



**Starwood House
Avenue One
Letchworth Garden City
SG6 2TS**

**Flood Risk Assessment
& Drainage Strategy Report**

For

Letchworth Investment LLP

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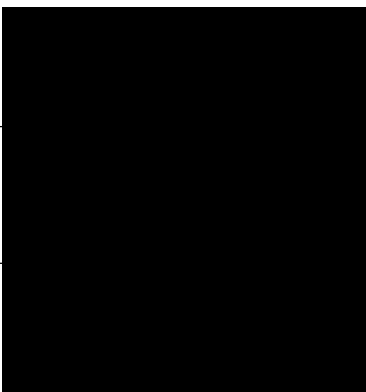
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CONTENTS

1.0 EXECUTIVE SUMMARY	1
2.0 DEVELOPMENT DETAILS	3
2.1 CONTEXT	3
2.2 LOCATION.....	3
3.0 PLANNING POLICY	5
3.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF).....	5
3.2 STRATEGIC FLOOD RISK ASSESSMENT	5
3.3 LOCAL FLOOD RISK MANAGEMENT STRATEGY	7
3.4 HERTFORDSHIRE COUNTY COUNCIL SUSTAINABLE DRAINAGE	7
3.5 NORTH HERTFORDSHIRE COUNCIL POLICIES	7
4.0 FLOOD RISK REVIEW	8
4.1 FLUVIAL & TIDAL FLOODING	8
4.2 SURFACE WATER FLOODING	9
4.3 GROUNDWATER FLOODING.....	11
4.4 SEWER FLOODING.....	11
4.5 RESERVOIR FLOODING	12
4.6 SUMMARY.....	12
5.0 DRAINAGE STRATEGY	13
5.1 CONSULTATION	13
5.1 EXISTING DRAINAGE	13
5.2 RUNOFF RATES.....	13
5.3 GEOLOGY	14
5.4 SUSTAINABLE DRAINAGE ASSESSMENT	14
5.5 CLIMATE CHANGE	16
5.6 SURFACE WATER STRATEGY	17
5.7 WATER QUALITY, QUANTITY, AMENITY & BIODIVERSITY	18
5.8 MANAGEMENT & MAINTENANCE	20
5.9 FOUL WATER STRATEGY	20
6.0 MANAGEMENT, MAINTENANCE AND RISK	21
7.0 CONCLUSION	22
APPENDIX A – SITE MASTERPLAN	23
APPENDIX B – TOPOGRAPHICAL SURVEY, GPR SURVEY & CCTV PLAN	24
APPENDIX C – BGL DRAWINGS.....	25
APPENDIX D – BGL HYDRAULIC CALCULATIONS.....	26
APPENDIX E – MANAGEMENT & MAINTENANCE PLAN	27
APPENDIX F – THAMES WATER SEWER MAPS	28

1.0 EXECUTIVE SUMMARY

This Flood Risk Assessment & Drainage Strategy report has been prepared by Burrows Graham Ltd. on behalf of Letchworth Investment LLP to support the planning application for the erection of two buildings for Flexible Use Classes Eg (ii) (iii), B2 and B8 (flexible), including servicing, parking, access and landscaping at Starwood House, Avenue one, Letchworth Garden City, SG6 2TS.

In accordance with the National Planning Policy Framework (NPPF), North Hertfordshire District Council (NHDC) Strategic Flood Risk Assessment (SFRA), and Hertfordshire County Council (HCC) Sustainable Drainage Guidance for Development, this report has studied and assessed the flood risk to the site by all sources.

A review of the EA Flood Maps shows that the site is located within Flood Zone 1, i.e. land defined as having less than a 1 in 1000 annual probability of flooding from of river or sea water. The site is defined as 'less vulnerable' such that the development can be considered 'appropriate' in accordance with NPPF guidelines. As the site is located within Flood Zone 1, the sequential and exception tests are not required by the local authority.

Further to this, the site is considered to be at very low risk from all other sources of flooding; tidal, surface water, sewer, groundwater and artificial sources.

A review of the site topographical, GPR and CCTV surveys would indicate that the current development is served by a below ground surface water drainage network that outfalls unrestricted via a 300mm diameter pipe to a Thames Water (TW) adopted manhole to the north east of the site within the centre of Third Avenue. The 1200mm diameter TW sewer then flows in a northerly direction, eventually outfalling to Pix Brook. The foul drainage serving the current building generally runs in parallel with the surface water drainage and outfalls again at the northeast corner to a 225mm diameter TW foul sewer in Third Avenue.

The surface water drainage strategy as outlined below is to restrict the proposed flow rate to satisfy HCC and TW Policies for brownfield developments, and to ensure that the flood risk to the site and surrounding catchment is not increased by the development. The Sustainable Drainage Systems (SuDS) hierarchy has been considered in the drainage strategy discussed in Section 5. The surface water runoff will be collected from the new impermeable areas and directed via the underground network through a geocellular attenuation tank located beneath the service yard of both units, before outfalling into the existing private surface water drain that outfalls to the TW adopted surface water sewer. The peak rate of runoff will be restricted to the respective Greenfield runoff rates. The existing site is fully impermeable and discharges at an unrestricted rate. As such the proposed strategy provides a significant reduction in these pre-development discharge rates. A detailed Drainage layout with hydraulic calculations incorporating a climate change allowance of 40% have been prepared to support this approach and can be found in the Appendices. SuDS in the form of permeable paving, small areas of green roofs and rainwater gardens will also be incorporated into the layout.

There is no residual flood risk from the development site to the surrounding district due to the reduction in storm water flow rates. The development does not therefore increase the risk of flooding to other adjacent neighbourhoods. Out of chamber or gully flooding for the extreme 100 year plus climate change event may occur within the development site and is classed as exceedance flows. Flood water from this event will be contained within the lower lying yard areas of the development site and directed away from the proposed unit.

Foul flows will be collected by a new gravity network and discharge to the existing Thames Water foul water sewer via the existing connection to the northeast of the site.

2.0 DEVELOPMENT DETAILS

2.1 CONTEXT

This Flood Risk Assessment & Drainage Strategy report has been prepared by Burrows Graham Ltd. on behalf of Letchworth Investment LLP to support the planning application for the erection of two buildings for Flexible Use Classes Eg (ii) (iii), B2 and B8 (flexible), including servicing, parking, access and landscaping at Starwood House, Avenue one, Letchworth Garden City, SG6 2TS.

2.2 LOCATION

Site Name: Avenue one, Letchworth Garden City, SG6 2TS.

Grid Reference: 523289, 232792

Site Area: 2.64 Ha

Site Description: The largely rectangular plan shape of the site boundary encompasses an existing industrial building with external yards and parking areas to the northeast. There is one point of access leading from Avenue One at the northwest corner.

Hedging, trees and shrubbery are located on all sides of the site but particularly to the east of the site beyond the hardstanding car park and heavier along the periphery of both the eastern and southern boundaries.

The site is located within the centre of Letchworth Garden City Business Park and therefore encompasses existing commercial, industrial and retails units to all sides. The site is approximately 1km to the east of Letchworth Garden City Town Centre.

A review of the topographical information indicates the current building to hold a floor level of 81.85m AOD. Steps and ramps around the periphery of the building drop the levels down to circa 80.80m. The yards and car parking abutting the building fall away at a shallow grade to all boundaries. The site entrance leading onto Avenue One to the northwest holds a level of 80.32m AOD.



Figure 1: Site Location

3.0 PLANNING POLICY

3.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

Local planning authorities are advised by the National Planning Policy Framework (NPPF) 2024 to consult the Environment Agency (EA) and Lead Local Flood Authorities (LLFA) on all developments of an area greater than 1Ha and those that are at an increased risk of flooding.

This report has been prepared to assess the requirements of the NPPF in accordance with the current EA and LLFA policies and will primarily assess the following.

- Determining whether the site is likely to be affected by flooding and whether it would increase flood risk elsewhere.
- Assessing whether the proposed development is appropriate in the suggested location.
- Detailing any measures necessary to mitigate any flood risk identified, to ensure that the proposed development and occupants would be safe, and that flood risk would not be increased elsewhere.
- Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
- Discuss Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
- Devise an appropriate surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
- Include the appropriate climate change allowances for both fluvial and surface water runoff.
- Consider the recommendations of the North Hertfordshire District Council Strategic Flood Risk Assessment (SFRA) and other local policies.

A review of the EA Flood Maps shows that the site is located within Flood Zone 1 (land defined as having less than a 1 in 1000 annual probability of flooding from of river or sea water in any year). The site is defined as 'less vulnerable' such that the development can be considered 'appropriate' in accordance with NPPF guidelines. As the site is within Flood Zone 1, the sequential and exception tests are not required by the local authority.

3.2 STRATEGIC FLOOD RISK ASSESSMENT

The aim of a Strategic Flood Risk Assessment (SFRA) is to assess the risks in a particular area with regard to all types of flooding and to determine how much development is permitted in that area. It can assess this by looking at how drainage systems in the area should function and how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that regional planning bodies (RPB's) or local planning authorities should prepare SFRA's in consultation with the EA.

The SFRA provides a detailed understanding of flood risk across all areas and from all sources. It states that the sequential and exception tests must be provided where applicable and climate change must be taken into consideration over the lifespan of the development.

North Hertfordshire District Council in partnership with consultant WSP have produced the North Hertfordshire District Council Strategic Flood Risk Assessment (July 2008) to demonstrate and define its understanding and role in managing flood risk across all Borough's. A fundamental aim of the strategy is that NHBC embraces and supports its role as Lead Local Flood Authority for the area, and this means taking the lead in helping with infrastructure development and re-development and working with other bodies in North Hertfordshire with flood risk. The Council wants to encourage and wherever possible enforce current thinking and guidance and be able to provide improvements through working better together. The Strategy is aimed at providing an overview and assessment of local flood risk in Letchworth, setting out objectives and measures for how they will manage and reduce local flood risk. This Strategy builds on existing and developing approaches to flood risk management and promotes the use of a wide range of measures to manage flood risk. Risk should be managed in a co-ordinated way within catchments and balance the needs of communities, the economy and the environment.

The full report can be obtained from North Hertfordshire District Council website with the main objectives below:

- To better understand local flood risk and make best use of available information in order to better manage flood risk to people, businesses, property, infrastructure and the natural environment.
- To reduce the potential impact and costs of flooding in the Borough.
- To ensure resilience of local water bodies and drainage assets.
- To ensure appropriate development in areas of flood risk.
- To develop a collaborative partnership approach to flood risk management, and cooperate with other Risk Management Authorities (RMAs) and key stakeholders working across catchments.
- To assist communities in understanding information on flood risk and supporting themselves.
- To encourage, support and provide flood risk management which seeks to enhance and protect the environment.
- Determine the variations in risk from all sources of flooding across the Borough.
- Prepare broad policies for the management of flood risk.
- Steer development towards areas of lowest flood risk, through application of the Sequential Test and, where necessary, the Exception Test.
- Consider opportunities to reduce flood risk to existing communities through better management of surface water, provision for conveyance and storage for flood water; and
- Identify the level of detail required for site-specific Flood Risk Assessments.

3.3 LOCAL FLOOD RISK MANAGEMENT STRATEGY

The aim of this document is to set out the council's approach to managing flood risk in the short and long term. Hertfordshire's Local Flood Risk Management Strategy was published in 2018. The primary aim of the document is to improve the understanding of flood risks within the County and provide a source of information which can be utilised to identify ways of managing flood risk. The second objective is to reduce the risk of flooding for people and businesses in the County, and put forward key actions to ensure this can be achieved.

3.4 HERTFORDSHIRE COUNTY COUNCIL SUSTAINABLE DRAINAGE

Hertfordshire County Council acting as Lead Local Flood Authority (LLFA) that includes the Lethworth area have prepared the Hertfordshire LLFA Summary Guidance for Developers with the aim of how SuDS can be integrated into the fabric of development starting at the planning stage and leading through the concept, outline and detailed design stages.

The main principles of the report along with details from the Hertfordshire County Council website for the integration of SuDS for Major developments are summarised below:

- Details of how runoff is collected from roofs, roads and other hard surfaces to keep water at or near the surface.
- Site control features shown with approximate volumes, flow control locations and details.
- Flow routes including low flow, overflow and exceeding routes.
- Confirmation of sub-catchments with location of flow controls.
- Confirm the destination of the "controlled flow of clean water" from the site – the ground by infiltration, a watercourse or the surface water sewer.
- Existing brownfield sites to discharge at Greenfield rates unless can confirm this is not achievable.
- Detailed SuDS management train approach to be incorporated throughout the scheme with appropriate measures from prevention, source control through to site control.
- Exceedance flows beyond the 30-year event can be incorporated as long as the water is managed and does not flow off site or cause flood risk to the development building.
- Detailed plans and hydraulic calculations to be provided at planning stage.

3.5 NORTH HERTFORDSHIRE COUNCIL POLICIES

North Hertfordshire District Council Local Plan (2011-2031) was adopted in November 2022. Policy NE7 (Reducing Flood Risk) and Policy NE8 (Sustainable drainage Systems) specifically relate to reducing flood risk and integrating sustainable drainage within all new developments.

These sections of the Local Plan have been assessed for this scheme as part of this FRA and all the main elements such as reducing flood risk and incorporating SuDS methods have all been incorporated.

4.0 FLOOD RISK REVIEW

The NPPF guidelines require the developer to assess the impact of the proposed development runoff on the downstream catchment in conjunction with assessing the risk of runoff from the surrounding area on the proposed development layout.

In the following sections the flood risk to the site from all sources will be assessed.

4.1 FLUVIAL & TIDAL FLOODING

The site is not located near the sea or a tidally influenced watercourse, therefore the risk of tidal flooding is deemed to be very low.

No watercourse has been identified in close proximity. Pix Brook is located approximately 3km to the northwest.

The National Planning Policy Framework (NPPF) categorises fluvial and tidal flood risk as follows:

- Zone 1 (low probability) – Land assessed as having less than a 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Zone 2 (medium probability) – Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year; and
- Zone 3a (high probability) – Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- 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 EA. (Not separately distinguished from Zone 3a on the Flood Map).

Figure 2 below locates the site on the Environment Agency's (EA) indicative floodplain map. This shows the site as located within low-risk Flood Zone 1, i.e. probability of annual fluvial flooding significantly less than 1 in 1000 in any one year (<0.1%). The risk from fluvial flood water is therefore reduced to acceptable levels and no further assessment is required.

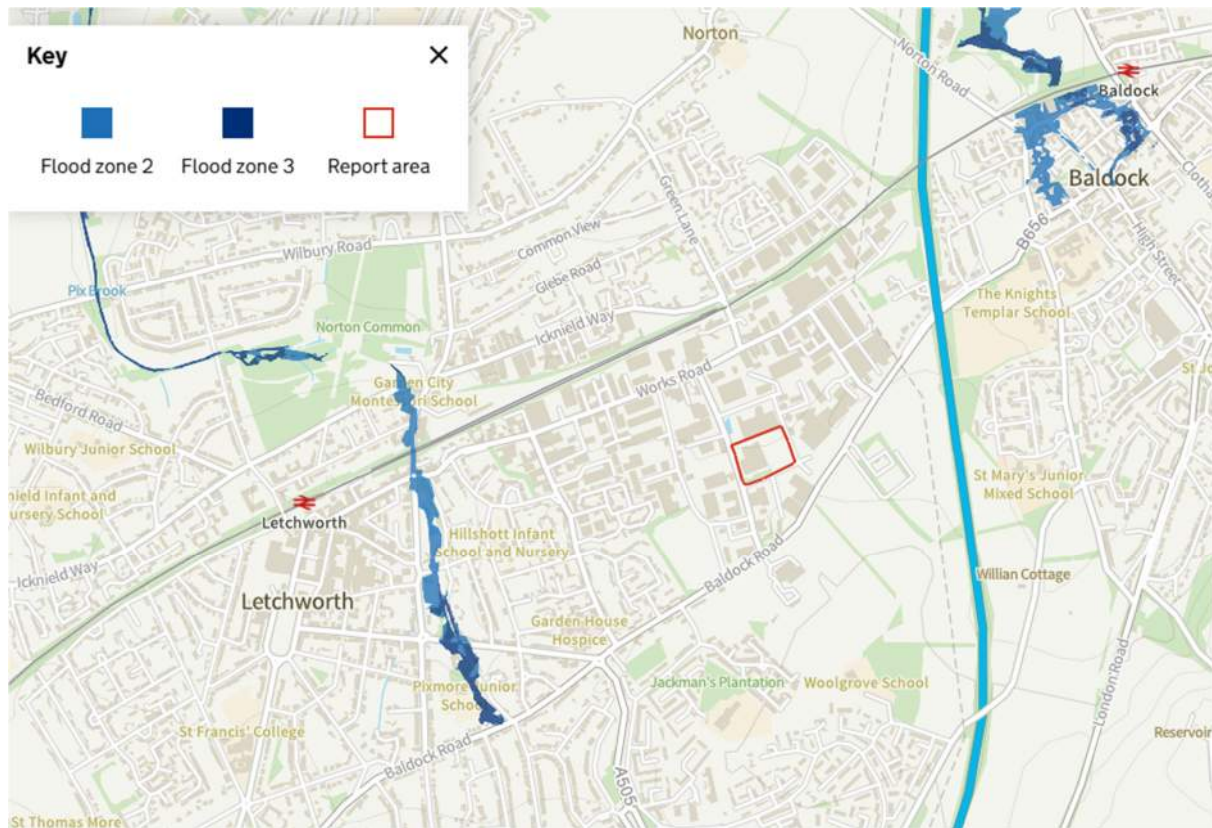


Figure 2: Extract from EA Fluvial Flood Risk Maps

4.2 SURFACE WATER FLOODING

The EA descriptions for the High, Medium and Low risk scenarios for surface water flooding are as follows:

- High risk means that each year this area has a chance of flooding of greater than 3.3%.
- Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%.
- Low risk means that each year this area has a chance of flooding of between 0.1% and 1%.
- Very Low risk means that each year this area has a chance of flooding of less than 0.1%.

A review of the EA's 30 year and 100-year surface water flood maps (Figures 3 & 4 below) indicates that the site area is predominantly classed as at 'very low risk' of surface water flooding. Some small, isolated areas of higher risk are identified predominantly within the south western parking areas. These areas are due to a low point in the existing topography where any surplus rainwater water has the potential to be retained on the surface.

It is noted these maps do not consider the existing drainage infrastructure serving these areas such that in reality the extent of any such surface water flooding would be significantly reduced. Furthermore, the redevelopment of the site will mitigate against this risk by removing the existing buildings, parking areas and access road, and replacing with new buildings and external areas to suit the development intent. The new impermeable areas will be directed into a new underground drainage network designed in line with local and national guidance.

There are no overland flood flow routes to be maintained as part of the development.

In light of this the site can be considered at low risk from surface water flooding.

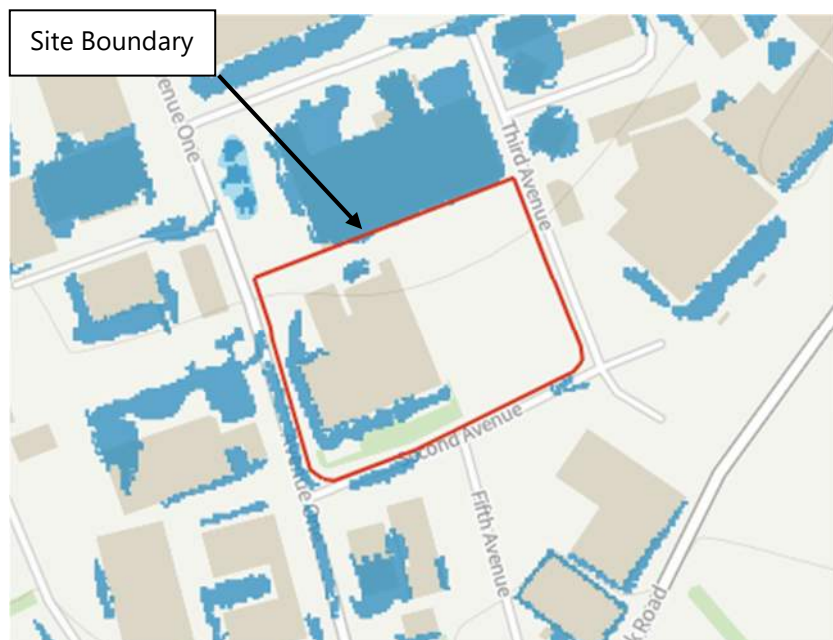


Figure 3: Extract from EA 30yr Surface Water Flood Risk Map



Figure 4:: Extract from EA 100yr Surface Water Flood Risk Map

4.3 GROUNDWATER FLOODING

Groundwater flooding occurs when the water table, the level of water below the ground, rises above the ground surface or into cellars and basements. Groundwater flooding is most likely to occur in low lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks.

According to the SFRA the presence of the chalk aquifer in Hertfordshire and other under groundwater bearing areas such as the river gravel deposits mean that there is potential for groundwater flooding in Hertfordshire. There are confirmed cases of groundwater flooding in the county ranging from localised emergence affecting single properties to a number of larger events that have impacted at the settlement scale.

A detailed Phase 2 site investigation has been completed at the site and supported the findings of the underlying Chalk strata. These did not identify any elevated ground water levels.

The proposed development does not include any below ground basement areas and floor levels will be raised above the external levels. Based on this and the deeper groundwater levels, the risk of groundwater flooding to the site is considered low.

4.4 SEWER FLOODING

The Thames Water (TW) sewer records have been reviewed and indicate that there are no public sewers crossing the site. A 600mm diameter surface water sewer flows clockwise around the site boundary within the adopted highways of Third Avenue, Second Avenue and Avenue One before flowing north away from the site. A 1200mm diameter surface water flows north within Third Avenue to the northeast of the site. The TW adopted foul sewer network follows the same routing as the surface water drainage in a 225mm diameter pipe.

A review of the site topographical, GPR and CCTV surveys would indicate that the current development is served by a below ground surface water drainage network that outfalls unrestricted via a 300mm diameter pipe to a Thames Water (TW) adopted manhole to the north east of the site within the centre of Third Avenue. This is located online of the 1200mm diameter TW sewer that flows in a northerly direction, eventually outfalling to Pix Brook. The foul drainage serving the existing building generally runs in parallel with the surface water drainage and outfalls again at the northeast corner to a 225mm diameter TW foul sewer in Third Avenue.

The extensive drainage network serving the surrounding urban district ensures that the development footprint is protected from the impact of both upstream and downstream runoff. It is speculated that complete protection may well exist beyond a storm event equivalent to the 30-year statistical event. Beyond this projection, there may be a small degree of peripheral 'Exceedance' flooding within the areas above the sewers. However, this is expected to be localised and restricted to the location of specific manhole covers located outside the development footprint.

Thus, flood risk to the site from sewers is diminished to acceptable levels and considered to be low.

4.5 RESERVOIR FLOODING

Reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority and ensures that reservoirs are inspected regularly, and essential safety work is carried out.

The Long-Term Flood Risk Assessment (Flood Risk from Reservoirs) map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. It can be seen from this map that the site is at very low risk. Ensuring that the reservoirs are adequately maintained the risk of reservoir flooding can be considered as low.

4.6 SUMMARY

Below is a table summary of the flood risks associated with the development site.

Source	Probability of Flood Risk	Impacts	Remarks
Tidal	Low	Low	The development building is not influenced by Tidal flood risk.
Fluvial (Watercourse)	Low	Low	The development is located in low flood risk zone 1.
Surface Water (Overland Flood Flow)	Low - Medium	Low	The development is located within a predominantly very low risk zone. The redeveloped site will include reprofiling of the site and new drainage infrastructure such that the post development risk is retained at the same level.
Sewers & New Drainage	Low	Low	No adopted sewers within development boundary. New private drainage will serve the buildings and external yard area, designed to current guidance with any exceedance flooding located away from the buildings.
Groundwater	Low	Low	Development does not include basements. Building elevated above existing ground levels. No evidence from the site investigations of elevated groundwater levels.
Artificial Sources	Low	Low	Low risk from other sources.

Table 1: Flood Risk Summary Table

5.0 DRAINAGE STRATEGY

5.1 CONSULTATION

Thames Water

Thames Water have been consulted via a pre development enquiry. Their response has yet to be received. Based on experience of similar scheme, it can be expected that the foul drainage can discharge unrestricted to the TW adopted foul water sewer. In terms of the surface water, the SuDS hierarchal approach should be considered. Should it be found that infiltration is not feasible then TW will accept connection to the adopted surface water sewer at the respective greenfield rates. Refer to Appendix G for details.

5.1 EXISTING DRAINAGE

The Thames Water (TW) sewer records have been reviewed and indicate that there are no public sewers crossing the site. A 600mm diameter surface water sewer flows clockwise around the site boundary within the adopted highways or Third Avenue, Second Avenue and Avenue One before flowing north away from the site. A 1200mm diameter surface water flows north within Third Avenue to the northeast of the site. The TW adopted foul sewer network follows the same routing as the surface water drainage in a 225mm diameter pipe.

A review of the site topographical, GPR and CCTV surveys would indicate that the current development is served by a below ground surface water drainage network that outfalls unrestricted via a 300mm diameter pipe to a Thames Water (TW) adopted manhole to the north east of the site within the centre of Third Avenue. This is located online of the 1200mm diameter TW sewer that flows in a northerly direction, eventually outfalling to Pix Brook. The foul drainage serving the existing building generally runs in parallel with the surface water drainage and outfalls again at the northeast corner to a 225mm diameter TW foul sewer in Third Avenue.

The site is therefore considered to be brownfield for drainage purposes. Refer to Appendix B for the GPR survey and CCTV Plan, plus Appendix F for a copy of the TW sewer records.

5.2 RUNOFF RATES

The existing brownfield flow rates from the site have been defined in Table 2 below based on the modified rational method for the various storm events for the existing impermeable area currently draining to the surface water sewer via the existing connection. These are considered to be on the high side and very much dictated by the size of the existing piped network.

Impermeable Area (ha)	1 year (30mm/hr)	30 year (65mm/hr)	100 year (95mm/hr)
1.60ha	133 l/s	289 l/s	422 l/s

Table 2: Brownfield Runoff Rates

To satisfy Hertfordshire County Council & TW guidance & policy, the existing Greenfield rates have also been defined in Table 3 below for the full development area. Refer to Appendix D for full details.

	Area (ha)	1 year (l/s)	Qbar (l/s)	30 year (l/s)	100 year (l/s)
Greenfield Runoff Rates	2.64	5.4	6.2	15.3	22.2

Table 3: Greenfield Runoff Rates

5.3 GEOLOGY

A detailed Phase 2 Site Investigation has been carried out at the site. This has identified shallow Made Ground to a depth of circa 1.7m BGL, over Chalk recovered as structureless melange of off white.

Given the depth of made ground and underlying chalk that could be susceptible to dissolution features, infiltration is not considered a viable SuDS technique for the site. This has also been advised by the specialist Geotechnical Consultant.

5.4 SUSTAINABLE DRAINAGE ASSESSMENT

Sustainable Drainage Systems (SuDS) are utilised in line with the CIRIA 753 guidance and Hertfordshire County Council & North Hertfordshire District Council SuDS Policy, with the aim to minimise the development's impact on the runoff quantity and quality and maximise amenity and biodiversity opportunities.

The CIRIA 753 Management train approach is a fundamental principle of SuDS systems, it aims to primarily reduce pollution, flow rates and volume of runoff from the site. The main objective is to treat the runoff as close to the source as possible and it is imperative that at least two of the following should be included within the drainage strategy.

- **Prevention** – The use of good site design and rainwater re-use measures to prevent runoff.
- **Source Control** – Controlling the runoff as close to source as possible by using green roofs, porous pavements and soakaways.
- **Site Control** – Use of water management techniques within local area, i.e. detention basins and geocellular storage.
- **Regional Control** – Management of water from a number of sites in a specific location, i.e. balancing ponds and wetlands.

Table 4 below provides an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates & volumes, and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the industrial led development.

Method	Comment	Suitability	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	<i>Not Suitable for Main Building:</i>	- Green roofs are better suited to be installed on flat roof areas. Given the building roof is predominantly pitched this will reduce the effectiveness of the system retaining water runoff. - Additional loading from a green roof on a large span structure will significantly increase structural and foundation design, which is not considered a sustainable approach particularly when considering reducing carbon footprint. - Roof is also being installed with PVs so there will be limited room to incorporate significant areas of green roofs that will provide any additional sustainability benefits. - The standard main roof has a 25-year envelope warranty, which will be compromised by having a green roof. - Small areas of Green roofs are to be added to the low level cycle shelters.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site and reduces treated water consumption.	<i>Not Suitable:</i>	- The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs. - Limited end use with small office area. - There is evidence that occupiers disconnect the system as the running and maintenance costs outweighs the benefits of reducing water demand.
Infiltration Options	Reduces total run off volume from the development.	<i>Not Suitable:</i>	Intrusive investigations would indicate that the underlying ground is unsuitable for infiltration due to the made ground and deeper chalk.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<i>Not Suitable:</i>	Intrusive investigations would indicate that the underlying ground is unsuitable for infiltration due to the made ground and deeper chalk.

Method	Comment	Suitability	Suitability for Development
Permeable Surfacing (Standard)	- Can be used to enhance quality of runoff water. - Sub-base provides 'source' storage and reduces the volume of storage downstream. - The storage can be created with selection of the stone fill or use of plastic box stems.	<i>Suitable:</i>	The car parking bays are to be constructed using permeable surfacing.
Swales, basins and ponds	- Provide areas for above ground runoff storage. - Allow filtering of particulate matter, improving water quality	<i>Not suitable:</i>	No available area for attenuation pond or other green SuDS to be allocated.
Bio-Retention	Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.	<i>Suitable:</i>	Rainwater gardens and Tree pits are to be included adjacent the main access road.
Geocellular Storage	- Suitable for sites with insufficient space for basins etc. - Suitable for sites where topography prevents the use of open basins etc. - Can be very effective infiltration devices subject to ground conditions.	<i>Suitable:</i>	Incorporated into the main design to act as the means of attenuation.

Table 4: SuDS Viability & Assessment

5.5 CLIMATE CHANGE

In May 2022, the Environment Agency released updated climate change allowances for peak rainfall intensities which should be applied to new developments. Rather than nationwide allowances, each area will have its own peak rainfall allowances. In the case of the Letchworth area, this is the Upper and Bedford Ouse Management Catchment peak rainfall allowances.

Based on the nature of the development, a lifespan of 60 years is anticipated. Therefore, the potential climate change allowance for the 2070's ranges between 25% for the central allowance and 40% for the upper end allowance. In line with the EA Guidance for this design life, the Central allowance of 25% for climate change on peak rainfall intensity would be applicable. However, to satisfy Hertfordshire County Council & North Hertfordshire District Council guidance, the 40% 'Upper End' climate change allowance has also been simulated in the hydraulic model for the 1 in 100-year event to confirm there is no risk to the buildings.

5.6 SURFACE WATER STRATEGY

Based on the SuDS review, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail in Table 5 below:

Method	Suitability	Suitability for Development
Infiltration to Ground	No	The upper Made Ground geology and deeper Chalk layers means that infiltration is not viable.
Connection to Watercourse	No	There are no watercourses in close proximity.
Connection to Surface Water Sewer	Yes	Existing connection to be reused to the TW surface water sewer to the northeast of the site at Greenfield Rates.
Connection to a Combined Sewer	No	Other more viable options which would take precedent.

Table 5: SuDS Hierarchal Approach

Surface water generated from the roof of the new buildings will merge with the runoff from the new yards and parking areas and be directed into an underground drainage network that passes through a number of geocellular attenuation tanks and full retention petrol separators. This network will then outfall into the Thames Water surface water sewer in Third Avenue via the existing pipework, at a maximum restricted rate of 22.2l/s for the extreme 1 in 100 year plus 40% allowance for climate change. This rate is in line with HCC Sustainable Drainage policy as discussed in Section 3.4.

The car parking bays will be constructed using permeable surfacing, small areas of green roof to the cycle shelters and tree pits/rainwater gardens to the access road, which will provide additional SuDS quality treatment prior to outfall. Due to the limited external areas, other green SuDS options are not possible to be included within the development boundary.

Table 6 below defines the post development flows rates based on the local policy. As shown in the table, these rates incorporate a minimum **95%** reduction in the existing predevelopment discharge rates.

Full details of this strategy can be found on the BGL drawing in Appendix C and the hydraulic calculations in Appendix D.

	1 year	30 year	100 year + 40% CC
Existing Brownfield Runoff Rates (Estimated based on the existing impermeable area, and unrestricted flows)	133 l/s	289 l/s	422 l/s (100yr)
Greenfield Rates	5.4 l/s	15.3 l/s	22.2 l/s
Post Development Peak Flow Rates (from BGL Hydraulic Model)	5.4 l/s	18.8 l/s (inc 25% CC)	22.1 l/s
Minimum Percentage Reduction in Post Development Runoff Rates	96%	95%	95%

Table 6: Pre and Post Development Runoff Rates

The proposed private drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations part H guidance, i.e. to show no flooding to the 30-year storm return period criterion. Events exceeding this up to and including the 100 year plus climate change allowance have been assessed. Flooding from these events is classed as exceedance flooding. The hydraulic model has determined that a small volume of exceedance flooding will be retained in the low-lying yard areas. These are set down from the finished floor level of the building and will not flow off site.

5.7 WATER QUALITY, QUANTITY, AMENITY & BIODIVERSITY

Surface water run-off from hard paved areas at risk of contamination should receive water quality treatment. Commercial yards and non-residential parking areas are considered as a medium hazard in terms of contamination. Figure 5 illustrates the pollution hazard indices for different land use classifications from The CIRIA SuDS Manual C753 (2015).

TABLE 26.2 Pollution hazard indices for different land use classifications				
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, homezones 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 (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg 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 ¹	High	0.8 ²	0.8 ²	0.9 ²

Figure 5: Pollution Hazard indices for land use classification (Table 26.2 the CIRIA SuDS manual 2015)

Figure 6 illustrates the SuDS Component mitigation indices from The CIRIA SuDS Manual C753 (2015).

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters				
Type of SuDS component	Mitigation indices ¹			
	TSS	Metals	Hydrocarbons	
Filter strip	0.4	0.4	0.5	
Filter drain	0.4 ²	0.4	0.4	
Swale	0.5	0.6	0.6	
Bioretention system	0.8	0.8	0.8	
Permeable pavement	0.7	0.6	0.7	
Detention basin	0.5	0.5	0.6	
Pond ⁴	0.7 ³	0.7	0.5	
Wetland	0.8 ³	0.8	0.8	
Proprietary treatment systems ^{5,6}	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.			

Notes

- 1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.
- 2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
- 3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
- 4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.
- 5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: <http://tinyurl.com/qf7yuj7>
- 6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

Figure 6: Indicative SuDS mitigation indices (Table 26.3 the CIRIA SuDS manual 2015)

The selection of permeable surfacing to the parking bays along with the proprietary treatment systems in terms of the Petrol Separators to the yard areas would ensure that the SuDS mitigation component index (Figure 7) exceeds the pollution hazard index (Figure 6).

The following measures have also been included within the surface water drainage proposals.

- All runoff from the car parking bays has a medium risk and will pass through permeable paving.
- In addition, all runoff from heavier duty hardstanding areas will also pass through Class 1 full retention separators.
- As detailed under Section 5.6 - Surface Water Strategy, the mimicking of water quantity has been considered by reducing the offsite peak discharge rates and providing attenuation to control the runoff rates and peak volumes to the downstream network.
- In terms of Amenity and Biodiversity, as discussed and justified in the Section 5.4 - Sustainable Drainage, there are limited areas on this fully developed site to form green SuDS infrastructure to provide amenity and biodiversity areas linked to the drainage strategy. Notwithstanding, reference should be made to the landscape drawings and the Ecology & Biodiversity report which details improvements being made in relation to this provision.

5.8 MANAGEMENT & MAINTENANCE

The long-term maintenance of the new drainage infrastructure will be with the owner / occupier of the proposed industrial units in line with best practice guidance. Refer to Appendix E for full details.

5.9 FOUL WATER STRATEGY

Foul flows generated by the new development will discharge to the existing Thames Water adopted foul water sewer within Third Avenue to the northeast of the site via an existing connection. The site will drain by a private gravity network to this drain and be designed in line with Building Regulations Guidance.

Refer to Appendix C for the outline foul water drainage plan.

6.0 MANAGEMENT, MAINTENANCE AND RISK

A private management company will maintain the drainage infrastructure as part of the site wide management and maintenance strategy, detailed in Appendix E.

Should exceedance flooding occur, access and egress to the development shall be from the main site access onto Avenue One to the northwest.

The use of SuDS in the form of Source Control and Site Control measures will help to minimise the flood risk impact to the surrounding drainage network.

Up to and including the 100-year plus increase in rainfall allowance due to climate change (CC) event, the report has justified that there is no risk of flooding to the new hard standing area or occupiers.

Flood risk to people and property can be managed but it can never be completely removed; a residual risk remains after flood management or mitigation measures have been put in place. This relates to a rainfall event beyond what can be fully quantified.

7.0 CONCLUSION

In conclusion, this report has studied and assessed the flood risk to the site by all sources with the proposals complying with national, regional and local planning policy & guidance. A review of the EA Flood Maps shows that the site is located within Flood Zone 1, i.e. land defined as having less than a 1 in 1000 annual probability of flooding from of river or sea water. Further to this, the report has found the site to be at 'low risk' from all sources of flooding; tidal, fluvial, pluvial, sewer, groundwater and artificial sources.

The surface water drainage strategy is to reduce the peak post development flow rates passing off the roof and new hardstanding area to the respective greenfield rates up to 22.2l/s including a 40% allowance for climate change. This satisfies Hertfordshire County Council & TW SuDS policy. The Sustainable Drainage Systems (SuDS) hierarchy has been considered in the drainage strategy. Due to the Made Ground and deeper Chalk Strata, the surface water runoff collected from the impermeable areas will be directed via permeable surfacing and underground network to a number of geocellular tanks located beneath the service yard area, connecting into the Thames Water surface water sewer in Avenue One via the existing connection.

The existing site is fully impermeable and currently discharges unrestricted, thus the proposed surface water strategy provides a significant reduction in the pre-development discharge rates.

There is no residual flood risk from the development site to the surrounding district due to the reduction in storm water flow rates. The development does not therefore increase the risk of flooding to other adjacent neighbourhoods.

Foul flows will discharge unrestricted to the TW foul water sewer network located to the northeast of the site via a new gravity network and existing connection.

APPENDIX A – SITE MASTERPLAN



Based on ordnance and topographical measured survey.

Ordnance Survey Licence Number: 100022432

Topographical & measured building survey prepared by Terrain Surveys.
Drawing Number: TS25-173-T-1-2D

Tree survey prepared by: Aspect Ecology.
Drawing Number: 12296 PAIA 01, 12296 TCP 01 & 12296 TS 01

KEY

- Application Boundary
2.67 Hectares / 6.59 Acres
- Ownership Boundary
- Highways Boundary
- Proposed Security Fence
- Retaining Wall
- Refuse Storage
- Active Car Charging Points
- Passive Car Charging Points
- Retained, Existing Trees
- Proposed Trees

Rev PL1: Planning Issue. TB - 17.04.2025

Drawing Status:
PLANNING

CMP
Architects

Client



Project
Avenue One, Letchworth

Title
Proposed Site Plan

Scale @ A1 / A3 1:500 / 1:1000	Drawn TB	Date 17.04.2025	Revision PL1
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Drg. No.

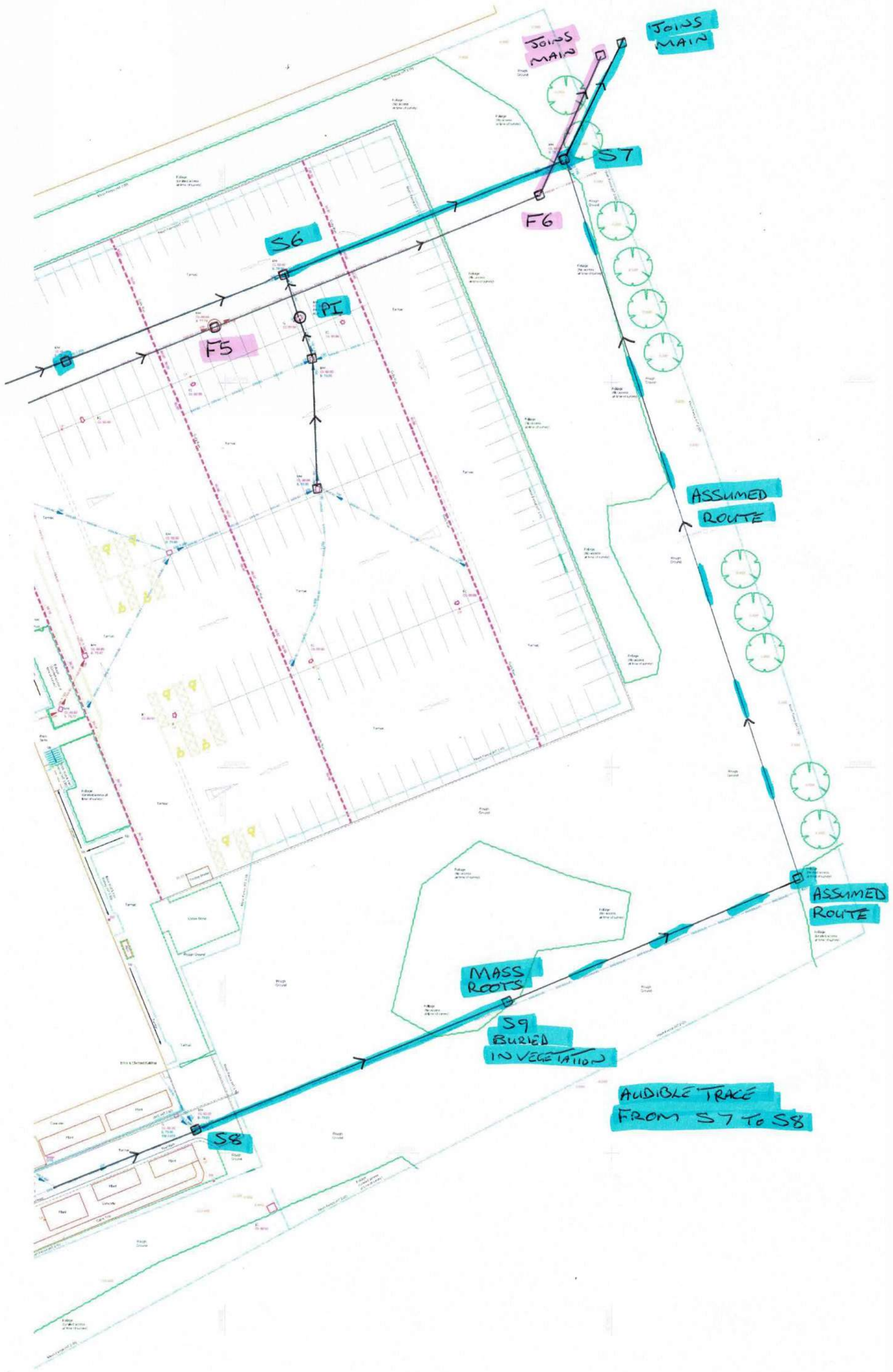
L060-CMP-SI-ZZ-DR-A-00100

Do not scale from this drawing, use figured dimensions only. Subject to accurate site survey. All dimensions to be checked and verified for any discrepancies. All drawings to be read in conjunction with all CMP Architects and other consultants' contract documentation. Any discrepancies to be reported before any work commences. All items installed by others are to be fully site coordinated and programmed with the Contractor. All products to be installed to manufacturers recommendations.
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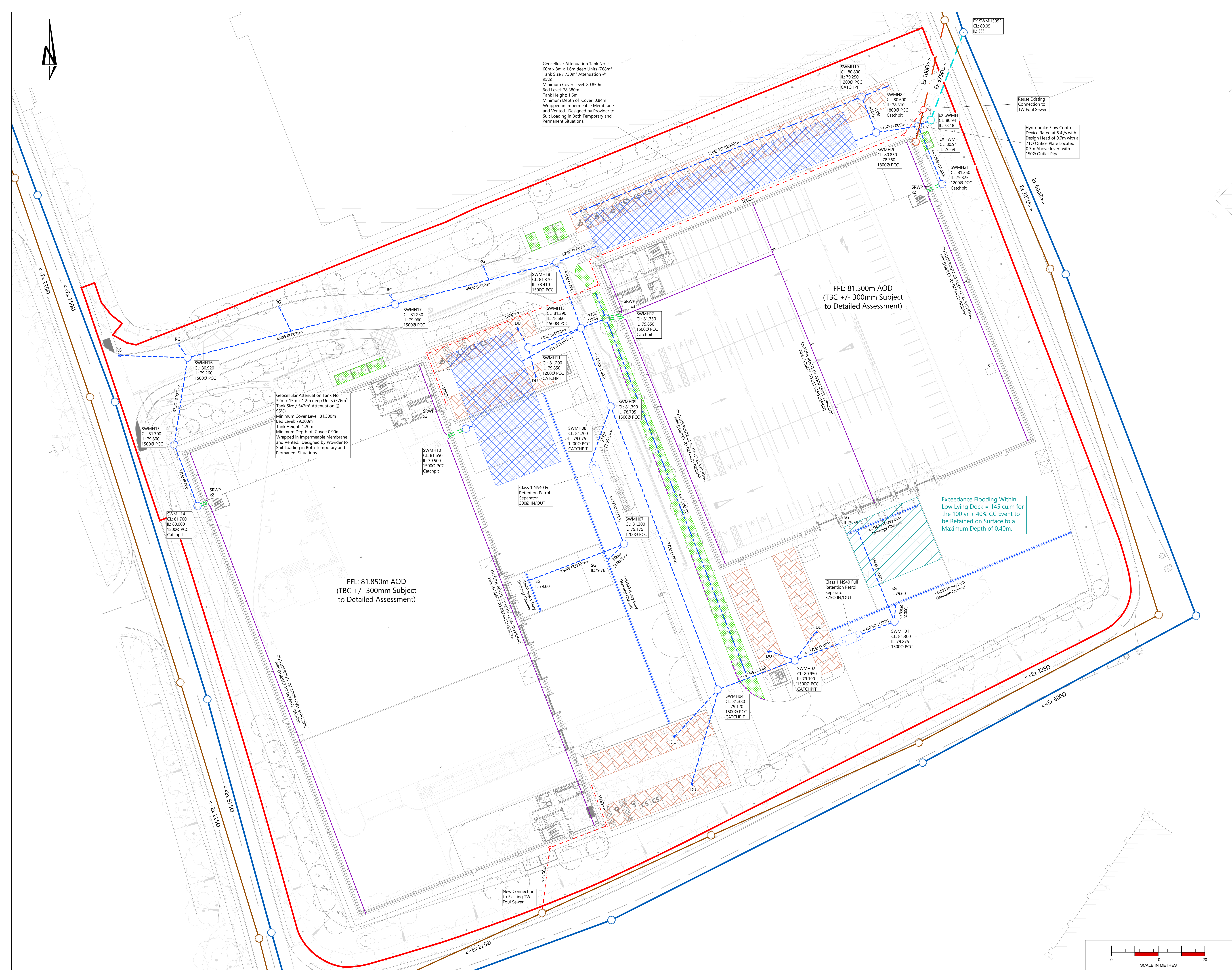
APPENDIX B – TOPOGRAPHICAL SURVEY, GPR SURVEY & CCTV PLAN







APPENDIX C – BGL DRAWINGS



THIS DRAWING IS THE COPYRIGHT OF BURROWS GRAHAM LIMITED.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION

1. Add residual risks here

MAINTENANCE

1. Add residual risks here

DEMOLITION

1. Add residual risks here

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT

KEY:

Existing TW Foul Water Sewer

Existing TW Surface Water Sewer

Existing Foul Water Drainage

Existing Surface Water Drainage

Existing Drainage to be Abandoned

Surface Water Drainage Pipe

Surface Water Drainage Manhole

Surface Water Drainage Channel

Filter Drainage Pipe

Offlet Kerb Drainage

Foul Water Drainage Pipe

Foul Water Drainage Manhole

Below Ground Syphonic Pipework

Above Ground Syphonic Pipework

Proposed Permeable Surfacing

Proposed Green SuDS (Tree Pits/Rain Garden & Green Roof's)

DU

Diffuser Unit at Base of Permeable Surfacing

Planning Boundary

Note not all Existing Drainage is Shown on this Drawing. Refer to GPR and Other Surveys for the Full Extent.

REV	DATE	BY	DESCRIPTION	CHKD
P02	25.04.25	PG	Unit 1 Car Park Updated	RM
P01	17.04.25	PG	Issued for Information	RM

Burrows Graham

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CLIENT
Wrenbrigde

PROJECT
Letchworth, Ave One

DRAWING TITLE

DRAINAGE STRATEGY PLAN

BGL PROJECT NUMBER

40365

DRAWING STATUS

INFORMATION

OFFICE

SOUTH

SCALE @ A0

1:250

DATE

16.04.2025

DRAWN BY

PG

CHECKED BY

RM

DRAWING No

40365-BGL-XX-XX-DR-C-00210

REV

P02

APPENDIX D – BGL HYDRAULIC CALCULATIONS

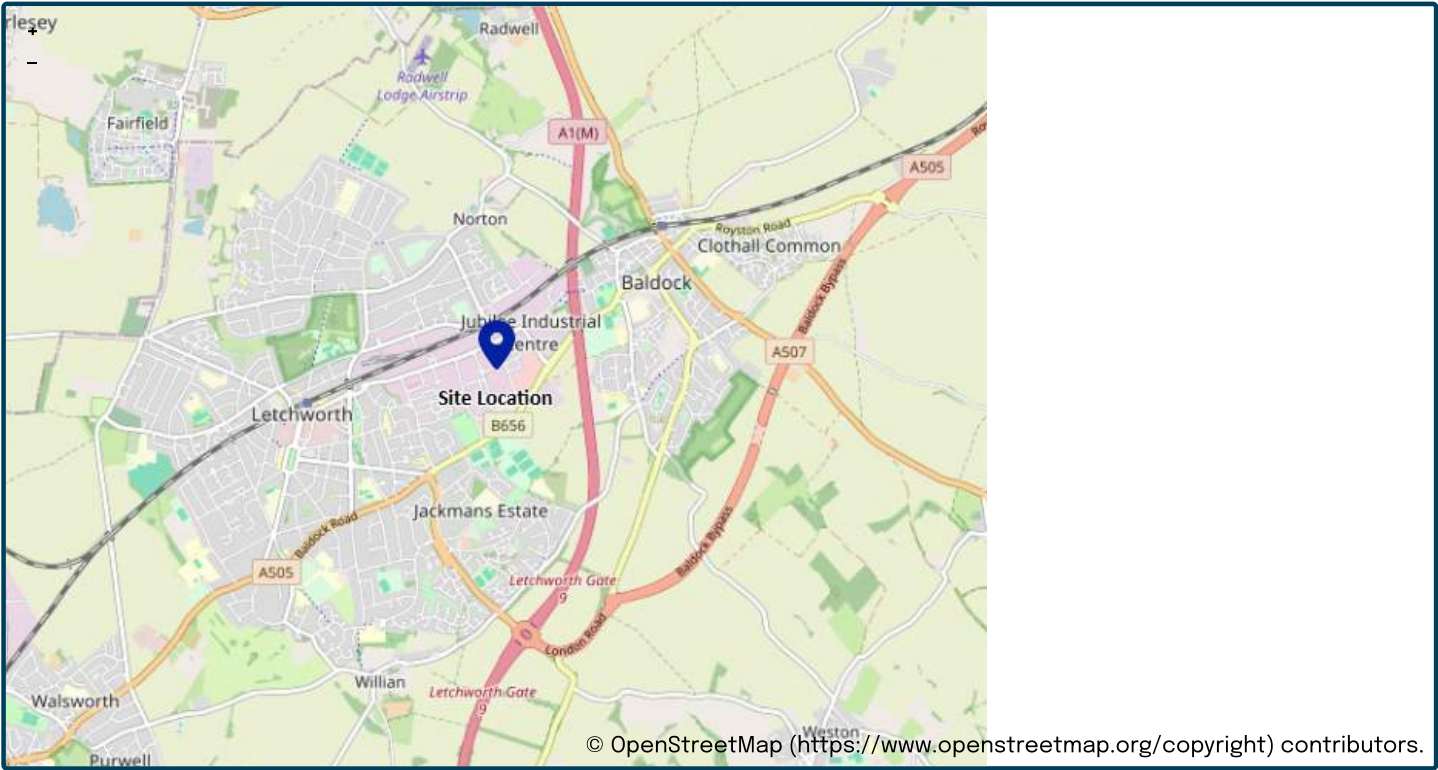
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

Project details

Date	10/04/2025
Calculated by	Paul Graveney
Reference	40365
Model version	0.6.5

Location

Site name	Avenue One
Site location	Letchworth



Site easting	523246
Site northing	232926

Site details

Total site area (ha)	2.64	ha
----------------------	------	----

Greenfield runoff

Method

Method	IH124
--------	-------

IH124

SAAR (mm)	My value 593 mm	Map value ☐ 593
How should SPR be derived?	WRAP soil type	
WRAP soil type	3	☐ 3
SPR	0.37	☐ 0.37
QBar (IH124) (l/s)	6.2 l/s	

Growth curve factors

Hydrological region	My value 5	Map value ☐ 5
1 year growth factor	0.87	
2 year growth factor	0.89	
10 year growth factor	1.65	
30 year growth factor	2.45	
100 year growth factor	3.56	
200 year growth factor	4.21	

Results

Method	IH124
Flow rate 1 year (l/s)	5.4 l/s
Flow rate 2 year (l/s)	5.6 l/s
Flow rate 10 years (l/s)	10.3 l/s
Flow rate 30 years (l/s)	15.3 l/s
Flow rate 100 years (l/s)	22.2 l/s
Flow rate 200 years (l/s)	26.3 l/s

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (0.6.5) developed by HR Wallingford and available at uksuds.com (<https://www.uksuds.com/>). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [uksuds.com/terms-conditions](https://www.uksuds.com/terms-conditions) (<https://www.uksuds.com/terms-conditions>). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	150.0		

Adoptable Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	749	1500
499	1350	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100 | 150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
DC01	0.035	4.00	80.250	300	0.700
DC02	0.178	4.00	80.800	300	1.200
SWMH01			81.300	1500	2.025
PI01			81.300	1500	2.060
SWMH03	0.048	10.00	81.220	1500	2.030
SWMH04	0.047	10.00	81.380	1350	2.260
DC03	0.019	4.00	80.600	300	1.000
DC04	0.202	4.00	81.185	300	1.585
SWMH07			81.300	1350	2.125
PI02			81.300	1350	2.225
SWMH09			81.390	1350	2.595
SWMH10	0.296	4.00	81.650	1500	2.150
TANK01			81.300	100	2.100
SWMH11	0.045	4.00	81.200	1200	1.350
SWMH12	0.487	4.00	81.350	1500	1.700
SWMH13			81.390	1500	2.730
SWMH14	0.296	4.00	81.700	1500	1.700
SWMH15			81.700	1500	1.900
SWMH16	0.050	4.00	80.920	1500	1.660
SWMH17	0.050	4.00	81.230	1500	2.170
SWMH18			81.370	1500	2.960
TANK02			80.900	100	2.520

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
SWMH19	0.100	10.00	80.800	1200	1.550
SWMH20			80.850	1500	2.490
SWMH21	0.129	4.00	81.350	1500	1.525
SWMH22			80.600	2100	2.290
EXMH01			80.940	1350	2.760
EXMH3052			80.050	1350	2.170

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	DC01	SWMH01	21.000	0.600	79.550	79.400	0.150	140.0	150	4.41	108.2
2.000	DC02	SWMH01	4.000	0.600	79.600	79.450	0.150	26.7	225	4.03	108.2
1.001	SWMH01	PI01	7.000	0.600	79.275	79.240	0.035	200.0	375	4.50	108.2
1.002	PI01	SWMH03	11.000	0.600	79.240	79.190	0.050	220.0	375	4.66	108.2
1.003	SWMH03	SWMH04	17.000	0.600	79.190	79.120	0.070	242.9	375	10.24	76.6
1.004	SWMH04	SWMH09	64.000	0.600	79.120	78.870	0.250	256.0	375	11.19	72.8
3.000	DC03	SWMH07	22.000	0.600	79.600	79.400	0.200	110.0	150	4.38	108.2
4.000	DC04	SWMH07	4.000	0.600	79.600	79.450	0.150	26.7	225	4.03	108.2
3.001	SWMH07	PI02	14.000	0.600	79.175	79.075	0.100	140.0	375	4.54	108.2
3.002	PI02	SWMH09	12.000	0.600	79.075	78.975	0.100	120.0	375	4.66	108.2
1.005	SWMH09	SWMH13	17.000	0.600	78.795	78.735	0.060	283.3	450	11.43	71.9
5.000	SWMH10	TANK01	6.000	0.600	79.500	79.460	0.040	150.0	375	4.07	108.2
5.001	TANK01	SWMH13	6.000	0.600	79.200	79.150	0.050	120.0	375	4.13	108.2
6.000	SWMH11	SWMH13	11.000	0.600	79.850	79.650	0.200	55.0	150	4.13	108.2
7.000	SWMH12	SWMH13	5.000	0.600	79.650	79.350	0.300	16.7	300	4.02	108.2
1.006	SWMH13	SWMH18	14.000	0.600	78.660	78.560	0.100	140.0	525	11.55	71.5
8.000	SWMH14	SWMH15	13.000	0.600	80.000	79.800	0.200	65.0	375	4.10	108.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.847	15.0	13.7	0.550	1.750	0.035	0.0	113	0.958
2.000	2.543	101.1	69.6	0.975	1.625	0.178	0.0	138	2.736
1.001	1.277	141.1	83.3	1.650	1.685	0.213	0.0	208	1.328
1.002	1.217	134.4	83.3	1.685	1.655	0.213	0.0	214	1.280
1.003	1.158	127.9	72.2	1.655	1.885	0.261	0.0	202	1.192
1.004	1.128	124.5	81.0	1.885	2.145	0.308	0.0	221	1.198
3.000	0.957	16.9	7.4	0.850	1.750	0.019	0.0	69	0.926
4.000	2.543	101.1	79.0	1.360	1.625	0.202	0.0	150	2.803
3.001	1.529	168.9	86.4	1.750	1.850	0.221	0.0	190	1.537
3.002	1.653	182.5	86.4	1.850	2.040	0.221	0.0	181	1.630
1.005	1.203	191.2	137.5	2.145	2.205	0.529	0.0	283	1.304
5.000	1.477	163.1	115.7	1.775	1.465	0.296	0.0	234	1.597
5.001	1.653	182.5	115.7	1.725	1.865	0.296	0.0	217	1.746
6.000	1.359	24.0	17.6	1.200	1.590	0.045	0.0	96	1.483
7.000	3.869	273.5	190.4	1.400	1.740	0.487	0.0	185	4.170
1.006	1.891	409.3	350.5	2.205	2.285	1.357	0.0	376	2.112
8.000	2.250	248.5	115.7	1.325	1.525	0.296	0.0	180	2.212

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
8.001	SWMH15	SWMH16	18.000	0.600	79.800	79.335	0.465	38.7	375	4.20	108.2
8.002	SWMH16	SWMH17	45.000	0.600	79.260	79.060	0.200	225.0	450	4.75	108.2
8.003	SWMH17	SWMH18	35.000	0.600	79.060	78.910	0.150	233.3	450	5.19	106.7
1.007	SWMH18	TANK02	9.000	0.600	78.410	78.380	0.030	300.0	675	11.65	71.1
1.008	TANK02	SWMH20	6.000	0.600	78.380	78.360	0.020	300.0	675	11.72	70.9
9.000	SWMH19	SWMH20	7.000	0.600	79.250	78.950	0.300	23.3	150	10.06	77.3
1.009	SWMH20	SWMH22	8.000	0.600	78.360	78.310	0.050	160.0	675	11.78	70.6
10.000	SWMH21	SWMH22	13.000	0.600	79.825	79.325	0.500	26.0	225	4.08	108.2
1.010	SWMH22	EXMH01	4.000	0.600	78.310	78.180	0.130	30.8	375	11.80	50.0
1.011	EXMH01	EXMH3052	19.000	0.600	78.180	77.880	0.300	63.3	375	11.94	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
8.001	2.920	322.4	115.7	1.525	1.210	0.296	0.0	155	2.687
8.002	1.351	214.9	135.3	1.210	1.720	0.346	0.0	260	1.425
8.003	1.326	210.9	152.7	1.720	2.010	0.396	0.0	284	1.439
1.007	1.508	539.5	450.5	2.285	1.845	1.753	0.0	474	1.677
1.008	1.508	539.5	448.9	1.845	1.815	1.753	0.0	473	1.676
9.000	2.093	37.0	28.0	1.400	1.750	0.100	0.0	98	2.296
1.009	2.069	740.4	473.0	1.815	1.615	1.853	0.0	393	2.188
10.000	2.576	102.4	50.4	1.300	1.050	0.129	0.0	111	2.563
1.010	3.276	361.8	358.1	1.915	2.385	1.982	0.0	307	3.708
1.011	2.280	251.8	358.1	2.385	1.795	1.982	0.0	375	2.309

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	21.000	140.0	150	Circular	80.250	79.550	0.550	81.300	79.400	1.750
2.000	4.000	26.7	225	Circular	80.800	79.600	0.975	81.300	79.450	1.625
1.001	7.000	200.0	375	Circular	81.300	79.275	1.650	81.300	79.240	1.685
1.002	11.000	220.0	375	Circular	81.300	79.240	1.685	81.220	79.190	1.655
1.003	17.000	242.9	375	Circular	81.220	79.190	1.655	81.380	79.120	1.885
1.004	64.000	256.0	375	Circular	81.380	79.120	1.885	81.390	78.870	2.145
3.000	22.000	110.0	150	Circular	80.600	79.600	0.850	81.300	79.400	1.750
4.000	4.000	26.7	225	Circular	81.185	79.600	1.360	81.300	79.450	1.625
3.001	14.000	140.0	375	Circular	81.300	79.175	1.750	81.300	79.075	1.850
3.002	12.000	120.0	375	Circular	81.300	79.075	1.850	81.390	78.975	2.040

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	DC01	300	Manhole	Adoptable	SWMH01	1500	Manhole	Adoptable
2.000	DC02	300	Manhole	Adoptable	SWMH01	1500	Manhole	Adoptable
1.001	SWMH01	1500	Manhole	Adoptable	PI01	1500	Manhole	Adoptable
1.002	PI01	1500	Manhole	Adoptable	SWMH03	1500	Manhole	Adoptable
1.003	SWMH03	1500	Manhole	Adoptable	SWMH04	1350	Manhole	Adoptable
1.004	SWMH04	1350	Manhole	Adoptable	SWMH09	1350	Manhole	Adoptable
3.000	DC03	300	Manhole	Adoptable	SWMH07	1350	Manhole	Adoptable
4.000	DC04	300	Manhole	Adoptable	SWMH07	1350	Manhole	Adoptable
3.001	SWMH07	1350	Manhole	Adoptable	PI02	1350	Manhole	Adoptable
3.002	PI02	1350	Manhole	Adoptable	SWMH09	1350	Manhole	Adoptable

Pipeline Schedule

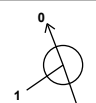
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.005	17.000	283.3	450	Circular	81.390	78.795	2.145	81.390	78.735	2.205
5.000	6.000	150.0	375	Circular	81.650	79.500	1.775	81.300	79.460	1.465
5.001	6.000	120.0	375	Circular	81.300	79.200	1.725	81.390	79.150	1.865
6.000	11.000	55.0	150	Circular	81.200	79.850	1.200	81.390	79.650	1.590
7.000	5.000	16.7	300	Circular	81.350	79.650	1.400	81.390	79.350	1.740
1.006	14.000	140.0	525	Circular	81.390	78.660	2.205	81.370	78.560	2.285
8.000	13.000	65.0	375	Circular	81.700	80.000	1.325	81.700	79.800	1.525
8.001	18.000	38.7	375	Circular	81.700	79.800	1.525	80.920	79.335	1.210
8.002	45.000	225.0	450	Circular	80.920	79.260	1.210	81.230	79.060	1.720
8.003	35.000	233.3	450	Circular	81.230	79.060	1.720	81.370	78.910	2.010
1.007	9.000	300.0	675	Circular	81.370	78.410	2.285	80.900	78.380	1.845
1.008	6.000	300.0	675	Circular	80.900	78.380	1.845	80.850	78.360	1.815
9.000	7.000	23.3	150	Circular	80.800	79.250	1.400	80.850	78.950	1.750
1.009	8.000	160.0	675	Circular	80.850	78.360	1.815	80.600	78.310	1.615
10.000	13.000	26.0	225	Circular	81.350	79.825	1.300	80.600	79.325	1.050
1.010	4.000	30.8	375	Circular	80.600	78.310	1.915	80.940	78.180	2.385
1.011	19.000	63.3	375	Circular	80.940	78.180	2.385	80.050	77.880	1.795

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.005	SWMH09	1350	Manhole	Adoptable	SWMH13	1500	Manhole	Adoptable
5.000	SWMH10	1500	Manhole	Adoptable	TANK01	100	Manhole	Adoptable
5.001	TANK01	100	Manhole	Adoptable	SWMH13	1500	Manhole	Adoptable
6.000	SWMH11	1200	Manhole	Adoptable	SWMH13	1500	Manhole	Adoptable
7.000	SWMH12	1500	Manhole	Adoptable	SWMH13	1500	Manhole	Adoptable
1.006	SWMH13	1500	Manhole	Adoptable	SWMH18	1500	Manhole	Adoptable
8.000	SWMH14	1500	Manhole	Adoptable	SWMH15	1500	Manhole	Adoptable
8.001	SWMH15	1500	Manhole	Adoptable	SWMH16	1500	Manhole	Adoptable
8.002	SWMH16	1500	Manhole	Adoptable	SWMH17	1500	Manhole	Adoptable
8.003	SWMH17	1500	Manhole	Adoptable	SWMH18	1500	Manhole	Adoptable
1.007	SWMH18	1500	Manhole	Adoptable	TANK02	100	Manhole	Adoptable
1.008	TANK02	100	Manhole	Adoptable	SWMH20	1500	Manhole	Adoptable
9.000	SWMH19	1200	Manhole	Adoptable	SWMH20	1500	Manhole	Adoptable
1.009	SWMH20	1500	Manhole	Adoptable	SWMH22	2100	Manhole	Adoptable
10.000	SWMH21	1500	Manhole	Adoptable	SWMH22	2100	Manhole	Adoptable
1.010	SWMH22	2100	Manhole	Adoptable	EXMH01	1350	Manhole	Adoptable
1.011	EXMH01	1350	Manhole	Adoptable	EXMH3052	1350	Manhole	Adoptable

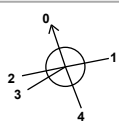
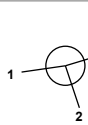
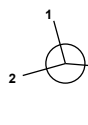
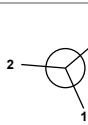
Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
DC01	79.164	43.898	80.250	0.700	300	 0	1.000	79.550	150
DC02	80.811	35.126	80.800	1.200	300	 0	2.000	79.600	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
SWMH01	74.469	19.593	81.300	2.025	1500		1 2	2.000 1.000	79.450 79.400	225 150
PI01	65.021	19.387	81.300	2.060	1500		1 0	1.001 1.002	79.240 79.240	375 375
SWMH03	45.442	18.056	81.220	2.030	1500		1 0	1.002 1.003	79.190 79.190	375 375
SWMH04	26.829	13.641	81.380	2.260	1350		1 0	1.003 1.004	79.120 79.120	375 375
DC03	-15.455	28.033	80.600	1.000	300		0	3.000	79.600	150
DC04	-1.638	27.308	81.185	1.585	300		0	4.000	79.600	225
SWMH07	4.922	32.652	81.300	2.125	1350		1 2 0	4.000 3.000 3.001	79.450 79.400 79.175	225 150 375
PI02	-1.738	50.894	81.300	2.225	1350		1 0	3.001 3.002	79.075 79.075	375 375
SWMH09	10.958	59.661	81.390	2.595	1350		1 2 0	3.002 1.004 1.005	78.975 78.870 78.795	375 375 450
SWMH10	-25.709	57.937	81.650	2.150	1500		0	5.000	79.500	375
TANK01	-17.077	59.826	81.300	2.100	100		1 0	5.000 5.001	79.460 79.200	375 375
SWMH11	-8.311	70.688	81.200	1.350	1200		0	6.000	79.850	150
SWMH12	16.796	75.730	81.350	1.700	1500		0	7.000	79.650	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
SWMH13	5.605	73.559	81.390	2.730	1500		1 2 3 4 0	7.000 6.000 5.001 1.005 1.006	79.350 79.650 79.150 78.735 78.660	300 150 375 450 525
SWMH14	-65.248	44.716	81.700	1.700	1500		0	8.000	80.000	375
SWMH15	-69.325	55.713	81.700	1.900	1500		1 0	8.000 8.001	79.800 79.800	375 375
SWMH16	-63.024	75.483	80.920	1.660	1500		1 0	8.001 8.002	79.335 79.260	375 450
SWMH17	-23.855	81.043	81.230	2.170	1500		1 0	8.002 8.003	79.060 79.060	450 450
SWMH18	1.876	84.746	81.370	2.960	1500		1 2 0	8.003 1.006 1.007	78.910 78.560 78.410	450 525 675
TANK02	14.530	88.560	80.900	2.520	100		1 0	1.007 1.008	78.380 78.380	675 675
SWMH19	34.465	102.666	80.800	1.550	1200		0	9.000	79.250	150
SWMH20	36.621	94.746	80.850	2.490	1500		1 2 0	9.000 1.008 1.009	78.950 78.360 78.360	150 675 675
SWMH21	58.682	81.414	81.350	1.525	1500		0	10.000	79.825	225
SWMH22	53.232	93.390	80.600	2.290	2100		1 2 0	10.000 1.009 1.010	79.325 78.310 78.310	225 675 375
EXMH01	66.960	105.085	80.940	2.760	1350		1 0	1.010 1.011	78.180 78.180	375 375
EXMH3052	75.981	114.033	80.050	2.170	1350		1	1.011	77.880	375

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	20.0		

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	35	0	0
100	40	0	0

Node SWMH22 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	78.310	Product Number	CTL-SHE-0114-5400-0700-5400
Design Depth (m)	0.700	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.4	Min Node Diameter (mm)	1200

Node SWMH22 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	13.0		
Invert Level (m)	79.000	Diameter (m)	0.071		

Node TANK02 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	78.380
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	480.0	480.0	1.600	480.0	604.3	1.601	0.0	604.3

Node TANK01 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	79.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	450.0	450.0	1.200	450.0	540.2	1.201	0.0	540.2

Approval Settings

Node Size	✓	Accuracy (m)	1.000
Node Losses	✓	Crossings	✓
Link Size	✓	Cover Depth	✓
Minimum Diameter (mm)	150	Minimum Cover Depth (m)	
Link Length	✓	Maximum Cover Depth (m)	3.000
Maximum Length (m)	100.000	Backdrops	✓
Coordinates	✓	Minimum Backdrop Height (m)	

Approval Settings

Maximum Backdrop Height (m)	1.500	Return Period (years)	
Full Bore Velocity	✓	Maximum Surcharged Depth (m)	0.100
Minimum Full Bore Velocity (m/s)		Flooding	✓
Maximum Full Bore Velocity (m/s)	3.000	Return Period (years)	30
Proportional Velocity	✓	Time to Half Empty	x
Return Period (years)		Discharge Rates	✓
Minimum Proportional Velocity (m/s)	0.750	Discharge Volume	✓
Maximum Proportional Velocity (m/s)	3.000	100 year 360 minute (m³)	
Surcharged Depth	✓		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	61.955	17.531	30 year +35% CC 360 minute summer	45.029	11.587
1 year 15 minute winter	43.477	17.531	30 year +35% CC 360 minute winter	29.270	11.587
1 year 30 minute summer	38.972	11.028	30 year +35% CC 480 minute summer	34.503	9.118
1 year 30 minute winter	27.349	11.028	30 year +35% CC 480 minute winter	22.923	9.118
1 year 60 minute summer	25.447	6.725	30 year +35% CC 600 minute summer	27.578	7.543
1 year 60 minute winter	16.906	6.725	30 year +35% CC 600 minute winter	18.843	7.543
1 year 120 minute summer	20.859	5.512	30 year +35% CC 720 minute summer	24.062	6.449
1 year 120 minute winter	13.858	5.512	30 year +35% CC 720 minute winter	16.171	6.449
1 year 180 minute summer	17.661	4.545	30 year +35% CC 960 minute summer	19.084	5.025
1 year 180 minute winter	11.480	4.545	30 year +35% CC 960 minute winter	12.642	5.025
1 year 240 minute summer	14.619	3.863	30 year +35% CC 1440 minute summer	13.162	3.528
1 year 240 minute winter	9.712	3.863	30 year +35% CC 1440 minute winter	8.846	3.528
1 year 360 minute summer	11.563	2.975	100 year +40% CC 15 minute summer	501.452	141.894
1 year 360 minute winter	7.516	2.975	100 year +40% CC 15 minute winter	351.896	141.894
1 year 480 minute summer	9.164	2.422	100 year +40% CC 30 minute summer	322.524	91.263
1 year 480 minute winter	6.088	2.422	100 year +40% CC 30 minute winter	226.333	91.263
1 year 600 minute summer	7.492	2.049	100 year +40% CC 60 minute summer	211.773	55.965
1 year 600 minute winter	5.119	2.049	100 year +40% CC 60 minute winter	140.697	55.965
1 year 720 minute summer	6.647	1.781	100 year +40% CC 120 minute summer	130.860	34.582
1 year 720 minute winter	4.467	1.781	100 year +40% CC 120 minute winter	86.940	34.582
1 year 960 minute summer	5.399	1.422	100 year +40% CC 180 minute summer	99.620	25.636
1 year 960 minute winter	3.577	1.422	100 year +40% CC 180 minute winter	64.755	25.636
1 year 1440 minute summer	3.860	1.035	100 year +40% CC 240 minute summer	77.751	20.547
1 year 1440 minute winter	2.594	1.035	100 year +40% CC 240 minute winter	51.656	20.547
30 year +35% CC 15 minute summer	381.586	107.976	100 year +40% CC 360 minute summer	57.659	14.838
30 year +35% CC 15 minute winter	267.779	107.976	100 year +40% CC 360 minute winter	37.480	14.838
30 year +35% CC 30 minute summer	243.856	69.003	100 year +40% CC 480 minute summer	44.156	11.669
30 year +35% CC 30 minute winter	171.127	69.003	100 year +40% CC 480 minute winter	29.336	11.669
30 year +35% CC 60 minute summer	159.206	42.073	100 year +40% CC 600 minute summer	35.275	9.648
30 year +35% CC 60 minute winter	105.773	42.073	100 year +40% CC 600 minute winter	24.102	9.648
30 year +35% CC 120 minute summer	100.807	26.640	100 year +40% CC 720 minute summer	30.757	8.243
30 year +35% CC 120 minute winter	66.974	26.640	100 year +40% CC 720 minute winter	20.671	8.243
30 year +35% CC 180 minute summer	77.342	19.903	100 year +40% CC 960 minute summer	24.345	6.411
30 year +35% CC 180 minute winter	50.274	19.903	100 year +40% CC 960 minute winter	16.127	6.411
30 year +35% CC 240 minute summer	60.569	16.007	100 year +40% CC 1440 minute summer	16.732	4.484
30 year +35% CC 240 minute winter	40.241	16.007	100 year +40% CC 1440 minute winter	11.245	4.484

Results for 1 year Critical Storm Duration. Lowest mass balance: 79.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	DC01	10	79.603	0.053	3.9	0.0570	0.0000	OK
15 minute summer	DC02	10	79.680	0.080	20.0	0.2418	0.0000	OK
15 minute summer	SWMH01	10	79.394	0.119	23.9	0.2105	0.0000	OK
15 minute summer	PI01	10	79.358	0.118	23.8	0.2079	0.0000	OK
15 minute summer	SWMH03	10	79.311	0.121	26.7	0.2708	0.0000	OK
15 minute summer	SWMH04	11	79.241	0.121	29.2	0.2238	0.0000	OK
15 minute summer	DC03	10	79.636	0.036	2.1	0.0162	0.0000	OK
15 minute summer	DC04	10	79.686	0.086	22.7	0.2251	0.0000	OK
15 minute summer	SWMH07	10	79.278	0.103	24.8	0.1474	0.0000	OK
15 minute summer	PI02	10	79.175	0.100	24.8	0.1426	0.0000	OK
15 minute summer	SWMH09	11	78.963	0.168	50.2	0.2398	0.0000	OK
15 minute summer	SWMH10	10	79.628	0.128	33.3	0.5798	0.0000	OK
240 minute summer	TANK01	144	79.250	0.050	12.0	22.5340	0.0000	OK
15 minute summer	SWMH11	10	79.899	0.049	5.1	0.0880	0.0000	OK
15 minute summer	SWMH12	10	79.760	0.110	54.8	0.8276	0.0000	OK
480 minute winter	SWMH13	464	78.916	0.256	21.6	0.4531	0.0000	OK
15 minute summer	SWMH14	10	80.100	0.100	33.3	0.5250	0.0000	OK
15 minute summer	SWMH15	10	79.885	0.085	33.3	0.1505	0.0000	OK
15 minute summer	SWMH16	10	79.393	0.133	38.9	0.3141	0.0000	OK
15 minute summer	SWMH17	11	79.202	0.142	44.6	0.3162	0.0000	OK
480 minute winter	SWMH18	464	78.916	0.506	28.2	0.8949	0.0000	OK
480 minute winter	TANK02	464	78.916	0.536	27.9	244.5845	0.0000	OK
15 minute winter	SWMH19	13	79.295	0.045	6.4	0.1088	0.0000	OK
480 minute summer	SWMH20	448	78.917	0.557	11.8	0.9842	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	DC01	1.000	SWMH01	3.9	0.705	0.259	0.1153	
15 minute summer	DC02	2.000	SWMH01	20.0	1.775	0.198	0.0451	
15 minute summer	SWMH01	1.001	PI01	23.8	0.800	0.169	0.2085	
15 minute summer	PI01	1.002	SWMH03	23.7	0.789	0.177	0.3311	
15 minute summer	SWMH03	1.003	SWMH04	26.3	0.930	0.205	0.5214	
15 minute summer	SWMH04	1.004	SWMH09	27.5	0.918	0.221	1.9229	
15 minute summer	DC03	3.000	SWMH07	2.1	0.647	0.122	0.0705	
15 minute summer	DC04	4.000	SWMH07	22.7	1.827	0.224	0.0498	
15 minute summer	SWMH07	3.001	PI02	24.8	1.033	0.147	0.3356	
15 minute summer	PI02	3.002	SWMH09	24.8	1.116	0.136	0.2662	
15 minute summer	SWMH09	1.005	SWMH13	50.3	0.991	0.263	0.8635	
15 minute summer	SWMH10	5.000	TANK01	33.3	1.087	0.204	0.1839	
240 minute summer	TANK01	5.001	SWMH13	6.2	0.746	0.034	0.0498	
15 minute summer	SWMH11	6.000	SWMH13	5.1	1.052	0.212	0.0533	
15 minute summer	SWMH12	7.000	SWMH13	54.8	2.654	0.200	0.1034	
480 minute winter	SWMH13	1.006	SWMH18	21.6	0.983	0.053	1.8256	
15 minute summer	SWMH14	8.000	SWMH15	33.3	1.577	0.134	0.2750	
15 minute summer	SWMH15	8.001	SWMH16	33.3	1.849	0.103	0.3247	
15 minute summer	SWMH16	8.002	SWMH17	39.0	0.977	0.182	1.8027	
15 minute summer	SWMH17	8.003	SWMH18	43.2	1.041	0.205	1.4530	
480 minute winter	SWMH18	1.007	TANK02	27.9	0.844	0.052	2.6614	
480 minute winter	TANK02	1.008	SWMH20	9.4	0.288	0.017	1.8558	
15 minute winter	SWMH19	9.000	SWMH20	6.4	1.508	0.173	0.0297	
480 minute summer	SWMH20	1.009	SWMH22	9.3	0.123	0.013	2.6161	

Results for 1 year Critical Storm Duration. Lowest mass balance: 79.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SWMH21	10	79.885	0.060	14.5	0.2072	0.0000	OK
480 minute summer	SWMH22	448	78.919	0.609	9.3	2.1091	0.0000	SURCHARGED
60 minute summer	EXMH01	137	78.219	0.039	5.4	0.0551	0.0000	OK
60 minute winter	EXMH3052	138	77.918	0.038	5.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SWMH21	10.000	SWMH22	14.5	1.775	0.142	0.1062	
480 minute summer	SWMH22	1.010	EXMH01	5.4	1.009	0.015	0.0214	
60 minute summer	EXMH01	1.011	EXMH3052	5.4	0.925	0.021	0.1109	89.2

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 79.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	DC01	10	80.250	0.700	24.2	0.7497	1.7544	FLOOD
15 minute summer	DC02	11	80.595	0.995	123.3	3.0208	0.0000	FLOOD RISK
15 minute summer	SWMH01	11	80.245	0.970	128.3	1.7132	0.0000	SURCHARGED
15 minute summer	PI01	11	80.199	0.959	114.0	1.6939	0.0000	SURCHARGED
15 minute summer	SWMH03	11	80.140	0.950	128.6	2.1281	0.0000	SURCHARGED
15 minute summer	SWMH04	11	80.033	0.913	146.8	1.6863	0.0000	SURCHARGED
15 minute summer	DC03	11	79.953	0.353	13.2	0.1591	0.0000	SURCHARGED
15 minute summer	DC04	10	80.385	0.785	139.9	2.0570	0.0000	SURCHARGED
360 minute winter	SWMH07	352	79.936	0.761	17.9	1.0892	0.0000	SURCHARGED
360 minute winter	PI02	352	79.935	0.860	17.3	1.2300	0.0000	SURCHARGED
360 minute winter	SWMH09	352	79.936	1.141	39.1	1.6326	0.0000	SURCHARGED
15 minute summer	SWMH10	10	79.959	0.459	204.9	2.0774	0.0000	SURCHARGED
360 minute winter	TANK01	352	79.935	0.735	77.7	330.9307	0.0000	SURCHARGED
15 minute summer	SWMH11	10	80.194	0.344	31.2	0.6193	0.0000	SURCHARGED
15 minute summer	SWMH12	10	80.654	1.004	337.3	7.5257	0.0000	SURCHARGED
360 minute winter	SWMH13	344	79.936	1.276	84.4	2.2552	0.0000	SURCHARGED
15 minute summer	SWMH14	10	80.322	0.322	204.9	1.6921	0.0000	OK
15 minute summer	SWMH15	10	80.091	0.291	203.1	0.5143	0.0000	OK
360 minute winter	SWMH16	344	79.935	0.675	28.2	1.5992	0.0000	SURCHARGED
360 minute winter	SWMH17	344	79.935	0.875	30.5	1.9487	0.0000	SURCHARGED
360 minute winter	SWMH18	344	79.936	1.526	107.4	2.6961	0.0000	SURCHARGED
360 minute winter	TANK02	344	79.936	1.556	109.1	709.5584	0.0000	SURCHARGED
480 minute winter	SWMH19	512	79.947	0.697	10.8	1.6869	0.0000	SURCHARGED
360 minute summer	SWMH20	408	80.320	1.960	22.8	3.4640	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	DC01	1.000	SWMH01	19.3	1.095	1.287	0.3697	
15 minute summer	DC02	2.000	SWMH01	109.0	2.742	1.078	0.1591	
15 minute summer	SWMH01	1.001	PI01	114.0	1.059	0.808	0.7721	
15 minute summer	PI01	1.002	SWMH03	109.8	1.039	0.817	1.2133	
15 minute summer	SWMH03	1.003	SWMH04	128.4	1.186	1.004	1.8751	
15 minute summer	SWMH04	1.004	SWMH09	147.2	1.335	1.182	7.0590	
15 minute summer	DC03	3.000	SWMH07	12.1	0.944	0.713	0.3873	
15 minute summer	DC04	4.000	SWMH07	133.7	3.362	1.322	0.1591	
360 minute winter	SWMH07	3.001	PI02	17.3	0.893	0.102	1.5442	
360 minute winter	PI02	3.002	SWMH09	16.8	0.919	0.092	1.3236	
360 minute winter	SWMH09	1.005	SWMH13	38.9	0.785	0.203	2.6935	
15 minute summer	SWMH10	5.000	TANK01	205.0	1.864	1.257	0.6375	
360 minute winter	TANK01	5.001	SWMH13	-54.2	0.941	-0.297	0.6618	
15 minute summer	SWMH11	6.000	SWMH13	30.1	1.711	1.254	0.1917	
15 minute summer	SWMH12	7.000	SWMH13	326.0	4.631	1.192	0.3508	
360 minute winter	SWMH13	1.006	SWMH18	83.3	1.070	0.204	3.0245	
15 minute summer	SWMH14	8.000	SWMH15	203.1	2.262	0.817	1.2521	
15 minute summer	SWMH15	8.001	SWMH16	199.2	2.224	0.618	1.8189	
360 minute winter	SWMH16	8.002	SWMH17	26.4	0.853	0.123	7.1300	
360 minute winter	SWMH17	8.003	SWMH18	28.4	0.856	0.135	5.5455	
360 minute winter	SWMH18	1.007	TANK02	104.8	1.264	0.194	3.2128	
360 minute winter	TANK02	1.008	SWMH20	428.6	1.201	0.795	2.1419	
480 minute winter	SWMH19	9.000	SWMH20	-10.8	1.346	-0.292	0.1232	
360 minute summer	SWMH20	1.009	SWMH22	13.5	0.078	0.018	2.8558	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 79.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SWMH21	10	80.021	0.196	89.4	0.6775	0.0000	OK
600 minute winter	SWMH22	630	79.917	1.607	119.3	5.5664	0.0000	SURCHARGED
240 minute summer	EXMH01	256	78.251	0.071	17.8	0.1010	0.0000	OK
240 minute summer	EXMH3052	256	77.947	0.067	17.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SWMH21	10.000	SWMH22	89.4	2.645	0.873	0.4365	
600 minute winter	SWMH22	1.010	EXMH01	17.1	1.353	0.047	0.0505	
240 minute summer	EXMH01	1.011	EXMH3052	17.8	1.291	0.071	0.2619	371.1

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 79.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	DC01	312	80.250	0.700	18.3	0.7497	140.1838	FLOOD
15 minute summer	DC02	10	80.800	1.200	161.9	3.6444	4.2196	FLOOD
360 minute winter	SWMH01	288	80.534	1.259	21.7	2.2251	0.0000	SURCHARGED
360 minute winter	PI01	288	80.535	1.295	21.1	2.2885	0.0000	SURCHARGED
360 minute winter	SWMH03	288	80.536	1.346	25.6	3.0155	0.0000	SURCHARGED
360 minute winter	SWMH04	288	80.537	1.417	30.0	2.6179	0.0000	SURCHARGED
360 minute winter	DC03	288	80.540	0.940	2.0	0.4241	0.0000	FLOOD RISK
15 minute summer	DC04	10	81.131	1.531	183.8	4.0123	0.0000	FLOOD RISK
360 minute winter	SWMH07	288	80.540	1.365	23.2	1.9539	0.0000	SURCHARGED
360 minute winter	PI02	288	80.540	1.465	22.8	2.0969	0.0000	SURCHARGED
360 minute winter	SWMH09	288	80.540	1.745	52.2	2.4974	0.0000	SURCHARGED
360 minute winter	SWMH10	288	80.541	1.041	30.8	4.7049	0.0000	SURCHARGED
360 minute winter	TANK01	288	80.541	1.341	109.0	540.2357	0.0000	SURCHARGED
360 minute winter	SWMH11	288	80.541	0.691	4.7	1.2420	0.0000	SURCHARGED
15 minute summer	SWMH12	10	81.324	1.674	443.1	12.5526	0.0000	FLOOD RISK
360 minute winter	SWMH13	288	80.540	1.880	108.0	3.3227	0.0000	SURCHARGED
15 minute summer	SWMH14	10	80.932	0.932	269.4	4.8932	0.0000	SURCHARGED
15 minute summer	SWMH15	11	80.604	0.804	248.4	1.4201	0.0000	SURCHARGED
360 minute winter	SWMH16	288	80.541	1.281	36.0	3.0365	0.0000	SURCHARGED
360 minute winter	SWMH17	288	80.541	1.481	39.5	3.2990	0.0000	SURCHARGED
360 minute winter	SWMH18	288	80.540	2.130	115.3	3.7643	0.0000	SURCHARGED
360 minute winter	TANK02	288	80.540	2.160	118.3	729.8453	0.0000	SURCHARGED
360 minute winter	SWMH19	288	80.542	1.292	10.3	3.1273	0.0000	FLOOD RISK
360 minute winter	SWMH20	288	80.540	2.180	21.8	3.8523	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	DC01	1.000	SWMH01	-17.6	-0.998	-1.174	0.3697	
15 minute summer	DC02	2.000	SWMH01	123.7	3.111	1.224	0.1591	
360 minute winter	SWMH01	1.001	PI01	21.1	0.741	0.150	0.7721	
360 minute winter	PI01	1.002	SWMH03	20.7	0.700	0.154	1.2133	
360 minute winter	SWMH03	1.003	SWMH04	25.2	0.754	0.197	1.8751	
360 minute winter	SWMH04	1.004	SWMH09	29.6	0.775	0.238	7.0590	
360 minute winter	DC03	3.000	SWMH07	2.0	0.610	0.118	0.3873	
15 minute summer	DC04	4.000	SWMH07	172.6	4.341	1.707	0.1591	
360 minute winter	SWMH07	3.001	PI02	22.8	0.963	0.135	1.5442	
360 minute winter	PI02	3.002	SWMH09	22.6	0.948	0.124	1.3236	
360 minute winter	SWMH09	1.005	SWMH13	51.9	0.783	0.271	2.6935	
360 minute winter	SWMH10	5.000	TANK01	30.4	1.057	0.186	0.6618	
360 minute winter	TANK01	5.001	SWMH13	-89.2	0.932	-0.489	0.6618	
360 minute winter	SWMH11	6.000	SWMH13	4.7	1.030	0.196	0.1937	
15 minute summer	SWMH12	7.000	SWMH13	419.7	5.961	1.535	0.3520	
360 minute winter	SWMH13	1.006	SWMH18	88.9	1.057	0.217	3.0245	
15 minute summer	SWMH14	8.000	SWMH15	248.4	2.265	0.999	1.4339	
15 minute summer	SWMH15	8.001	SWMH16	246.2	2.232	0.764	1.9853	
360 minute winter	SWMH16	8.002	SWMH17	34.4	0.858	0.160	7.1300	
360 minute winter	SWMH17	8.003	SWMH18	39.1	0.845	0.185	5.5455	
360 minute winter	SWMH18	1.007	TANK02	112.9	1.366	0.209	3.2128	
360 minute winter	TANK02	1.008	SWMH20	20.0	-0.064	0.037	2.1419	
360 minute winter	SWMH19	9.000	SWMH20	9.8	1.402	0.266	0.1232	
360 minute winter	SWMH20	1.009	SWMH22	21.3	0.061	0.029	2.8558	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 79.69%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	SWMH21	288	80.541	0.716	13.4	2.4751	0.0000	SURCHARGED
360 minute winter	SWMH22	288	80.540	2.230	22.9	7.7248	0.0000	FLOOD RISK
360 minute winter	EXMH01	288	78.258	0.078	22.0	0.1112	0.0000	OK
360 minute winter	EXMH3052	288	77.954	0.074	22.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	SWMH21	10.000	SWMH22	13.4	1.661	0.131	0.5170	
360 minute winter	SWMH22	1.010	EXMH01	22.0	1.421	0.061	0.0621	
360 minute winter	EXMH01	1.011	EXMH3052	22.1	1.385	0.088	0.3026	551.3

APPENDIX E – MANAGEMENT & MAINTENANCE PLAN

PROPOSED DEVELOPMENT, STARWOOD HOUSE, AVENUE ONE, LETCHWORTH

TECHNICAL NOTE

DRAINAGE MAINTENANCE PLAN

DOCUMENT CONTROL SHEET

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1	15/04/2025	First Issue

Burrows Graham Limited has prepared this report in accordance with the instructions of the above-named Client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

1 INTRODUCTION

This document has been prepared to provide a maintenance methodology to the surface water drainage elements proposed for this development. If any discrepancies from manufactures guidance are encountered, the proprietary system guidance should be adopted, refer to enclosed Appendices.

This drainage system's management and maintenance will be the responsibility of Letchworth Investments LLP who will appoint a suitable management company, or pass this document to future occupiers & tenants, with this document used as a reference point for how the drainage maintenance will be implemented. This document will be included in the final O&M File to be compiled on completion of the development and will include details of the As Built drainage, and detailed maintenance document for installed proprietary drainage systems.

The surface water drainage works are composed of the following:

- Linear drainage channels, connecting pipe network, manholes & inspection chambers.
- Geocellular attenuation tanks.
- Permeable Surfacing
- Oil separators.

Refer to drawing 40365-BGL-XX-X-DR-C-0210 for the Proposed Drainage Layout.

Any man-entry into the system and silt removal should be carried out by trained personnel with adequate personal protective equipment. Approved safety procedures must be followed in accordance with the Health and Safety Act.

Long-term management practices include monthly sweeping of external paved areas. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilised during storm events and transported to the drainage system.

During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the filter drains and the upstream/downstream chambers.

2 MAINTENANCE STRATEGY

2.1 INSPECTION, MANHOLE AND CATCHPIT CHAMBERS

Access points have been located at the head of each run, at a change in direction and at a change of pipe size in accordance with Building Regulations Part H.

The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access.

2.2 PIPES

Pipes are proprietary products, and the materials can vary across the site and as such where used the manufacturer's recommendations should be followed. Regardless of the product used, the pipes will be fully compliant with the BGL drainage specification.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance are important to identify areas which may have been obstructed / clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk.

2.3 CHANNELS & GULLIES

Channels and gullies should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Remove manhole and chamber covers to sewers and flow control on network– inspect to ensure water is flowing freely and that the water flow route is unobstructed. Remove debris and silt as required.	Half Yearly Undertake one of these inspections after leaf fall in autumn
Occasional Maintenance	None required	
Remedial Actions	Re-line or replace pipework if unable to clear blockages by jetting.	As required
Monitoring	Inspect chambers for build-up of silt and debris	Half yearly

Table 1 – Operation & maintenance requirements for pipe network, manholes & inspection chambers, drainage channels & gullies.

2.4 ATTENUATION TANKS

Geocellular tanks are modular storage systems made with plastic units. These units can be assembled to achieved re required volume and usually on multiple layers. Generally, the units have 95% of voids content and are used to create an efficient below ground structure to store surface water.

The geocellular units and geotextile are proprietary products and therefore manufacturer's recommendations should also be taken into consideration.

Access for maintenance should be provided by an access shaft located on the tank and from the manhole chambers downstream of the tank.

Regular inspection and maintenance are important for the effective operation of attenuation tanks as designed. As the feature is buried, a regular inspection regime is very important to ensure the correction functionality of the surface water drainage network.

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris form the catchment surface (where it may cause risks to performance).	Monthly.
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockages by sediment, algae or other matter; remove and replace surface infiltration medium as required.	Annually.
	Remove sediments from pre-treatment structures and/or internal forebays.	Annually, or as required.
Remedial Actions	Repair/rehabilitate inlets, outlets, overflows and vents.	As required.
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tank for sediment build-up and remove if necessary.	Every 5 years or as required.

Table 2 – Operation & maintenance requirements for attenuation storage tanks - Based on CIRIA SuDS Manual 2015

2.5 POROUS PAVED AREA

Permeable surfacing enables any water landing on the surface to infiltrate directly to ground at source, thus acting close to a permeable surface.

Regular inspection and maintenance are important for the effective operation of the permeable surfacing to allow it to work efficiently through its design life.

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surfaces from adjacent impermeable areas as this is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the surface.	As required
	Remedial works to any depressions, rutting and cracked considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and/or weed growth. -if required, take remedial action.	Three-monthly, 48 hours after large storms in the first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

Table 3 – Operation & Maintenance requirements for Porous Paved Area – CIRIA SuDS Manual 2015

2.6 PROPRIETARY SURFACE WATER TREATMENT SYSTEMS

These are manufactured products to provide a treatment to the surface water by removing specific pollutant, such as petrol interceptors.

Table 4 sets out the recommended maintenance actions and frequency. Manufacture guidance/recommendations should always be used when available.

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation.	Monthly for 3 months, then annually.
	Change the filter media.	As recommended by manufacturer.
	Remove sediment, oil grease and floatables.	As necessary – indicated by system inspections or immediately following significant spill.
Remedial Actions	Replace malfunctioning parts or structures.	As required.
Monitoring	Inspect for evidence of poor operation.	Biannually
	Inspect filter media and establish appropriate replacement frequencies.	Biannually
	Inspect sediment accumulation rates and establish removal frequencies.	Monthly during first half year of operation, then every six months.

Table 4 – Operation & maintenance requirements for proprietary surface water treatment systems - CIRIA SuDS Manual 2015

APPENDIX F – THAMES WATER SEWER MAPS

