

Pell Frischmann

BEW Parcel SC1 - Residential Development

Sustainable Drainage Report

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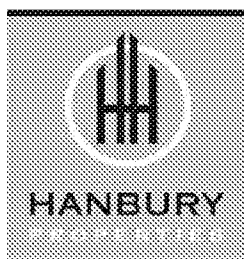
Prepared for

CC Projects Limited, Ashmarden Ltd and
Hanbury (PM) Ltd

Prepared by

Pell Frischmann

5 Manchester Square
London
W1U 3PD



Pell Frischmann

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1 Introduction

1.1.1 This Sustainable Drainage Report (SDR) sets out the principles of the drainage design for the proposed development and summarises the reasoning behind the chosen design. This includes:

- Consideration of national and local guidance
- A suitable framework for the sustainable management of surface water
- Justification of specific flow rates
- Volumes of attenuation provided
- The sustainable drainage features to be implemented and their associated benefits
- A proposed adoption and maintenance regime
- A foul water drainage strategy

1.1.2 This SDR has been produced by Pell Frischmann on behalf of C.C Projects, Ashmarden Ltd and Hanbury (PM) Ltd in respect of a site located east of the existing A29 (Westergate Street / Lidsey Road), Bognor Regis.

1.1.3 The site forms part of the Barnham, Eastergate and Westergate site allocation within the Arun Local Plan 2011-2031 where it is referenced as 'SD5 BEW' under Policy HSP2 c. Therefore, the principle of the development has been established. The Arun Local Plan 2011-2031 has carried out a sequential test confirming the appropriateness of the site for such a development.

1.1.4 Subsequent to the site's allocation in the Local Plan, the BEW Framework Masterplan was produced to provide a comprehensive masterplan for the strategic site allocation, demonstrating how the site can contribute to the delivery of housing and employment needs of the Local Plan through the plan period (2011-2031).

1.1.5 Specifically, the Framework Masterplan set out drainage constraints and opportunities, namely outlining key watersheds across the development area and identification of strategic attenuation basins and ponds that could be used to accommodate the volume of surface water storage anticipated to serve the development.

1.1.6 The Framework Masterplan was endorsed by the Council's Development Control Committee in November 2020, subject to the submission of a Phasing and Infrastructure Delivery Plan.

1.1.7 The application site is referred to as BEW SC1 and forms the land south of Barnham Road and north of the railway line as well as the route of the A29 realignment in Arun District of West Sussex. A site location plan is provided for reference as Figure 1.1. Development proposals submitted as part of a planning application should be reviewed alongside this report.

1.1.8 This report focusses on the proposed development drainage strategy, with highway drainage proposals around the A29 realignment and associated road network set out in a separate report by Pell Frischmann (report ref: 100148-PEF-ZZ-XX-RP-CD-000003). The strategies have been separated in part due to the different strategies for managing surface water and potential separation of future adoption and maintenance of the drainage features.

1.1.9 A Flood Risk Assessment (FRA) has also been produced by Pell Frischmann (report ref: 100148-PEF-ZZ-XX-RP-YE-000020) that provides a comprehensive review of flood risk issues across the site. The FRA and SDR are to be included as appendices to the Environmental Statement (ES).

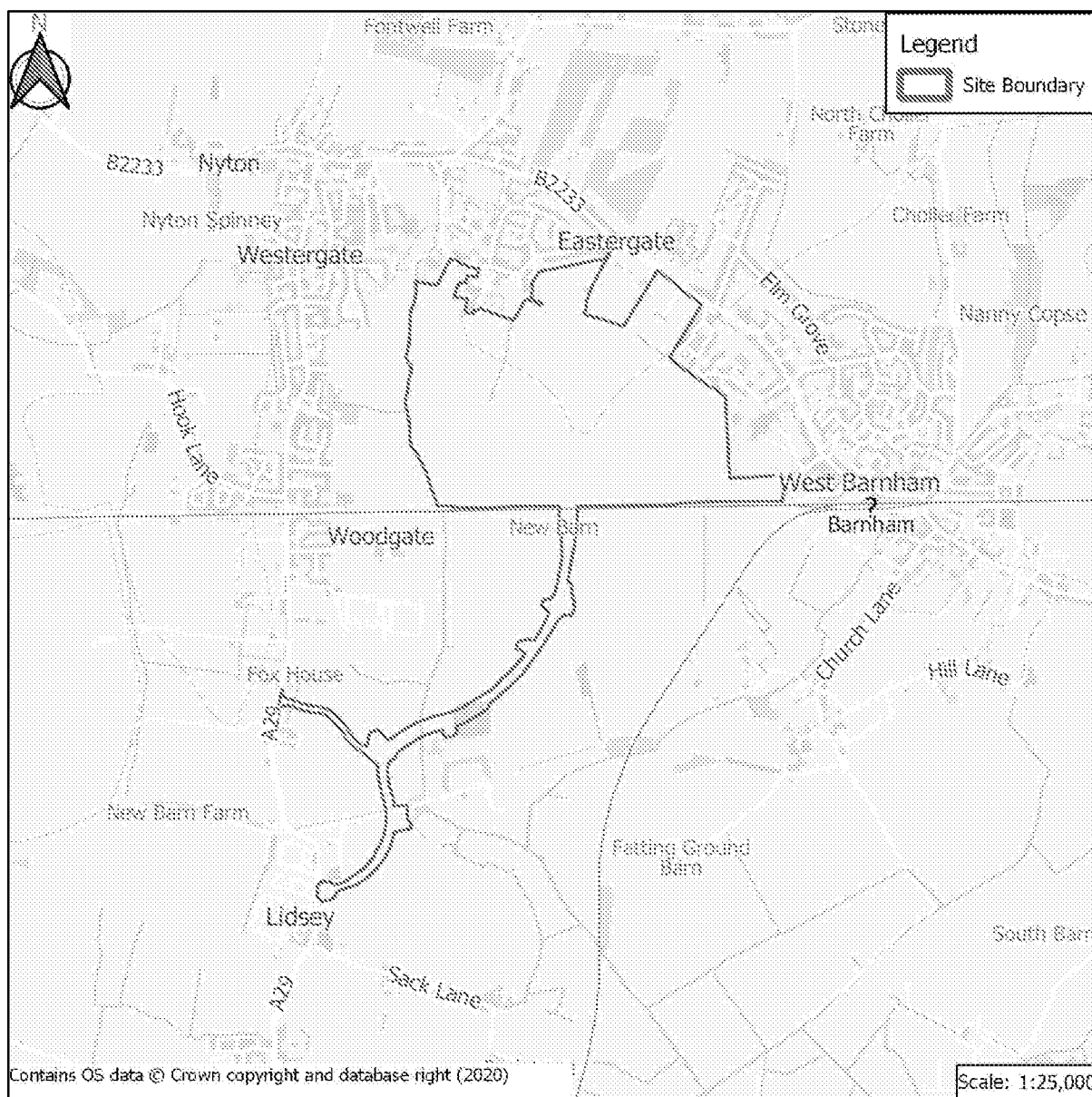


Figure 1.1 Site Location Plan

1.2 Sustainable Drainage Guidance

SuDS Design Guidance

- 1.2.1 Sustainable Drainage Systems (SuDS) aim to mimic the natural runoff regime and minimise any detriment to the wider water environment. In keeping with the 4 pillars of SuDS design, using a range of features can provide a variety of benefits, from managing water quantity and quality, to improving biodiversity and local amenity value.
- 1.2.2 The CIRIA SuDS Manual and the DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems provide extensive information on the implementation of SuDS features. These documents have been utilised to inform this strategy.

1.2.3 Furthermore, there is specific local guidance from West Sussex County Council (WSCC) and Arun District Council (ADC) titled the "West Sussex LLFA Policy for the Management of Surface Water"¹ which has also been utilised and will be referenced within the report where appropriate.

1.2.4 In line with the Environment Agency (EA) guidance on rainfall climate change predictions and considering the nature of the proposals, a 40% allowance has been applied when calculating the attenuation requirements for the residential elements of the development. For development types other than residential, a 20% climate change allowance has been applied.

Local Policy & Studies

1.2.5 The Arun Local Plan 2011-2031² was adopted by the Council in July 2018, setting out the vision objectives and a sustainable strategy for delivering the necessary growth of the District over the Plan Period.

1.2.6 Specifically, Chapter 18 of the Local Plan addresses 'Water' with its strategic objective "To plan for climate change and work in harmony with the environment to conserve natural resources and increase biodiversity".

1.2.7 The following list provides a summary of the key policies related to the Water Environment:

- Policy W SP1 – This relates to water in many forms and includes encouraging water efficiency measures to protect water resources and water quality. It also promotes the incorporation of SuDS as part of a surface water strategy using them as design features to enhance waterbodies and provide flood relief.
- Policy W DM1 – This policy relates specifically to water supply and quality, stating development will only be permitted where sufficient water supplies can be provided and not considered detrimental to existing resources. It also requires demonstration of adequate drainage capacity in the foul and surface water network. Specific advice is provided regarding any discharges to the Lidsey Wastewater Treatment Works catchment.
- Policy W DM2 – Relates to flood risk issues, setting out a range of criteria that must be met for development to be permissible. Development must demonstrate adequate management of flood risks identified and contribute to sustainability benefits to the wider community, including a reduction in flood risk where possible.
- Policy W DM3 – Focuses on the provision of SuDS to capture and store water on site that will also aid in improving water quality. Specific policy points relate to the suitable inclusion of SuDS measures and design criteria that should be met. These policy points align with the Local Surface Water Management Policy prepared by West Sussex County Council, discussed below.
- Policy W DM4 – Outlines policy points centred on protecting the coast and providing sea defence works. Due to the location of the Proposed Development, this policy is unlikely to be directly relevant to the assessment.

1.2.8 Alongside the Arun Local Plan, the Barnham & Eastergate Neighbourhood Plan³ aims to provide local people with an ability to shape changes that should occur within the Parish and developers with clarity as to the requirements that need to be met for developments.

1.2.9 The following list provide a summary of the key policy within the Neighbourhood Plan.

- Policy ES1: Flooding, Drainage and New Development

¹ West Sussex County Council (2018); *West Sussex LLFA Policy for the Management of Surface Water*; available at <https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/flooding/flood-risk-management/flood-reports-projects-and-policies/>

² Arun District Council (July 2018); *The Arun Local Plan 2011-2031, Final Report*; prepared by Arun District Council

³ Barnham and Eastergate Parish Council (July 2014); *Barnham and Eastergate Neighbourhood Development Plan 2014-29, Final Report*; prepared by BEPC

Lidsey Surface Water Management Plan

- 1.2.10 Following several flood events in West Sussex County during 2012 and 2013, West Sussex County Council made a resolution to address issues regarding drainage infrastructure as part of 'Operation Watershed'. A key output of this was the creation of the Lidsey Surface Water Management Plan⁴ that outlines how surface water should be managed within this catchment.
- 1.2.11 The entire application site falls within the Lidsey Surface Water Management Plan area, and as such will use the information contained to advise on baseline conditions in relation to local flood risk. Where relevant, specific policies and recommendations for the management of surface water will be incorporated into the design and assessment of the Proposed Development as part of the Flood Risk Assessment and Sustainable Drainage Report.

⁴ West Sussex County Council, Southern Water, Arun District Council, Environment Agency (2013): *The Lidsey Surface Water Management Plan: Final Report*; prepared by Atkins on behalf of the above organisations

2 Existing Site Conditions

- 2.1.1 The existing site is predominantly given over to agricultural land, dominated by arable fields. The Lidsey Rife comprises a dominant topographical feature in the landscaping running through the western part of the overall site. A series of smaller, interconnected engineered watercourses are present, predominantly serving a land drainage function, as shown in Figure 2.1.
- 2.1.2 Along the northern boundary, a watercourse referred to as the 'School Stream' flows both east and west to a point where a headwall is present. This headwall leads into a culverted section of watercourse that re-emerges just north of the railway line in the east of the site, before passing under the railway and continuing its route as an open watercourse.
- 2.1.3 Within the overall site boundary, there are no areas considered to be served by existing positive drainage infrastructure, and as such, the entire area is subject to a natural regime of surface water runoff, evapotranspiration, and infiltration where ground conditions permit.

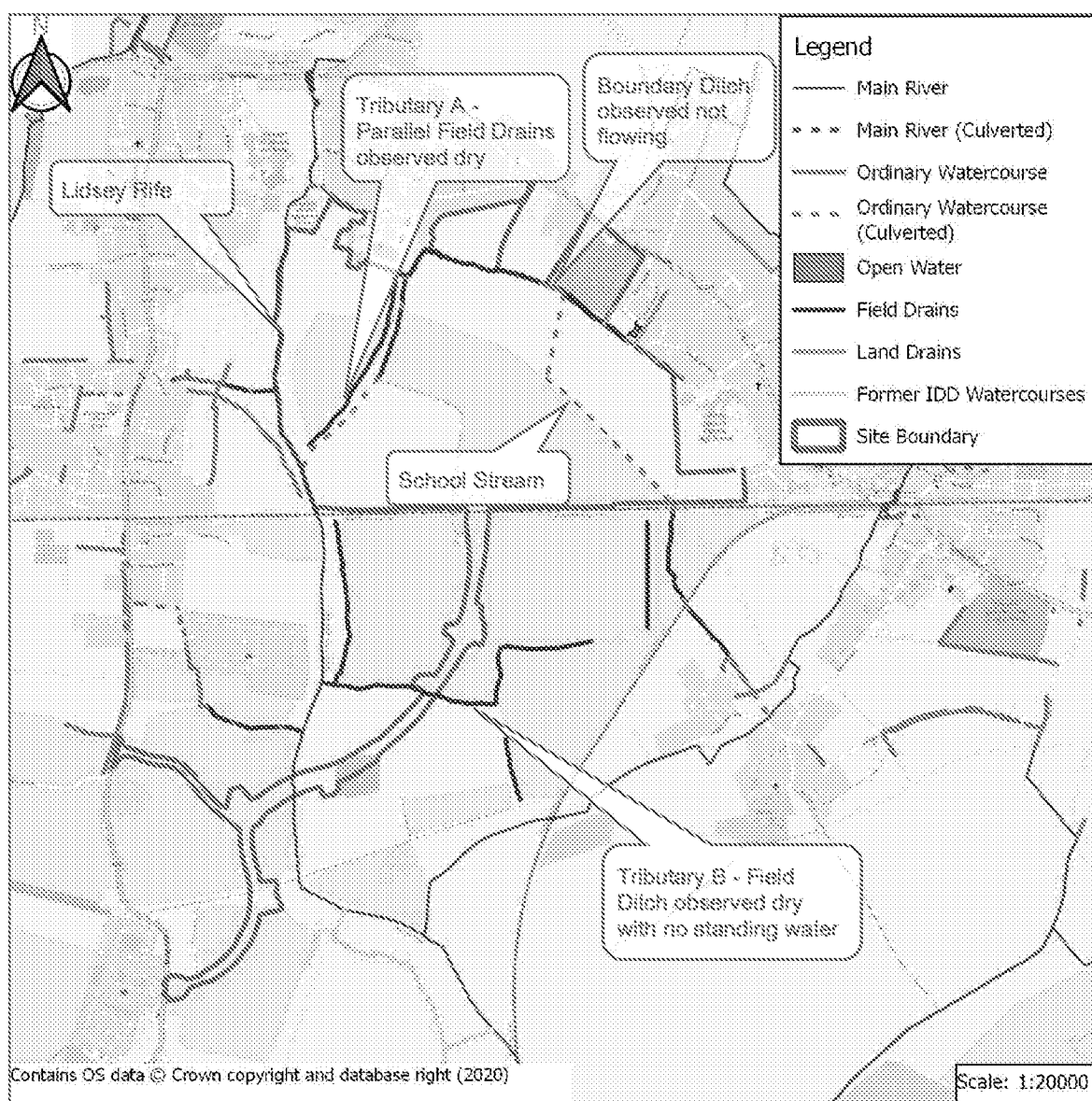


Figure 2.1 Watercourse Location Plan including Site Observations

- 2.1.4 The EA Flood Map for Planning shows the site is located largely within Flood Zone 1 (Low Probability) and so at low risk of flooding from fluvial and tidal sources. However, there are extents of Flood Zone 2 and 3 in the west associated with the Lidsey Rife within a defined floodplain corridor parallel to the watercourse. Some floodplain also extends along the defined ditches with some connectivity to the Lidsey Rife. Further discussion regarding the risk from this source is discussed in the accompanying FRA.
- 2.1.5 The development site covers a large area and therefore has a varied, undulating topography. The low point of the site is found along the Lidsey Rife in the west where levels vary from 1.88m AOD in the south to 6.75m AOD in the north.
- 2.1.6 There is a high ridge point running north-south through the centre of the site. The most elevated point is found towards the north with levels around 10.96m AOD, adjacent to the railway levels are found around 9.73m AOD. This level along the railway falls eastwards to approximately 6.27m AOD before rising back up to meet Gospond Road at 8.78m AOD and also falls westwards towards the Lidsey Rife to levels around 1.88m AOD.
- 2.1.7 The topographical survey is included as Appendix A.
- 2.1.8 British Geological Survey mapping suggests the site is underlain by superficial deposits comprising of Head (gravel, sand, silt and clay), River Terrace Deposits and Raised Beach Deposits consisting of mainly silts, sands and gravels.
- 2.1.9 The site is wholly underlain by bedrock geology of London Clay which is further underlain by clays, sands, and silts.
- 2.1.10 Aquifer designations within the superficial deposits covering the site are categorised as Superficial A aquifers with a Medium-low groundwater vulnerability. The bedrock geology is designated as an Unproductive aquifer.

2.2 Existing Runoff Rates

- 2.2.1 An assessment of the equivalent greenfield QBAR surface water runoff rate from the entire proposed development area has been undertaken and is summarised within Table 2.1 below.
- 2.2.2 The runoff rates have been estimated using the IH124 method, with appropriate prorated adjustments for a site of less than 50ha, as recommended in Interim Code of Practice for Sustainable Drainage. The runoff rate has been calculated for an area of 27.0ha which equates to the anticipated contributing impermeable area for the development to ensure a pre and post development comparison is representative as all other permeable areas will continue to drain as they currently do. Over this 27ha, the QBAR rate is equivalent to 3.8l/s/ha.

Table 2.1 Equivalent Runoff Rates

Return Period (Years)	Runoff Rate (l/s)
1	87.0
Mean Annual Flow Rate (QBAR)	102.4
30	232.0
100	326.6

2.3 Existing Runoff Volume

- 2.3.1 An assessment of the surface water runoff volume from the proposed development area has been made for a 1 in 100-year 6-hour storm. As the site is currently undeveloped, this assessment has been carried out using the Source Control module within Micro Drainage (using FEH Data) to be 4,300m³, full results are included within Appendix B.

3 Surface Water Drainage Strategy

3.1 Drainage Hierarchy

3.1.1 The Planning Policy Guidance and the SuDS Manual identify that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:

1. Into the ground (infiltration),
2. To a surface water body,
3. To a surface water sewer, highway drain or other such drainage system,
4. To a combined sewer.

3.1.2 The aim of this approach is to manage surface water runoff as close to where it falls as possible and in doing so, mimic the natural drainage regime. With reference to ADC and WSCC guidance, discharge to a combined or foul sewer is not considered acceptable.

3.1.3 When assessing the suitability of disposing surface water via infiltration, the underlying geology and the groundwater table must be considered.

3.1.4 A geo-environmental desk study (reference A13394-PF-C-ZZ-XX-RPT-0001) has been produced by Pell Frischmann and corroborates the underlying bedrock and superficial deposits shown on the BGS mapping. The report also indicates that the superficial deposits of River Terrace deposits are to be found at a depth of up to 3.5m bgl. Ordinarily, this depth and type of soil would be conducive to infiltration, but in this case, it will need to be implemented in specific locations wherever the groundwater depth permits.

3.1.5 The groundwater table at the site has been monitored across the entire Framework Masterplan area (so including land south of the railway not part of this application) over the winter period (October 2019 to March 2020) as per ADC and WSCC guidance, with additional monitoring carried out between March 2020 and January 2021.

3.1.6 The groundwater monitoring results, included as Appendix C, record the groundwater table between 840mm and 50mm below ground level (bgl). A summary of the highest recorded groundwater levels is provided in Table 3.1, with monitoring locations shown in Figure 3.1 for reference. Note only those monitoring locations found north of the railway line have been summarised below, the FRA provides a full analysis of groundwater levels across the site.

Table 3.1 Summary of Highest Groundwater Levels Recorded

Borehole Ref	Well Datum (mAOD)	Minimum Depth Below Ground Level (bgl)	Corresponding Water Level (mAOD)	Date of Minimum Depth Recording
DS001	8.12	0.11	6.01	23/12/2019
DS002	10.13	0.45	9.68	23/12/2019
DS003	9.8	0.3	9.5	17/02/2020
DS004	8.81	0.2	8.41	11/12/2020
DS005	10.29	0.15	10.14	23/12/2019
DS006	9.15	0.65	8.5	11/12/2020
DS007	8.22	0.45	7.77	23/12/2019
DS008	8.07	0.84	7.23	23/12/2019
DS009	9.89	0.3	9.39	11/12/2020
DS010	7.31	0.4	6.91	11/12/2020
DS022	8.93	0.37	8.56	06/03/2020

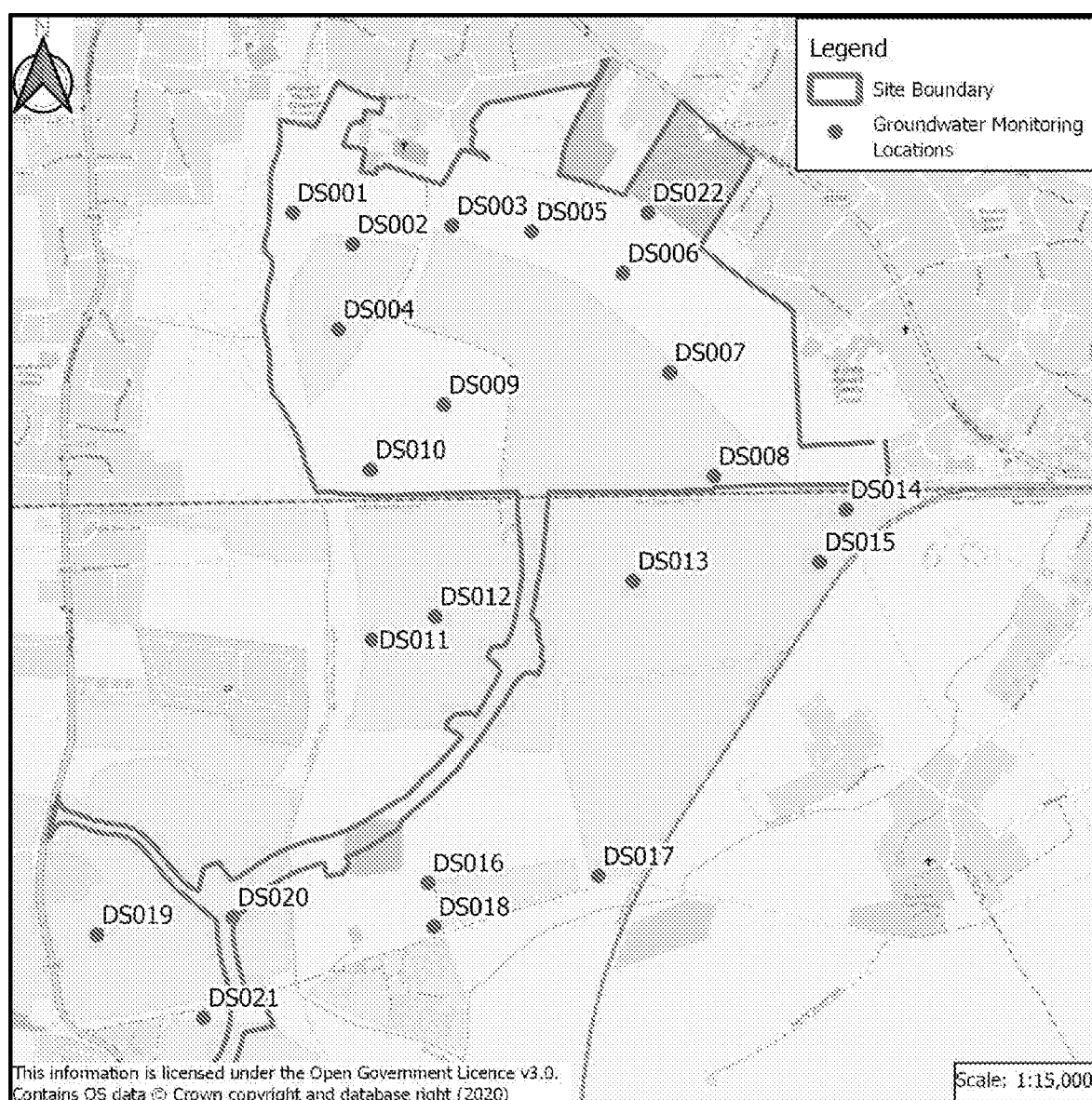


Figure 3.1 Groundwater Monitoring Locations

- 3.1.7 The shallow nature of the groundwater precludes the implementation of infiltration drainage features as the principal method of discharging surface water runoff from the site. Typically, BRE guidance suggests a minimum 1m freeboard should be provided between the base of an infiltration feature and the maximum winter groundwater level, with acknowledgement that this freeboard can be reduced in Arun District.
- 3.1.8 However, in the centre of the development site there is a high ridge running north-south where the deepest groundwater levels are typically found, it may be appropriate to use infiltration features as supplementary SuDS due to the other potential benefits they can provide whilst not relying on any attenuation capability.
- 3.1.9 The extensive network of land drainage ditches and ordinary watercourses within the site and along the boundaries provide suitable locations for discharging surface water runoff from the site and would be in keeping with the current drainage regime, providing the QBAR greenfield runoff rate is met.
- 3.1.10 Therefore, this is the intended method of discharging the surface water runoff and it is not necessary to assess the viability of discharging to any of the nearby public sewers. Should, for any reason, connection to a watercourse be unsuitable, the possibility of connecting to a sewer could be investigated.

3.2 Surface Water Attenuation

- 3.2.1 The overall application area is approximately 92ha, this includes both development space, public open space and the A29 extension. The development plots, including associated internal highways used to define the drainage strategy outlined below, comprise approximately 42ha.
- 3.2.2 Residential plots have been given an assumed impermeability of 65% which accounts for footprint, driveways, access etc and excludes areas given over to gardens and communal green spaces. Furthermore, a 6% uplift in contributing impermeable area has been included when calculating the required attenuation, this allows for urban creep as per the West Sussex LLFA Policy for the Management of Surface Water (PMSW) and is based on an average density of 31 dwellings per hectare. The school and the apartment block (Plot 8) have been given 50% and 90% impermeability respectively and no urban creep is accounted for.
- 3.2.3 These figures may change during detailed design but represent a conservative approach for the current outline strategy. Further refinement of impermeable areas and allowance for urban creep will need to be considered at reserved matters stage as individual development phases are brought forward.
- 3.2.4 Details of the proposed plots and their percentage of impermeability are included in Table 3.2, the total impermeable area contributing to the drainage system is therefore 27.0ha. Corresponding plot references are included for reference on the drainage strategy drawing included as Appendix D.
- 3.2.5 Development drainage has been kept separate from the main A29 adoptable highway drainage network to comply with current requirements regarding the adoptability of roads and drainage by the appropriate highways authority.
- 3.2.6 Using the total contributing impermeable area and the equivalent greenfield QBAR runoff rate (27.0ha and 102.4l/s respectively) pro-rata figure of 3.8 l/s/ha has been calculated and can be applied to each plot to give the runoff rate restriction based on the area of the plot. Detailed design should also ensure no increase in the runoff rate for the 1 in 1-year event to comply with latest policy and best practice.
- 3.2.7 As a runoff rate restriction is required, it is necessary to provide surface water attenuation to balance the excess volume in a safe manner. Sufficient storage is provided for events up to the 1 in 100-year storm with a 40% allowance for climate change.

Table 3.2 Plot areas, runoff rates and volumes of attenuation

Plot	Total Area (ha)	Impermeability (%)	Resultant Impermeable Area, inc. urban creep (ha)	Discharge Rate (l/s)	Volume of Attenuation (m³)
Plot 1	10.53	65%	7.254	25.9	6518
Plot 2	7.74	65%	5.331	19.1	4773
Plot 3	2.29	65%	1.580	5.7	1395
Plot 4	1.31	65%	0.905	3.2	799
Plot 5	0.90	65%	0.619	2.2	521
Plot 6	7.23	65%	4.979	17.8	4418
Plot 7	7.64	65%	5.266	18.8	4708
Plot 8	0.98	90%	0.880	3.3	771
Primary School	3.37	50%	1.687	6.4	1481
Total	42.0		27.0	102.4	25384

- 3.2.8 The primary nature of these attenuation SuDS features is that of dry, grassed basins which fill up when storm events occur but do not have a permanent body of water. In line with existing design standards and best practice they have a total depth of 1.3m which provides 1m depth for water storage and 300mm as freeboard. The side slopes of the basins shown on the latest drainage strategy drawing have 1:5 gradients wherever possible, with a minimum gradient of 1:3 where spatial constraints do not allow for this. A maintenance track around the top of the basin with a width of at least 3m is also provided to each basin, this adheres to SuDS Policy 6 of the WSLFA PMSW.
- 3.2.9 These basins provide suitable storage capacity, treat the water by naturally filtering out contaminants, provide a pleasant green landscape when not attenuating runoff and enhance biodiversity through wildflower planting and the associated habitats that offers. This achieves all 4 pillars of good SuDS design.
- 3.2.10 In addition to the dry basins, and in the interest of ecological benefit and landscaping opportunities, some of the basins are to be designed with a permanent body of water. To achieve this, the invert level of the out-going pipe will be set at 1.3m below ground level with further excavation below this level in which water will sit but not drain away. Regular introduction of flows will encourage movement and refresh the water column minimising the risk of stagnation and eutrophication.
- 3.2.11 The side slopes of these basins can also be modified to provide less of a slope and facilitate other ecological aspirations. The location of these 'wet' basins and basins with gentler gradients are to be confirmed and will be subject to additional safety and spatial constraints.
- 3.2.12 As the development progresses any SuDS features will be designed in line with the CDM Regulations 2015 and the health and safety observations made within the SuDS Manual.
- 3.2.13 At detailed design stage, any basin that is designed with a base level below the maximum winter groundwater level in that location will need to ensure the design has suitable lining to prevent the ingress of groundwater into the SuDS feature, reducing its overall capacity to store runoff. Furthermore, any lining will require suitable anchoring and calculations to demonstrate stability to avoid floatation from the hydrostatic uplift caused by the groundwater table.
- 3.2.14 Where the design affords a freeboard between the base of the feature and winter groundwater levels, the features should be designed without lining to allow infiltration when permeability allows. Further calculations will be needed to support design of the feature with infiltration rates determined through location-specific testing to BRE365 or similar during the winter period, with sufficient freeboard provided to ensure adequate capacity within the basins if infiltration is impeded.

- 3.2.15 These surface water attenuation SuDS have been positioned between the plot they serve and their respective receiving watercourse to facilitate gravity connections. A drainage strategy drawing, reference A13394-PEF-GEN-XX-DR-CD-0536 shows an indicative location for the attenuation features and is included as **Appendix D**.
- 3.2.16 As mentioned previously, a separate report has been prepared covering the highway drainage elements. To provide context to the surface water drainage strategy, a Composite Drainage Plan (drawing ref: A13394-PEF-GEN-XX-DR-CD-0511) has been prepared that shows all proposed surface water features, which is included for reference as **Appendix E**.
- 3.2.17 To complement these principal SuDS features, other measures should be included at detail design to promote rainwater capture and localised source control measures, providing additional levels of treatment to surface water runoff. These include, but are not limited to:
- Water butts
 - Rainwater harvesting systems
 - Permeable paving
 - Filter drains
 - Swales
 - Rain gardens
 - Tree Pits
- 3.2.18 It is recommended that the final layout uses the proposed road infrastructure to provide drainage exceedance routes (overland flood flow) through the development and towards the formal drainage features, for events in excess of the capacity of the drainage system or in the event of there being a failure of part of the network (e.g. blockage / damage).
- 3.2.19 In addition to the volume of storage provided within the main attenuation basins, there will be additional capacity within the upstream pipes and manholes which has not been accounted for at this stage and therefore a further level of redundancy to the network is provided.
- 3.2.20 As the proposed strategy seeks to restrict runoff to the equivalent QBAR rate for all return periods, the runoff volume criteria of the non-statutory technical standards for sustainable drainage systems is met, and provision of long-term storage is not required.

3.3 Maintenance

- 3.3.1 For the proposed surface water drainage system to function correctly, it will need to be appropriately maintained. There are essentially 3 possibilities for these maintenance responsibilities, they are:
- Southern Water, as the local sewerage undertaker.
 - WSCC, as LLFA or SuDS Approval Body (SAB) (if section 3 of the FWM Act 2010 is enacted)
 - A private management company.
- 3.3.2 Furthermore, there are 3 discrete components to the system – the pipe network, the principal SuDS (basin, ponds, swales, and outfalls) and ancillary SuDS (permeable paving, tree planters etc.). A situation may arise whereby one of the bodies adopts a specific part of the network (the pipe network for example) but not one of the other components. In this case, a combination of adopting bodies may be required and agreements should be put in place to reflect this.
- 3.3.3 The maintenance schedule for the network must be comprehensive and detail the specific maintenance requirements for each element of the drainage system. The CIRIA SuDS Manual has extensive information relating to the maintenance of SuDS which should be consulted when specifying the requirements.

3.3.4 For pipes, manholes and gullies, both general best practice and specific manufacturer maintenance protocols should be followed.

3.3.5 In the event that a management company adopts all, or some of the drainage network, requirements for the ongoing maintenance of the infrastructure should form part of the Operation and Maintenance (O&M) manual for the site, clearly detailing the extent of responsibility and features to be maintained. Any specialist or proprietary products specified should have a manufacturer specific maintenance regime which should be included. It is envisaged that the O&M manual will be developed at the detailed design stage. A summary of general best practice maintenance is given below.

- All drainage features should be situated in open areas which are readily accessible.
- Gullies, pipes, manholes and silt traps should be inspected and de-silted at least once per year, where necessary.
- Wherever permeable paving is incorporated it should be swept a minimum of every 6 months to maintain flow capacity of the joints between blocks.
- For the basins which are designed to be dry, they should be seeded with a wildflower grass seed mix that can tolerate wet ground conditions and should be mowed periodically over the summer months to ensure they do not become overgrown.
- For the basins which are designed to be wet, plants which are suitable for growing in permanent water should be used, such as bull rushes and reeds.
- Regular inspections of all basins should be undertaken to remove litter/debris, invasive/colonising vegetation, and silt build-up as necessary.
- Inlet and outlet structures should be regularly inspected with remedial work as required to ensure clear flow of water and the prevention of silt/vegetation build up.
- Flow control chambers should be inspected every 6 months to ensure proper function with any litter or debris removed as necessary.

4 Foul Water Drainage

- 4.1.1 As the site is currently undeveloped, there is no existing foul network serving the site although a foul sewer does flow southwards along part of the south-western boundary parallel to the Lidsey Rife, which ultimately connects to Lidsey Wastewater Treatment Works (WwTW). There are also foul sewers located to the north under Barnham Road and to the east near Gospond Road that may provide points of connection for foul water from the proposed development, which are understood to drain to Ford Wastewater Treatment Works to the east.
- 4.1.2 The existing public foul water sewer which runs parallel to the Lidsey Rife has a manhole within the site boundary (MH3302) which has a cover level of 1.75m AOD and an invert level of 0.18m AOD. Due to its significantly low topographical position, it is possible that the entire development can drain to this manhole, subject to its capacity and the capacity of the downstream network.
- 4.1.3 An indicative foul water drainage layout (BEW-PF-GEN-XX-DR-C-0535_Indicative Foul Strategy) is included as Appendix F and shows a pipe network with associated levels.
- 4.1.4 There is a small area of development in the east, adjacent to Gospond Road which cannot be drained to MH3302. However, the levels in Gospond Road are higher than the proposed levels for this area of development, therefore a pumping station will be required for this discrete parcel of development.
- 4.1.5 The anticipated foul water flows generated by the development has been calculated based on 4000 litres per dwelling per day, in accordance with Sewers for Adoption. This 4000l/dwelling/day is typically based on an average occupancy rate of 3 people/dwelling, using 200l/person/day with a peaking factor of 6 and 10% allowance for infiltration.
- 4.1.6 Based on 4000l/dwelling/day and an anticipated 1250 dwellings, a foul flow rate of 57.9l/s has been calculated.
- 4.1.7 In their 'Developer Services' Foul Sewerage Modelling Criteria⁹ advisory document Southern Water put forward a methodology assuming an occupancy rate of 2.4 people/dwelling, per capita flow of 125l/person/day, a peaking factor between 1.4-2.5 and 10% allowance for infiltration. Assuming a peaking factor of 1.4, this equates to a peak flow rate of 6.6l/s.
- 4.1.8 A pre-development was submitted to Southern Water, and their response estimates a peak flow rate of 6.51l/s for the development. Southern Water identify a lack of capacity within the proposed point of connection, identifying that further network reinforcements will be required to serve the development. Southern Water is obliged to provide these upgrades within 24 months of planning permission being granted under the responsibilities of the Water Industry Act 1991. A copy of the pre-development enquiry response is included as Appendix G.
- 4.1.9 Since early in the project inception, discussions have been on-going with Southern Water to develop a strategic solution to manage foul flows from the proposed development. At this stage, it is understood options for treating foul water from the site are being developed and strategic planning includes predicted flows from the site given its allocated status. Therefore, any upgrade works required to accommodate flows from this development are already being progressed and should be made available in a timescale to suit the current development programme.

⁹ Southern Water (2018); *Developer Services: Foul Sewerage Modelling Criteria*; published V1.1 15th January 2018, available at <https://www.southernwater.co.uk/media/3025/ds-modelling-criteria.pdf>

5 Summary

- 5.1.1 This report and supporting appendices demonstrate that the drainage design for the development will comply with the relevant local and national standards.
- 5.1.2 This SDR is intended to support an Outline planning application and as such the level of detail included is commensurate with the nature of the proposals.

Table 5.1 Summary of Key Information

Topic		Existing Site	Proposed Development
Site Area (hectares)		92	42 (net developable)
Impermeable Area (hectares)		-	27.0
Number of Sub-Catchments		-	8
Outfall Location(s)		Ditches/Watercourses	Ditches/Watercourses
Peak Runoff Rate (l/s)	1 in 1-year	87.0	87.0
	QBAR	102.4	102.4
	1 in 30-year	232.0	102.4
	1 in 100-year	326.6	102.4
1 in 100-year +CC		-	102.4
Proposed Storage Volume		-	25,384
SuDS Features		-	Surface water attenuation basins Water butts Rainwater harvesting systems Permeable paving Filter drains Swales Rain gardens Tree Pits
Maintenance Responsibilities		Tenant Farmers	Southern Water, as the local sewerage undertaker. WSCC, as LLFA or SuDS Approval Body (SAB) (should section 3 of the FWM Act 2010 be enacted) A private management company.

- 5.1.3 It is envisaged that the final drainage design will be determined at the detailed design stage as the development layout is finalised.

Appendix A Topographical Survey



Appendix B MicroDrainage Results

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<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.265	0.565	25.8	3505.2	O K
120 min Winter	99.374	0.674	25.8	4231.6	O K
180 min Winter	99.444	0.744	25.8	4710.3	O K
240 min Winter	99.497	0.797	25.8	5070.3	O K
360 min Winter	99.572	0.872	25.8	5595.5	O K
480 min Winter	99.625	0.925	25.8	5973.2	O K
600 min Winter	99.665	0.965	25.8	6262.6	O K
720 min Winter	99.697	0.997	25.8	6492.1	O K
860 min Winter	99.698	0.998	25.8	6496.3	O K
1440 min Winter	99.681	0.981	25.8	6372.0	O K
2160 min Winter	99.635	0.935	25.8	6043.4	O K
2880 min Winter	99.586	0.886	25.8	5696.7	O K
4320 min Winter	99.565	0.865	25.8	5544.9	O K
5760 min Winter	99.526	0.826	25.8	5274.0	O K
7200 min Winter	99.478	0.778	25.8	4941.9	O K
8640 min Winter	99.420	0.720	25.8	4545.4	O K
10080 min Winter	99.358	0.658	25.8	4124.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	3161.9	70	
120 min Winter	35.770	0.0	3767.4	128	
180 min Winter	26.789	0.0	4057.4	188	
240 min Winter	21.821	0.0	4142.0	246	
360 min Winter	16.343	0.0	4071.8	362	
480 min Winter	13.312	0.0	4006.7	480	
600 min Winter	11.354	0.0	3959.5	596	
720 min Winter	9.970	0.0	3925.0	714	
860 min Winter	7.756	0.0	3840.0	842	
1440 min Winter	5.444	0.0	3677.1	1392	
2160 min Winter	3.821	0.0	7562.0	2032	
2880 min Winter	2.972	0.0	7428.1	2304	
4320 min Winter	2.222	0.0	6827.5	3240	
5760 min Winter	1.808	0.0	10407.8	4160	
7200 min Winter	1.541	0.0	11051.1	5112	
8640 min Winter	1.352	0.0	11583.5	5968	
10080 min Winter	1.211	0.0	12007.3	6760	
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 7.254

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	2.418	4 8	2.418	8 12	2.418

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Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	5810.0	1.000	7239.6	1.300	7699.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0222-2590-1000-2590
Design Head (m)	1.000
Design Flow (l/s)	25.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	222
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	25.9
Flush-Flo™	0.365	25.8
Kick-Flo®	0.737	22.4
Mean Flow over Head Range	-	21.5

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

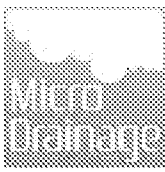
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.5	1.200	28.2	3.000	43.9	7.000	66.1
0.200	22.0	1.400	30.4	3.500	47.3	7.500	68.4
0.300	25.7	1.600	32.4	4.000	50.4	8.000	70.6
0.400	25.8	1.800	34.3	4.500	53.4	8.500	72.7
0.500	25.4	2.000	36.1	5.000	56.2	9.000	74.7
0.600	24.7	2.200	37.8	5.500	58.8	9.500	76.7
0.800	23.3	2.400	39.4	6.000	61.4		
1.000	25.9	2.600	40.9	6.500	63.8		

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Pell Frischmann				Page 1																																																																																																																																					
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<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.272	0.572	19.1	2574.6	O K
120 min Winter	99.380	0.680	19.1	3107.8	O K
180 min Winter	99.450	0.750	19.1	3458.7	O K
240 min Winter	99.501	0.801	19.1	3721.2	O K
360 min Winter	99.575	0.875	19.1	4103.9	O K
480 min Winter	99.627	0.927	19.1	4378.6	O K
600 min Winter	99.667	0.967	19.1	4588.7	O K
720 min Winter	99.698	0.998	19.1	4754.7	O K
960 min Winter	99.697	0.997	19.1	4752.8	O K
1440 min Winter	99.679	0.979	19.1	4652.4	O K
2160 min Winter	99.631	0.931	19.1	4399.0	O K
2880 min Winter	99.581	0.881	19.1	4135.3	O K
4320 min Winter	99.557	0.857	19.1	4008.5	O K
5760 min Winter	99.517	0.817	19.1	3799.5	O K
7200 min Winter	99.468	0.768	19.1	3549.4	O K
8640 min Winter	99.410	0.710	19.1	3257.0	O K
10080 min Winter	99.345	0.645	19.1	2934.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	2375.2	70	
120 min Winter	35.770	0.0	2822.9	128	
180 min Winter	26.789	0.0	3019.2	186	
240 min Winter	21.821	0.0	3049.6	246	
360 min Winter	16.343	0.0	2989.4	362	
480 min Winter	13.312	0.0	2944.8	480	
600 min Winter	11.354	0.0	2914.6	596	
720 min Winter	9.870	0.0	2893.8	714	
960 min Winter	7.756	0.0	2837.9	942	
1440 min Winter	5.444	0.0	2731.9	1392	
2160 min Winter	3.821	0.0	5623.0	2032	
2880 min Winter	2.972	0.0	5509.2	2304	
4320 min Winter	2.222	0.0	5075.0	3240	
5760 min Winter	1.808	0.0	7677.9	4160	
7200 min Winter	1.541	0.0	8157.7	5112	
8640 min Winter	1.352	0.0	8557.8	5968	
10080 min Winter	1.211	0.0	8885.3	6760	
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Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	4168.4	1.000	5391.3	1.300	5788.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0195-1910-1000-1910
Design Head (m)	1.000
Design Flow (l/s)	19.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	19.1
Flush-Flo™	0.337	19.1
Kick-Flo®	0.717	16.3
Mean Flow over Head Range	-	16.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.8	1.200	20.8	3.000	32.3	7.000	48.6
0.200	18.2	1.400	22.4	3.500	34.8	7.500	50.3
0.300	19.0	1.600	23.9	4.000	37.1	8.000	51.9
0.400	19.0	1.800	25.3	4.500	39.3	8.500	53.5
0.500	18.6	2.000	26.6	5.000	41.3	9.000	55.0
0.600	18.0	2.200	27.8	5.500	43.3	9.500	56.4
0.800	17.2	2.400	29.0	6.000	45.1		
1.000	19.1	2.600	30.2	6.500	46.9		

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File PLOT 3 ATTENUATION BASI...		Checked by				
Innovyze		Source Control 2020.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>						
Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer		99.081	0.381	5.7	460.8	O K
30 min Summer		99.155	0.455	5.7	560.2	O K
60 min Summer		99.239	0.539	5.7	678.5	O K
120 min Summer		99.334	0.634	5.7	817.6	O K
180 min Summer		99.394	0.694	5.7	908.1	O K
240 min Summer		99.437	0.737	5.7	974.9	O K
360 min Summer		99.498	0.798	5.7	1071.0	O K
480 min Summer		99.539	0.839	5.7	1138.6	O K
600 min Summer		99.570	0.870	5.7	1189.0	O K
720 min Summer		99.593	0.893	5.7	1228.0	O K
960 min Summer		99.587	0.887	5.7	1218.0	O K
1440 min Summer		99.560	0.860	5.7	1173.2	O K
2160 min Summer		99.511	0.811	5.7	1092.5	O K
2880 min Summer		99.469	0.769	5.7	1024.8	O K
4320 min Summer		99.448	0.748	5.7	992.8	O K
5760 min Summer		99.422	0.722	5.7	951.5	O K
7200 min Summer		99.392	0.692	5.7	905.3	O K
8640 min Summer		99.359	0.659	5.7	854.8	O K
10080 min Summer		99.319	0.619	5.7	794.7	O K
15 min Winter		99.123	0.423	5.7	516.7	O K
30 min Winter		99.204	0.504	5.7	628.5	O K
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer		157.551	0.0	406.7	27	
30 min Summer		96.114	0.0	464.1	41	
60 min Summer		58.634	0.0	667.6	70	
120 min Summer		35.770	0.0	802.7	130	
180 min Summer		26.789	0.0	873.2	190	
240 min Summer		21.821	0.0	892.8	250	
360 min Summer		16.343	0.0	878.3	368	
480 min Summer		13.312	0.0	864.0	488	
600 min Summer		11.354	0.0	853.4	606	
720 min Summer		9.970	0.0	845.8	726	
960 min Summer		7.756	0.0	830.6	964	
1440 min Summer		5.444	0.0	801.9	1440	
2160 min Summer		3.821	0.0	1582.2	1828	
2880 min Summer		2.972	0.0	1603.8	2196	
4320 min Summer		2.222	0.0	1491.4	2996	
5760 min Summer		1.808	0.0	2048.8	3864	
7200 min Summer		1.541	0.0	2180.8	4688	
8640 min Summer		1.352	0.0	2293.5	5536	
10080 min Summer		1.211	0.0	2390.4	6352	
15 min Winter		157.551	0.0	443.5	27	
30 min Winter		96.114	0.0	475.7	41	
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Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.297	0.597	5.7	762.0	O K
120 min Winter	99.401	0.701	5.7	919.4	O K
180 min Winter	99.466	0.766	5.7	1021.4	O K
240 min Winter	99.514	0.814	5.7	1097.5	O K
360 min Winter	99.581	0.881	5.7	1208.2	O K
480 min Winter	99.628	0.928	5.7	1287.0	O K
600 min Winter	99.663	0.963	5.7	1346.9	O K
720 min Winter	99.690	0.990	5.7	1393.9	O K
960 min Winter	99.687	0.987	5.7	1388.9	O K
1440 min Winter	99.665	0.965	5.7	1351.0	O K
2160 min Winter	99.615	0.915	5.7	1265.5	O K
2880 min Winter	99.564	0.864	5.7	1179.1	O K
4320 min Winter	99.535	0.835	5.7	1131.4	O K
5760 min Winter	99.494	0.794	5.7	1065.1	O K
7200 min Winter	99.447	0.747	5.7	990.5	O K
8640 min Winter	99.395	0.695	5.7	910.0	O K
10080 min Winter	99.333	0.633	5.7	815.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	743.8	70	
120 min Winter	35.770	0.0	873.4	128	
180 min Winter	26.789	0.0	896.3	186	
240 min Winter	21.821	0.0	887.2	246	
360 min Winter	16.343	0.0	871.4	362	
480 min Winter	13.312	0.0	862.8	480	
600 min Winter	11.354	0.0	858.9	596	
720 min Winter	9.870	0.0	858.8	712	
960 min Winter	7.756	0.0	851.8	942	
1440 min Winter	5.444	0.0	838.4	1392	
2160 min Winter	3.821	0.0	1708.7	2032	
2880 min Winter	2.972	0.0	1660.3	2304	
4320 min Winter	2.222	0.0	1541.4	3244	
5760 min Winter	1.808	0.0	2294.4	4160	
7200 min Winter	1.541	0.0	2441.4	5112	
8640 min Winter	1.352	0.0	2566.1	5976	
10080 min Winter	1.211	0.0	2672.3	6864	
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.580

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0	4 0.527	4	8 0.527	8	12 0.527

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5 Manchester Square London W1U 3PD		
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Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1092.7	1.000	1757.1	1.300	1987.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0112-5700-1000-5700
Design Head (m)	1.000
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.7
Flush-Flo™	0.296	5.7
Kick-Flo®	0.642	4.6
Mean Flow over Head Range	-	4.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.2	3.000	9.5	7.000	14.3
0.200	5.5	1.400	6.7	3.500	10.3	7.500	14.7
0.300	5.7	1.600	7.1	4.000	10.9	8.000	15.2
0.400	5.6	1.800	7.5	4.500	11.6	8.500	15.7
0.500	5.4	2.000	7.9	5.000	12.2	9.000	16.1
0.600	5.0	2.200	8.2	5.500	12.7	9.500	16.5
0.800	5.1	2.400	8.6	6.000	13.3		
1.000	5.7	2.600	8.9	6.500	13.8		

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File Plot 4 Attenuation Basi...		Checked by			
Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.098	0.398	3.2	263.8	O K
30 min Summer	99.172	0.472	3.2	320.8	O K
60 min Summer	99.255	0.555	3.2	388.5	O K
120 min Summer	99.348	0.648	3.2	468.2	O K
180 min Summer	99.406	0.706	3.2	519.5	O K
240 min Summer	99.447	0.747	3.2	557.5	O K
360 min Summer	99.504	0.804	3.2	612.2	O K
480 min Summer	99.544	0.844	3.2	650.6	O K
600 min Summer	99.572	0.872	3.2	679.3	O K
720 min Summer	99.594	0.894	3.2	701.4	O K
960 min Summer	99.588	0.888	3.2	695.2	O K
1440 min Summer	99.562	0.862	3.2	668.7	O K
2160 min Summer	99.513	0.813	3.2	620.7	O K
2880 min Summer	99.471	0.771	3.2	580.7	O K
4320 min Summer	99.452	0.752	3.2	562.2	O K
5760 min Summer	99.427	0.727	3.2	539.4	O K
7200 min Summer	99.400	0.700	3.2	514.1	O K
8640 min Summer	99.370	0.670	3.2	487.2	O K
10080 min Summer	99.337	0.637	3.2	457.8	O K
15 min Winter	99.140	0.440	3.2	295.9	O K
30 min Winter	99.221	0.521	3.2	359.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	157.551	0.0	239.7	27	
30 min Summer	96.114	0.0	265.5	41	
60 min Summer	58.634	0.0	387.7	72	
120 min Summer	35.770	0.0	465.2	130	
180 min Summer	26.789	0.0	498.9	190	
240 min Summer	21.821	0.0	499.9	250	
360 min Summer	16.343	0.0	490.8	368	
480 min Summer	13.312	0.0	483.4	488	
600 min Summer	11.354	0.0	478.4	606	
720 min Summer	9.970	0.0	475.2	726	
960 min Summer	7.756	0.0	468.7	964	
1440 min Summer	5.444	0.0	457.2	1442	
2160 min Summer	3.821	0.0	912.0	1844	
2880 min Summer	2.972	0.0	918.1	2220	
4320 min Summer	2.222	0.0	847.5	3028	
5760 min Summer	1.808	0.0	1175.5	3864	
7200 min Summer	1.541	0.0	1251.5	4688	
8640 min Summer	1.352	0.0	1316.6	5536	
10080 min Summer	1.211	0.0	1373.0	6360	
15 min Winter	157.551	0.0	258.3	27	
30 min Winter	96.114	0.0	267.7	41	
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Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.312	0.612	3.2	436.4	O K
120 min Winter	99.413	0.713	3.2	526.3	O K
180 min Winter	99.475	0.775	3.2	584.5	O K
240 min Winter	99.521	0.821	3.2	628.0	O K
360 min Winter	99.584	0.884	3.2	691.2	O K
480 min Winter	99.628	0.928	3.2	736.2	O K
600 min Winter	99.661	0.961	3.2	770.4	O K
720 min Winter	99.686	0.986	3.2	797.3	O K
960 min Winter	99.683	0.983	3.2	794.2	O K
1440 min Winter	99.662	0.962	3.2	771.9	O K
2160 min Winter	99.615	0.915	3.2	722.2	O K
2880 min Winter	99.564	0.864	3.2	671.2	O K
4320 min Winter	99.537	0.837	3.2	643.8	O K
5760 min Winter	99.499	0.799	3.2	606.8	O K
7200 min Winter	99.455	0.755	3.2	565.7	O K
8640 min Winter	99.408	0.708	3.2	521.7	O K
10080 min Winter	99.355	0.655	3.2	474.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	431.7	70	
120 min Winter	35.770	0.0	499.7	128	
180 min Winter	26.789	0.0	500.8	186	
240 min Winter	21.821	0.0	494.9	246	
360 min Winter	16.343	0.0	486.6	362	
480 min Winter	13.312	0.0	483.0	480	
600 min Winter	11.354	0.0	482.6	596	
720 min Winter	9.870	0.0	485.0	714	
960 min Winter	7.756	0.0	484.3	944	
1440 min Winter	5.444	0.0	478.3	1394	
2160 min Winter	3.821	0.0	968.1	2036	
2880 min Winter	2.972	0.0	939.1	2312	
4320 min Winter	2.222	0.0	875.2	3244	
5760 min Winter	1.808	0.0	1316.4	4168	
7200 min Winter	1.541	0.0	1401.2	5112	
8640 min Winter	1.352	0.0	1473.4	5976	
10080 min Winter	1.211	0.0	1534.2	6872	
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Innovyze	Source Control 2020.1	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.905

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.302	4 8	0.302	8 12	0.302

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File Plot 4 Attenuation Basi...	Checked by	
Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	573.5	1.000	1076.5	1.300	1258.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0085-3200-1000-3200
Design Head (m)	1.000
Design Flow (l/s)	3.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	85
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.2
Flush-Flo™	0.296	3.2
Kick-Flo®	0.624	2.6
Mean Flow over Head Range	-	2.8

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	2.6	1.200	3.5	3.000	5.3	7.000	7.9
0.200	3.1	1.400	3.7	3.500	5.7	7.500	8.2
0.300	3.2	1.600	4.0	4.000	6.1	8.000	8.5
0.400	3.1	1.800	4.2	4.500	6.4	8.500	8.7
0.500	3.0	2.000	4.4	5.000	6.8	9.000	8.9
0.600	2.7	2.200	4.6	5.500	7.1	9.500	9.2
0.800	2.9	2.400	4.8	6.000	7.4		
1.000	3.2	2.600	5.0	6.500	7.7		

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File Plot 5 Attenuation Basi...		Checked by			
Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.126	0.426	3.0	179.5	O K
30 min Summer	99.201	0.501	3.0	218.0	O K
60 min Summer	99.284	0.584	3.0	263.3	O K
120 min Summer	99.373	0.673	3.0	315.6	O K
180 min Summer	99.426	0.726	3.0	348.3	O K
240 min Summer	99.464	0.764	3.0	371.8	O K
360 min Summer	99.513	0.813	3.0	404.3	O K
480 min Summer	99.545	0.845	3.0	425.8	O K
600 min Summer	99.567	0.867	3.0	440.6	O K
720 min Summer	99.582	0.882	3.0	451.0	O K
960 min Summer	99.563	0.863	3.0	438.1	O K
1440 min Summer	99.517	0.817	3.0	407.2	O K
2160 min Summer	99.460	0.760	3.0	369.7	O K
2880 min Summer	99.411	0.711	3.0	338.7	O K
4320 min Summer	99.374	0.674	3.0	315.8	O K
5760 min Summer	99.328	0.628	3.0	289.0	O K
7200 min Summer	99.273	0.573	3.0	257.0	O K
8640 min Summer	99.219	0.519	3.0	227.6	O K
10080 min Summer	99.168	0.468	3.0	200.8	O K
15 min Winter	99.170	0.470	3.0	201.5	O K
30 min Winter	99.251	0.551	3.0	244.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	157.551	0.0	176.1	26	
30 min Summer	96.114	0.0	212.4	41	
60 min Summer	58.634	0.0	269.5	70	
120 min Summer	35.770	0.0	328.4	130	
180 min Summer	26.789	0.0	368.1	190	
240 min Summer	21.821	0.0	398.5	248	
360 min Summer	16.343	0.0	442.0	368	
480 min Summer	13.312	0.0	461.6	486	
600 min Summer	11.354	0.0	461.2	604	
720 min Summer	9.970	0.0	457.7	724	
960 min Summer	7.756	0.0	449.2	962	
1440 min Summer	5.444	0.0	430.6	1252	
2160 min Summer	3.821	0.0	636.3	1620	
2880 min Summer	2.972	0.0	659.4	2020	
4320 min Summer	2.222	0.0	734.3	2856	
5760 min Summer	1.808	0.0	805.2	3696	
7200 min Summer	1.541	0.0	857.6	4464	
8640 min Summer	1.352	0.0	902.6	5192	
10080 min Summer	1.211	0.0	941.9	5952	
15 min Winter	157.551	0.0	196.4	26	
30 min Winter	96.114	0.0	232.8	41	
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Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.341	0.641	3.0	296.2	O K
120 min Winter	99.437	0.737	3.0	355.2	O K
180 min Winter	99.496	0.796	3.0	392.7	O K
240 min Winter	99.537	0.837	3.0	420.0	O K
360 min Winter	99.592	0.892	3.0	458.3	O K
480 min Winter	99.629	0.929	3.0	484.3	O K
600 min Winter	99.654	0.954	3.0	502.9	O K
720 min Winter	99.673	0.973	3.0	516.5	O K
960 min Winter	99.658	0.958	3.0	505.6	O K
1440 min Winter	99.615	0.915	3.0	474.8	O K
2160 min Winter	99.548	0.848	3.0	427.6	O K
2880 min Winter	99.488	0.788	3.0	387.9	O K
4320 min Winter	99.431	0.731	3.0	351.1	O K
5760 min Winter	99.362	0.662	3.0	308.6	O K
7200 min Winter	99.269	0.569	3.0	255.2	O K
8640 min Winter	99.181	0.481	3.0	207.2	O K
10080 min Winter	99.101	0.401	3.0	166.9	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	301.7	70	
120 min Winter	35.770	0.0	367.1	128	
180 min Winter	26.789	0.0	410.4	186	
240 min Winter	21.821	0.0	441.6	244	
360 min Winter	16.343	0.0	466.9	360	
480 min Winter	13.312	0.0	465.2	478	
600 min Winter	11.354	0.0	461.8	594	
720 min Winter	9.870	0.0	458.8	708	
960 min Winter	7.756	0.0	451.7	934	
1440 min Winter	5.444	0.0	437.6	1364	
2160 min Winter	3.821	0.0	712.2	1708	
2880 min Winter	2.972	0.0	737.8	2164	
4320 min Winter	2.222	0.0	804.5	3112	
5760 min Winter	1.808	0.0	901.8	4032	
7200 min Winter	1.541	0.0	960.6	4824	
8640 min Winter	1.352	0.0	1011.1	5528	
10080 min Winter	1.211	0.0	1055.4	6168	
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.619

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.206	4 8	0.206	8 12	0.206

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	345.9	1.000	754.1	1.300	907.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.0
Flush-Flo™	0.297	3.0
Kick-Flo®	0.623	2.4
Mean Flow over Head Range	-	2.6

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	2.4	1.200	3.3	3.000	5.0	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		

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Innovyze			Source Control 2020.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>							
	Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
	15 min Summer		99.058	0.358	18.8	1453.0	O K
	30 min Summer		99.131	0.431	18.8	1766.5	O K
	60 min Summer		99.216	0.516	18.8	2139.9	O K
	120 min Summer		99.313	0.613	18.8	2578.2	O K
	180 min Summer		99.375	0.675	18.8	2863.7	O K
	240 min Summer		99.421	0.721	18.8	3078.7	O K
	360 min Summer		99.487	0.787	18.8	3390.0	O K
	480 min Summer		99.532	0.832	18.8	3608.3	O K
	600 min Summer		99.566	0.866	18.8	3771.6	O K
	720 min Summer		99.592	0.892	18.8	3897.9	O K
	960 min Summer		99.587	0.887	18.8	3873.8	O K
	1440 min Summer		99.560	0.860	18.8	3744.7	O K
	2160 min Summer		99.513	0.813	18.8	3517.2	O K
	2880 min Summer		99.472	0.772	18.8	3320.5	O K
	4320 min Summer		99.453	0.753	18.8	3229.6	O K
	5760 min Summer		99.423	0.723	18.8	3087.1	O K
	7200 min Summer		99.385	0.685	18.8	2910.0	O K
	8640 min Summer		99.346	0.646	18.8	2728.9	O K
	10080 min Summer		99.307	0.607	18.8	2553.3	O K
	15 min Winter		99.099	0.399	18.8	1629.0	O K
	30 min Winter		99.180	0.480	18.8	1981.4	O K
	Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
	15 min Summer		157.551	0.0	1161.3	27	
	30 min Summer		96.114	0.0	1384.2	41	
	60 min Summer		58.634	0.0	2008.0	70	
	120 min Summer		35.770	0.0	2429.1	130	
	180 min Summer		26.789	0.0	2685.9	190	
	240 min Summer		21.821	0.0	2847.4	250	
	360 min Summer		16.343	0.0	2957.7	368	
	480 min Summer		13.312	0.0	2913.6	488	
	600 min Summer		11.354	0.0	2866.5	606	
	720 min Summer		9.970	0.0	2825.9	726	
	960 min Summer		7.756	0.0	2750.5	964	
	1440 min Summer		5.444	0.0	2603.7	1440	
	2160 min Summer		3.821	0.0	4888.5	1792	
	2880 min Summer		2.972	0.0	4984.1	2160	
	4320 min Summer		2.222	0.0	4842.0	2984	
	5760 min Summer		1.808	0.0	6415.1	3808	
	7200 min Summer		1.541	0.0	6824.3	4616	
	8640 min Summer		1.352	0.0	7170.1	5376	
	10080 min Summer		1.211	0.0	7449.3	6160	
	15 min Winter		157.551	0.0	1290.3	26	
	30 min Winter		96.114	0.0	1498.5	41	
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Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.274	0.574	18.8	2402.0	O K
120 min Winter	99.382	0.682	18.8	2897.7	O K
180 min Winter	99.452	0.752	18.8	3223.0	O K
240 min Winter	99.502	0.802	18.8	3465.6	O K
360 min Winter	99.575	0.875	18.8	3818.0	O K
480 min Winter	99.626	0.926	18.8	4069.3	O K
600 min Winter	99.665	0.965	18.8	4260.2	O K
720 min Winter	99.695	0.995	18.8	4409.9	O K
960 min Winter	99.692	0.992	18.8	4398.6	O K
1440 min Winter	99.670	0.970	18.8	4286.9	O K
2160 min Winter	99.618	0.918	18.8	4027.8	O K
2880 min Winter	99.567	0.867	18.8	3777.9	O K
4320 min Winter	99.537	0.837	18.8	3633.2	O K
5760 min Winter	99.492	0.792	18.8	3413.5	O K
7200 min Winter	99.437	0.737	18.8	3152.9	O K
8640 min Winter	99.369	0.669	18.8	2837.7	O K
10080 min Winter	99.304	0.604	18.8	2537.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	2243.4	70	
120 min Winter	35.770	0.0	2684.3	128	
180 min Winter	26.789	0.0	2908.3	186	
240 min Winter	21.821	0.0	2990.4	246	
360 min Winter	16.343	0.0	2952.4	362	
480 min Winter	13.312	0.0	2909.0	480	
600 min Winter	11.354	0.0	2877.3	596	
720 min Winter	9.870	0.0	2854.3	712	
960 min Winter	7.756	0.0	2796.1	942	
1440 min Winter	5.444	0.0	2683.6	1390	
2160 min Winter	3.821	0.0	5380.9	2012	
2880 min Winter	2.972	0.0	5382.4	2272	
4320 min Winter	2.222	0.0	4991.8	3204	
5760 min Winter	1.808	0.0	7183.8	4152	
7200 min Winter	1.541	0.0	7638.7	5048	
8640 min Winter	1.352	0.0	8024.7	5880	
10080 min Winter	1.211	0.0	8345.9	6656	
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.979

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0	4 1.660	4	8 1.660	8	12 1.660

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	3860.0	1.000	5039.7	1.300	5424.3

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0193-1880-1000-1880
Design Head (m)	1.000
Design Flow (l/s)	18.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	193
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	18.8
Flush-Flo™	0.336	18.8
Kick-Flo®	0.717	16.1
Mean Flow over Head Range	-	15.8

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	6.7	1.200	20.5	3.000	31.8	7.000	47.9
0.200	18.0	1.400	22.1	3.500	34.2	7.500	49.5
0.300	18.7	1.600	23.5	4.000	36.5	8.000	51.1
0.400	18.7	1.800	24.9	4.500	38.6	8.500	52.6
0.500	18.3	2.000	26.2	5.000	40.7	9.000	54.1
0.600	17.8	2.200	27.4	5.500	42.6	9.500	55.5
0.800	16.9	2.400	28.6	6.000	44.4		
1.000	18.8	2.600	29.7	6.500	46.2		

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Innovyze		Source Control 2020.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>						
Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer		99.057	0.357	17.7	1362.0	O K
30 min Summer		99.129	0.429	17.7	1655.9	O K
60 min Summer		99.213	0.513	17.7	2005.9	O K
120 min Summer		99.310	0.610	17.7	2416.7	O K
180 min Summer		99.372	0.672	17.7	2684.2	O K
240 min Summer		99.417	0.717	17.7	2885.6	O K
360 min Summer		99.482	0.782	17.7	3176.7	O K
480 min Summer		99.527	0.827	17.7	3380.7	O K
600 min Summer		99.561	0.861	17.7	3533.3	O K
720 min Summer		99.586	0.886	17.7	3651.1	O K
960 min Summer		99.581	0.881	17.7	3627.6	O K
1440 min Summer		99.554	0.854	17.7	3504.6	O K
2160 min Summer		99.507	0.807	17.7	3289.5	O K
2880 min Summer		99.466	0.766	17.7	3103.6	O K
4320 min Summer		99.447	0.747	17.7	3016.0	O K
5760 min Summer		99.416	0.716	17.7	2880.8	O K
7200 min Summer		99.378	0.678	17.7	2713.2	O K
8640 min Summer		99.339	0.639	17.7	2542.1	O K
10080 min Summer		99.301	0.601	17.7	2376.3	O K
15 min Winter		99.097	0.397	17.7	1527.1	O K
30 min Winter		99.178	0.478	17.7	1857.5	O K
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer		157.551	0.0	1096.5	27	
30 min Summer		96.114	0.0	1306.1	41	
60 min Summer		58.634	0.0	1888.6	70	
120 min Summer		35.770	0.0	2284.7	130	
180 min Summer		26.789	0.0	2526.5	190	
240 min Summer		21.821	0.0	2678.1	250	
360 min Summer		16.343	0.0	2780.3	368	
480 min Summer		13.312	0.0	2737.6	488	
600 min Summer		11.354	0.0	2692.9	606	
720 min Summer		9.970	0.0	2654.7	726	
960 min Summer		7.756	0.0	2584.3	964	
1440 min Summer		5.444	0.0	2447.6	1440	
2160 min Summer		3.821	0.0	4591.9	1784	
2880 min Summer		2.972	0.0	4684.1	2160	
4320 min Summer		2.222	0.0	4555.5	2984	
5760 min Summer		1.808	0.0	6017.3	3808	
7200 min Summer		1.541	0.0	6401.5	4616	
8640 min Summer		1.352	0.0	6726.5	5376	
10080 min Summer		1.211	0.0	6989.7	6160	
15 min Winter		157.551	0.0	1217.9	26	
30 min Winter		96.114	0.0	1413.0	41	
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<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.271	0.571	17.7	2251.7	O K
120 min Winter	99.379	0.679	17.7	2716.3	O K
180 min Winter	99.448	0.748	17.7	3021.0	O K
240 min Winter	99.498	0.798	17.7	3248.1	O K
360 min Winter	99.570	0.870	17.7	3578.0	O K
480 min Winter	99.621	0.921	17.7	3813.0	O K
600 min Winter	99.659	0.959	17.7	3991.5	O K
720 min Winter	99.688	0.988	17.7	4131.5	O K
960 min Winter	99.686	0.986	17.7	4119.9	O K
1440 min Winter	99.664	0.964	17.7	4013.5	O K
2160 min Winter	99.611	0.911	17.7	3768.4	O K
2880 min Winter	99.560	0.860	17.7	3532.3	O K
4320 min Winter	99.530	0.830	17.7	3393.9	O K
5760 min Winter	99.484	0.784	17.7	3185.7	O K
7200 min Winter	99.429	0.729	17.7	2939.1	O K
8640 min Winter	99.362	0.662	17.7	2640.8	O K
10080 min Winter	99.296	0.596	17.7	2357.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	2110.0	70	
120 min Winter	35.770	0.0	2524.8	128	
180 min Winter	26.789	0.0	2735.2	186	
240 min Winter	21.821	0.0	2811.1	246	
360 min Winter	16.343	0.0	2773.2	362	
480 min Winter	13.312	0.0	2731.8	480	
600 min Winter	11.354	0.0	2702.0	596	
720 min Winter	9.870	0.0	2680.3	712	
960 min Winter	7.756	0.0	2626.3	942	
1440 min Winter	5.444	0.0	2522.2	1390	
2160 min Winter	3.821	0.0	5056.2	2012	
2880 min Winter	2.972	0.0	5061.1	2272	
4320 min Winter	2.222	0.0	4694.8	3204	
5760 min Winter	1.808	0.0	6738.3	4152	
7200 min Winter	1.541	0.0	7165.6	5048	
8640 min Winter	1.352	0.0	7528.7	5880	
10080 min Winter	1.211	0.0	7831.8	6656	
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<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FEH</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>1999</td> </tr> <tr> <td>Site Location</td> <td>GB 494650 103150 SU 94650 03150</td> </tr> <tr> <td>C (1km)</td> <td>-0.025</td> </tr> <tr> <td>D1 (1km)</td> <td>0.402</td> </tr> <tr> <td>D2 (1km)</td> <td>0.242</td> </tr> <tr> <td>D3 (1km)</td> <td>0.398</td> </tr> <tr> <td>E (1km)</td> <td>0.308</td> </tr> <tr> <td>F (1km)</td> <td>2.318</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> </tr> <tr> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 4.668 <table> <thead> <tr> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To:</th> <th>From:</th> <th>To:</th> <th>From:</th> <th>To:</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4</td> <td>4</td> <td>8</td> <td>8</td> <td>12</td> </tr> <tr> <td></td> <td>1.556</td> <td></td> <td>1.556</td> <td></td> <td>1.556</td> </tr> </tbody> </table>			Rainfall Model	FEH	Return Period (years)	100	FEH Rainfall Version	1999	Site Location	GB 494650 103150 SU 94650 03150	C (1km)	-0.025	D1 (1km)	0.402	D2 (1km)	0.242	D3 (1km)	0.398	E (1km)	0.308	F (1km)	2.318	Summer Storms	Yes	Winter Storms	Yes	Cv (Summer)	0.750	Cv (Winter)	0.840	Shortest Storm (mins)	15	Longest Storm (mins)	10080	Climate Change %	+40	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From:	To:	From:	To:	From:	To:	0	4	4	8	8	12		1.556		1.556		1.556
Rainfall Model	FEH																																																											
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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	3626.8	1.000	4772.8	1.300	5147.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0188-1770-1000-1770
Design Head (m)	1.000
Design Flow (l/s)	17.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	188
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	17.7
Flush-Flo™	0.329	17.7
Kick-Flo®	0.710	15.0
Mean Flow over Head Range	-	14.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.6	1.200	19.3	3.000	29.9	7.000	45.0
0.200	17.0	1.400	20.8	3.500	32.2	7.500	46.6
0.300	17.7	1.600	22.1	4.000	34.4	8.000	48.0
0.400	17.6	1.800	23.4	4.500	36.4	8.500	49.5
0.500	17.2	2.000	24.6	5.000	38.3	9.000	50.9
0.600	16.6	2.200	25.8	5.500	40.1	9.500	52.2
0.800	15.9	2.400	26.9	6.000	41.8		
1.000	17.7	2.600	27.9	6.500	43.4		

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Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.077	0.377	3.3	256.4	O K
30 min Summer	99.152	0.452	3.3	311.7	O K
60 min Summer	99.238	0.538	3.3	377.3	O K
120 min Summer	99.335	0.635	3.3	454.5	O K
180 min Summer	99.396	0.696	3.3	504.2	O K
240 min Summer	99.440	0.740	3.3	540.9	O K
360 min Summer	99.501	0.801	3.3	593.3	O K
480 min Summer	99.543	0.843	3.3	629.8	O K
600 min Summer	99.574	0.874	3.3	656.9	O K
720 min Summer	99.598	0.898	3.3	677.5	O K
960 min Summer	99.589	0.889	3.3	670.1	O K
1440 min Summer	99.557	0.857	3.3	641.7	O K
2160 min Summer	99.503	0.803	3.3	594.7	O K
2880 min Summer	99.457	0.757	3.3	555.7	O K
4320 min Summer	99.434	0.734	3.3	535.8	O K
5760 min Summer	99.404	0.704	3.3	511.2	O K
7200 min Summer	99.371	0.671	3.3	484.0	O K
8640 min Summer	99.334	0.634	3.3	453.9	O K
10080 min Summer	99.289	0.589	3.3	417.9	O K
15 min Winter	99.120	0.420	3.3	287.5	O K
30 min Winter	99.202	0.502	3.3	349.8	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	157.551	0.0	234.0	27	
30 min Summer	96.114	0.0	267.8	41	
60 min Summer	58.634	0.0	376.4	70	
120 min Summer	35.770	0.0	454.3	130	
180 min Summer	26.789	0.0	498.1	190	
240 min Summer	21.821	0.0	514.3	250	
360 min Summer	16.343	0.0	509.7	368	
480 min Summer	13.312	0.0	502.2	488	
600 min Summer	11.354	0.0	496.3	606	
720 min Summer	9.970	0.0	491.9	726	
960 min Summer	7.756	0.0	483.2	964	
1440 min Summer	5.444	0.0	466.8	1440	
2160 min Summer	3.821	0.0	891.5	1796	
2880 min Summer	2.972	0.0	912.9	2164	
4320 min Summer	2.222	0.0	867.2	2988	
5760 min Summer	1.808	0.0	1142.7	3816	
7200 min Summer	1.541	0.0	1216.7	4680	
8640 min Summer	1.352	0.0	1280.2	5528	
10080 min Summer	1.211	0.0	1335.2	6256	
15 min Winter	157.551	0.0	255.6	26	
30 min Winter	96.114	0.0	275.1	41	
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<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.297	0.597	3.3	423.9	O K
120 min Winter	99.404	0.704	3.3	511.0	O K
180 min Winter	99.471	0.771	3.3	567.3	O K
240 min Winter	99.520	0.820	3.3	609.2	O K
360 min Winter	99.589	0.889	3.3	669.8	O K
480 min Winter	99.637	0.937	3.3	712.6	O K
600 min Winter	99.672	0.972	3.3	745.0	O K
720 min Winter	99.700	1.000	3.3	770.1	O K
960 min Winter	99.695	0.995	3.3	765.5	O K
1440 min Winter	99.668	0.968	3.3	740.9	O K
2160 min Winter	99.611	0.911	3.3	689.2	O K
2880 min Winter	99.555	0.855	3.3	640.2	O K
4320 min Winter	99.521	0.821	3.3	610.0	O K
5760 min Winter	99.475	0.775	3.3	570.5	O K
7200 min Winter	99.423	0.723	3.3	526.7	O K
8640 min Winter	99.365	0.665	3.3	479.0	O K
10080 min Winter	99.291	0.591	3.3	419.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	420.0	70	
120 min Winter	35.770	0.0	497.8	128	
180 min Winter	26.789	0.0	517.5	186	
240 min Winter	21.821	0.0	514.3	246	
360 min Winter	16.343	0.0	506.1	362	
480 min Winter	13.312	0.0	501.2	480	
600 min Winter	11.354	0.0	498.8	596	
720 min Winter	9.870	0.0	498.6	712	
960 min Winter	7.756	0.0	494.7	942	
1440 min Winter	5.444	0.0	487.6	1390	
2160 min Winter	3.821	0.0	979.2	2016	
2880 min Winter	2.972	0.0	964.7	2280	
4320 min Winter	2.222	0.0	895.3	3204	
5760 min Winter	1.808	0.0	1279.8	4152	
7200 min Winter	1.541	0.0	1362.3	5048	
8640 min Winter	1.352	0.0	1433.1	5968	
10080 min Winter	1.211	0.0	1494.9	6760	
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.880

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.293	4 8	0.293	8 12	0.293

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Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	627.6	1.000	922.3	1.300	1021.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0086-3300-1000-3300
Design Head (m)	1.000
Design Flow (l/s)	3.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.3
Flush-Flo™	0.296	3.3
Kick-Flo®	0.624	2.7
Mean Flow over Head Range	-	2.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	3.6	3.000	5.5	7.000	8.2
0.200	3.2	1.400	3.9	3.500	5.9	7.500	8.5
0.300	3.3	1.600	4.1	4.000	6.3	8.000	8.7
0.400	3.2	1.800	4.3	4.500	6.6	8.500	9.0
0.500	3.1	2.000	4.5	5.000	7.0	9.000	9.2
0.600	2.8	2.200	4.8	5.500	7.3	9.500	9.5
0.800	3.0	2.400	4.9	6.000	7.6		
1.000	3.3	2.600	5.1	6.500	7.9		

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Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³) Status
15 min Summer 99.101 0.401 3.3 256.4 O K					
30 min Summer 99.174 0.474 3.3 311.6 O K					
60 min Summer 99.257 0.557 3.3 377.2 O K					
120 min Summer 99.350 0.650 3.3 454.2 O K					
180 min Summer 99.407 0.707 3.3 503.7 O K					
240 min Summer 99.447 0.747 3.3 540.1 O K					
360 min Summer 99.504 0.804 3.3 592.2 O K					
480 min Summer 99.542 0.842 3.3 628.5 O K					
600 min Summer 99.570 0.870 3.3 655.3 O K					
720 min Summer 99.591 0.891 3.3 675.8 O K					
960 min Summer 99.583 0.883 3.3 667.8 O K					
1440 min Summer 99.552 0.852 3.3 638.4 O K					
2160 min Summer 99.502 0.802 3.3 590.2 O K					
2880 min Summer 99.459 0.759 3.3 550.5 O K					
4320 min Summer 99.436 0.736 3.3 530.2 O K					
5760 min Summer 99.409 0.709 3.3 505.6 O K					
7200 min Summer 99.378 0.678 3.3 478.6 O K					
8640 min Summer 99.344 0.644 3.3 449.2 O K					
10080 min Summer 99.302 0.602 3.3 414.2 O K					
15 min Winter 99.142 0.442 3.3 287.5 O K					
30 min Winter 99.223 0.523 3.3 349.7 O K					
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer 157.551 0.0 237.3 27					
30 min Summer 96.114 0.0 270.1 41					
60 min Summer 58.634 0.0 378.3 70					
120 min Summer 35.770 0.0 456.8 130					
180 min Summer 26.789 0.0 500.7 190					
240 min Summer 21.821 0.0 514.6 250					
360 min Summer 16.343 0.0 508.7 368					
480 min Summer 13.312 0.0 501.3 488					
600 min Summer 11.354 0.0 495.7 606					
720 min Summer 9.970 0.0 491.8 726					
960 min Summer 7.756 0.0 484.0 964					
1440 min Summer 5.444 0.0 469.6 1440					
2160 min Summer 3.821 0.0 894.5 1800					
2880 min Summer 2.972 0.0 917.3 2164					
4320 min Summer 2.222 0.0 871.5 2984					
5760 min Summer 1.808 0.0 1143.4 3816					
7200 min Summer 1.541 0.0 1217.5 4680					
8640 min Summer 1.352 0.0 1281.2 5528					
10080 min Summer 1.211 0.0 1336.6 6264					
15 min Winter 157.551 0.0 258.9 27					
30 min Winter 96.114 0.0 275.2 41					
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Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.314	0.614	3.3	423.9	O K
120 min Winter	99.415	0.715	3.3	510.7	O K
180 min Winter	99.477	0.777	3.3	566.8	O K
240 min Winter	99.521	0.821	3.3	608.6	O K
360 min Winter	99.584	0.884	3.3	668.9	O K
480 min Winter	99.627	0.927	3.3	711.7	O K
600 min Winter	99.658	0.958	3.3	743.9	O K
720 min Winter	99.683	0.983	3.3	768.9	O K
960 min Winter	99.678	0.978	3.3	763.9	O K
1440 min Winter	99.653	0.953	3.3	738.6	O K
2160 min Winter	99.601	0.901	3.3	685.8	O K
2880 min Winter	99.550	0.850	3.3	635.7	O K
4320 min Winter	99.517	0.817	3.3	604.7	O K
5760 min Winter	99.474	0.774	3.3	564.9	O K
7200 min Winter	99.426	0.726	3.3	521.1	O K
8640 min Winter	99.373	0.673	3.3	473.8	O K
10080 min Winter	99.305	0.605	3.3	416.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	422.2	70	
120 min Winter	35.770	0.0	500.4	128	
180 min Winter	26.789	0.0	516.9	186	
240 min Winter	21.821	0.0	512.9	246	
360 min Winter	16.343	0.0	504.6	362	
480 min Winter	13.312	0.0	500.0	480	
600 min Winter	11.354	0.0	498.2	596	
720 min Winter	9.870	0.0	498.8	712	
960 min Winter	7.756	0.0	496.0	942	
1440 min Winter	5.444	0.0	489.9	1390	
2160 min Winter	3.821	0.0	982.9	2016	
2880 min Winter	2.972	0.0	967.6	2280	
4320 min Winter	2.222	0.0	898.9	3208	
5760 min Winter	1.808	0.0	1280.5	4152	
7200 min Winter	1.541	0.0	1363.3	5048	
8640 min Winter	1.352	0.0	1434.4	5968	
10080 min Winter	1.211	0.0	1496.5	6848	
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.880

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.293	4 8	0.293	8 12	0.293

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	552.4	1.000	1047.5	1.300	1226.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0086-3300-1000-3300
Design Head (m)	1.000
Design Flow (l/s)	3.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.3
Flush-Flo™	0.296	3.3
Kick-Flo®	0.624	2.7
Mean Flow over Head Range	-	2.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	3.6	3.000	5.5	7.000	8.2
0.200	3.2	1.400	3.9	3.500	5.9	7.500	8.5
0.300	3.3	1.600	4.1	4.000	6.3	8.000	8.7
0.400	3.2	1.800	4.3	4.500	6.6	8.500	9.0
0.500	3.1	2.000	4.5	5.000	7.0	9.000	9.2
0.600	2.8	2.200	4.8	5.500	7.3	9.500	9.5
0.800	3.0	2.400	4.9	6.000	7.6		
1.000	3.3	2.600	5.1	6.500	7.9		

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5 Manchester Square London W1U 3PD					
Date 25/06/2021 14:26		Designed by YLawson			
File School Attenuation Basi...		Checked by			
Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.084	0.384	6.4	491.6	O K
30 min Summer	99.159	0.459	6.4	597.7	O K
60 min Summer	99.244	0.544	6.4	723.6	O K
120 min Summer	99.340	0.640	6.4	871.5	O K
180 min Summer	99.400	0.700	6.4	967.4	O K
240 min Summer	99.443	0.743	6.4	1037.9	O K
360 min Summer	99.503	0.803	6.4	1138.9	O K
480 min Summer	99.544	0.844	6.4	1209.3	O K
600 min Summer	99.574	0.874	6.4	1261.5	O K
720 min Summer	99.597	0.897	6.4	1301.3	O K
960 min Summer	99.589	0.889	6.4	1287.6	O K
1440 min Summer	99.559	0.859	6.4	1234.0	O K
2160 min Summer	99.507	0.807	6.4	1146.1	O K
2880 min Summer	99.464	0.764	6.4	1072.6	O K
4320 min Summer	99.440	0.740	6.4	1034.2	O K
5760 min Summer	99.411	0.711	6.4	985.6	O K
7200 min Summer	99.377	0.677	6.4	931.2	O K
8640 min Summer	99.337	0.637	6.4	867.8	O K
10080 min Summer	99.294	0.594	6.4	800.5	O K
15 min Winter	99.127	0.427	6.4	551.3	O K
30 min Winter	99.208	0.508	6.4	670.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	157.551	0.0	438.9	27	
30 min Summer	96.114	0.0	510.2	41	
60 min Summer	58.634	0.0	714.4	70	
120 min Summer	35.770	0.0	862.8	130	
180 min Summer	26.789	0.0	949.6	190	
240 min Summer	21.821	0.0	993.9	250	
360 min Summer	16.343	0.0	993.0	368	
480 min Summer	13.312	0.0	977.9	488	
600 min Summer	11.354	0.0	965.6	606	
720 min Summer	9.970	0.0	956.1	726	
960 min Summer	7.756	0.0	937.5	964	
1440 min Summer	5.444	0.0	901.3	1440	
2160 min Summer	3.821	0.0	1701.0	1780	
2880 min Summer	2.972	0.0	1743.0	2144	
4320 min Summer	2.222	0.0	1674.1	2984	
5760 min Summer	1.808	0.0	2188.0	3808	
7200 min Summer	1.541	0.0	2329.3	4680	
8640 min Summer	1.352	0.0	2450.5	5456	
10080 min Summer	1.211	0.0	2553.9	6248	
15 min Winter	157.551	0.0	482.3	26	
30 min Winter	96.114	0.0	533.1	41	
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File School Attenuation Basi...		Checked by			
Innovyze		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.302	0.602	6.4	812.7	O K
120 min Winter	99.407	0.707	6.4	980.1	O K
180 min Winter	99.473	0.773	6.4	1088.2	O K
240 min Winter	99.521	0.821	6.4	1168.6	O K
360 min Winter	99.588	0.888	6.4	1285.1	O K
480 min Winter	99.634	0.934	6.4	1367.5	O K
600 min Winter	99.669	0.969	6.4	1429.7	O K
720 min Winter	99.695	0.995	6.4	1478.1	O K
960 min Winter	99.691	0.991	6.4	1469.5	O K
1440 min Winter	99.665	0.965	6.4	1423.1	O K
2160 min Winter	99.610	0.910	6.4	1324.7	O K
2880 min Winter	99.558	0.858	6.4	1232.2	O K
4320 min Winter	99.523	0.823	6.4	1173.6	O K
5760 min Winter	99.477	0.777	6.4	1095.7	O K
7200 min Winter	99.425	0.725	6.4	1009.0	O K
8640 min Winter	99.366	0.666	6.4	912.7	O K
10080 min Winter	99.291	0.591	6.4	795.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.634	0.0	797.2	70	
120 min Winter	35.770	0.0	948.7	128	
180 min Winter	26.789	0.0	1006.0	186	
240 min Winter	21.821	0.0	1003.1	246	
360 min Winter	16.343	0.0	986.7	362	
480 min Winter	13.312	0.0	976.2	480	
600 min Winter	11.354	0.0	970.3	596	
720 min Winter	9.870	0.0	967.7	712	
960 min Winter	7.756	0.0	956.5	942	
1440 min Winter	5.444	0.0	937.5	1390	
2160 min Winter	3.821	0.0	1874.5	2012	
2880 min Winter	2.972	0.0	1864.9	2260	
4320 min Winter	2.222	0.0	1729.6	3204	
5760 min Winter	1.808	0.0	2450.4	4152	
7200 min Winter	1.541	0.0	2608.1	5048	
8640 min Winter	1.352	0.0	2743.0	5968	
10080 min Winter	1.211	0.0	2860.6	6752	
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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 494650 103150 SU 94650 03150
C (1km)	-0.025
D1 (1km)	0.402
D2 (1km)	0.242
D3 (1km)	0.398
E (1km)	0.308
F (1km)	2.318
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.687

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0	4 0.562	4	8 0.562	8	12 0.562

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Date 25/06/2021 14:26	Designed by YLawson	
File School Attenuation Basi...	Checked by	
Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.700

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1159.0	1.000	1840.9	1.300	2076.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0119-6400-1000-6400
Design Head (m)	1.000
Design Flow (l/s)	6.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	98.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	6.4
Flush-Flo™	0.297	6.4
Kick-Flo®	0.649	5.2
Mean Flow over Head Range	-	5.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	1.200	7.0	3.000	10.7	7.000	16.1
0.200	6.2	1.400	7.5	3.500	11.5	7.500	16.6
0.300	6.4	1.600	8.0	4.000	12.3	8.000	17.1
0.400	6.3	1.800	8.4	4.500	13.0	8.500	17.6
0.500	6.1	2.000	8.9	5.000	13.7	9.000	18.1
0.600	5.7	2.200	9.3	5.500	14.3	9.500	18.6
0.800	5.8	2.400	9.7	6.000	14.9		
1.000	6.4	2.600	10.0	6.500	15.5		

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Appendix C Groundwater Monitoring Factual Report

BARNHAM, EASTERGATE,
WESTERGATE (BEW)
LONG TERM GROUND WATER
MONITORING
SOUTHERN CONSORTIUM
29TH JANUARY 2021

Appendix D Surface Water Drainage Strategy

GENERAL NOTES

01. TO NOT SCALE THIS DRAWING.

02. ANY INFORMATION DISCREPANCIES SHALL BE THE RESPONSIBILITY OF THE CLIENT.

03. ALL DIMENSIONS ARE IN METERS AND ALL ELEVATIONS ARE IN METERS ABOVE SEA LEVEL UNLESS NOTED OTHERWISE.

04. NORTH IS INDICATED BY AN ARROW.

05. THIS DRAWING IS TO BE USED IN CONNECTION WITH THE PROJECT AND NOT FOR ANY OTHER PURPOSE.

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08. THE CLIENT SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE RELEVANT AUTHORITIES.

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