treatment before discharging into the drainage system if required for treatment.
Type:	**Rainwater Harvesting** (Source Control)
Constraints:	The benefits of rainwater harvesting on a specific design storm event cannot be quantified, due to the seasonal availability of storage within the structure.
Opportunities:	Opportunities in amenity areas to provide harvesting features such as water butts exist. However, it is difficult to quantify contribution, and therefore not included within calculations as part of this surface water management strategy.
Type:	**Swales, etc.** (Permeable Conveyance)
Constraints:	In order to provide practicable attenuation benefits 1:3 side-slope swales tend to require a significant land requirement. Due to potential slope stability issues gradients are required to be flatter than 1:3, requiring more land take.

Opportunities:	There are some available landscaped areas around the edge of the development to provide small extents of swales.
Type:	**Attenuation Basins**
Constraints:	In order to provide practicable attenuation benefits, 1:3 side-slopes on the basin tend to require a significant land requirement. Due to potential slope stability issues gradients are required to be flatter than 1:3, requiring more land take.
Opportunities:	There are some available landscaped areas around the edge of the development to provide basins for storage.
Type:	**GreenRoofs**
Constraints:	Subject to Architect's design.
Opportunities:	None due to the proposed pitched roofs of the dwellings.
Type:	**Attenuation Tanks** (end of pipe treatment)
Constraints:	None
Opportunities:	Should additional attenuation be required this could be achieved by use of oversized sewers or geo-cellular storage attenuation.

6.10. After consideration of the CIRIA C753 SuDS Management Train approach, the most viable SuDS options for this site is a solution combining a series of cascading basins and under-drained swales for storage and treatment, along with some additional buried storage to provide all storage required. Refer to **Drawing No. 2008170-030** in **Appendix D** for the proposed surface water drainage strategy.

Existing and Proposed Surface Water Discharge Rates

Existing development

6.11. The planning red line boundary area equates to 5.34 ha and comprises entirely of greenfield land. From the existing topography of the site, it is assumed that surface water runoff currently flows to the surrounding ditches on the site and the Stansted Brook to the south.

6.12. The existing greenfield runoff rates from the site were calculated using Microdrainage's ICP SuDS method and are presented in **Table 6-2** below. Full calculations can be found in **Appendix E**.

Table 6-2: Existing and Proposed Discharge rates

Return Period Event	Existing Greenfield (l/s)	Proposed Discharge Rate (l/s)
1:1	6.3	6.3
1:30	16.8	13.1
1:100	23.7	18.3
1:100 +40% CC	-	23.6

Proposed development

6.13. After consideration of the CIRIA C753 management train approach, the most viable SuDS options for the Site are cascading attenuation basins and swales in order to provide appropriate water quality treatment prior to discharge into the Stansted Brook.

6.14. The site is not suitable for implementing any infiltration SuDS systems due to underlying geology.

6.15. In line with the ECC SuDS Design Guide, discharge rates from new developments should be restricted to greenfield rates or as close as practically possible. The proposed strategy is to flow match to the existing greenfield runoff rates, as shown in **Table 6-2**.

6.16. It is proposed for the site to discharge the surface water into the EA Main River, the Stansted Brook, to the south of the site to mimic the existing topography of the site.

6.17. In order to achieve the proposed discharge rates, the total storage volume has been provided within the proposed basins and buried storage, with freeboard provided within the basins. **Table 6-3** below breaks down the storage for the 2 catchments and where the storage has been provided.

Table 6-3: Storage Requirements

Catchment	Storage required for the 1:100 year + 40% CC Storm Event (m^3)	Total Storage provided (m^3)	Storage within Basin (m^3)	Storage within Buried Storage (m^3)
A	905	1042	1042	N/A
B	531	676	415	261
Total	1436	1718	1457	261

6.18. Within the multiple basins, flows will be restricted prior to discharging further downstream, to utilise the storage within the basins.

6.19. Additional storage will be available within the swales, although this has not been accounted for in the preliminary calculations.

6.20. MicroDrainage Source Control modelling results show there is no flooding on the Site for the 1 in 100 year including 40% climate change

rainfall event and a 300mm freeboard has been provided within the basin. MicroDrainage modelling results are included in **Appendix E**.

6.21. For the Proposed Drainage Strategy, refer to **Appendix D**.

Surface Water Quality

6.22. An assessment of the water quality of surface water runoff has been carried out in line with CIRIA C753 requirements, refer to **Appendix F**.

6.23. In determining the necessary SuDS treatment methods, reference is made to Table 26.2, Table 26.3 and Table 26.4 of the SuDS Manual (CIRIA C753), which have been duplicated in **Appendix F**. The tables outline the 'Simple Index Approach' which sets out the water treatment criteria in relation to land use and SuDS performance evidence. To ensure sufficient treatment is proposed for surface waters, the total pollution mitigation index of the selected SuDS methods must equal or exceed the pollution hazard index for the site.

6.24. Based upon the proposed estate road layout within the development, it is anticipated that the majority of the roads within the development parcels will accommodate less than 300 traffic movements per day, apart from the initial access to the site. The majority of the estate roads are therefore considered Low Risk, with the site access deemed Medium Risk.

6.25. As the calculations demonstrate, a series of cascading basins provide sufficient treatment for the Low and Medium Risk development. It has therefore been demonstrated that adequate treatment is provided within the proposed SuDS network prior to discharge of run-off into the existing watercourses. In addition to the basins considered within the pollution assessment, additional road side swales will be incorporated to provide additional source control.

Long Term Storage and Urban Creep

6.26. As the site is not being restricted to the 1 in 1 year greenfield rate, an allowance for Long Term Storage (LTS) is required. The LTS volume

for the total development site has been estimated as 344m³ (calculations are included within **Appendix G).** Long term storage will be provided for within the freeboard of Basin A. Flow restrictions will be installed to limit the discharge at 1l/s, under the maximum of 2l/s/Ha required for long term storage.

6.27. In accordance with the LASOO Best Practice Guidance for the Non statutory technical standards, urban creep will be applied to the site. A 10% increase of impermeable area has been applied to house and garage roof areas.

Future Maintenance

6.28. A management company will be appointed to maintain communal areas, landscaping and shared SuDS throughout the development.

6.29. All maintenance will be in accord with the best practices and the CIRIA Manual C753. Please refer to **Appendix H** for an overview of the maintenance tasks required.

Half Drain Time

6.30. The half drain time for the development, after a 1 in 30 year event, can be seen within **Table 6-4**. The half drain time requirements set out within the ECC Sustainable Drainage Systems Design Guide (February 2020), is to half drain within 24 hours for a 1 in 30 year storm event.

Table 6-4: Half Drain Times

Basin	Half Drain Time (hours)	Does it meet the 24 hour half drain time?	Freeboard after 1:30 year storm (mm)	Freeboard after a 1:10 year storm and 1 in 30 year (mm)
A	64.7	No	561	216
B	4.2	Yes	N/A	N/A

6.31. Basin B can be seen to half drain within 4.4 hours, greatly under the 24 hour requirement.

6.32. Basin A, does not meet the half drain time requirement, half draining within 64.7 hours at a rate of 1l/s. As per the ECC SuDS Design Guide, if the half drain time of 24 hours cannot be achieved, then a 1 in 10

year storm event must be accommodate directly after a 1 in 10 year storm event. The freeboard within Basin after a 1:30 year storm event will be 561mm. A 1 in 10 year storm has been run after the 30 year storm and shows that a freeboard of 216mm is still provided. For further calculations on the storm events, refer to **Appendix E**.

7. PROPOSED FOUL WATER DRAINAGE STRATEGY

7.1. The existing site is currently greenfield land, and thus has no foul water flows associated with the site.

7.2. Based on the Sewerage Sector Guidance Appendix C of 0.05 l/s per dwelling, the peak foul flow rate for the proposed development is calculated to be 6.5l/s.

7.3. There is currently a 150mm dia. foul sewer running through the southern half of the development. It is proposed that this existing sewer will be diverted through the development.

7.4. It is proposed that foul flows from the development will discharge into the diverted Thames Water foul sewers within the development boundary.

7.5. Under the Ofwat Charging agreement, from April 2020, existing sewer networks are obliged to accommodate flows from new developments.

7.6. For the foul drainage strategy, refer to **Appendix D**.

8. CONCLUSIONS

8.1. This FRA has been produced to support the outline planning application for the proposed residential development at the land south of Henham Road, Elsenham.

8.2. The proposal includes the development of the greenfield site south of Henham Road, for 130 residential dwellings with associated parking, landscaping and infrastructure works.

8.3. The majority of the Site is located in Flood Zone 1, with a small portion of the site located in Flood Zone 2 along the southern boundary. The Environment Agency's surface water flood maps show that the development site is in an area that has a 'Low' risk of surface water flooding, with a small section of 'medium' risk along the southern boundary of the site, and no other means of flooding identified as posing a risk to the site.

8.4. Finished flood levels will be raised to a minimum of 300mm above the 1 in 100 year, including climate change, flood level (81.6m AOD + 300mm) above a level of 81.9m AOD. All development will be set a minimum of 8m back from the adjacent Stansted Brook main river.

8.5. The drainage strategy set out in this report is suitable to protect the site and surrounding areas from surface water flooding for all events up to and including the 1 in 100-year storm event including climate change.

8.6. The peak foul flow rate for the proposed development is calculated to be 6.5 l/s. It is proposed that foul flows from the development will discharge into Thames Water foul sewer running through the site, which is proposed to be diverted through the developments highways. Under the current Ofwat charging scheme, Thames Water must provide capacity within their network to accommodate the proposed development.

8.7. In conclusion, this FRA demonstrates that the proposals are consistent with the aims of NPPF, PPG and ECC SuDS Guidance. The site would

not be at risk of flooding or increase the flood risk to others as a result of the proposed flood mitigation works.

Appendix A

Proposed Development Layout

1:500
0m 5m 15m 30m

ELSENHAM CROSS
HENHAM ROAD
COURTYARD
ENTRANCE GREEN
BUNGALOWS
ELSENHAM PLACE BARNS
ORCHARD
ARRIVAL POINT
HALL ROAD
OLD VICARAGE
HERITAGE TRAIL
COURTYARD
COURTYARD
COURTYARD
RETAINED DITCH
BASIN
HERITAGE TRAIL
PLAY AREA
BASIN
STANSTED BROOK
VIEW TO ST. MARY'S

KEY

- SITE BOUNDARY
- LISTED BUILDINGS
- PUBLIC FOOTPATH
- EXISTING TREES
- PROPOSED BUILDINGS
- LANDMARKS
- KEY VIEWS
- PROPOSED TREES

DAP

HENHAM ROAD
ILLUSTRATIVE LAYOUT PLAN
LAND SOUTH OF HENHAM ROAD
ELSENHAM
BISHOPS STORTFORD, CM22 6DN
COUNTRYSIDE
28.03.2022 1:500@A1 PROJECT 1669
303.02

Appendix B

Topographical Survey

N

0 0 0 0 0 0

Countryside
Properties

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U V 9

Appendix C

Thames Water Asses Plans and Sewer Survey

Asset location search

Property Searches

Ardent Consulting Engineers
52-56 Leadenhall Street
LONDON
EC3M 5JE

Search address supplied St. Anthonys
Henham Road
Elsenham
Bishop'S Stortford
CM22 6DH

Your reference 2008170

Our reference ALS/ALS Standard/2020_4318959

Search date 8 December 2020

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
[redacted]

0845 070 9148

Asset location search

Property Searches

Search address supplied: St. Anthonys, Henham Road, Elsenham, Bishop'S Stortford, CM22 6DH

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: [redacted]

Asset location search

Thames Water Property Searches

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd
Tamblin Way
Hatfield

Asset location search

Thames Water Property Searches

AL10 9EZ
Tel: 0345 3572401

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Clean Water queries

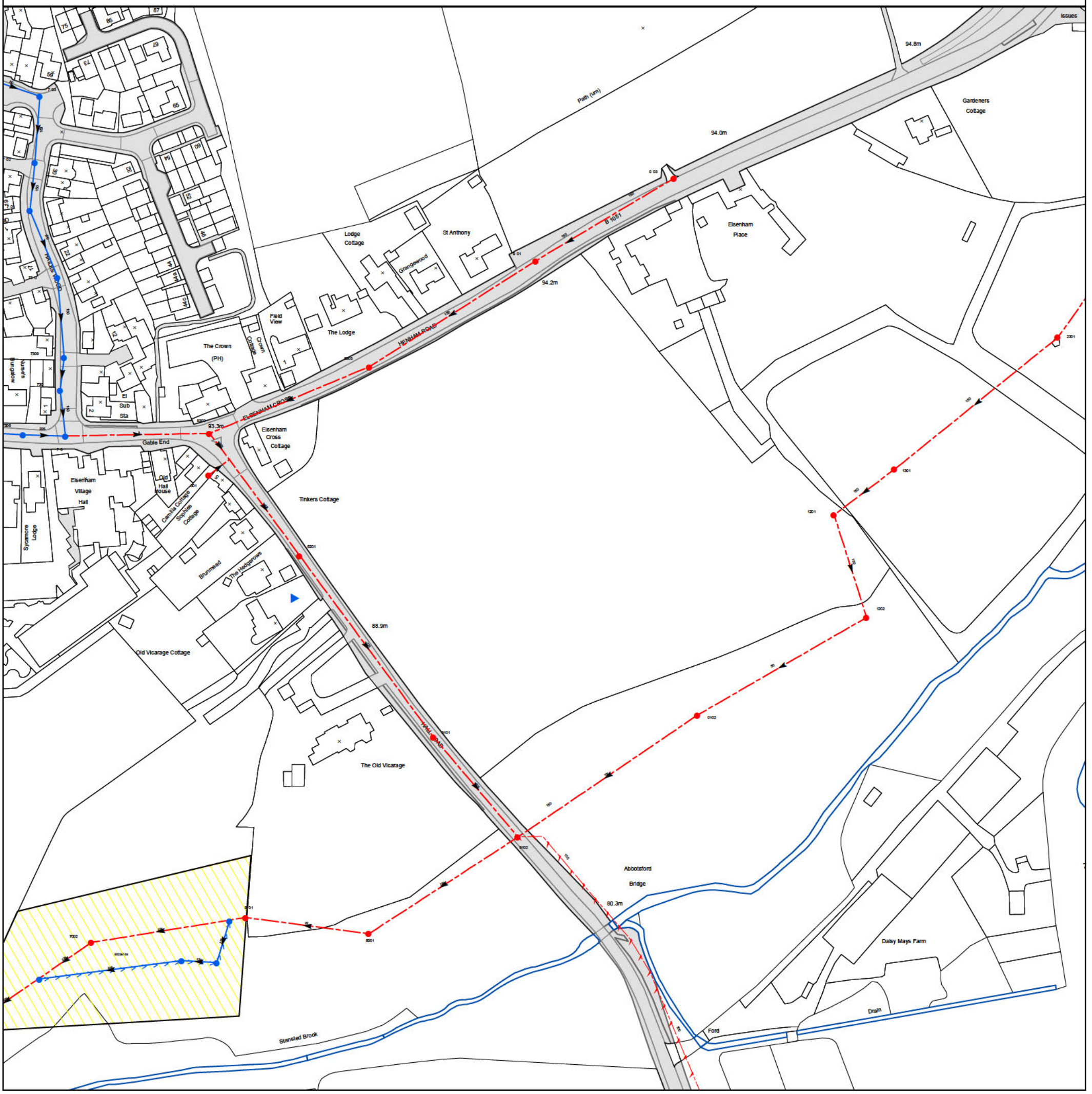
Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

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

ALS/ALS Standard/2020_4318959



0 10 20 40 60 80 Meters

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

Scale:	1:1792
Width:	500m
Printed By:	G1KANAGA
Print Date:	10/12/2020
Map Centre:	553976,226274
Grid Reference:	TL5326SE

Comments:

ALS/ALS Standard/2020_4318959

NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL
9401	93.93	90.82
0102	83.78	81.69
1202	83.37	82.23
2301	87.51	84.99
8303	93.73	90.19
8301	92.89	91.8
7401		
7301	93.13	89.72
7307		
7403		
9102	82.52	81.29
8302	93.38	89.47

REFERENCE	COVER LEVEL	INVERT LEVEL
0403	94.01	91.52
1201	85.49	82.5
1301	86.47	84.49
8001	81.41	80.82
7002	81.68	80.3
8101	81.37	80.59
7306		
7309		
7310		
7402		
9101	85.38	83.65
8201	90.72	89.13

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

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

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

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

Control Valve

Drop Pipe

Ancillary

Weir

End Items

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

Outfall

Undefined End

Inlet

Other Symbols

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

Public/Private Pumping Station

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

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

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

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes

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

2) All measurements on the plans are metric.

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

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

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

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

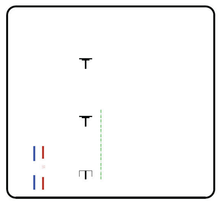
If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

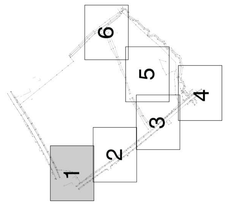
If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

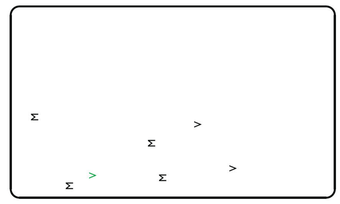
Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Macleod Simmonds
GEOSPATIAL SURVEYS







Constructionline
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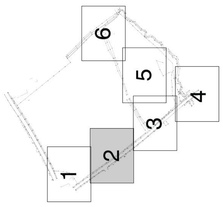
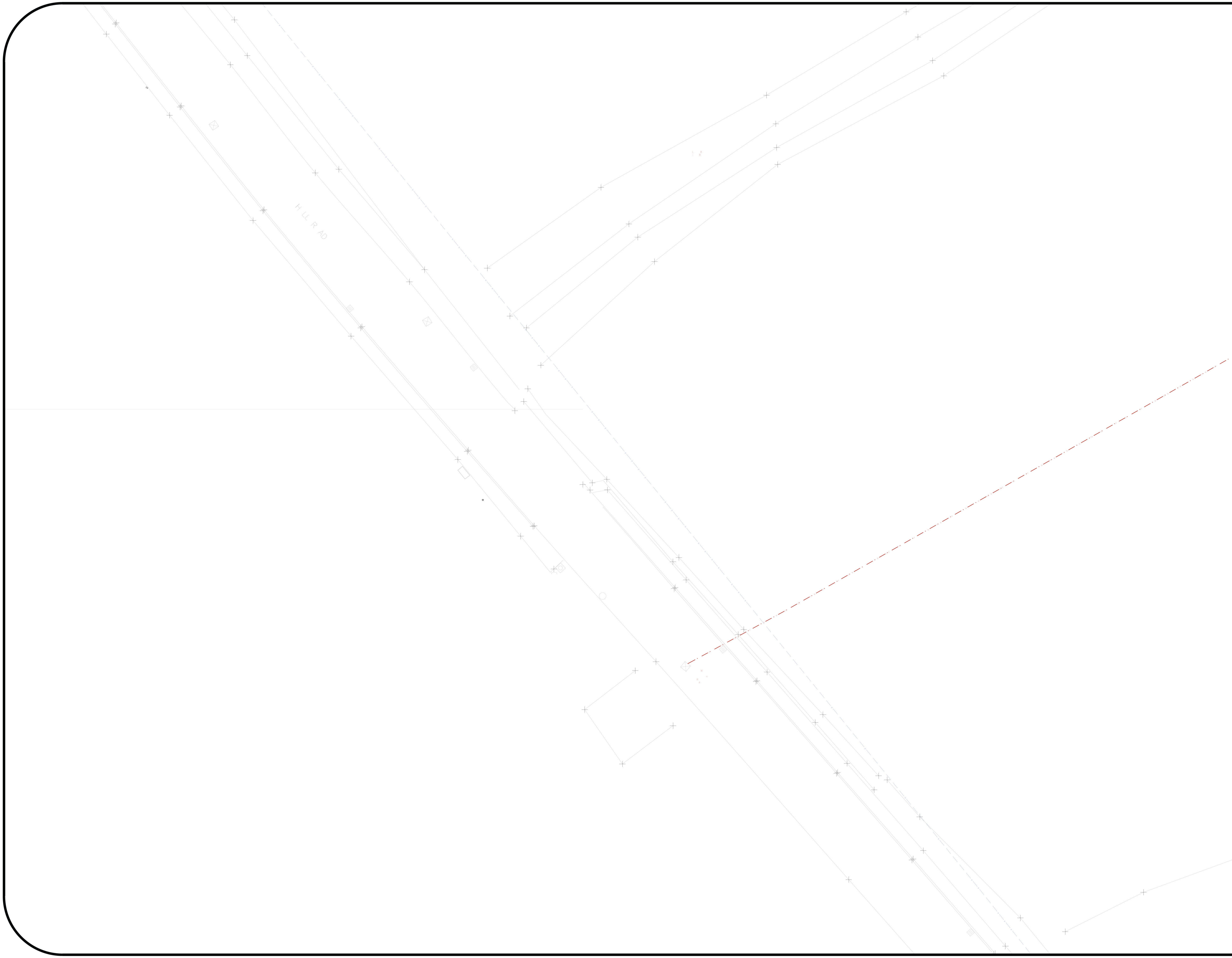
©

Macleod Simmonds
GEOSPATIAL SURVEYS





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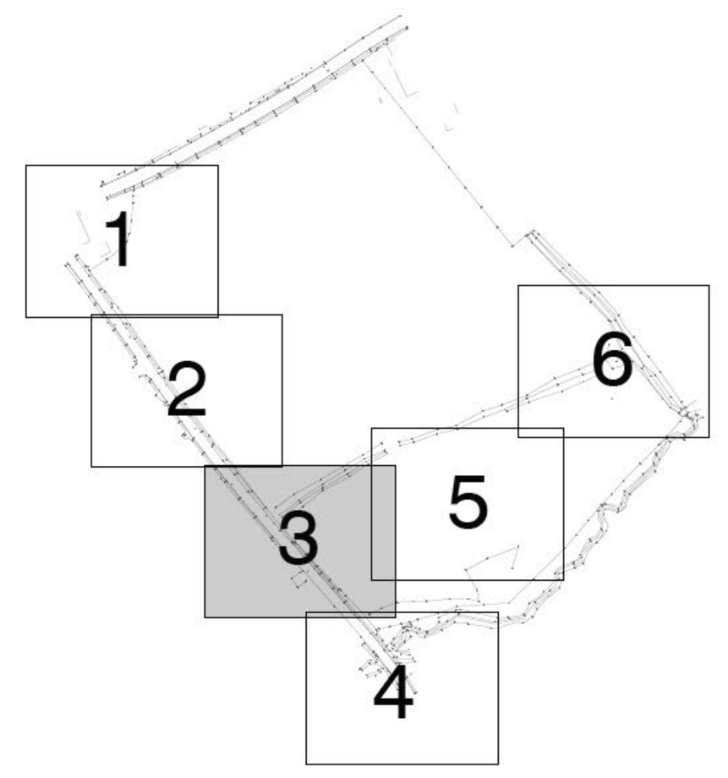
GEOSPATIAL SURVEYS



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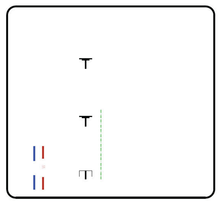
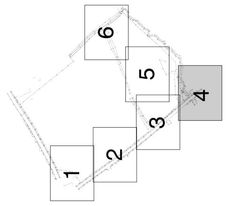
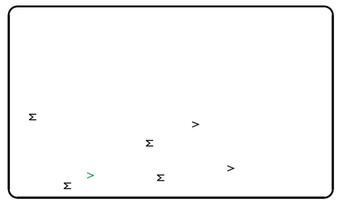
GEOSPATIAL SURVEYS







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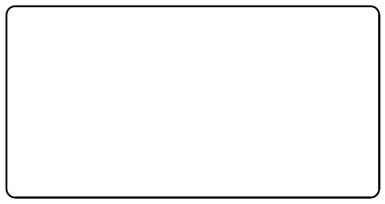
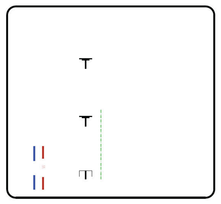
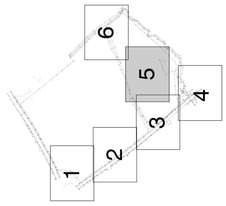
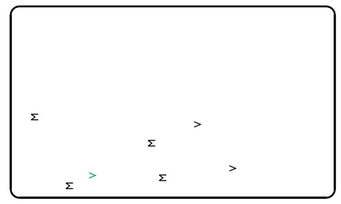
GEOSPATIAL SURVEYS









Macleod Simmonds
GEOSPATIAL SURVEYS

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Appendix D

Proposed Drainage Strategy

N

Field View

The Lodge

HENHAM ROAD

ELSENHAM CROSS

Elsenham Cross Cottage

Tinkers Cottage

The Hedgerows

The Old Vicarage

HALL ROAD

Abbotsford Bridge

CATCHMENT A
TOTAL AREA: 1.67ha
PERCENTAGE IMPERMEABLE: 60%
IMPERMEABLE AREA: 1.00ha

CATCHMENT B
TOTAL AREA: 1.84ha
PERCENTAGE IMPERMEABLE: 60%
IMPERMEABLE AREA: 1.10ha

SITE AREA: 5.13ha
DEVELOPMENT AREA: 3.51ha
ASSUME 60% IMPERMEABLE
IMPERMEABLE AREA: 2.10ha

GREENFIELD RUNOFF RATE:
Q1: 6.3 l/s
Q30: 16.8 l/s
Q100: 23.7 l/s

PROPOSED UNDER-DRAINED SWALE

PROPOSED UNDER-DRAINED SWALE

BASIN A
CL: 87.50
IL: 86.30
BASE AREA: 587m²
TOP AREA: 1185m²
VOLUME: 1042m³
FREEBOARD: 119mm

EXISTING FW MANHOLE
CL: 85.510
IL: 82.550

PROPOSED FW MH ON EXISTING FW SEWER
CL: 84.95
IL: 82.43

PROPOSED FLOW CONTROL CHAMBER
CL: 87.50
IL: 86.25
MAX DISCHARGE RATE: 1 l/s

EXISTING FW MANHOLE TO BE REMOVED
CL: 83.405
IL: 82.265

BURIED STORAGE TANK
MIN. CL: 83.10
IL: 81.30
AREA: 290m²
DEPTH: 0.9m
VOLUME: 261m³

EXISTING FW MANHOLE AND SEWER TO BE REMOVED DURING DIVERSION

PROPOSED FW MH ON EXISTING FW SEWER
CL: 83.30
IL: 81.30

EXISTING FW MANHOLE
CL: 82.546
IL: 81.286

BASIN B
CL: 82.50
IL: 81.00
BASE AREA: 79m²
TOP AREA: 544m²
VOLUME: 415m³
FREEBOARD: 302mm

PROPOSED FLOW CONTROL CHAMBER
CL: 82.50
IL: 80.95
1:1 YR DISCHARGE RATE: 6.7 l/s
1:100 YR DISCHARGE RATE: 25.7 l/s

HEADWALL
IL 79.61

VEGETATION

TALL TREES

KEY

- SITE BOUNDARY
- FOUL WATER SEWER & MANHOLE
- SURFACE WATER SEWER & MANHOLE
- PROPOSED UNDER-DRAINED SWALE
- PROPOSED BASIN
- PROPOSED BURIED STORAGE TANK
- PCC HEADWALL
- PROPOSED EXCEEDANCE ROUTE
- CATCHMENT A
- CATCHMENT B
- ROOT PROTECTION AREAS
- 1 IN 30 YEAR FLOOD EXTENTS
- 1 IN 100 YEAR FLOOD EXTENTS
- 1 IN 1000 YEAR FLOOD EXTENTS
- FFL: 85.450 PROPOSED FINISHED FLOOR LEVEL

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METERS UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVEL AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. ANY WORKS OUTSIDE RED SITE BOUNDARY ARE FOR INFORMATION PURPOSES ONLY. UNLESS SPECIFICALLY NOTED, ALL WORKS OUTSIDE THE SITE BOUNDARY WILL BE UNDERTAKEN BY OTHERS UNDER A SEPARATE.
7. ALL EXISTING SERVICE ROUTES HAVE BEEN TRANSCRIBED FROM THE RESPECTIVE UNDERTAKERS RECORDS AND AS SUCH NO RESPONSIBILITY IS ACCEPTED BY ARDENT CONSULTING ENGINEERS FOR THE ACCURACY OF ROUTES SHOWN.
8. THE AVOIDANCE AND PROTECTION OF SERVICES DURING THE WORKS IS THE RESPONSIBILITY OF THE CONTRACTOR.
9. THE CONTRACTOR IS REMINDED OF HIS OBLIGATION TO VERIFY THE ROUTE OF ALL SERVICES ON SITE PRIOR TO THE COMMENCEMENT OF THE WORKS.
10. THE CONTRACTOR SHOULD ALLOW FOR ANY NECESSARY LIAISON WITH THE STATUTORY UTILITIES DURING THE COURSE OF THE WORKS TO AVOID ANY DISRUPTION TO RETAINED SERVICES.
11. THE CONTRACTOR SHOULD NOTE THAT THE SERVICES SHOWN ARE NOT TO BE CONSIDERED EXHAUSTIVE. PRIVATE SERVICES MAY BE PRESENT WITHIN THE LIMIT OF WORKS AND CARE SHOULD BE TAKEN TO LOCATE AND AVOID THESE DURING CONSTRUCTION.

ALL INFORMATION REGARDING DRAINAGE IS INDICATIVE ONLY AND FOR INFORMATION ONLY.

SITE LAYOUT IS BASED UPON DAP ARCHITECTURE DRAWING, PROP SCHEME DESIGN PLAN REV 100.02 RECEIVED MARCH 2022

TOPOGRAPHICAL SURVEY IS BASED UPON SURVEY BY COUNTRYSIDE PROPERTIES, REF. SURV2956 REV A DATED MARCH 2022.

TREE ROOT PROTECTION SURVEY IS BASED UPON SURVEY BY HALLWOOD ASSOCIATES, REF. HWA10767_APII DATED MARCH 2022.

NOT FOR CONSTRUCTION

FOR INFORMATION ONLY

0m 5m 25m

Scale: 1:500 @ A1

Rev	Description	Drn	Chk	App	Date
B	FFLs AND EXCEEDANCE ARROWS ADDED.	AW	AW	BB	01.04.22
A	LAYOUT UPDATED AND BASINS MOVED.	AW	AW	BB	29.03.22

ARDENT CONSULTING ENGINEERS
Third Floor
The Hallmark Building
52-56 Leadenhall Street
London
EC3M 5JE
Tel: 020 7680 4088

Client
COUNTRYSIDE PARTNERSHIPS PLC

Project Title:
LAND SOUTH OF HENHAM ROAD, ELSENHAM

Drawing Title:
DRAINAGE STRATEGY

A1 Scale	Date	Designed by
1:500	MARCH 2022	DCR
Drawn by	Checked by	Approved by
DCR	AW	BB

Drawing Number: 2008170-030 Rev B

File Location: y:\ardent projects\2008170 - land south of henham road, elsenham\technical\acad\drawings\2008170-030 drainage strategy.dwg

Appendix E

Greenfield Calculations and Proposed Surface Water Drainage Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 621 Urban 0.000
Area (ha) 2.510 Soil 0.400 Region Number Region 6

Results l/s

QBAR Rural 7.4
QBAR Urban 7.4

Q1 year 6.3

Q1 year 6.3
Q30 years 16.8
Q100 years 23.7

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	2008170 - Attenuation Basin B Calcs.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	86.394	0.094	0.7	57.3	O K
30 min Summer	86.420	0.120	0.7	73.5	O K
60 min Summer	86.447	0.147	0.7	91.0	O K
120 min Summer	86.475	0.175	0.7	109.4	O K
180 min Summer	86.492	0.192	0.7	120.6	O K
240 min Summer	86.504	0.204	0.7	128.6	O K
360 min Summer	86.520	0.220	0.7	139.7	O K
480 min Summer	86.530	0.230	0.7	146.2	O K
600 min Summer	86.537	0.237	0.7	150.8	O K
720 min Summer	86.542	0.242	0.7	154.1	O K
960 min Summer	86.547	0.247	0.7	158.1	O K
1440 min Summer	86.550	0.250	0.7	160.0	O K
2160 min Summer	86.545	0.245	0.7	156.5	O K
2880 min Summer	86.538	0.238	0.7	152.0	O K
4320 min Summer	86.526	0.226	0.7	143.6	O K
5760 min Summer	86.514	0.214	0.7	135.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.107	0.0	57.5	27
30 min Summer	20.041	0.0	61.1	41
60 min Summer	12.513	0.0	93.5	70
120 min Summer	7.646	0.0	114.4	130
180 min Summer	5.702	0.0	122.8	190
240 min Summer	4.625	0.0	124.5	250
360 min Summer	3.436	0.0	125.5	368
480 min Summer	2.768	0.0	125.6	488
600 min Summer	2.340	0.0	125.3	606
720 min Summer	2.040	0.0	124.8	726
960 min Summer	1.643	0.0	123.7	964
1440 min Summer	1.211	0.0	121.2	1442
2160 min Summer	0.893	0.0	239.3	1880
2880 min Summer	0.719	0.0	238.6	2252
4320 min Summer	0.530	0.0	226.8	3028
5760 min Summer	0.427	0.0	307.1	3864

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	86.503	0.203	0.7	127.8	O K
8640 min Summer	86.492	0.192	0.7	120.2	O K
10080 min Summer	86.480	0.180	0.7	112.7	O K
15 min Winter	86.406	0.106	0.7	64.3	O K
30 min Winter	86.434	0.134	0.7	82.6	O K
60 min Winter	86.465	0.165	0.7	102.3	O K
120 min Winter	86.496	0.196	0.7	123.3	O K
180 min Winter	86.515	0.215	0.7	136.1	O K
240 min Winter	86.529	0.229	0.7	145.4	O K
360 min Winter	86.548	0.248	0.7	158.5	O K
480 min Winter	86.559	0.259	0.7	166.5	O K
600 min Winter	86.568	0.268	0.7	172.4	O K
720 min Winter	86.574	0.274	0.7	176.7	O K
960 min Winter	86.582	0.282	0.7	182.5	O K
1440 min Winter	86.589	0.289	0.7	187.4	O K
2160 min Winter	86.588	0.288	0.7	186.5	O K
2880 min Winter	86.580	0.280	0.7	180.9	O K
4320 min Winter	86.562	0.262	0.7	168.7	O K
5760 min Winter	86.544	0.244	0.7	156.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	0.361	0.0	324.7	4680
8640 min Summer	0.315	0.0	339.7	5456
10080 min Summer	0.280	0.0	353.1	6256
15 min Winter	31.107	0.0	59.4	26
30 min Winter	20.041	0.0	62.2	41
60 min Winter	12.513	0.0	104.8	70
120 min Winter	7.646	0.0	123.0	128
180 min Winter	5.702	0.0	125.2	186
240 min Winter	4.625	0.0	125.9	246
360 min Winter	3.436	0.0	125.9	362
480 min Winter	2.768	0.0	125.4	480
600 min Winter	2.340	0.0	124.7	596
720 min Winter	2.040	0.0	123.9	714
960 min Winter	1.643	0.0	122.4	944
1440 min Winter	1.211	0.0	119.6	1402
2160 min Winter	0.893	0.0	242.5	2060
2880 min Winter	0.719	0.0	239.3	2656
4320 min Winter	0.530	0.0	229.4	3292
5760 min Winter	0.427	0.0	344.1	4208

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	86.527	0.227	0.7	143.8	O K
8640 min Winter	86.508	0.208	0.7	131.5	O K
10080 min Winter	86.490	0.190	0.7	119.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	0.361	0.0	363.7	5112
8640 min Winter	0.315	0.0	380.6	5968
10080 min Winter	0.280	0.0	395.6	6768

Cascade Rainfall Details for 2008170 - Attenuation Basin A Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.000

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.333	4	8	0.333	8	12	0.333

Cascade Model Details for 2008170 - Attenuation Basin A Calcs.SRCX

Storage is Online Cover Level (m) 87.500

Tank or Pond Structure

Invert Level (m) 86.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	587.0	1.200	1185.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	86.250
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

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	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	2008170 - Attenuation Basin B Calcs.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	86.524	0.224	0.7	142.0	O K
30 min Summer	86.582	0.282	0.7	182.4	O K
60 min Summer	86.639	0.339	0.7	223.6	O K
120 min Summer	86.695	0.395	0.7	265.2	O K
180 min Summer	86.726	0.426	0.7	289.4	O K
240 min Summer	86.748	0.448	0.7	306.3	O K
360 min Summer	86.777	0.477	0.7	329.1	O K
480 min Summer	86.797	0.497	0.7	345.4	O K
600 min Summer	86.812	0.512	0.7	357.5	O K
720 min Summer	86.823	0.523	0.7	367.0	O K
960 min Summer	86.840	0.540	0.7	380.6	O K
1440 min Summer	86.858	0.558	0.7	396.0	O K
2160 min Summer	86.868	0.568	0.7	403.9	O K
2880 min Summer	86.866	0.566	0.7	402.9	O K
4320 min Summer	86.849	0.549	0.7	388.5	O K
5760 min Summer	86.829	0.529	0.7	372.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.325	0.0	63.8	27
30 min Summer	49.096	0.0	62.4	42
60 min Summer	30.183	0.0	122.0	72
120 min Summer	18.023	0.0	114.8	132
180 min Summer	13.199	0.0	112.5	192
240 min Summer	10.542	0.0	112.1	250
360 min Summer	7.645	0.0	113.7	370
480 min Summer	6.087	0.0	116.0	490
600 min Summer	5.098	0.0	117.6	610
720 min Summer	4.409	0.0	118.8	730
960 min Summer	3.505	0.0	120.4	968
1440 min Summer	2.533	0.0	121.8	1446
2160 min Summer	1.829	0.0	239.3	2164
2880 min Summer	1.451	0.0	240.7	2884
4320 min Summer	1.046	0.0	238.1	4192
5760 min Summer	0.829	0.0	464.9	4832

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	86.812	0.512	0.7	357.4	O K
8640 min Summer	86.796	0.496	0.7	344.5	O K
10080 min Summer	86.781	0.481	0.7	332.9	O K
15 min Winter	86.549	0.249	0.7	159.2	O K
30 min Winter	86.613	0.313	0.7	204.6	O K
60 min Winter	86.676	0.376	0.7	250.8	O K
120 min Winter	86.737	0.437	0.7	297.7	O K
180 min Winter	86.772	0.472	0.7	325.1	O K
240 min Winter	86.795	0.495	0.7	344.2	O K
360 min Winter	86.827	0.527	0.7	370.4	O K
480 min Winter	86.850	0.550	0.7	389.2	O K
600 min Winter	86.867	0.567	0.7	403.4	O K
720 min Winter	86.880	0.580	0.8	414.6	O K
960 min Winter	86.900	0.600	0.8	431.1	O K
1440 min Winter	86.922	0.622	0.8	450.7	O K
2160 min Winter	86.937	0.637	0.8	463.3	O K
2880 min Winter	86.939	0.639	0.8	465.8	O K
4320 min Winter	86.929	0.629	0.8	456.7	O K
5760 min Winter	86.909	0.609	0.8	438.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	0.692	0.0	452.6	5552
8640 min Summer	0.597	0.0	438.7	6312
10080 min Summer	0.527	0.0	425.2	7152
15 min Winter	76.325	0.0	63.4	27
30 min Winter	49.096	0.0	60.9	41
60 min Winter	30.183	0.0	117.1	72
120 min Winter	18.023	0.0	112.3	130
180 min Winter	13.199	0.0	112.8	188
240 min Winter	10.542	0.0	115.1	248
360 min Winter	7.645	0.0	118.4	366
480 min Winter	6.087	0.0	120.5	484
600 min Winter	5.098	0.0	122.1	602
720 min Winter	4.409	0.0	123.2	720
960 min Winter	3.505	0.0	124.6	954
1440 min Winter	2.533	0.0	125.4	1424
2160 min Winter	1.829	0.0	248.4	2120
2880 min Winter	1.451	0.0	249.0	2800
4320 min Winter	1.046	0.0	245.1	4148
5760 min Winter	0.829	0.0	473.6	5368

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	86.886	0.586	0.8	419.7	O K
8640 min Winter	86.867	0.567	0.7	403.5	O K
10080 min Winter	86.848	0.548	0.7	387.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	0.692	0.0	467.5	5840
8640 min Winter	0.597	0.0	460.2	6736
10080 min Winter	0.527	0.0	449.2	7664

Cascade Rainfall Details for 2008170 - Attenuation Basin A Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.000

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.333	4	8	0.333	8	12	0.333

Cascade Model Details for 2008170 - Attenuation Basin A Calcs.SRCX

Storage is Online Cover Level (m) 87.500

Tank or Pond Structure

Invert Level (m) 86.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	587.0	1.200	1185.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	86.250
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

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	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	2008170 - Attenuation Basin B Calcs.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	86.585	0.285	0.7	184.7	O K
30 min Summer	86.660	0.360	0.7	239.3	O K
60 min Summer	86.733	0.433	0.7	294.8	O K
120 min Summer	86.803	0.503	0.7	350.1	O K
180 min Summer	86.841	0.541	0.7	381.7	O K
240 min Summer	86.867	0.567	0.7	403.2	O K
360 min Summer	86.900	0.600	0.8	431.8	O K
480 min Summer	86.924	0.624	0.8	452.4	O K
600 min Summer	86.942	0.642	0.8	468.0	O K
720 min Summer	86.956	0.656	0.8	480.2	O K
960 min Summer	86.976	0.676	0.8	498.0	O K
1440 min Summer	86.999	0.699	0.8	518.8	O K
2160 min Summer	87.013	0.713	0.8	531.4	O K
2880 min Summer	87.014	0.714	0.8	533.0	O K
4320 min Summer	87.000	0.700	0.8	520.0	O K
5760 min Summer	86.977	0.677	0.8	498.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.071	0.0	62.3	27
30 min Summer	64.248	0.0	56.7	42
60 min Summer	39.674	0.0	112.6	72
120 min Summer	23.696	0.0	115.5	132
180 min Summer	17.315	0.0	119.4	192
240 min Summer	13.789	0.0	121.9	252
360 min Summer	9.941	0.0	125.1	370
480 min Summer	7.888	0.0	127.1	490
600 min Summer	6.588	0.0	128.6	610
720 min Summer	5.684	0.0	129.6	730
960 min Summer	4.500	0.0	130.8	968
1440 min Summer	3.234	0.0	131.3	1448
2160 min Summer	2.320	0.0	261.0	2164
2880 min Summer	1.832	0.0	261.2	2884
4320 min Summer	1.311	0.0	256.5	4320
5760 min Summer	1.034	0.0	495.7	5136

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	86.955	0.655	0.8	479.7	O K
8640 min Summer	86.936	0.636	0.8	462.4	O K
10080 min Summer	86.918	0.618	0.8	446.9	O K
15 min Winter	86.616	0.316	0.7	207.0	O K
30 min Winter	86.699	0.399	0.7	268.2	O K
60 min Winter	86.778	0.478	0.7	330.4	O K
120 min Winter	86.854	0.554	0.7	392.8	O K
180 min Winter	86.896	0.596	0.8	428.5	O K
240 min Winter	86.925	0.625	0.8	452.9	O K
360 min Winter	86.962	0.662	0.8	485.5	O K
480 min Winter	86.988	0.688	0.8	509.3	O K
600 min Winter	87.008	0.708	0.8	527.3	O K
720 min Winter	87.024	0.724	0.8	541.6	O K
960 min Winter	87.046	0.746	0.8	562.9	O K
1440 min Winter	87.074	0.774	0.8	588.7	O K
2160 min Winter	87.093	0.793	0.9	606.8	O K
2880 min Winter	87.099	0.799	0.9	612.4	O K
4320 min Winter	87.092	0.792	0.9	605.9	O K
5760 min Winter	87.073	0.773	0.8	587.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	0.859	0.0	490.9	5848
8640 min Summer	0.738	0.0	481.7	6656
10080 min Summer	0.649	0.0	468.3	7368
15 min Winter	99.071	0.0	60.8	27
30 min Winter	64.248	0.0	54.8	42
60 min Winter	39.674	0.0	113.1	72
120 min Winter	23.696	0.0	120.5	130
180 min Winter	17.315	0.0	124.4	190
240 min Winter	13.789	0.0	127.0	248
360 min Winter	9.941	0.0	130.0	366
480 min Winter	7.888	0.0	132.0	484
600 min Winter	6.588	0.0	133.3	602
720 min Winter	5.684	0.0	134.2	720
960 min Winter	4.500	0.0	135.1	956
1440 min Winter	3.234	0.0	134.9	1428
2160 min Winter	2.320	0.0	270.4	2124
2880 min Winter	1.832	0.0	269.6	2824
4320 min Winter	1.311	0.0	262.9	4156
5760 min Winter	1.034	0.0	517.2	5472

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	87.049	0.749	0.8	564.8	O K
8640 min Winter	87.025	0.725	0.8	543.1	O K
10080 min Winter	87.004	0.704	0.8	524.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	0.859	0.0	511.5	6640
8640 min Winter	0.738	0.0	502.2	6920
10080 min Winter	0.649	0.0	489.3	7776

Cascade Rainfall Details for 2008170 - Attenuation Basin A Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.000

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.333	4	8	0.333	8	12	0.333

Cascade Model Details for 2008170 - Attenuation Basin A Calcs.SRCX

Storage is Online Cover Level (m) 87.500

Tank or Pond Structure

Invert Level (m) 86.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	587.0	1.200	1185.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	86.250
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

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	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	2008170 - Attenuation Basin B Calcs.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	86.687	0.387	0.7	259.0	O K
30 min Summer	86.785	0.485	0.7	335.7	O K
60 min Summer	86.879	0.579	0.8	413.6	O K
120 min Summer	86.969	0.669	0.8	492.0	O K
180 min Summer	87.019	0.719	0.8	537.1	O K
240 min Summer	87.052	0.752	0.8	568.0	O K
360 min Summer	87.096	0.796	0.9	609.6	O K
480 min Summer	87.127	0.827	0.9	640.3	O K
600 min Summer	87.151	0.851	0.9	663.8	O K
720 min Summer	87.170	0.870	0.9	682.5	O K
960 min Summer	87.198	0.898	0.9	711.0	O K
1440 min Summer	87.233	0.933	0.9	746.9	Flood Risk
2160 min Summer	87.260	0.960	0.9	774.5	Flood Risk
2880 min Summer	87.271	0.971	0.9	786.2	Flood Risk
4320 min Summer	87.271	0.971	0.9	785.9	Flood Risk
5760 min Summer	87.255	0.955	0.9	769.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.700	0.0	55.0	27
30 min Summer	89.947	0.0	58.6	42
60 min Summer	55.544	0.0	122.8	72
120 min Summer	33.174	0.0	130.9	132
180 min Summer	24.241	0.0	135.1	192
240 min Summer	19.305	0.0	137.7	252
360 min Summer	13.918	0.0	140.9	370
480 min Summer	11.043	0.0	142.9	490
600 min Summer	9.223	0.0	144.1	610
720 min Summer	7.957	0.0	145.0	730
960 min Summer	6.300	0.0	145.7	970
1440 min Summer	4.527	0.0	145.2	1448
2160 min Summer	3.248	0.0	293.4	2168
2880 min Summer	2.565	0.0	292.0	2884
4320 min Summer	1.836	0.0	284.2	4324
5760 min Summer	1.447	0.0	568.8	5760

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	87.233	0.933	0.9	746.4	Flood Risk
8640 min Summer	87.212	0.912	0.9	725.3	Flood Risk
10080 min Summer	87.193	0.893	0.9	705.3	O K
15 min Winter	86.727	0.427	0.7	290.2	O K
30 min Winter	86.834	0.534	0.7	376.1	O K
60 min Winter	86.937	0.637	0.8	463.6	O K
120 min Winter	87.034	0.734	0.8	551.6	O K
180 min Winter	87.088	0.788	0.9	602.5	O K
240 min Winter	87.125	0.825	0.9	637.5	O K
360 min Winter	87.172	0.872	0.9	684.8	O K
480 min Winter	87.207	0.907	0.9	719.8	Flood Risk
600 min Winter	87.233	0.933	0.9	746.8	Flood Risk
720 min Winter	87.254	0.954	0.9	768.5	Flood Risk
960 min Winter	87.286	0.986	0.9	801.6	Flood Risk
1440 min Winter	87.326	1.026	1.0	844.5	Flood Risk
2160 min Winter	87.358	1.058	1.0	879.6	Flood Risk
2880 min Winter	87.373	1.073	1.0	897.0	Flood Risk
4320 min Winter	87.381	1.081	1.0	905.4	Flood Risk
5760 min Winter	87.372	1.072	1.0	895.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.203	0.0	562.0	6560
8640 min Summer	1.034	0.0	551.5	7184
10080 min Summer	0.909	0.0	537.5	7968
15 min Winter	138.700	0.0	55.6	27
30 min Winter	89.947	0.0	61.0	42
60 min Winter	55.544	0.0	128.1	72
120 min Winter	33.174	0.0	136.4	130
180 min Winter	24.241	0.0	140.6	190
240 min Winter	19.305	0.0	143.2	248
360 min Winter	13.918	0.0	146.3	366
480 min Winter	11.043	0.0	148.2	486
600 min Winter	9.223	0.0	149.3	604
720 min Winter	7.957	0.0	150.0	722
960 min Winter	6.300	0.0	150.4	958
1440 min Winter	4.527	0.0	149.2	1430
2160 min Winter	3.248	0.0	303.5	2136
2880 min Winter	2.565	0.0	300.9	2828
4320 min Winter	1.836	0.0	290.9	4200
5760 min Winter	1.447	0.0	590.1	5536

Cascade Summary of Results for 2008170 - Attenuation Basin A Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	87.355	1.055	1.0	877.0	Flood Risk
8640 min Winter	87.334	1.034	1.0	853.1	Flood Risk
10080 min Winter	87.310	1.010	0.9	827.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.203	0.0	581.2	6848
8640 min Winter	1.034	0.0	569.0	8048
10080 min Winter	0.909	0.0	553.9	8472

Cascade Rainfall Details for 2008170 - Attenuation Basin A Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.000

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.333	4	8	0.333	8	12	0.333

Cascade Model Details for 2008170 - Attenuation Basin A Calcs.SRCX

Storage is Online Cover Level (m) 87.500

Tank or Pond Structure

Invert Level (m) 86.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	587.0	1.200	1185.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	86.250
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

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	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

	Upstream Structures	Outflow To	Overflow To
2008170 - Attenuation Basin A Calcs.SRCX		(None)	(None)

Half Drain Time : 155 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	81.359	0.359	0.0	6.3	6.3	57.7	O K
30 min Summer	81.392	0.392	0.0	6.3	6.3	72.5	O K
60 min Summer	81.419	0.419	0.0	6.3	6.3	84.9	O K
120 min Summer	81.433	0.433	0.0	6.3	6.3	91.3	O K
180 min Summer	81.432	0.432	0.0	6.3	6.3	90.9	O K
240 min Summer	81.429	0.429	0.0	6.3	6.3	89.6	O K
360 min Summer	81.422	0.422	0.0	6.3	6.3	86.2	O K
480 min Summer	81.412	0.412	0.0	6.3	6.3	81.7	O K
600 min Summer	81.402	0.402	0.0	6.3	6.3	77.2	O K
720 min Summer	81.392	0.392	0.0	6.3	6.3	72.7	O K
960 min Summer	81.372	0.372	0.0	6.3	6.3	63.7	O K
1440 min Summer	81.331	0.331	0.0	6.3	6.3	45.6	O K
2160 min Summer	81.232	0.232	0.0	6.3	6.3	23.3	O K
2880 min Summer	81.128	0.128	0.0	6.3	6.3	11.6	O K
4320 min Summer	81.069	0.069	0.0	5.5	5.5	5.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.107	0.0	121.5	25
30 min Summer	20.041	0.0	143.8	38
60 min Summer	12.513	0.0	196.7	66
120 min Summer	7.646	0.0	240.5	122
180 min Summer	5.702	0.0	263.9	158
240 min Summer	4.625	0.0	277.1	190
360 min Summer	3.436	0.0	295.5	258
480 min Summer	2.768	0.0	308.2	326
600 min Summer	2.340	0.0	318.3	396
720 min Summer	2.040	0.0	326.7	464
960 min Summer	1.643	0.0	340.4	598
1440 min Summer	1.211	0.0	360.9	858
2160 min Summer	0.893	0.0	504.3	1192
2880 min Summer	0.719	0.0	523.4	1508
4320 min Summer	0.530	0.0	541.7	2204

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	81.052	0.052	0.0	4.6	4.6	4.4	O K
7200 min Summer	81.043	0.043	0.0	4.0	4.0	3.5	O K
8640 min Summer	81.036	0.036	0.0	3.6	3.6	3.0	O K
10080 min Summer	81.031	0.031	0.0	3.3	3.3	2.5	O K
15 min Winter	81.376	0.376	0.0	6.3	6.3	65.4	O K
30 min Winter	81.413	0.413	0.0	6.3	6.3	82.4	O K
60 min Winter	81.446	0.446	0.0	6.3	6.3	97.2	O K
120 min Winter	81.465	0.465	0.0	6.3	6.3	106.3	O K
180 min Winter	81.466	0.466	0.0	6.3	6.3	106.8	O K
240 min Winter	81.462	0.462	0.0	6.3	6.3	104.7	O K
360 min Winter	81.451	0.451	0.0	6.3	6.3	99.8	O K
480 min Winter	81.437	0.437	0.0	6.3	6.3	93.0	O K
600 min Winter	81.421	0.421	0.0	6.3	6.3	85.9	O K
720 min Winter	81.405	0.405	0.0	6.3	6.3	78.7	O K
960 min Winter	81.374	0.374	0.0	6.3	6.3	64.5	O K
1440 min Winter	81.306	0.306	0.0	6.3	6.3	34.9	O K
2160 min Winter	81.103	0.103	0.0	6.2	6.2	9.1	O K
2880 min Winter	81.068	0.068	0.0	5.4	5.4	5.8	O K
4320 min Winter	81.046	0.046	0.0	4.2	4.2	3.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	0.427	0.0	645.3	2936
7200 min Summer	0.361	0.0	682.1	3640
8640 min Summer	0.315	0.0	713.7	4336
10080 min Summer	0.280	0.0	741.8	5104
15 min Winter	31.107	0.0	131.2	25
30 min Winter	20.041	0.0	154.7	38
60 min Winter	12.513	0.0	220.4	66
120 min Winter	7.646	0.0	264.3	120
180 min Winter	5.702	0.0	283.2	174
240 min Winter	4.625	0.0	296.7	202
360 min Winter	3.436	0.0	316.4	276
480 min Winter	2.768	0.0	330.0	354
600 min Winter	2.340	0.0	340.9	430
720 min Winter	2.040	0.0	350.1	502
960 min Winter	1.643	0.0	365.2	646
1440 min Winter	1.211	0.0	388.1	896
2160 min Winter	0.893	0.0	539.5	1156
2880 min Winter	0.719	0.0	558.4	1472
4320 min Winter	0.530	0.0	582.2	2204

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Winter	81.035	0.035	0.0	3.5	3.5	2.9	O K
7200 min Winter	81.029	0.029	0.0	3.1	3.1	2.3	O K
8640 min Winter	81.024	0.024	0.0	2.8	2.8	1.9	O K
10080 min Winter	81.020	0.020	0.0	2.6	2.6	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	0.427	0.0	722.8	2856
7200 min Winter	0.361	0.0	764.0	3672
8640 min Winter	0.315	0.0	799.4	4408
10080 min Winter	0.280	0.0	830.9	5120

Cascade Rainfall Details for 2008170 - Attenuation Basin B Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.367	4	8	0.367	8	12	0.367

Cascade Model Details for 2008170 - Attenuation Basin B Calcs.SRCX

Storage is Online Cover Level (m) 82.500

Complex Structure

Tank or Pond

Invert Level (m) 81.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	79.0	1.500	544.0

Tank or Pond

Invert Level (m) 81.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	290.0	0.900	290.0	0.901	0.0

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0124-6300-0520-6300
Design Head (m)	0.520
Design Flow (l/s)	6.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	80.950
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)	0.520	6.3	Kick-Flo®	0.391	5.5
Flush-Flo™	0.195	6.3	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

Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	9.3	3.000	14.4	7.000	21.6
0.200	6.3	1.400	10.0	3.500	15.5	7.500	22.4
0.300	6.1	1.600	10.7	4.000	16.5	8.000	23.1
0.400	5.6	1.800	11.3	4.500	17.5	8.500	23.8
0.500	6.2	2.000	11.9	5.000	18.4	9.000	24.5
0.600	6.7	2.200	12.4	5.500	19.1	9.500	25.2
0.800	7.7	2.400	12.9	6.000	20.0		
1.000	8.5	2.600	13.4	6.500	20.8		

Orifice

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 81.690

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

	Upstream Structures	Outflow To	Overflow To
2008170 - Attenuation Basin A Calcs.SRCX		(None)	(None)

Half Drain Time : 251 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	81.556	0.556	0.0	6.8	6.8	149.8	O K
30 min Summer	81.635	0.635	0.0	7.2	7.2	189.9	O K
60 min Summer	81.704	0.704	0.0	7.6	7.6	226.0	O K
120 min Summer	81.750	0.750	0.0	9.4	9.4	250.9	O K
180 min Summer	81.759	0.759	0.0	9.8	9.8	255.7	O K
240 min Summer	81.756	0.756	0.0	9.7	9.7	254.0	O K
360 min Summer	81.745	0.745	0.0	9.1	9.1	248.0	O K
480 min Summer	81.733	0.733	0.0	8.5	8.5	241.4	O K
600 min Summer	81.720	0.720	0.0	8.0	8.0	234.7	O K
720 min Summer	81.708	0.708	0.0	7.7	7.7	228.1	O K
960 min Summer	81.683	0.683	0.0	7.4	7.4	214.9	O K
1440 min Summer	81.635	0.635	0.0	7.2	7.2	190.0	O K
2160 min Summer	81.569	0.569	0.0	6.8	6.8	156.5	O K
2880 min Summer	81.509	0.509	0.0	6.5	6.5	127.3	O K
4320 min Summer	81.408	0.408	0.0	6.3	6.3	80.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.325	0.0	221.2	26
30 min Summer	49.096	0.0	264.9	40
60 min Summer	30.183	0.0	371.0	68
120 min Summer	18.023	0.0	412.0	124
180 min Summer	13.199	0.0	439.1	182
240 min Summer	10.542	0.0	460.0	220
360 min Summer	7.645	0.0	492.1	288
480 min Summer	6.087	0.0	517.7	360
600 min Summer	5.098	0.0	538.2	432
720 min Summer	4.409	0.0	555.3	504
960 min Summer	3.505	0.0	583.0	646
1440 min Summer	2.533	0.0	623.3	918
2160 min Summer	1.829	0.0	782.4	1320
2880 min Summer	1.451	0.0	815.3	1708
4320 min Summer	1.046	0.0	859.4	2468

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	81.315	0.315	0.0	6.3	6.3	38.9	O K
7200 min Summer	81.149	0.149	0.0	6.3	6.3	13.8	O K
8640 min Summer	81.082	0.082	0.0	6.1	6.1	7.1	O K
10080 min Summer	81.069	0.069	0.0	5.4	5.4	5.8	O K
15 min Winter	81.593	0.593	0.0	7.0	7.0	168.5	O K
30 min Winter	81.682	0.682	0.0	7.4	7.4	214.1	O K
60 min Winter	81.756	0.756	0.0	9.7	9.7	254.4	O K
120 min Winter	81.804	0.804	0.0	12.5	12.5	281.2	O K
180 min Winter	81.813	0.813	0.0	13.1	13.1	286.2	O K
240 min Winter	81.810	0.810	0.0	12.9	12.9	284.4	O K
360 min Winter	81.801	0.801	0.0	12.4	12.4	279.6	O K
480 min Winter	81.789	0.789	0.0	11.6	11.6	272.6	O K
600 min Winter	81.775	0.775	0.0	10.7	10.7	264.7	O K
720 min Winter	81.761	0.761	0.0	9.9	9.9	257.1	O K
960 min Winter	81.736	0.736	0.0	8.6	8.6	243.1	O K
1440 min Winter	81.673	0.673	0.0	7.3	7.3	209.6	O K
2160 min Winter	81.577	0.577	0.0	6.9	6.9	160.3	O K
2880 min Winter	81.491	0.491	0.0	6.4	6.4	118.7	O K
4320 min Winter	81.329	0.329	0.0	6.3	6.3	44.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	0.829	0.0	1121.5	3168
7200 min Summer	0.692	0.0	1137.5	3744
8640 min Summer	0.597	0.0	1147.6	4360
10080 min Summer	0.527	0.0	1155.0	5072
15 min Winter	76.325	0.0	239.7	26
30 min Winter	49.096	0.0	287.7	40
60 min Winter	30.183	0.0	395.9	66
120 min Winter	18.023	0.0	445.4	122
180 min Winter	13.199	0.0	478.7	174
240 min Winter	10.542	0.0	504.7	206
360 min Winter	7.645	0.0	542.1	280
480 min Winter	6.087	0.0	570.4	360
600 min Winter	5.098	0.0	593.1	440
720 min Winter	4.409	0.0	612.0	520
960 min Winter	3.505	0.0	642.6	684
1440 min Winter	2.533	0.0	687.1	996
2160 min Winter	1.829	0.0	856.9	1416
2880 min Winter	1.451	0.0	892.5	1820
4320 min Winter	1.046	0.0	941.0	2596

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Winter	81.081	0.081	0.0	6.0	6.0	7.0	O K
7200 min Winter	81.063	0.063	0.0	5.1	5.1	5.3	O K
8640 min Winter	81.052	0.052	0.0	4.6	4.6	4.3	O K
10080 min Winter	81.045	0.045	0.0	4.1	4.1	3.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	0.829	0.0	1208.9	2880
7200 min Winter	0.692	0.0	1234.6	3608
8640 min Winter	0.597	0.0	1254.1	4304
10080 min Winter	0.527	0.0	1266.6	4992

Cascade Rainfall Details for 2008170 - Attenuation Basin B Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.367	4	8	0.367	8	12	0.367

Cascade Model Details for 2008170 - Attenuation Basin B Calcs.SRCX

Storage is Online Cover Level (m) 82.500

Complex Structure

Tank or Pond

Invert Level (m) 81.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	79.0	1.500	544.0

Tank or Pond

Invert Level (m) 81.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	290.0	0.900	290.0	0.901	0.0

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0124-6300-0520-6300
Design Head (m)	0.520
Design Flow (l/s)	6.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	80.950
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)	0.520	6.3	Kick-Flo®	0.391	5.5
Flush-Flo™	0.195	6.3	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

Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	9.3	3.000	14.4	7.000	21.6
0.200	6.3	1.400	10.0	3.500	15.5	7.500	22.4
0.300	6.1	1.600	10.7	4.000	16.5	8.000	23.1
0.400	5.6	1.800	11.3	4.500	17.5	8.500	23.8
0.500	6.2	2.000	11.9	5.000	18.4	9.000	24.5
0.600	6.7	2.200	12.4	5.500	19.1	9.500	25.2
0.800	7.7	2.400	12.9	6.000	20.0		
1.000	8.5	2.600	13.4	6.500	20.8		

Orifice

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 81.690

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Upstream Structures	Outflow To	Overflow To
2008170 - Attenuation Basin A Calcs.SRCX	(None)	(None)

Half Drain Time : 259 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	81.648	0.648	0.0	7.2	7.2	196.2	O K
30 min Summer	81.750	0.750	0.0	9.4	9.4	250.7	O K
60 min Summer	81.830	0.830	0.0	14.2	14.2	295.8	O K
120 min Summer	81.878	0.878	0.0	16.0	16.0	323.7	O K
180 min Summer	81.884	0.884	0.0	16.2	16.2	327.2	O K
240 min Summer	81.882	0.882	0.0	16.1	16.1	326.3	O K
360 min Summer	81.871	0.871	0.0	15.8	15.8	319.5	O K
480 min Summer	81.857	0.857	0.0	15.3	15.3	311.2	O K
600 min Summer	81.842	0.842	0.0	14.8	14.8	302.5	O K
720 min Summer	81.828	0.828	0.0	14.1	14.1	294.8	O K
960 min Summer	81.806	0.806	0.0	12.6	12.6	282.1	O K
1440 min Summer	81.769	0.769	0.0	10.3	10.3	261.5	O K
2160 min Summer	81.718	0.718	0.0	7.9	7.9	233.4	O K
2880 min Summer	81.655	0.655	0.0	7.3	7.3	200.0	O K
4320 min Summer	81.540	0.540	0.0	6.7	6.7	142.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.071	0.0	266.6	26
30 min Summer	64.248	0.0	321.7	40
60 min Summer	39.674	0.0	439.8	66
120 min Summer	23.696	0.0	506.4	122
180 min Summer	17.315	0.0	547.8	162
240 min Summer	13.789	0.0	576.8	192
360 min Summer	9.941	0.0	617.1	258
480 min Summer	7.888	0.0	647.7	328
600 min Summer	6.588	0.0	672.0	398
720 min Summer	5.684	0.0	692.2	468
960 min Summer	4.500	0.0	724.7	612
1440 min Summer	3.234	0.0	771.5	900
2160 min Summer	2.320	0.0	950.1	1340
2880 min Summer	1.832	0.0	986.6	1740
4320 min Summer	1.311	0.0	1035.4	2512

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	81.446	0.446	0.0	6.3	6.3	97.3	O K
7200 min Summer	81.366	0.366	0.0	6.3	6.3	61.1	O K
8640 min Summer	81.235	0.235	0.0	6.3	6.3	23.7	O K
10080 min Summer	81.113	0.113	0.0	6.3	6.3	10.1	O K
15 min Winter	81.694	0.694	0.0	7.4	7.4	220.6	O K
30 min Winter	81.803	0.803	0.0	12.5	12.5	280.6	O K
60 min Winter	81.892	0.892	0.0	16.4	16.4	331.9	O K
120 min Winter	81.949	0.949	0.0	18.1	18.1	366.5	O K
180 min Winter	81.958	0.958	0.0	18.3	18.3	372.2	O K
240 min Winter	81.955	0.955	0.0	18.2	18.2	370.3	O K
360 min Winter	81.941	0.941	0.0	17.9	17.9	361.9	O K
480 min Winter	81.923	0.923	0.0	17.4	17.4	350.6	O K
600 min Winter	81.902	0.902	0.0	16.7	16.7	338.0	O K
720 min Winter	81.881	0.881	0.0	16.1	16.1	325.7	O K
960 min Winter	81.845	0.845	0.0	14.9	14.9	304.8	O K
1440 min Winter	81.798	0.798	0.0	12.1	12.1	277.5	O K
2160 min Winter	81.739	0.739	0.0	8.8	8.8	245.1	O K
2880 min Winter	81.659	0.659	0.0	7.3	7.3	202.3	O K
4320 min Winter	81.501	0.501	0.0	6.5	6.5	123.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.034	0.0	1314.3	3240
7200 min Summer	0.859	0.0	1341.3	3976
8640 min Summer	0.738	0.0	1358.6	4576
10080 min Summer	0.649	0.0	1368.3	5144
15 min Winter	99.071	0.0	289.6	26
30 min Winter	64.248	0.0	351.5	39
60 min Winter	39.674	0.0	479.6	66
120 min Winter	23.696	0.0	558.4	120
180 min Winter	17.315	0.0	604.4	172
240 min Winter	13.789	0.0	636.6	196
360 min Winter	9.941	0.0	681.1	272
480 min Winter	7.888	0.0	715.0	348
600 min Winter	6.588	0.0	742.0	424
720 min Winter	5.684	0.0	764.4	498
960 min Winter	4.500	0.0	800.3	642
1440 min Winter	3.234	0.0	852.0	938
2160 min Winter	2.320	0.0	1042.2	1412
2880 min Winter	1.832	0.0	1082.0	1872
4320 min Winter	1.311	0.0	1135.3	2648

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Winter	81.360	0.360	0.0	6.3	6.3	58.4	O K
7200 min Winter	81.092	0.092	0.0	6.2	6.2	8.0	O K
8640 min Winter	81.069	0.069	0.0	5.5	5.5	5.9	O K
10080 min Winter	81.058	0.058	0.0	4.9	4.9	4.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	1.034	0.0	1434.1	3464
7200 min Winter	0.859	0.0	1464.0	3744
8640 min Winter	0.738	0.0	1484.4	4400
10080 min Winter	0.649	0.0	1497.3	5136

Cascade Rainfall Details for 2008170 - Attenuation Basin B Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.100

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.367	4	8	0.367	8	12	0.367

Cascade Model Details for 2008170 - Attenuation Basin B Calcs.SRCX

Storage is Online Cover Level (m) 82.500

Complex Structure

Tank or Pond

Invert Level (m) 81.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	79.0	1.500	544.0

Tank or Pond

Invert Level (m) 81.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	290.0	0.900	290.0	0.901	0.0

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0124-6300-0520-6300
Design Head (m)	0.520
Design Flow (l/s)	6.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	80.950
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)	0.520	6.3	Kick-Flo®	0.391	5.5
Flush-Flo™	0.195	6.3	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

Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	9.3	3.000	14.4	7.000	21.6
0.200	6.3	1.400	10.0	3.500	15.5	7.500	22.4
0.300	6.1	1.600	10.7	4.000	16.5	8.000	23.1
0.400	5.6	1.800	11.3	4.500	17.5	8.500	23.8
0.500	6.2	2.000	11.9	5.000	18.4	9.000	24.5
0.600	6.7	2.200	12.4	5.500	19.1	9.500	25.2
0.800	7.7	2.400	12.9	6.000	20.0		
1.000	8.5	2.600	13.4	6.500	20.8		

Orifice

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 81.690

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

	Upstream Structures	Outflow To	Overflow To
2008170 - Attenuation Basin A Calcs.SRCX		(None)	(None)

Half Drain Time : 277 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	81.795	0.795	0.0	11.9	11.9	275.7	O K
30 min Summer	81.920	0.920	0.0	17.3	17.3	349.1	O K
60 min Summer	82.024	1.024	0.0	20.0	20.0	413.8	O K
120 min Summer	82.091	1.091	0.0	21.5	21.5	457.5	O K
180 min Summer	82.103	1.103	0.0	21.7	21.7	465.4	O K
240 min Summer	82.103	1.103	0.0	21.7	21.7	465.7	O K
360 min Summer	82.093	1.093	0.0	21.5	21.5	458.8	O K
480 min Summer	82.078	1.078	0.0	21.2	21.2	449.0	O K
600 min Summer	82.060	1.060	0.0	20.8	20.8	436.8	O K
720 min Summer	82.040	1.040	0.0	20.3	20.3	423.7	O K
960 min Summer	82.000	1.000	0.0	19.4	19.4	398.1	O K
1440 min Summer	81.935	0.935	0.0	17.7	17.7	358.2	O K
2160 min Summer	81.867	0.867	0.0	15.7	15.7	317.5	O K
2880 min Summer	81.823	0.823	0.0	13.8	13.8	291.6	O K
4320 min Summer	81.762	0.762	0.0	10.0	10.0	257.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.700	0.0	341.0	26
30 min Summer	89.947	0.0	429.6	39
60 min Summer	55.544	0.0	581.0	66
120 min Summer	33.174	0.0	678.3	122
180 min Summer	24.241	0.0	735.1	166
240 min Summer	19.305	0.0	774.7	196
360 min Summer	13.918	0.0	829.8	260
480 min Summer	11.043	0.0	871.7	328
600 min Summer	9.223	0.0	905.0	396
720 min Summer	7.957	0.0	932.7	466
960 min Summer	6.300	0.0	977.2	602
1440 min Summer	4.527	0.0	1041.5	868
2160 min Summer	3.248	0.0	1258.1	1260
2880 min Summer	2.565	0.0	1307.5	1648
4320 min Summer	1.836	0.0	1374.8	2468

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Summer	81.696	0.696	0.0	7.5	7.5	221.5	O K
7200 min Summer	81.603	0.603	0.0	7.0	7.0	173.4	O K
8640 min Summer	81.523	0.523	0.0	6.6	6.6	133.9	O K
10080 min Summer	81.454	0.454	0.0	6.3	6.3	101.2	O K
15 min Winter	81.852	0.852	0.0	15.1	15.1	308.4	O K
30 min Winter	81.990	0.990	0.0	19.1	19.1	391.9	O K
60 min Winter	82.105	1.105	0.0	21.8	21.8	466.6	O K
120 min Winter	82.182	1.182	0.0	23.3	23.3	519.3	O K
180 min Winter	82.198	1.198	0.0	23.6	23.6	531.2	O K
240 min Winter	82.195	1.195	0.0	23.5	23.5	528.7	O K
360 min Winter	82.181	1.181	0.0	23.3	23.3	519.0	O K
480 min Winter	82.160	1.160	0.0	22.9	22.9	504.3	O K
600 min Winter	82.135	1.135	0.0	22.4	22.4	486.9	O K
720 min Winter	82.108	1.108	0.0	21.8	21.8	468.8	O K
960 min Winter	82.055	1.055	0.0	20.7	20.7	433.5	O K
1440 min Winter	81.964	0.964	0.0	18.5	18.5	375.9	O K
2160 min Winter	81.875	0.875	0.0	15.9	15.9	322.0	O K
2880 min Winter	81.821	0.821	0.0	13.7	13.7	291.0	O K
4320 min Winter	81.754	0.754	0.0	9.6	9.6	252.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.447	0.0	1715.0	3344
7200 min Summer	1.203	0.0	1752.6	4104
8640 min Summer	1.034	0.0	1779.2	4840
10080 min Summer	0.909	0.0	1797.5	5552
15 min Winter	138.700	0.0	376.0	25
30 min Winter	89.947	0.0	476.5	39
60 min Winter	55.544	0.0	641.3	66
120 min Winter	33.174	0.0	749.4	120
180 min Winter	24.241	0.0	812.5	174
240 min Winter	19.305	0.0	856.7	204
360 min Winter	13.918	0.0	917.9	276
480 min Winter	11.043	0.0	964.5	352
600 min Winter	9.223	0.0	1001.5	426
720 min Winter	7.957	0.0	1032.3	500
960 min Winter	6.300	0.0	1081.8	642
1440 min Winter	4.527	0.0	1153.1	916
2160 min Winter	3.248	0.0	1383.9	1304
2880 min Winter	2.565	0.0	1438.3	1704
4320 min Winter	1.836	0.0	1512.3	2596

Cascade Summary of Results for 2008170 - Attenuation Basin B Calcs.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
5760 min Winter	81.653	0.653	0.0	7.2	7.2	199.0	O K
7200 min Winter	81.531	0.531	0.0	6.6	6.6	137.8	O K
8640 min Winter	81.425	0.425	0.0	6.3	6.3	87.5	O K
10080 min Winter	81.213	0.213	0.0	6.3	6.3	21.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Winter	1.447	0.0	1873.7	3520
7200 min Winter	1.203	0.0	1914.6	4320
8640 min Winter	1.034	0.0	1944.2	5104
10080 min Winter	0.909	0.0	1965.1	5544

Cascade Rainfall Details for 2008170 - Attenuation Basin B Calcs.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.100

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.367	4	8	0.367	8	12	0.367

Cascade Model Details for 2008170 - Attenuation Basin B Calcs.SRCX

Storage is Online Cover Level (m) 82.500

Complex Structure

Tank or Pond

Invert Level (m) 81.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	79.0	1.500	544.0

Tank or Pond

Invert Level (m) 81.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	290.0	0.900	290.0	0.901	0.0

Complex Outflow Control

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0124-6300-0520-6300
Design Head (m)	0.520
Design Flow (l/s)	6.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	124
Invert Level (m)	80.950
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)	0.520	6.3	Kick-Flo®	0.391	5.5
Flush-Flo™	0.195	6.3	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

Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	9.3	3.000	14.4	7.000	21.6
0.200	6.3	1.400	10.0	3.500	15.5	7.500	22.4
0.300	6.1	1.600	10.7	4.000	16.5	8.000	23.1
0.400	5.6	1.800	11.3	4.500	17.5	8.500	23.8
0.500	6.2	2.000	11.9	5.000	18.4	9.000	24.5
0.600	6.7	2.200	12.4	5.500	19.1	9.500	25.2
0.800	7.7	2.400	12.9	6.000	20.0		
1.000	8.5	2.600	13.4	6.500	20.8		

Orifice

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 81.690

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	87.060	0.760	0.8	111.5	O K
30 min Summer	87.092	0.792	0.9	142.0	O K
60 min Summer	87.124	0.824	0.9	172.9	O K
120 min Summer	87.155	0.855	0.9	204.1	O K
180 min Summer	87.174	0.874	0.9	222.3	O K
240 min Summer	87.186	0.886	0.9	234.9	O K
360 min Summer	87.203	0.903	0.9	252.0	Flood Risk
480 min Summer	87.214	0.914	0.9	263.5	Flood Risk
600 min Summer	87.222	0.922	0.9	271.7	Flood Risk
720 min Summer	87.228	0.928	0.9	277.7	Flood Risk
960 min Summer	87.235	0.935	0.9	285.4	Flood Risk
1440 min Summer	87.241	0.941	0.9	291.0	Flood Risk
2160 min Summer	87.237	0.937	0.9	287.1	Flood Risk
2880 min Summer	87.227	0.927	0.9	276.7	Flood Risk
4320 min Summer	87.210	0.910	0.9	259.5	Flood Risk
5760 min Summer	87.197	0.897	0.9	246.3	O K
7200 min Summer	87.186	0.886	0.9	234.5	O K
8640 min Summer	87.174	0.874	0.9	223.1	O K
10080 min Summer	87.163	0.863	0.9	212.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	60.159	0.0	71.0	27
30 min Summer	38.412	0.0	72.3	42
60 min Summer	23.519	0.0	144.2	72
120 min Summer	14.040	0.0	146.7	130
180 min Summer	10.303	0.0	148.1	190
240 min Summer	8.251	0.0	149.0	250
360 min Summer	6.015	0.0	150.3	370
480 min Summer	4.805	0.0	151.0	488
600 min Summer	4.035	0.0	151.5	608
720 min Summer	3.497	0.0	151.8	728
960 min Summer	2.790	0.0	152.0	966
1440 min Summer	2.027	0.0	151.4	1444
2160 min Summer	1.472	0.0	299.4	2160
2880 min Summer	1.173	0.0	298.5	2572
4320 min Summer	0.851	0.0	286.7	3296
5760 min Summer	0.678	0.0	486.0	4088
7200 min Summer	0.568	0.0	509.9	4904
8640 min Summer	0.491	0.0	518.6	5712
10080 min Summer	0.435	0.0	497.7	6552

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	87.074	0.774	0.8	125.0	O K
30 min Winter	87.110	0.810	0.9	159.3	O K
60 min Winter	87.145	0.845	0.9	194.0	O K
120 min Winter	87.181	0.881	0.9	229.4	O K
180 min Winter	87.201	0.901	0.9	250.2	Flood Risk
240 min Winter	87.215	0.915	0.9	264.8	Flood Risk
360 min Winter	87.235	0.935	0.9	284.7	Flood Risk
480 min Winter	87.248	0.948	0.9	298.4	Flood Risk
600 min Winter	87.257	0.957	0.9	308.3	Flood Risk
720 min Winter	87.265	0.965	0.9	315.9	Flood Risk
960 min Winter	87.274	0.974	0.9	326.2	Flood Risk
1440 min Winter	87.283	0.983	0.9	335.9	Flood Risk
2160 min Winter	87.284	0.984	0.9	336.9	Flood Risk
2880 min Winter	87.278	0.978	0.9	330.1	Flood Risk
4320 min Winter	87.257	0.957	0.9	307.6	Flood Risk
5760 min Winter	87.239	0.939	0.9	289.0	Flood Risk
7200 min Winter	87.223	0.923	0.9	272.3	Flood Risk
8640 min Winter	87.207	0.907	0.9	255.6	Flood Risk
10080 min Winter	87.190	0.890	0.9	238.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	60.159	0.0	71.6	27
30 min Winter	38.412	0.0	73.0	41
60 min Winter	23.519	0.0	145.8	70
120 min Winter	14.040	0.0	148.5	130
180 min Winter	10.303	0.0	150.0	188
240 min Winter	8.251	0.0	151.1	246
360 min Winter	6.015	0.0	152.3	364
480 min Winter	4.805	0.0	153.1	482
600 min Winter	4.035	0.0	153.5	598
720 min Winter	3.497	0.0	153.8	716
960 min Winter	2.790	0.0	153.8	950
1440 min Winter	2.027	0.0	152.9	1412
2160 min Winter	1.472	0.0	303.5	2088
2880 min Winter	1.173	0.0	301.7	2744
4320 min Winter	0.851	0.0	294.3	3504
5760 min Winter	0.678	0.0	545.1	4384
7200 min Winter	0.568	0.0	554.6	5328
8640 min Winter	0.491	0.0	540.2	6224
10080 min Winter	0.435	0.0	521.5	7072

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.431	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.000

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.333	4	8	0.333	8	12	0.333

Model Details

Storage is Online Cover Level (m) 87.500

Tank or Pond Structure

Invert Level (m) 86.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.638	0.0	0.639	887.0	1.200	1184.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	86.250
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

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	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

Appendix F

Pollution Hazard Indices Tables

Pollution hazard indices for different land use classifications (land use shaded grey applicable for the development)

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

Indicative SuDS mitigation indices for discharges to surface waters (SuDS components shaded grey applicable to this development)

	Mitigation indices		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio retention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Indicative SuDS mitigation indices for discharges to surface waters

For surface water discharge from Residential Parking Areas and Low Traffic Roads <300 traffic movements/day			
	Required mitigation indices		
Source	**TSS**	**Metals**	**Hydrocarbons**
Medium – Catchment A	0.7	0.6	0.7
Low – Catchment B	0.5	0.4	0.5
Catchment A - Drainage Network			
Basin A	0.5	0.5	0.6
Basin B	0.5 x 0.5	0.5 x 0.5	0.6 x 0.5
Check	+0.05	+0.15	+0.2
Catchment B - Drainage Network			
Basin B	0.5	0.5	0.6
Check	+0.0	+0.1	+0.1

Total SuDS mitigation index = mitigation index$_1$ + (0.5 x mitigation index$_2$)

Appendix G

Long Term Storage Calculations

4.3 Initial sizing of long term storage volume

Long term storage is to be provided to cater for the additional runoff caused by the development compared to the volume that would be contributed from the site in its greenfield state. This volume must be catered for as either infiltration storage or in storage with the ability to be discharged at a rate of less than 2 l/s/ha. Designing the drainage system with Long Term storage will result in less total storage being required than not providing LTS.

Discussion on the equation and practical provision of Long Term storage is provided in Chapter 7.

1. Development area	(A)		ha	Excluding public open space which is not modified by the development
2. Estimate of PIMP (percentage impermeable area)	(PIMP)		%	
3. Impermeable area (A · PIMP/100)	(AP)		ha	All hard surfaces in the development
4. Long Term storage factor	(LTF)			Storage volume per unit area per mm of rainfall (see Figure A10.1 or A10.2) see note 3.
5. Rainfall depth	(RD)		mm	Rainfall depth for 100 year 6 hour event (Appendix 1 Figure A3.1).
6. Long Term storage volume (RD · LTF · AP)	($LTVol_{100yr\ 6hr}$)		M^3	See note 2

Note 1 *Where Long Term storage is being discharged directly to the receiving water at 2 l/s/ha, the values for Q_{30} and Q_{100} for attenuation storage discharge rate should be reduced accordingly. If this is the case, the calculation for Attenuation storage should be based on (Q_{BAR}/A – 0.5) l/s/ha unless this reduces below a value of 1.0 l/s/ha, in which case 1.0 l/s/ha should be used.*

2 *LTF is defined such that the equation of item 6 uses rainfall depth in millimetres and area in hectares.*

3 *There is a choice of LTF factor based on the assumption as to whether the pervious area contributes to the 100 year runoff based on its SPR value. The conservative assumption would be to assume it does (Figure A10.1) unless the site is designed to minimise the runoff from green areas (Figure A10.2). 80% runoff is assumed to occur from pervious surfaces. Other options can be assumed working from first principles using the formulae in Chapter 7.*

Appendix H

SuDS Maintenance Plan

Maintenance and Management

The attenuation basins and swale would be maintained by a management company set up by the developer. As construction has not yet commenced, the process of finalising the management company contract has not yet commenced. The developer will ensure that the measures as outlined below form part of the management company contract details, for the ongoing maintenance of all SuDS features on site.

The indicative maintenance requirements for each proposed SuDS component is given below. Taken from CIRIA report C753 "The SuDS Manual".

Drainage Pipes

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Remove sediment and debris from inspection chambers and hydrobrake chambers	Annually
	Cleaning of gutters and any filters on downpipes	Annually
	Remove any root ingress	As required
Occasional Maintenance	CCTV survey of drains to check alignment, cracking and joint displacement	10 year intervals

Detention Basins

MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
Regular Maintenance	Litter and debris removal	Monthly (or as required)
	Cut the grass – for spillways and access routes	Monthly (during growing season, or as required)
	Cut the meadow grass in and around the basin	Half yearly (spring, before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)

	Inspect inlets, outlets and overflows for evidence of blockage and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility structure for all silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year) then annually or as required
	Check any mechanical devices e.g. penstocks	Half yearly
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlet, outlet and forebay	Annually or as required
	Manage wetland plants in outlet pool – where provided	Annually
Occasional Maintenance	Re-seed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin where required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Realign rip-rap	As required
	Repair / rehabilitate inlets, outlets and overflows	As required

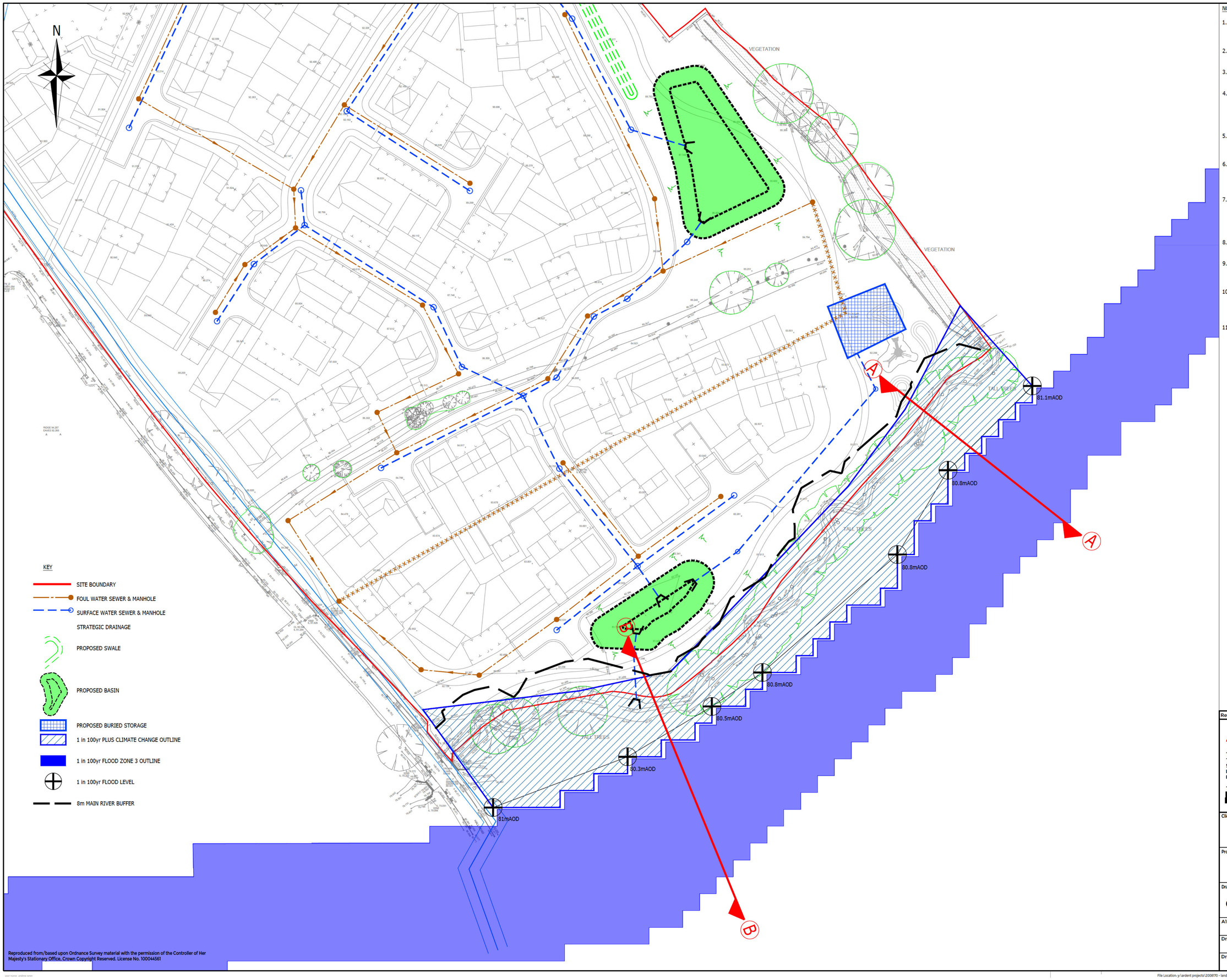
Swale

Maintenance Period	Maintenance Task	Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season) or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over > 10% of the filter strip area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required

	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Appendix I

Climate Change Flood Level Plan



NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METERS UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVEL AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. ANY WORKS OUTSIDE RED SITE BOUNDARY ARE FOR INFORMATION PURPOSES ONLY. UNLESS SPECIFICALLY NOTED, ALL WORKS OUTSIDE THE SITE BOUNDARY WILL BE UNDERTAKEN BY OTHERS UNDER A SEPARATE.
7. ALL EXISTING SERVICE ROUTES HAVE BEEN TRANSCRIBED FROM THE RESPECTIVE UNDERTAKERS RECORDS AND AS SUCH NO RESPONSIBILITY IS ACCEPTED BY ARDENT CONSULTING ENGINEERS FOR THE ACCURACY OF ROUTES SHOWN.
8. THE AVOIDANCE AND PROTECTION OF SERVICES DURING THE WORKS IS THE RESPONSIBILITY OF THE CONTRACTOR.
9. THE CONTRACTOR IS REMINDED OF HIS OBLIGATION TO VERIFY THE ROUTE OF ALL SERVICES ON SITE PRIOR TO THE COMMENCEMENT OF THE WORKS.
10. THE CONTRACTOR SHOULD ALLOW FOR ANY NECESSARY LIAISON WITH THE STATUTORY UTILITIES DURING THE COURSE OF THE WORKS TO AVOID ANY DISRUPTION TO RETAINED SERVICES.
11. THE CONTRACTOR SHOULD NOTE THAT THE SERVICES SHOWN ARE NOT TO BE CONSIDERED EXHAUSTIVE. PRIVATE SERVICES MAY BE PRESENT WITHIN THE LIMIT OF WORKS AND CARE SHOULD BE TAKEN TO LOCATE AND AVOID THESE DURING CONSTRUCTION.

ALL INFORMATION REGARDING DRAINAGE IS INDICATIVE ONLY AND FOR INFORMATION ONLY.

SITE LAYOUT IS BASED UPON DAP ARCHITECTURE DRAWING, PROP SCHEME DESIGN PLAN REV 100.02 DATED FEBRUARY 2022

TOPOGRAPHICAL SURVEY IS BASED UPON SURVEY BY COUNTRYSIDE PROPERTIES, REF. SURV2956 REV A DATED MARCH 2022.

TREE ROOT PROTECTION SURVEY IS BASED UPON SURVEY BY HALLWOOD ASSOCIATES, REF. HWA10767_APII DATED MARCH 2022.

FOR INFORMATION ONLY

0m 5m 25m

Scale: 1:500 @A1

Rev	Description	Drn	Chk	App	Date

ARDENT CONSULTING ENGINEERS
Third Floor
The Hallmark Building
52-56 Leadenhall Street
London
EC3M 5JE
Tel: 020 7680 4088
[redacted]

Client
COUNTRYSIDE PARTNERSHIPS PLC

Project Title:
LAND SOUTH OF HENHAM ROAD, ELSENHAM

Drawing Title:
CLIMATE CHANGE FLOOD LEVEL PLAN

A1 Scale	Date	Designed by
1:500	MARCH 2022	TR
Drawn by	Checked by	Approved by
TR	CC	BB

Drawing Number	Rev
2008170-031	–