



Higher Standen Drive, Clitheroe

Lancashire County Council

Drainage Strategy & Maintenance Report

Client: Applethwaite Ltd

Our Ref: P26127-DGC-Z1-GF-REP-C-0001-P03

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Table of Contents

1. Introduction

2. Site Conditions and Infiltration Feasibility

3. Flood Risk Overview

4. Drainage Hierarchy and Design Philosophy

- 4.1 Drainage Hierarchy Review
- 4.2 Rainwater Harvesting and Reuse Assessment
- 4.3 Source Control and First 5 mm Interception Strategy
- 4.4 Gravity Led Surface Water Appraisal
- 4.5 Climate Change and Design Standards

5. Hydraulic Design and Surface Water Management

- 5.1 Design Inputs and Catchment Definition
- 5.2 Greenfield Runoff and Flow Control
- 5.3 Attenuation Storage Provision
- 5.4 Conveyance and Watercourse Outfall
- 5.5 Exceedance and Finished Floor Level Strategy
- 5.6 Amenity and Biodiversity
- 5.7 Water Quality Management

6. Foul Water Drainage

7. Construction Phase Surface Water Management

8. Operation and Maintenance Manual

9. Conclusion

Appendices

- A - P26127-DGC-Z1-GF-DR-C-0001-P05 - Drainage Strategy
- B - 26127-Water Quality Design for SuDS - SIA CIRIA C753 Calcs
- C – Extracts of E3P Phase II Geoenvironmental Site Assessment
- D - Higher Standen Drive - Hydraulic Calcs - 05.08.2026

1. Introduction

This report has been prepared by DGC Consulting Engineers in support of the proposed development at Higher Standen Drive, Clitheroe BB7 1RS.

The proposals comprise the construction of 60 no. of low-rise residential dwellings including associated garages, gardens, driveways and site access road.

The site has a total site area of 2.57 ha and is situated at the southwestern end of Higher Standen Drive (centre at grid reference: SD 74679 40663). It is solely comprised of agricultural fields.

The site is bordered to the North by green areas of Public Open Space (POS), to the East by residential development, to the South by agricultural fields and to the West by a tributary of the River Ribble.



Figure 1: Site Location

This report sets out the proposed surface water drainage strategy, foul drainage approach and, associated operation and maintenance principles for the development.

The drainage proposals have been developed in accordance with the following:

- National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG)
- National Standards for Sustainable Drainage Systems (SuDS) 2025
- CIRIA C753 SuDS Manual
- Building Regulations Part H3

These documents together form the basis of the current review framework adopted by the Lead Local Flood Authority (LLFA) who in the case of this site are Lancashire County Council.

The strategy provided within this report has been prepared based on the latest proposed drainage layout and site levels information. Surface water runoff is to be managed through a combination of plot level source control measures and an online attenuation basin. The collected surface water effluent will then be discharged via gravity, at restricted rate, to the adjacent ordinary watercourse.

The drainage strategy has been developed to provide a policy-compliant solution, ensuring that surface water runoff is managed on site without increasing flood risk elsewhere, whilst also delivering water quality, amenity and biodiversity benefits in line with current SuDS requirements.

2. Site Conditions and Infiltration Feasibility

A Phase II Geoenvironmental Site Assessment has been undertaken by E3P (ref: 17-912-R2-1, November 2024) to assess ground conditions, hydrogeology and the feasibility of infiltration-based drainage for the proposed development. The investigation comprised six window sample probeholes (WS101–WS106), eight mechanically excavated trial pits (TP101–TP108) and the construction of four groundwater and ground gas monitoring installations, advanced on 14th October 2024.

Ground Conditions

No Made Ground was encountered at any exploratory location. Topsoil comprising brown sandy CLAY was identified across the site to depths ranging from 0.15 m to 0.35 m below ground level (bgl).

Beneath the topsoil, superficial deposits were encountered at all exploratory locations to a proven depth of 5.45 m bgl, with the base of the superficial deposits not reached in any hole. The superficial deposits generally comprise brown slightly gravelly slightly sandy CLAY with fine to medium angular to subrounded gravel of sandstone and mudstone, becoming more gravelly with depth. Below approximately 1.20 m bgl, deposits are recorded as grey slightly sandy gravelly CLAY, increasing in stiffness with depth.

The drift geology is designated as a Secondary (Undifferentiated) Aquifer (Devensian Till), underlain by a Secondary A Aquifer in the bedrock geology (Clitheroe Limestone Formation and Hodder Mudstone Formation). The site is not located within a groundwater source protection zone, and no groundwater abstractions are recorded within 1 km of the site.

Groundwater

Groundwater strikes and seepages were recorded at the following locations during the investigation:

- WS101: strikes at 1.00 m and 4.00 m bgl within CLAY
- WS102: strike at 1.30 m bgl within CLAY
- TP104: seepage at 1.00 m bgl, perched within CLAY
- TP108: seepage at 1.50 m bgl, perched within CLAY

Subsequent groundwater monitoring (October to November 2024) recorded standing water levels between approximately 1.05 m and 1.64 m bgl across the four monitoring installations (WS101, WS102, WS104 and WS105). E3P note that due to the predominantly low permeability cohesive drift stratum, which is slow to recharge, water levels recorded within the standpipes

may be representative of surface water collecting within the installations rather than a true representation of a continuous groundwater table.

Infiltration Feasibility

The E3P geotechnical assessment confirms that soakaway drainage is unlikely to be suitable due to the presence of low permeability cohesive deposits across the site. This conclusion is recorded explicitly within the Developed Geotechnical Risk Register (Section 5.17 of the E3P report), which identifies low permeability soils as a site-wide constraint affecting 100% of the site area.

Particle size distribution testing on selected samples indicates that the near-surface materials comprise predominantly silt and clay fractions (75–78% fines content at TP105 and TP108), with limited sand and gravel. Atterberg limits testing confirmed the clay soils to be of low plasticity (Plasticity Index 14–21%), with low volume change potential.

The combination of cohesive low permeability superficial deposits, shallow perched groundwater and the absence of any permeable stratum within the investigation depth confirms that infiltration-based drainage is not feasible at this site. These findings are consistent with the published BGS drift geology, which identifies the superficial deposits as Devensian Till.

Notwithstanding this, shallow storage and natural losses may occur locally within permeable paving sub-bases and landscaped areas, providing secondary benefits in terms of runoff interception and water quality. These processes do not form part of the primary drainage strategy.

In accordance with the drainage hierarchy, infiltration has therefore been assessed and discounted on justified technical grounds, with the drainage strategy progressing to the next most sustainable discharge option, as detailed in Section 4.

3. Flood Risk Preview (Summary)

A Flood Risk Assessment (FRA) has been prepared separately by Sutcliffe (Ref: 35161-SUT-ZZ-00-RP-C-0001, Rev D, March 2026) for the proposed development at Higher Standen Drive, Clitheroe.

The FRA confirms that the development site is located entirely within Flood Zone 1 as defined by the Environment Agency, indicating a low probability of flooding from rivers or the sea. The site is not within any flood risk area for surface water, groundwater, reservoir or infrastructure failure, and no emergency access or escape routes are required.

Surface water flood risk can be mitigated through the careful consideration of finished floor levels (proposed at 150mm above existing ground levels) and the implementation of an appropriate SuDS drainage scheme. The development will not increase the risk of flooding off site.

This drainage strategy has been developed to align with the overarching conclusions of the FRA, ensuring that surface water runoff is managed on site in a manner consistent with the findings of the flood risk assessment and the requirements of the NPPF and local planning policy.

EA surface water flood mapping indicates a low risk of surface water flooding within the site boundary, limited to the northern and western extents. This risk is considered manageable through the implementation of an appropriate drainage strategy and careful consideration of finished floor levels.

The EA Flood Map for Planning confirms the site is not within a groundwater flood risk area, and the site topography provides sufficient relief to preclude any significant risk of groundwater emergence.

The Sutcliffe FRA should be read in conjunction with this report in the context of its flood risk assessment and evaluation only. The surface water drainage methodology, design standards and technical approach outlined within the FRA have been superseded by the detailed drainage strategy presented within this report, which represents the primary technical reference for drainage design purposes.

4. Drainage Hierarchy & Design Philosophy

4.1 Drainage Hierarchy Review

A full review of the surface water drainage hierarchy has been undertaken in accordance with Standard 1 of the National Standards for SuDS (2025), alongside current national planning policy and LLFA guidance.

The strategy prioritises the management of runoff at source through the use of multifunctional SuDS, before utilising an online attenuation basin to accommodate flows stored to facilitate the implementation of controlled discharge. This ensures that the most sustainable and practicable drainage solutions are adopted across the development.

The assessment of drainage options for the site is summarised below (continued overleaf):

Priority	Drainage Option	Feasibility	Design Response
1	Rainwater harvesting and reuse	Not viable as a site wide solution due to cost, complexity and long term maintenance requirements for domestic systems	Water butts proposed to larger dwellings (typically 4 bed and above) as a proportionate plot level non potable reuse measure
2	Infiltration to ground	Not feasible based on the Phase II Ground Investigation by E3P (ref: 17-912-R2-1), which confirmed the presence of low permeability cohesive deposits and shallow perched groundwater across the site	Excluded as a primary drainage solution on justified technical grounds
3	Source control and interception	Feasible across the development	Permeable paving to private drives and parking areas to provide interception of the first 5 mm of rainfall at source

Priority	Drainage Option	Feasibility	Design Response
4	Online attenuation basin	Feasible and required to accommodate storage requirement.	Attenuation provided via an online attenuation basin integrated within the drainage network
5	Discharge to ordinary watercourse	Feasible and preferred in line with drainage hierarchy	Controlled discharge via one outfall to adjacent ordinary watercourse, a tributary of the River Ribble
6	Discharge to surface water sewer	Feasible if required as surface water sewer is located south of the site.	Not proposed
7	Discharge to combined sewer	Not likely to be feasible as a combined sewer has not been found to be within close proximity of the site.	Not proposed

The hierarchy review confirms that infiltration has been assessed and discounted on site-specific technical grounds, with the strategy adopting source control and controlled discharge to the receiving watercourse as the most sustainable practicable solution. Full design detail is set out in Section 5.

4.2 Rainwater Harvesting and Reuse Assessment

In accordance with the surface water drainage hierarchy, rainwater harvesting and reuse has been considered as the first stage in the management of runoff.

A site wide rainwater harvesting system has been reviewed, however this has been discounted due to the nature and scale of the proposed residential development. The inclusion of communal or building level reuse systems is not considered proportionate and would introduce additional complexity in terms of installation, operation and long-term maintenance.

Notwithstanding this, opportunities for small scale reuse have been incorporated within the scheme. Water butts are proposed to larger residential plots, typically four-bedroom dwellings and above, to allow for the capture and reuse of roof runoff for non-potable uses such as garden watering.

This approach provides a simple and proportionate source control measure which contributes to runoff reduction and supports the wider SuDS strategy.

Rainwater harvesting has therefore been considered in full and incorporated where practical, in line with current SuDS guidance.

4.3 Source Control and First 5 mm Interception Strategy

Lancashire County Council, as the Lead Local Flood Authority (LLFA), requires that the first 5 mm of rainfall is intercepted at source as a minimum standard for new residential development, in accordance with the National Standards for Sustainable Drainage Systems (2025) and the LLFA's expectations around source control and runoff reduction. This strategy has been designed to demonstrate clear compliance with this requirement.

The drainage strategy adopts a SuDS first approach, with surface water managed at source wherever practicable before entering the wider drainage network, in accordance with Standard 2 of the National Standards for Sustainable Drainage Systems (2025).

Source control is provided across the development through the use of permeable paving within private drives and individual parking spaces. These features are designed to intercept and manage the first 5 mm of rainfall falling directly onto the permeable paved surfaces at plot level. Permeable paving has not been applied to shared private drives. The total permeable paved area across the development is approximately 1,971.77 m², covering all private drives and parking spaces, which represent the predominant impermeable area at plot level.

The permeable paving systems are formed with unlined sub-bases, providing storage capacity for rainfall from frequent and lower intensity events. As confirmed by site investigation (see Section 2), infiltration rates into the underlying cohesive strata are low; however, stored water dissipates gradually over time through a combination of slow percolation into the underlying strata and evapotranspiration losses. Given the low permeability soils confirmed by the E3P Phase II investigation, this dissipation may be slow, but the sub-base storage volume is sufficient to ensure that the retained first 5 mm does not return to the piped network under normal operating conditions. For the majority of rainfall events, the first 5 mm is therefore retained at source and does not contribute to downstream flow.

Roof drainage discharges directly to the formal surface water drainage network as routing it through permeable paving would introduce sediment loading and clogging risk.

Where rainfall exceeds the interception threshold, excess runoff from permeable paved areas is conveyed via the piped surface water drainage network toward downstream attenuation features. These elements are designed to manage runoff from larger storm events only.

Due to practical and ownership constraints, interception of the first 5 mm of rainfall from adoptable highway areas is not considered feasible. Highway runoff is therefore conveyed directly to the piped drainage network via conventional drainage features. Notwithstanding this,

the overall strategy maximises interception across private plots, which represent the majority of impermeable area.

4.4 Gravity Led Surface Water Appraisal

The proposed drainage strategy follows a clear SuDS management train, with surface water managed sequentially from source through to discharge. This approach provides interception, conveyance, attenuation and water quality treatment in accordance with current SuDS guidance.

The proposed SuDS principles are applied consistently across the drainage network.

The treatment and flow path can be summarised as follows (please see overleaf):

Stage	SuDS Component	Function
1	Permeable paving (private drives and parking areas)	Source control, interception of first 5 mm rainfall, initial water quality treatment
2	Conventional drainage network (pipes and chambers)	Conveyance of residual runoff exceeding interception threshold
4	Online attenuation basin	Primary storage, conveyance, water quality polishing and visual integration
5	Flow control (Hydro-Brake® or equivalent)	Restriction of discharge to greenfield equivalent rate
6	Outfall to receiving watercourse	Final discharge to tributary of River Ribble

This treatment train ensures that runoff is managed progressively, with the greatest level of control provided at source, followed by staged management through the drainage network prior to discharge.

4.5 Climate Change and Design Standards

The proposed drainage strategy has been developed to account for the long-term impacts of climate change and urban creep, in accordance with current national guidance and Environment Agency (EA) climate change allowances.

The site is located within the Ribble Management Catchment, where peak rainfall allowances have been applied based on the latest EA guidance. For residential development with a design

life of 100 years, the upper end climate change allowance has been adopted to ensure a precautionary design approach.

In accordance with current guidance, this equates to:

- 40% increase in rainfall intensity for the 1 in 30 yr storm event
- 50% increase in rainfall intensity for the 1 in 100 yr storm event

These allowances reflect the anticipated increase in storm intensity over the lifetime of the development and ensure that the drainage strategy remains resilient under future climate conditions.

In addition, a 10% allowance for urban creep* has been incorporated to account for potential increases in impermeable area over time, including extensions, hardstanding and changes to private plots.

** The 10% urban creep allowance has been applied to dwellings and associated garages only, in accordance with established design principles for residential development and consistent with Lancashire County Council (LCC) LLFA expectations and, has not been applied to highway or other adoptable areas.*

The inclusion of both climate change and urban creep allowances ensures that the proposed drainage strategy provides a future-proof solution, maintaining performance and preventing increased flood risk both on site and elsewhere over the lifetime of the development.

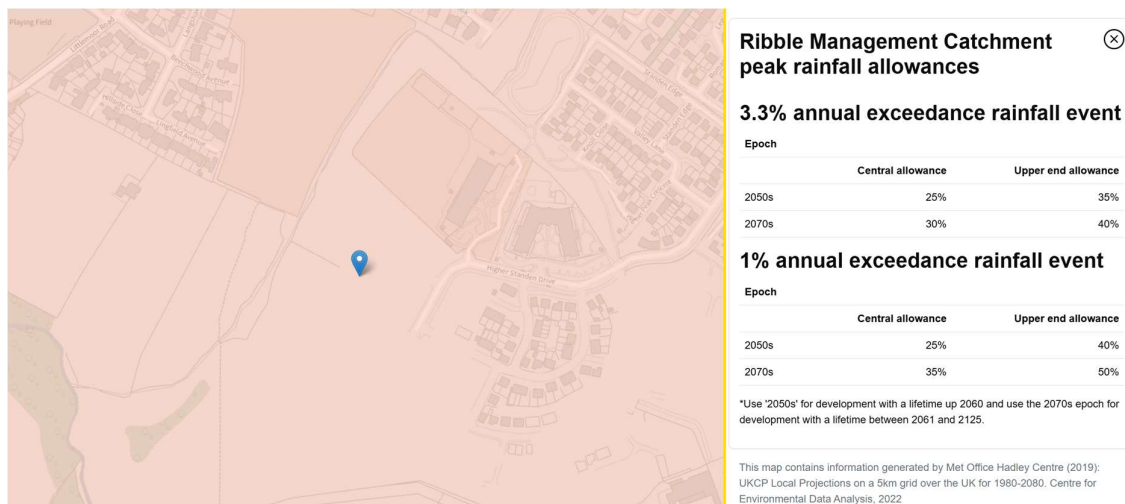


Figure 2: Climate Change Allowances

5. Hydraulic Design and Surface Water Management

5.1 Design Inputs and Catchment

The proposed surface water drainage design has been developed in accordance with the National Standards for Sustainable Drainage Systems (2025) and supporting CIRIA C753 guidance, consistent with the review framework currently applied by the LLFA.

Hydraulic simulations have been undertaken using Site3D, adopting a precautionary runoff methodology based on the defined impermeable contributing areas across the drainage network.

The hydraulic model applies the following conservative input assumptions:

- Volumetric runoff coefficient (C_v) = 1.0 (summer and winter)
- 10% urban creep allowance*
- Critical duration testing across all required design storm events

A volumetric runoff coefficient (C_v) of 1.0 has been applied to all impermeable contributing areas in both summer and winter conditions. This is a conservative assumption that assumes a 100% runoff response with no losses, providing a robust and precautionary basis for storage sizing and network design.

Site3D employs a runoff routing methodology based on contributing impermeable areas and defined invert levels, applying rational method principles and critical duration storm testing to size storage volumes and confirm hydraulic performance across the network. The software does not utilise a separate user-defined MADD (Maximum Allowable Discharge Deviation) factor input; losses are inherently incorporated within its runoff calculation process and therefore no additional reduction in runoff volume has been applied.

The site drains via a single gravity drainage network to its outfall. The contributing impermeable area is summarised as follows:

- Contributing impermeable area: 2.05 ha (including 10% urban creep*)

The network has its own attenuation provision and flow control arrangement prior to discharge to the receiving watercourse.

This catchment approach ensures that runoff is managed efficiently in accordance with the natural fall of the site, allowing attenuation features, comprising an online attenuation basin and treatment features, to be optimised locally within the network.

Full design standards and climate change allowances are set out in Section 4.5. Detailed hydraulic results are presented in Sections 5.2 and 5.3.

Hydraulic modelling confirms that no flooding occurs within the drainage system for all design events up to and including the 1 in 100 yr plus 50% climate change storm. All pipe and chamber levels, storage volumes and flow control settings have been verified through critical duration storm testing, with results presented in Appendix D.

5.2 Greenfield Runoff and Flow Control

Greenfield runoff for the site has been established using the IH124 method, based on the defined site characteristics and the total contributing development catchment areas for the network.

The allowable greenfield discharge rate has been derived based on the contributing catchment area draining to the single site outfall. The QBAR value of 9.38 l/s/ha has been derived using the IH124 method, based on the relevant hydrological descriptors for the site catchment. Full IH124 calculations are included in Appendix D.

It is noted that the total gross site area is 2.57 ha; however, the contributing impermeable catchment area to the outfall is 2.05 ha (including 10% urban creep*). This reflects the exclusion of the online attenuation basin and areas of public open space (POS) from the impermeable runoff calculation, as these areas do not generate meaningful impermeable runoff. QBAR has therefore been applied to the contributing development area only, representing the portion of the site draining to the single outfall, which is considered the appropriate and conservative basis for flow control sizing.

A QBAR value of 9.38 l/s/ha has been applied across the site. Based on the contributing development catchment areas, the greenfield runoff rate has been calculated as follows:

Development Catchment Area	QBAR	Calculated Greenfield Rate	Proposed Discharge Rate
2.05 ha	9.38 l/s/ha	19.229 l/s	18.5 l/s

The proposed discharge rates therefore align with the calculated greenfield QBAR rate with flows restricted prior to discharge to the receiving ordinary watercourse.

Hydraulic modelling confirms that the drainage networks and attenuation features are designed to accommodate all events up to and including the 1 in 100 yr storm event with 50% climate change, with no flooding within the system.

Overall, the proposed drainage strategy restricts discharge to greenfield equivalent rates, provides betterment during extreme rainfall events and ensures that runoff is managed on site without increasing flood risk elsewhere.



Figure 3: Greenfield Runoff

5.3 Attenuation Provision

The proposed surface water drainage strategy incorporates an online attenuation basin and treatment features to manage runoff from the development.

Attenuation has been provided in accordance with the contributing impermeable area and discharge requirements.

Network

Attenuation for the network is based on a contributing impermeable area of 2.05 ha, including a 10% allowance for urban creep*.

Attenuation storage is provided via an online attenuation basin, which accommodates a storage volume of approximately 735 m³, sized to accommodate all storm events up to and including the 1 in 100 yr return period event with 50% climate change, in accordance with current design standards.

Overall Attenuation Strategy

The attenuation strategy has been developed to ensure that runoff from the development is effectively managed on site, with flows attenuated prior to discharge and restricted to the calculated greenfield runoff rate.

The online attenuation basin accommodates the required attenuation volume, whilst providing water treatment within the system.

Hydraulic modelling confirms that the attenuation provision ensures no flooding occurs within the drainage system for all events up to and including the 1 in 100 yr storm event return period with 50% climate change.

This approach provides a deliverable, policy-compliant solution, balancing site constraints with the requirements for effective surface water management, water quality treatment and long-term system resilience.

5.4 Conveyance and Watercourse Outfall

Surface water runoff is conveyed through the development via a gravity-fed drainage network, reflecting the natural east-to-west topography of the site and the proposed layout. The network has been designed to provide efficient and controlled conveyance of runoff from source through to the point of discharge.

Runoff from roof drainage is collected via conventional guttering and downpipes, discharging directly into the piped surface water network. Runoff from permeable paved private drives and parking spaces is collected via the sub-base drainage layer, entering the piped network only once the interception threshold has been exceeded. Highway runoff is intercepted via gully pots located at regular intervals along the adopted road corridors, connecting to the piped drainage network.

The piped network follows the natural topography of the site, with flows directed generally from east to west toward the online attenuation basin located at the western end of the site. The network has been designed with continuous positive gravity falls throughout, ensuring reliable operation without the need for any pumped surface water infrastructure and avoiding localised low points, surcharging or ponding under design conditions.

The attenuation basin acts as the primary storage and control point for the entire site catchment, with all flows passing through the basin prior to restricted discharge to the receiving watercourse.

Runoff from private and adoptable areas is collected via conventional drainage infrastructure, including gullies, pipes and manholes, before being directed toward the downstream attenuation feature. The drainage system has been designed to maintain positive gravity falls throughout, ensuring reliable operation without the need for pumped surface water infrastructure.

Following attenuation, flows are conveyed to the proposed point of connection at the adjacent ordinary watercourse to the West of the site.

Discharge is controlled via a Hydro-Brake® flow control device located downstream of the attenuation feature, ensuring that runoff is restricted to the calculated greenfield runoff rate prior to entering the receiving watercourse.

The outfall is formed as a headwall structure, providing a stable interface between the drainage network and the receiving watercourse. These structures are designed to prevent erosion, control flow conditions and ensure long term operational performance.

The receiving watercourses has been identified as the most appropriate discharge point in accordance with the drainage hierarchy, representing the highest practicable tier following the demonstrated infeasibility of infiltration.

All outfalls will be subject to the relevant land drainage consents and approvals from the LLFA and associated regulatory bodies. Detailed outfall design, including headwall specification and erosion protection measures, will be confirmed at the detailed design stage.

This approach ensures that surface water runoff is conveyed efficiently through the site and discharged in a controlled manner, without increasing flood risk elsewhere, in accordance with current policy and SuDS guidance.

5.5 Exceedance and Overland Flow

The surface water drainage strategy has been developed to ensure that all runoff from events up to and including the 1 in 100 yr storm event return period with 50% climate change is contained within the drainage system, with no flooding predicted.

For events exceeding the design capacity of the system, exceedance flows have been considered and managed through the proposed site layout and levels strategy.

The site levels have been designed to direct exceedance flows away from built development and toward designated low points within the site, including road corridors and landscaped areas. These routes provide safe overland flow pathways, ensuring that any excess water is conveyed without risk to property.

Finished floor levels are set above surrounding ground levels, providing an appropriate freeboard and ensuring that properties remain protected during extreme rainfall events.

Exceedance flows follow the natural topography of the site, ultimately routing toward the downstream attenuation feature and receiving ordinary watercourse. This ensures continuity of flow paths and avoids uncontrolled ponding within developed areas.

The proposed approach ensures that:

- no flooding occurs for all events up to and including the 1 in 100 yr plus 50% climate change storm event
- exceedance flows are safely managed on the surface for more extreme events
- runoff is directed away from properties and critical infrastructure
- flow routes remain consistent with the overall drainage strategy

This provides a resilient drainage design, ensuring that flood risk is appropriately managed both within the site and for the surrounding area.

5.6 SuDS Integration, Amenity and Biodiversity

The proposed drainage strategy has been developed to provide a multifunctional SuDS solution that delivers not only attenuation and runoff control, but also wider water quality, amenity and biodiversity benefits in accordance with CIRIA C753 and current LLFA requirements.

Source control is provided through permeable paving to private drives and parking areas, intercepting and treating runoff at plot level as described in Section 4.3.

At site control level, the online attenuation basin and shallow SuDS treatment features (see Section 5.3) integrate with the wider landscape strategy through shallow side slopes, accessible maintenance margins and opportunities for marginal planting and native landscaping, contributing positively to visual amenity, habitat creation and biodiversity.

Rainwater harvesting has been assessed and addressed in Section 4.2.

The proposed SuDS measures and wider multifunctional benefits are summarised overleaf.

SuDS Compliance and Multifunctional Benefits

SuDS Requirement	Design Response	Compliance
Runoff destination hierarchy	Infiltration ruled out by E3P Phase II Ground Investigation — low permeability Devensian Till confirmed across the full investigation depth. Controlled discharge to adjacent ordinary watercourse.	✓ Compliant
First 5 mm interception	Plot level interception via permeable paving to private hardstanding areas	✓ Compliant
Peak flow control	Restricted to 19.0 l/s via a Hydro-Brake® flow control device	✓ Compliant
Volume control	Attenuation provided via an online attenuation basin with supplementary SuDS attenuation and treatment features	✓ Compliant
Water quality	Treatment train via permeable paving, conveyance network, SuDS features and controlled discharge	✓ Compliant
Amenity	SuDS features integrated within landscaped areas with accessible and visually positive design	✓ Compliant
Biodiversity	Opportunity for native planting and habitat creation within SuDS feature margins	✓ Compliant
Water reuse	Formal harvesting not proportionate, water butts can be incorporated to larger dwellings where appropriate	✓ Compliant

5.7 Water Quality Management

A water quality assessment has been undertaken in accordance with the Simple Index Approach (SIA) set out in CIRIA C753. The site is classified as Low pollution hazard land use (residential roofs and low-traffic driveways/access roads), with the treatment train comprising an online attenuation basin as the primary SuDS component and pervious paving as the secondary component. The SIA confirms that all total mitigation indices meet or exceed the required pollution hazard indices for TSS, metals and hydrocarbons, demonstrating sufficient water quality mitigation. The full SIA calculations are included in Appendix b.

6. Foul Water Drainage

The proposed foul water drainage strategy has been developed in accordance with current standards and in consultation with the statutory undertaker.

Foul flows from the development will be collected via a conventional gravity drainage network serving the proposed dwellings. Due to site levels and the location of the receiving public sewer, a fully gravity discharge is not achievable across the site.

A foul pumping station is therefore proposed to serve the development. The system will operate as follows:

- Foul flows are conveyed via gravity to a central pumping station
- The pumping station will comprise duty and standby pumps to ensure operational resilience
- Flows will be pumped via a rising main to a downstream connection point
- Discharge will then continue via gravity to the existing public foul sewer

The final connection to the public sewer will be made via a Section 106 agreement with the statutory undertaker.

The pumping station will be designed in accordance with current industry standards and will include appropriate emergency storage capacity to accommodate flows in the event of pump failure. Ancillary infrastructure such as non-return valves, isolation valves and air release valves will be incorporated as required.

At this stage, the foul drainage strategy is considered feasible based on the available information. Detailed design, including confirmation of pipe levels, pumping station specification and connection details, will be undertaken at the detailed design stage in agreement with the statutory undertaker.

This approach ensures that foul flows from the development are managed effectively and discharged to the public sewer network in a safe and controlled manner.

7. Construction Phase Surface Water Management

Surface water management during the construction phase will be undertaken in accordance with best practice and will form part of the Construction Environmental Management Plan.

The objective during construction is to ensure that surface water runoff is managed in a controlled manner, preventing sediment laden flows, debris and pollutants from entering the receiving watercourses or existing drainage infrastructure.

During the construction phase, the drainage strategy will be implemented in a staged manner, with temporary measures introduced early in the programme to manage runoff prior to completion of the permanent system.

The following principles will be adopted:

- Minimisation of runoff generation
Construction activities will be phased where practicable to limit exposed areas and reduce runoff volumes.
- Temporary surface water management
Temporary drainage measures, including cut off ditches, swales and settlement areas, will be utilised to intercept and control runoff.
- Sediment control
Silt fences, straw bales or equivalent measures will be installed where required to prevent migration of suspended solids.
- Protection of watercourses
Measures will be implemented to ensure that no direct discharge of untreated runoff enters the adjacent ditch or Fine Janes Brook.
- Pollution prevention
Storage of fuels, oils and chemicals will be undertaken in designated areas with appropriate containment to prevent accidental spillage.
- Wheel washing and site access control
Where required, wheel washing facilities will be provided to reduce tracking of sediment onto the public highway.

Temporary drainage measures will be regularly inspected and maintained throughout the construction period to ensure their continued effectiveness.

The detailed construction phase surface water management strategy will be developed by the appointed contractor and agreed with the relevant stakeholders prior to commencement of works.

This approach ensures that surface water runoff is appropriately managed during construction, minimising environmental impact and preventing increased flood risk both on site and downstream.

8. Operation and Maintenance Manual

A long-term maintenance regime will be implemented for all private, shared and adoptable drainage features to ensure the continued hydraulic, environmental and operational performance of the proposed drainage infrastructure for the lifetime of the development.

The proposed drainage system includes plot level source control features, surface water and foul sewer networks, site control SuDS infrastructure and an online attenuation basin. Each element will require routine inspection and maintenance to preserve hydraulic performance, water quality treatment, amenity value and biodiversity function.

The responsibilities identified below reflect the current anticipated adoption strategy. Final ownership and maintenance responsibilities will be confirmed at detailed design stage through agreement with the relevant adopting authority, highway authority, management company and, where applicable, any NAV provider.

All maintenance activities should be undertaken in accordance with CIRIA C753 The SuDS Manual to ensure long term performance of the drainage system. See below and continued overleaf, the associated maintenance schedule.

Maintenance Schedule

Drainage Asset	Maintenance Activity	Frequency	Responsibility
Permeable paving to private drives	Inspect for clogging, debris, ponding and surface wear. Sweep or vacuum clean to maintain permeability	Twice yearly and after severe storms	Private homeowner / management company
Water butts, where provided	Inspect outlets, overflows and condition, remove debris and confirm operation	Twice yearly	Private homeowner
Surface water sewer network	Inspect manholes and pipework, remove blockages, CCTV where required	Annually and after severe storms	Relevant adopting authority / management company
Highway gullies	Gully cleansing, silt removal and outlet checks	Every 6 months and after severe storms	Highway authority / adopting authority

Drainage Asset	Maintenance Activity	Frequency	Responsibility
Hydro-Brake® flow control chamber	Inspect control unit, remove debris and confirm operation	Annually and after severe storms	Relevant adopting authority / management company
Shallow SuDS attenuation and treatment features	Inspect inlets and outlets, remove silt, manage vegetation, maintain side slopes and confirm freeboard	Quarterly and after severe storms	Relevant adopting authority / management company
Outfall to watercourses	Inspect for blockage, scour and structural condition	Every 6 months and after severe storms	Relevant adopting authority / management company
Online attenuation basin	Inspect basin inlet and outlet structures, remove silt and debris, manage vegetation, maintain side slopes and confirm freeboard. Check flow control device operation.	Annually	Management company / adopting authority
Foul sewer network	Routine inspection and blockage clearance	Annually and as required	Relevant sewerage undertaker / NAV
Foul connection chamber	Inspect structure and flow conditions	Annually	Relevant sewerage undertaker / NAV

The above maintenance regime ensures that the hydraulic, water quality, amenity and biodiversity performance of the drainage system is retained for the long term, whilst providing a clear and practical framework for future adoption and site management.

Overall, the proposed maintenance strategy is considered proportionate, maintainable and aligned with current LLFA expectations.

9. Conclusion

The proposed surface water and foul water drainage strategy for the residential development at Higher Standen Drive, Clitheroe has been developed as a sustainable, site-specific and policy-compliant solution in support of the planning submission.

Ground conditions and infiltration feasibility have been assessed by E3P as part of the Phase II Geoenvironmental Site Assessment (ref: 17-912-R2-1, November 2024), which confirmed that infiltration-based drainage is not feasible due to the prevailing low permeability Devensian Till deposits and shallow perched groundwater conditions (see Section 2). The strategy therefore follows the drainage hierarchy by maximising source control and attenuation prior to controlled discharge.

Plot level interception of the first 5 mm of rainfall is provided through permeable paving to private drives and water butts to larger dwellings, as described in Sections 4.2 and 4.3.

The development is drained via a single surface water network operating under gravity and discharging to the receiving watercourse.

Residual runoff is attenuated via an online attenuation basin and shallow SuDS treatment features, accommodating all storm events up to and including the 1 in 100 yr plus 50% climate change return period, with discharge restricted to 18.5 l/s via a Hydro-Brake® flow control device (see Sections 5.2 and 5.3).

Water quality is addressed through the SuDS treatment train, which has been assessed in accordance with the CIRIA C753 SIA and shown to meet the required mitigation indices for all pollutant categories (see Section 5.7). The SuDS features also provide amenity and biodiversity benefits in line with current policy.

Construction phase surface water management will be addressed through a Construction Environmental Management Plan (see Section 7).

A long-term maintenance strategy aligned with CIRIA C753 has been prepared covering all drainage assets (see Section 8).

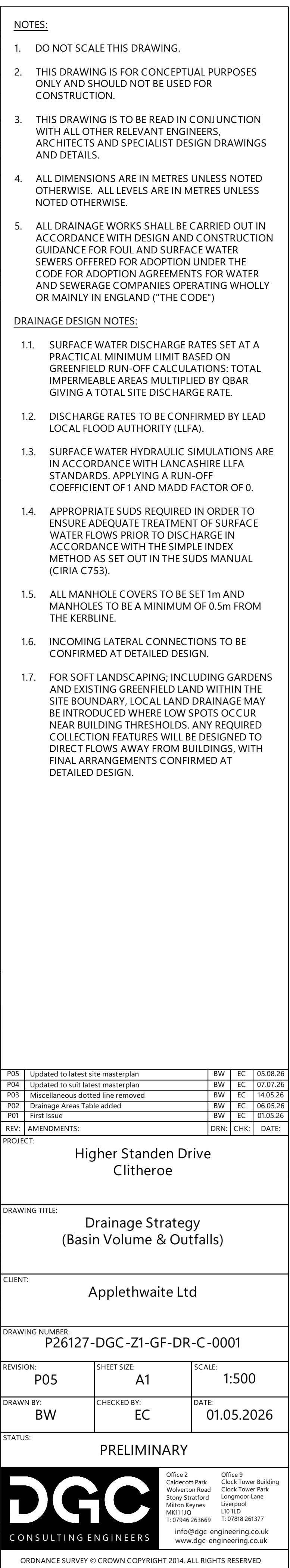
The proposed drainage strategy demonstrates compliance with:

- NPPF
- PPG
- Building Regulations Part H

- CIRIA SuDS Manual C753
- Design and Construction Guidance
- National Standards for Sustainable Drainage Systems (2025)
- LLFA drainage requirements
- Plot level first 5 mm interception principles
- 1 in 100 yr plus climate change design criteria
- SIA water quality requirements
- Long term operation and maintenance principles

Overall, the proposed development can be drained in a sustainable, maintainable and policy compliant manner without increasing flood risk on site or elsewhere and is therefore considered suitable for support by the Local Planning Authority and LLFA.

Appendix A) P26127-DGC-Z1-GF-DR-C-0001-P05 - Drainage Strategy



Appendix B) 26127-Water Quality Design for SuDS - SIA CIRIA C753 Calcs

Water Quality Design for SuDS - Simple Index Approach - SuDS Manual 2015 - CIRIA C753

Project: Higher Standen Drive, Clitheroe
Section: _____

Project No: 26127
Date: 05/05/2026
Sheet No: 1 of 1

Produced by: BW Checked by: EC

Key:

DROP DOWN LIST
 USER ENTRY
 AUTOMATICALLY CALCULATED

PLEASE NOTE!

This tool must be read in conjunction with Chapter 4 and Chapter 26 of the SuDS Manual as other key criteria, parameters and design conditions apply.

STEP 1: Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme

- If the land use varies across the 'runoff area', either:
 - use the land use type with the highest Pollution Hazard Index
 - apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.
- If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

Runoff Area Land Use Description		Pollution Hazard Indices			
		Total Suspended Solids	Metals	Hydrocarbons	
Select land use type from the drop down list (or 'Other' if none applicable):	Residential parking	Low	0.5	0.4	0.4
User Defined Indices					
Landuse Pollution Hazard Index		Low	0.5	0.4	0.4

STEP 2A: Determine the Pollution Mitigation Index for the proposed SuDS components

- This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component
- If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B
- This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components. This will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design.

SuDS Component Description		Pollution Mitigation Indices			
		Total Suspended Solids	Metals	Hydrocarbons	
Select SuDS Component 1 (i.e. the u/s component)	Detention basin	0.5	0.5	0.6	
Select SuDS Component 2	Pervious pavement (where the pavement is not designed as an infiltration component)	0.7	0.6	0.7	
Select SuDS Component 3	None				
If the proposed SuDS components are bespoke/proprietary select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:					
Aggregated Surface Water Pollution Mitigation Index		0.85	0.8	0.95	

STEP 2B: Determine the Pollution Mitigation Index for the proposed Groundwater Protection

- This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater
- This step should be applied where a SuDS component is allows any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design.
- Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

SuDS Component Description		Pollution Mitigation Indices			
		Total Suspended Solids	Metals	Hydrocarbons	
Select type of groundwater protection from the drop down list:	None				
If the proposed groundwater protection is bespoke/proprietary select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:					
Groundwater Protection Pollution Mitigation Index		0	0	0	

STEP 2C: Determine the Combined Pollution Mitigation Indices for the Runoff Area

- This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

Combined Pollution Mitigation Indices				
Total Suspended Solids	Metals	Hydrocarbons		
Combined Pollution Mitigation Indices for the Runoff Area	0.85	0.8	0.95	

STEP 2D: Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

- This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type
- When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.
- In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1.

Sufficiency of Pollution Mitigation Indices			
Total Suspended Solids	Metals	Hydrocarbons	
Sufficient	Sufficient	Sufficient	

Appendix C) Extracts of E3P Phase II Geoenvironmental Site Assessment

Phase II Geoenvironmental Site Assessment

Site: Higher Standen Drive, Clitheroe

Reference: 17-912-R2-1

Date: November 24





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QUALITY ASSURANCE

Report reference

17-912-R1 – Interim Report

REV REF:	DESCRIPTION	AUTHOR	CHECKED	AUTHORISED	DATE
R1-1	First issue	GC	KK	AS	30/11/24

This report has been prepared for the sole benefit, use, and information of the client. The liability of Environmental Engineering Partnership Limited T/A E3P with respect to the information contained in the report will not extend to any third party. This report has been prepared by the qualified persons as listed below.

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AUTHORISED BY	QUALIFICATIONS	POSITION
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EXECUTIVE SUMMARY

Site Address	Higher Standen Drive, Standen, Clitheroe BB7 1FT.
Grid Reference	N 374676 E 440681
Site Area	2.57 Ha
Proposed Development	The Trustees of the Standen Estate intend to construct a low-rise residential development comprising 68 dwellings with associated gardens, estate roads and infrastructure.
Current Site Use	The site is an irregularly shaped parcel of land located to the south east of Clitheroe, with access available from Higher Standen Drive, on the eastern boundary of the site. Currently the site comprises an open field, with trees present at the western boundary, alongside a tributary of the Pendleton brook. There is also a single tree located close to the centre of the field. There are no structures or stone wall located within the site. The site is located on a slight slope, with a fall of approximately 8 meters from the north east corner towards the western boundary of the site.
Site History	An examination of the relevant Ordnance Survey maps shows that the site has remain undeveloped agricultural fields since the earliest available mapping. The only minor changes relating to field boundaries. There is no evidence of structures on the site being present at any point in the recorded site history.

ENVIRONMENTAL SETTING

Geology	Drift Geology	Till (Devensian)
	Bedrock Geology	Clitheroe Limestone Formation and Hodder Mudstone Formation.
	Faults	The nearest geological fault is located 174m to the north west of the site, trending north west to south east, with a downthrow to the south west.
Geomorphology	A review of relevant records indicates that the site has not been subject to significant anthropogenic changes with the current site topography broadly representing natural landform.	
Hydrogeology	A Secondary (undifferentiated) Aquifer has been recorded on site in the drift geology with a Secondary A Aquifer in the bedrock geology.	
	The Groundsure report indicates that the site is not located within a groundwater source protection zone. Furthermore, there are no groundwater/potable abstractions within 1 km of the site.	
Hydrology	The nearest surface water feature is a tributary of the Pendleton Brook, located on the Western boundary of the site.	
	Due to the local topography, it is likely that any shallow groundwater, if present, will flow in a south westerly direction towards the Pendleton Brook tributary. The site is located within Flood Zone 1 - no risk of flooding	



Utility Locations	An 11 kV cable is present along the northwestern boundary of the site. There are no other below ground utilities at the site.
Landfill Sites and Waste Sites	There are no active or historic landfills within 250 m of the site.
Radon	Radon Class 1 - less than 1% of homes are estimated to be at or above the Action Level. No radon protection measures required.
Unexploded Ordnance	Low risk UXO area – no further assessment required.
PFAS	No potential current or historical sources of PFAS have been identified on site. No further risk assessment required.
Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction of the development have been identified within influencing distance of the subject site.
Previous Reports	The following previous report has been completed for the site: Phase I Geoenvironmental Site Assessment, Higher Standen Drive (ref: 17912-R1-1), September 2024. The key findings are summarised in Section 1.5 and where necessary, data has been used to support the geoenvironmental assessment.

E3P GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising: 6 x window sample probeholes; 8 x mechanically excavated trial pits; and - Construction of 4 No. environmental monitoring installations.
Ground Conditions	Made Ground No Made Ground was encountered during the investigation. Topsoil – 0.00 m bgl to 0.35 m bgl Topsoil was encountered within all exploratory hole locations to depths ranging from 0.15 m to 0.35 m bgl. The topsoil comprised brown sandy CLAY, without significant anthropogenic inclusions. Superficial – 0.15 m bgl to >5.45 m bgl Superficial deposits were encountered within all exploratory locations to a proven depth of 5.45 m bgl. The base of the superficial deposits was not encountered in any of the exploratory locations. Superficial deposits generally comprise brown slightly gravelly slightly sandy CLAY with fine to medium, angular to subrounded gravel of sandstone and mudstone. These deposits gradually become more gravelly with depth. Underlying these deposits at approximately 1.20 m bgl, the deposits are recorded as grey slightly sandy gravelly CLAY which increases in stiffness with depth. Solid Geology Solid geology was not encountered during the ground investigation.



Groundwater

Limited groundwater was encountered during the intrusive investigation. Groundwater strikes were encountered in WS101 and WS102 at 1.00 m and 4.00 m bgl and 1.00 m bgl, respectively. Seepages were encountered at 1.00 m and 1.50 m bgl in TP104 and TP108, respectively.

CONTAMINATED LAND ASSESSMENT

Initial Conceptual Site Model	There has been very little historical activity on site and therefore the likelihood of potentially contaminated soils is considered to be low.
Human Health	No elevated concentrations of potential contaminants of concern have been identified when compared with Tier 2 GACs for a residential end use (with plant uptake). Asbestos was not identified in any of the eleven samples submitted for analysis. Based on the above there is no unacceptable level of risk to human health for future end users and construction workers. Preliminary chemical analysis has confirmed the topsoil, and subsoil is likely to be suitable for re-use within any landscaped areas; however further chemical analysis in accordance with an agreed testing frequency will be required to confirm this prior to placement in any landscaped areas.
Controlled Waters	The site is considered to pose a low risk to controlled waters.
Ground Gas	Ground gas monitoring indicates the site falls into a classification Characteristic Situation 1; as such gas protection measures are not required. It should be noted that at this stage gas monitoring at the site remains ongoing.
Potable Infrastructure	Water A UKWIR Risk Assessment will be required to confirm the most suitable potable water supply pipework. Chemical analysis suggests that PE pipe is likely to be suitable.

GEOTECHNICAL ASSESSMENT

Underground Obstructions & Subterranean Hazards	Obstructions have not been identified to date and significant obstructions are not anticipated.
Allowable Capacity	Bearing Generally, the underlying cohesive deposits are to be firm, medium strength, with a net Allowable Bearing Capacity (ABC) of in excess of 80kN/m ² at an approximate depth of 1 meter below ground level (bgl). The ABC typically increases with depth.



Foundation Options	The suitable target founding stratum has been identified as the underlying stiff to very stiff CLAY. Following this assessment, it is recommended that shallow strip foundations, bearing upon the stiff to very stiff CLAY, is the most cost-effective solution. A deeper foundation solution will be required in any areas where soft to firm clays are recorded (such as WS105). The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural engineer.
Foundations Near Trees	Foundation depths within the conjectured influence of former, existing or proposed trees will need to be deepened to ensure that structural loading bears within the underlying target founding stratum, which cannot be subject to volumetric instability associated with fluctuation in moisture content.
Heave Precautions Near Trees	Given that the underlying clay is of low volume change potential, heave precautions will not be required to the internal face of a foundation less than 1.5 m in depth. Heave precautions will be required to the underside of floor slabs (where there is no 200 mm void) and pile ground beams are required within the modelled influencing distance of trees.
Building Floor Slabs	A ground bearing slab will be viable for the residential buildings, but it will need to be constructed on a granular sub-base with the thickness designed by a structural engineer to ensure that settlement tolerances are taken into consideration.
Soakaway Drainage	Soakaway drainage is unlikely to be suitable due to the presence of low permeability cohesive deposits across the site.
Sulphate Assessment	Concrete classification of DS-1, AC-1s applicable across the site.
Highway Infrastructure Construction &	Where a proposed highway or infrastructure is to be constructed, remediation works will be required to ensure the site is engineered to a suitable geotechnical design specification.
CBR Design %	Natural clay soils will provide a CBR in the order of 2–4% during drier climatic periods. However, if water is allowed to shed onto the formation, the CBR will reduce to < 2%, which will require specialist engineering of the subgrade.
Enabling Earthworks	Development levels are unlikely to change significantly; however, an element of cut-and-fill works will likely be required to prepare the development platform. As part of the earthworks design, materials should be assessed and characterised prior to re-use in the construction of upfill to a geotechnical design. All future earthworks should be completed in accordance with a Geotechnical Design Report (GDR) that will consider the ground model within the context of the potential for settlement induced by surcharge from earthworks, dynamic and permanent loading of the development and all known hazards.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: <i>Waste Classification – Guidance on the classification and assessment of waste</i>. This can be done upon request and in line with the Environment Agency sampling frequencies.



2.5. STORAGE, PRESERVATION AND TRANSPORT OF SAMPLES

Measures taken to ensure the quality and integrity of the collected samples, from collection to receipt of the samples by the laboratory, are summarised in Table 5.

Table 5 Sample Integrity Information

SUBJECT	CHEMICAL SAMPLING	
	Soil	Groundwater
Storage	Glass jars supplied by the laboratory were used for the collection of soil samples to be analysed for VOCs. Plastic tubs were used to collect soil samples for metals analysis, and asbestos screening.	Glass vials supplied by the laboratory were used for the collection of samples to be analysed for VOCs. Samples to be analysed for lower volatility compounds were stored in laboratory-prepared glass jars.
Preservation	Soil and groundwater sample containers were filled to minimise headspace prior to sealing and stored at a low temperature within cool boxes with cooling aids to minimise the loss of volatile contaminants and reduce microbial activity during the collection of samples.	
	Soil	Groundwater
Sample Integrity	Dedicated disposable nitrile gloves were worn and changed between sample collections to prevent cross-contamination.	Groundwater samples were collected using dedicated plastic tubing, which was changed between monitoring well locations to prevent cross-contamination.
Transport	Samples were stored and shipped in dedicated sample boxes provided by the laboratory. Sample details were recorded on the laboratory chain of custody form enclosed with the samples prior to dispatch. Scheduling information for the samples was confirmed with the laboratory via email.	

Chemical analysis has been undertaken by an accredited laboratory with the testing results summarised and discussed in Section 4 and the testing certificates included in APPENDIX VII.

Geotechnical samples were collected as required per location immediately after excavation, labelled and sealed to minimise moisture loss. The geotechnical samples were collected and couriered by a dedicated courier to an accredited geotechnical testing laboratory.

The testing results are summarised and discussed in Section 5 and the testing certificates included in Appendix VIII.



3. GROUND AND GROUNDWATER CONDITIONS

3.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 6.

Table 6 Summary of Strata

HOLE	DEPTH TO STRATUM (M BGL)			
	TOPSOIL	SANDY CLAY	GRAVELLY CLAY	GRAVELLY SANDY CLAY
TP101	0.00 – 0.20	-	-	0.20 – 2.20
TP102	0.00 – 0.30	-	1.20 – 2.30	0.30 – 1.20
TP103	0.00 – 0.25	-	-	0.25 – 2.20
TP104	0.00 – 0.20	-	-	0.20 – 2.30
TP105	0.00 – 0.35	-	-	0.35 – 2.00
TP106	0.00 – 0.25	-	-	0.25 – 2.00
TP107	0.00 – 0.15	-	-	0.15 – 2.15
TP108	0.00 – 0.20	0.20 – 1.20	-	1.20- 2.30
WS101	0.00 – 0.25	3.00 – 5.45	-	0.25 – 3.00
WS102	0.00 – 0.25	0.25 – 4.43	-	-
WS103	0.00 – 0.20	0.20 – 1.40	-	1.40 – 4.40
WS104	0.00 – 0.30	0.30 – 2.10	-	2.10 – 2.40
WS105	0.00 – 0.30	0.30 – 1.00	-	1.00 – 2.00
WS106	0.00 – 0.25	0.25 – 2.00	-	2.00 – 4.00

3.2. MADE GROUND

Made Ground was not encountered in any of the exploratory hole locations

3.3. TOPSOIL

Topsoil was encountered within all exploratory hole locations to depths ranging from 0.15 m to 0.35 m bgl. The topsoil comprised brown sandy CLAY, without significant anthropogenic inclusions.

A Depth of Topsoil Plan is presented as Drawing 17-752-008 in APPENDIX IV.



5.4. SOIL PLASTICITY

The Atterberg limits determinations, summarised in Table 23, show the clay to be of low plasticity.

Table 23 Summary of Plasticity Index Test results

LOCATION	DEPTH (m)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 MM SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS101	1.00 – 1.45	15.2	13	34	21	86	18.06	Low
WS102	2.00 – 2.45	26	18	32	14	99	13.86	Low
WS106	1.00 – 1.45	14	13	30	17	90	15.3	Low

The results of the Atterberg limits testing confirmed that the soils would be deemed to be “Low Volume Change Potential” in accordance with the classification system utilised by the LABC/NHBC industry guidance.

5.5. PH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in APPENDIX VII (summarised in Table 24), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1 in accordance with BRE *Special Digest 1* (2005).

Table 24 Summary of pH and Sulphate Data

LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	PH VALUE	CLASSIFICATION
TP101	0.1	< 0.010	7.6	DS-1, AC-1s
TP101	1.2	0.060	8.5	DS-1, AC-1s
TP102	0.5	< 0.010	7.4	DS-1, AC-1s
TP105	0.1	< 0.010	7.2	DS-1, AC-1s
TP105	0.6	0.031	7.1	DS-1, AC-1s
TP106	1.5	< 0.010	8.2	DS-1, AC-1s
WS102	0.1	< 0.010	6.5	DS-1, AC-1s
WS105	0.1	0.044	6.4	DS-1, AC-1s
WS105	0.5	< 0.010	7.0	DS-1, AC-1s

5.5.1. HIGHWAYS AND CONCRETE

MCHW Series 600 provides a criteria of 1500mg/l for water-soluble sulphate within 500mm of any concrete structure.

A second criteria of 300 mg/l is given with respect to soils within 500mm of steel structures.



5.8. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the safe allowable bearing capacity (ABC) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 26.

Table 26 Summary of ABC

COHESIVE SOILS			
Description	Depth (range m bgl)	Undrained Shear Strength (Cu) (kN/m ²)	Allowable Bearing Capacity (kN/m ²)
Firm CLAY	1.00–2.00	30.24	62.18
Stiff CLAY	1.00–2.00	40.33–82.22	82.91–169.04
Stiff gravelly CLAY.	2.00–4.00	59.38–211.21	122.09–434.25
Very stiff sandy CLAY.	2.00–5.00	77.65–228.38	159.65–469.56

Firm sandy CLAY was encountered between 1.00 – 2.00 m bgl in WS105 with an ABC of 62.18 kN/m², which would not be a suitable founding stratum and foundations in this location should be taken to the underlying stiff CLAY.

Elsewhere, the site is underlain by stiff to very stiff CLAY from depths of 1.00 m to 5.00 m bgl with an ABC of 82.91 – 469.56 kN/m². This is considered to be an appropriate founding stratum, and as such, it is anticipated that for the majority of the site the foundations will be taken to ~1.00 m bgl.

5.9. FOUNDATIONS OPTIONS APPRAISAL

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe allowable bearing capacity, the following recommendations have been developed for the site of the potential foundation solutions that may be adopted for the future residential development. The suitable target founding stratum has been identified as the underlying stiff to very stiff CLAY.

Following this assessment, it is recommended that strip foundations, bearing upon the stiff to very stiff CLAY at depth of >1.00m bgl is the most cost-effective solution.

The final foundation solution will be dependent on the structural loadings, elevation and should be designed by a suitably qualified structural.

5.10. GROUND FLOOR SLABS

Current building control regulations require that where infilled ground is present to depths in excess of 600 mm, or where the substratum is variable in terms of the structure and settlement potential, or where clay soils are present within the influence of existing or proposed trees, a suspended floor slab is required.

In this instance, it is considered that for the substructures in the areas of site investigated, the underlying stratum would have less than 600 mm of infill and, as such, a suspended floor slab may not be required.



5.18. FURTHER WORKS

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

- Foundations to be designed by suitably qualified Structural Engineer.
- Geotechnical Earthworks Specification
- Enabling Works Strategy.

END OF REPORT

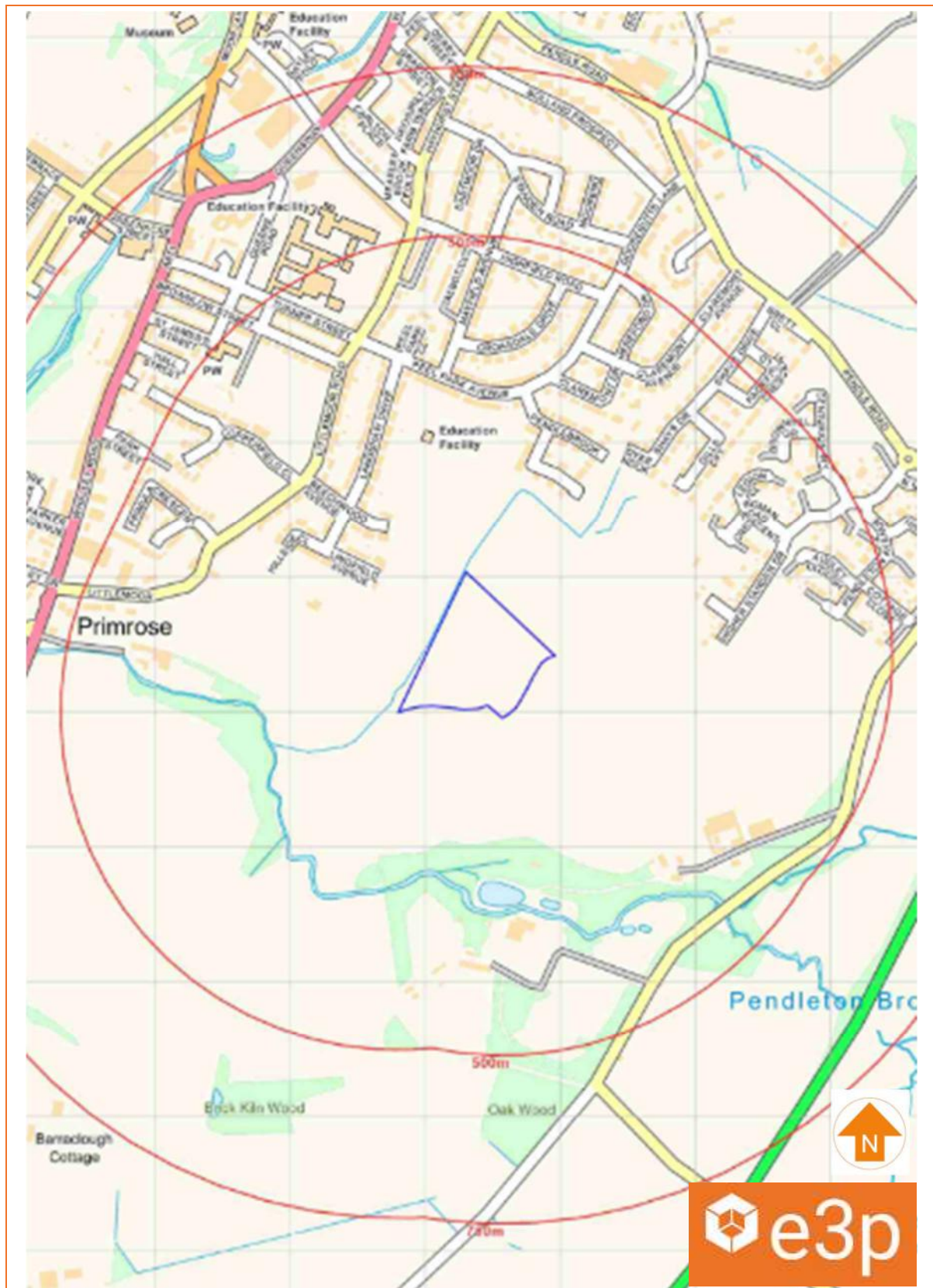
APPENDIX IV

DRAWINGS





DRAWING 17-912-001 – Site Location Plan



Appendix D) Higher Standen Drive - Hydraulic Calcs - 08.05.2026

Network Details

Manhole Schedule

Manhole	Catchment Area (ha)	Size (mm)	Type	CL (m)	IL (m)	Depth To Soffit (m)	Easting (m)	Northing (m)
S1	0.122	1350	Type C	101.115	99.690	1.200	374758.456	440662.750
S2	0.111	1350	Type C	100.166	98.738	1.203	374741.900	440671.939
S3	0.012	1350	Type C	98.959	97.472	1.262	374723.068	440682.999
S4	0.111	1350	Type C	98.741	97.316	1.200	374720.956	440696.513
S5	0.033	1350	Type C	98.579	97.021	1.259	374715.391	440688.981
S6	0.044	1350	Type C	98.294	96.576	1.418	374704.594	440677.097
S7	0.186	1350	Type C	96.602	94.803	1.424	374673.209	440704.246
S8	0.000	1350	Type C	95.893	94.496	1.172	374650.433	440711.890
S9	0.052	1350	Type C	96.000	94.290	1.335	374656.557	440718.961
S10-HW	0.000	1350	Type C	95.300	94.000	0.925	374648.175	440725.502
S11	0.065	1350	Type C	97.980	96.547	1.208	374692.523	440662.587
S12	0.048	1350	Type C	97.708	96.275	1.208	374681.721	440649.896
S13	0.094	1350	Type C	97.415	95.952	1.238	374672.152	440645.501
S14	0.118	1350	Type C	96.112	94.573	1.238	374627.985	440632.843
S15	0.065	1350	Type C	95.712	94.414	1.073	374600.230	440629.208
S16	0.051	1350	Type C	95.867	94.121	1.295	374611.477	440630.720
S17	0.024	1350	Type C	95.739	94.044	1.245	374607.078	440660.190
S18-HW	0.000	1350	Type C	95.300	94.000	0.850	374606.895	440671.655
S19-HW	0.000	1350	Type C	95.300	93.999	0.851	374618.376	440694.081
S20-HB	0.000	2100	Type C	95.300	93.986	1.089	374613.407	440696.859
S21-OUTFALL	0.000	1350	Type C	95.300	93.904	1.171	374601.983	440701.451

Pipe Schedule

Pipe Number	US Manhole	US IL (m)	DS Manhole	DS IL (m)	Shape	Dimension (mm)	Length (m)	Gradient (1:x)	Roughness (mm)	US Depth To Soffit (m)	DS Depth To Soffit (m)
1.000	S1	99.690	S2	98.738	Circ	225	18.935	20	0.600	1.200	1.203
1.001	S2	98.738	S3	97.472	Circ	225	21.840	17	0.600	1.203	1.262
1.002	S3	97.472	S5	97.096	Circ	225	9.732	26	0.600	1.262	1.259
2.000	S4	97.316	S5	97.096	Circ	225	9.365	42	0.600	1.200	1.259
1.003	S5	97.021	S6	96.576	Circ	300	16.056	36	0.600	1.259	1.418
1.004	S6	96.576	S7	94.878	Circ	300	41.499	24	0.600	1.418	1.424
1.005	S7	94.803	S9	94.290	Circ	375	22.222	43	0.600	1.424	1.335
3.000	S8	94.496	S9	94.440	Circ	225	9.354	167	0.600	1.172	1.335
1.006	S9	94.290	S10-HW	94.000	Circ	375	10.632	37	0.600	1.335	0.925
1.007	S10-HW	94.000	S19-HW	93.999	Circ	450	43.305	Flat	0.600	0.850	0.851
4.000	S11	96.547	S12	96.275	Circ	225	16.665	61	0.600	1.208	1.208
4.001	S12	96.275	S13	95.952	Circ	225	10.531	33	0.600	1.208	1.238
4.002	S13	95.952	S14	94.648	Circ	225	45.945	35	0.600	1.238	1.238
4.003	S14	94.573	S16	94.271	Circ	300	16.644	55	0.600	1.238	1.295
5.000	S15	94.414	S16	94.346	Circ	225	11.348	167	0.600	1.073	1.295
4.004	S16	94.121	S17	94.044	Circ	450	29.796	385	0.600	1.295	1.245
4.005	S17	94.044	S18-HW	94.000	Circ	450	11.466	263	0.600	1.245	0.850
4.006	S18-HW	94.000	S19-HW	93.999	Circ	450	25.194	Flat	0.600	0.850	0.851
1.008	S19-HW	93.999	S20-HB	93.986	Circ	450	5.693	431	0.600	0.851	0.864
1.009	S20-HB	93.986		93.904	Circ	225	12.312	150	0.600	1.089	1.171

Permeable Paving Schedule

Permeable Paving	Assigned Manhole	Effective Storage Volume (m3)	CL (m)	IL (m)	Storage Infil Rate (m/hr)	Safety Factor	Easting (m)	Northing (m)
Permeable Paving 6	S1	4.266	101.115	100.735	0.00000100	2.00	374748.131	440654.330
Permeable Paving 117	S1	3.068	101.115	100.735	0.00000000	2.00	374735.821	440613.469
Permeable Paving 118	S1	3.094	101.115	100.735	0.00000000	2.00	374738.993	440618.981
Permeable Paving 119	S1	3.873	101.115	100.735	0.00000000	2.00	374746.958	440634.294
Permeable Paving 1	S2	8.793	100.166	99.786	0.00000100	2.00	374735.140	440661.459
Permeable Paving 7	S3	3.922	98.959	98.579	0.00000100	2.00	374722.153	440669.693
Permeable Paving 43	S3	5.817	98.959	98.579	0.00000100	2.00	374733.041	440684.059
Permeable Paving 44	S3	2.400	98.959	98.579	0.00000100	2.00	374740.926	440679.615
Permeable Paving 37	S4	2.984	98.741	98.361	0.00000100	2.00	374714.364	440698.141

Permeable Paving Schedule

Permeable Paving	Assigned Manhole	Effective Storage Volume (m3)	CL (m)	IL (m)	Storage Infil Rate (m/hr)	Safety Factor	Easting (m)	Northing (m)
Permeable Paving 38	S4	3.459	98.741	98.361	0.00000100	2.00	374727.149	440714.282
Permeable Paving 39	S4	2.935	98.741	98.361	0.00000100	2.00	374732.742	440719.982
Permeable Paving 40	S4	2.550	98.741	98.361	0.00000100	2.00	374748.098	440721.031
Permeable Paving 41	S4	2.550	98.741	98.361	0.00000100	2.00	374744.009	440716.238
Permeable Paving 42	S4	3.993	98.741	98.361	0.00000100	2.00	374744.016	440706.474
Permeable Paving 36	S5	2.841	98.579	98.199	0.00000100	2.00	374709.693	440691.711
Permeable Paving 21	S7	2.500	96.602	96.222	0.00000100	2.00	374674.157	440692.371
Permeable Paving 34	S7	5.013	96.602	96.222	0.00000100	2.00	374670.505	440726.750
Permeable Paving 35	S7	2.497	96.602	96.222	0.00000100	2.00	374684.456	440702.647
Permeable Paving 18	S9	3.459	96.000	95.620	0.00000100	2.00	374631.714	440688.681
Permeable Paving 19	S9	4.622	96.000	95.620	0.00000100	2.00	374646.323	440685.846
Permeable Paving 20	S9	5.004	96.000	95.620	0.00000100	2.00	374650.074	440700.409
Permeable Paving 32	S9	4.200	96.000	95.620	0.00000100	2.00	374688.202	440745.426
Permeable Paving 33	S9	4.837	96.000	95.620	0.00000100	2.00	374683.616	440733.392
Permeable Paving 31	S9	6.432	96.000	95.620	0.00000100	2.00	374692.985	440749.062
Permeable Paving 120	S9	3.460	96.000	95.620	0.00000000	2.00	374694.684	440762.501
Permeable Paving 8	S11	2.849	97.980	97.600	0.00000100	2.00	374704.094	440662.798
Permeable Paving 22	S11	3.281	97.980	97.600	0.00000100	2.00	374691.087	440670.660
Permeable Paving 9	S12	2.865	97.708	97.328	0.00000100	2.00	374692.267	440648.943
Permeable Paving 27	S12	4.849	97.708	97.328	0.00000100	2.00	374677.913	440661.988
Permeable Paving 116	S12	5.696	97.708	97.328	0.00000000	2.00	374698.093	440655.752
Permeable Paving 23	S13	2.780	97.415	97.035	0.00000100	2.00	374668.626	440651.339
Permeable Paving 45	S13	3.566	97.415	97.035	0.00000100	2.00	374674.330	440659.540
Permeable Paving 47	S13	4.176	97.415	97.035	0.00000000	2.00	374683.490	440640.742
Permeable Paving 11	S14	5.101	96.112	95.732	0.00000100	2.00	374641.984	440622.472
Permeable Paving 12	S14	4.872	96.112	95.732	0.00000100	2.00	374628.015	440623.453
Permeable Paving 24	S14	2.397	96.112	95.732	0.00000100	2.00	374655.237	440646.856
Permeable Paving 26	S14	3.453	96.112	95.732	0.00000100	2.00	374637.028	440644.486
Permeable Paving 28	S14	10.729	96.112	95.732	0.00000100	2.00	374668.119	440634.096
Permeable Paving 29	S14	5.133	96.112	95.732	0.00000100	2.00	374654.641	440626.105
Permeable Paving 46	S14	3.640	96.112	95.732	0.00000100	2.00	374661.402	440651.748
Permeable Paving 25	S14	2.400	96.112	95.732	0.00000100	2.00	374648.892	440645.041
Permeable Paving 14	S15	4.830	95.712	95.332	0.00000100	2.00	374601.269	440620.412
Permeable Paving 15	S15	5.024	95.712	95.332	0.00000100	2.00	374587.483	440622.247
Permeable Paving 13	S16	5.050	95.867	95.487	0.00000100	2.00	374614.623	440621.669
Permeable Paving 16	S17	8.584	95.739	95.359	0.00000100	2.00	374618.520	440646.513
Permeable Paving 17	S17	3.947	95.739	95.359	0.00000100	2.00	374614.092	440661.012

Outfall Details

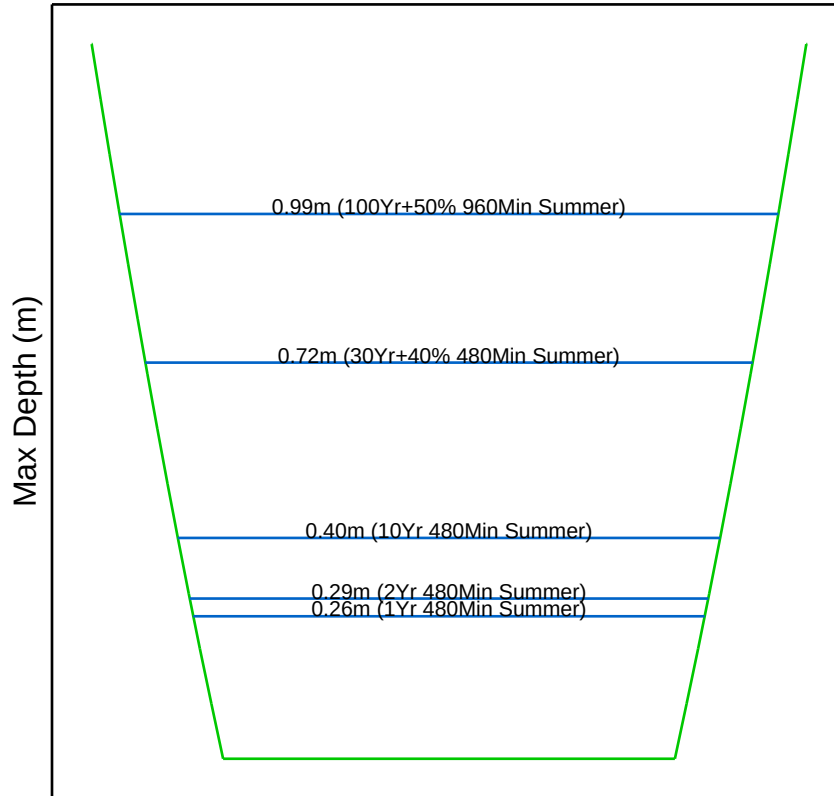
Outfall Manhole S21-OUTFALL : Free Discharge

Flow Control Details

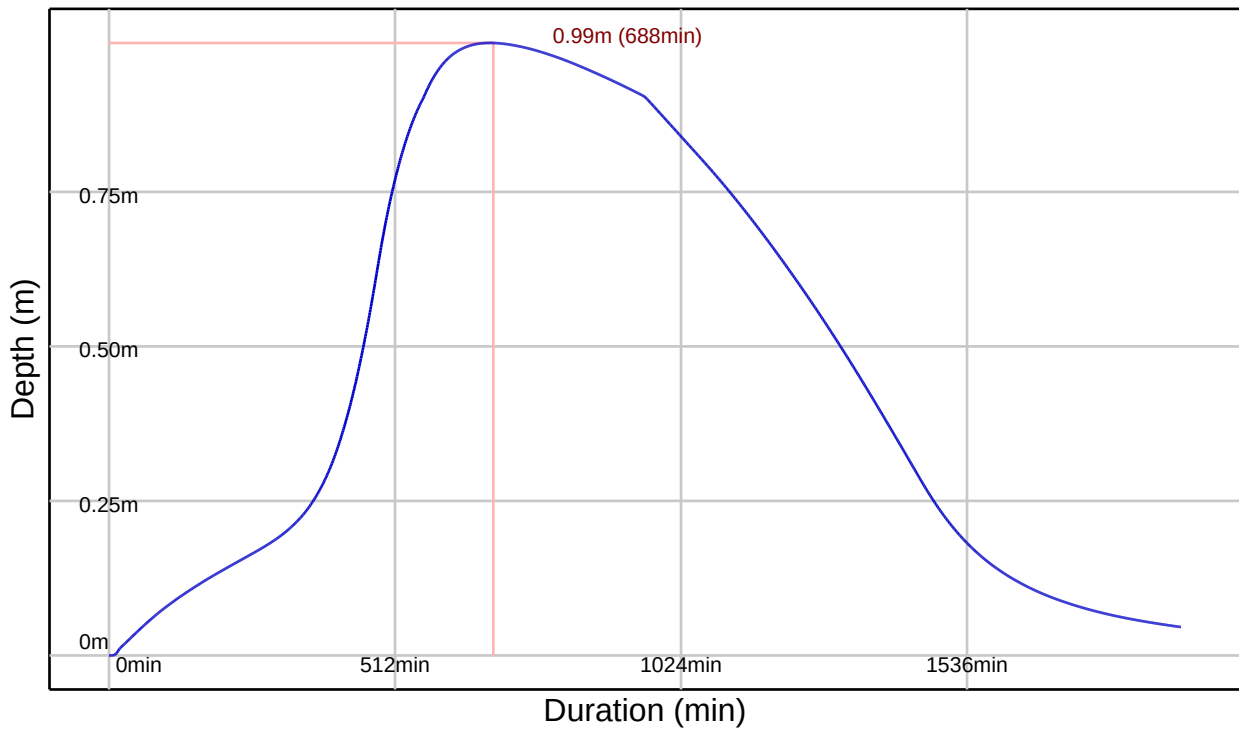
Pond Structure at Manhole S19-HW

Pond Invert (m)	Max Depth (m)	Volume To Water Level (m3)	Water Level (m)	Freeboard (m)	Infil Base (m/hr)	Infil Side (m/hr)	Safety Factor
94.000	1.300	734.947	95.000	0.300	0.00000000	0.00000000	2.00

Pond Depth/Area Diagram at S19-HW



Pond 1 at S19-HW (100Yr+50% 960Min Summer)

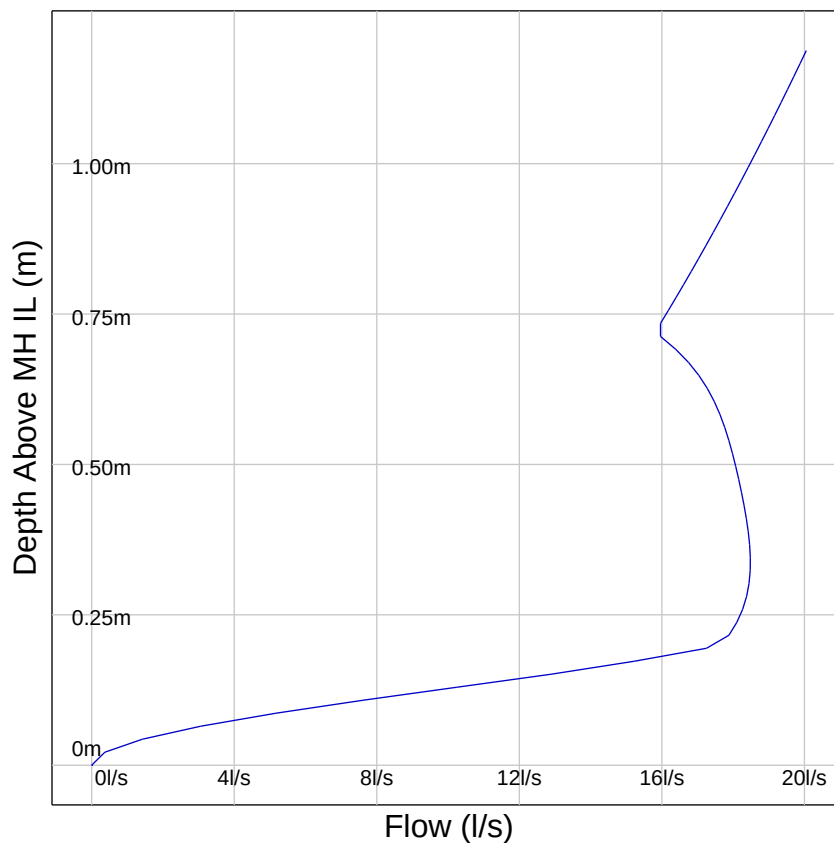


Controls within Manhole S20-HB

Hydro-Brake® Optimum Control

Model Ref	Design Depth (m)	Design Flow (l/s)	Invert Offset (m)	FF Head (m)	FF Flow (l/s)	KF Head (m)	KF Flow (l/s)
SHE-0192-1850-1000-1850	1.000	18.500	0.000	0.337	18.483	0.719	15.799

Hydro-Brake® Optimum Control from S20-HB to S21-OUTFALL



Simulation Settings

FSR: M5-60=19.10, R=0.26, Locale=England and Wales

Summer (Cv: 1.00), Winter (Cv: 1.00)

Global Time of Entry: 5.0 mins

Durations (mins): 15, 30, 60, 120, 240, 360, 480, 960, 1440

Return Periods (yrs) + Climate Change: (1, +0%), (2, +0%), (10, +0%), (30, +40%), (100, +50%)

Manhole Flood Risk Freeboard: 0.300m

Simulated Rainfall Events

Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %	Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %
1Yr 15Min Winter	30.567	0.00	-0.06	10Yr 240Min Winter	9.546	0.00	-0.02
1Yr 15Min Summer	30.567	0.00	-0.06	10Yr 360Min Summer	7.326	0.00	-0.01
1Yr 30Min Winter	20.667	0.00	-0.07	10Yr 360Min Winter	7.326	0.00	-0.01
1Yr 30Min Summer	20.667	0.00	-0.07	10Yr 480Min Summer	6.065	0.00	-0.01
1Yr 60Min Winter	13.593	0.00	-0.05	10Yr 480Min Winter	6.065	0.00	0.00
1Yr 60Min Summer	13.593	0.00	-0.05	10Yr 960Min Summer	3.834	0.00	0.00
1Yr 120Min Winter	8.863	0.00	-0.03	10Yr 960Min Winter	3.834	0.00	0.00
1Yr 120Min Summer	8.863	0.00	-0.03	10Yr 1440Min Summer	2.927	0.00	0.00
1Yr 240Min Winter	5.811	0.00	-0.01	10Yr 1440Min Winter	2.927	0.00	0.00
1Yr 240Min Summer	5.811	0.00	-0.01	30Yr+40% 15Min Summer	87.643	0.00	0.06
1Yr 360Min Winter	4.533	0.00	0.00	30Yr+40% 15Min Winter	87.643	0.00	0.04
1Yr 360Min Summer	4.533	0.00	0.00	30Yr+40% 30Min Summer	61.248	0.00	0.06
1Yr 480Min Winter	3.801	0.00	0.00	30Yr+40% 30Min Winter	61.248	0.00	0.02
1Yr 480Min Summer	3.801	0.00	0.00	30Yr+40% 60Min Summer	41.154	0.00	0.08
1Yr 960Min Summer	2.489	0.00	0.00	30Yr+40% 60Min Winter	41.154	0.00	0.03
1Yr 960Min Winter	2.489	0.00	0.00	30Yr+40% 120Min Summer	26.794	0.00	0.05
1Yr 1440Min Winter	1.946	0.00	0.00	30Yr+40% 120Min Winter	26.794	0.00	0.04
1Yr 1440Min Summer	1.946	0.00	0.00	30Yr+40% 240Min Summer	16.936	0.00	-0.02
2Yr 15Min Winter	35.376	0.00	-0.06	30Yr+40% 240Min Winter	16.936	0.00	-0.01
2Yr 15Min Summer	35.376	0.00	-0.06	30Yr+40% 360Min Summer	12.896	0.00	-0.02
2Yr 30Min Summer	24.080	0.00	-0.06	30Yr+40% 360Min Winter	12.896	0.00	-0.01
2Yr 30Min Winter	24.080	0.00	-0.06	30Yr+40% 480Min Summer	10.611	0.00	-0.01
2Yr 60Min Summer	15.906	0.00	-0.04	30Yr+40% 480Min Winter	10.611	0.00	-0.01
2Yr 60Min Winter	15.906	0.00	-0.04	30Yr+40% 960Min Summer	6.597	0.00	0.00
2Yr 120Min Summer	10.369	0.00	-0.03	30Yr+40% 960Min Winter	6.597	0.00	0.00
2Yr 120Min Winter	10.369	0.00	-0.03	30Yr+40% 1440Min Summer	4.980	0.00	0.00
2Yr 240Min Summer	6.747	0.00	-0.01	30Yr+40% 1440Min Winter	4.980	0.00	0.00
2Yr 240Min Winter	6.747	0.00	-0.01	100Yr+50% 15Min Summer	121.028	0.00	-0.03
2Yr 360Min Winter	5.238	0.00	0.00	100Yr+50% 15Min Winter	121.028	0.00	0.11
2Yr 360Min Summer	5.238	0.00	0.00	100Yr+50% 30Min Summer	85.574	0.00	0.16
2Yr 480Min Summer	4.375	0.00	0.00	100Yr+50% 30Min Winter	85.574	0.00	0.24
2Yr 480Min Winter	4.375	0.00	0.00	100Yr+50% 60Min Summer	57.936	0.00	0.56
2Yr 960Min Summer	2.835	0.00	0.00	100Yr+50% 60Min Winter	57.936	0.00	0.55
2Yr 960Min Winter	2.835	0.00	0.00	100Yr+50% 120Min Summer	37.700	0.00	0.61
2Yr 1440Min Summer	2.201	0.00	0.00	100Yr+50% 120Min Winter	37.700	0.00	0.59
2Yr 1440Min Winter	2.201	0.00	0.00	100Yr+50% 240Min Summer	23.523	0.00	0.39
10Yr 15Min Summer	49.662	0.00	-0.03	100Yr+50% 240Min Winter	23.523	0.00	0.38
10Yr 15Min Winter	49.662	0.00	-0.03	100Yr+50% 360Min Summer	17.760	0.00	0.14
10Yr 30Min Winter	34.337	0.00	-0.04	100Yr+50% 360Min Winter	17.760	0.00	0.13
10Yr 30Min Summer	34.337	0.00	-0.04	100Yr+50% 480Min Summer	14.515	0.00	-0.02
10Yr 60Min Summer	22.913	0.00	-0.03	100Yr+50% 480Min Winter	14.515	0.00	-0.02
10Yr 60Min Winter	22.913	0.00	-0.03	100Yr+50% 960Min Summer	8.860	0.00	-0.01
10Yr 120Min Winter	14.925	0.00	-0.02	100Yr+50% 960Min Winter	8.860	0.00	-0.01
10Yr 120Min Summer	14.925	0.00	-0.02	100Yr+50% 1440Min Winter	6.605	0.00	-0.00
10Yr 240Min Summer	9.546	0.00	-0.02	100Yr+50% 1440Min Summer	6.605	0.00	-0.01

Simulation Results

Return Period (yrs) + Climate Change (%):

1yr+0%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	8	99.751	0.060	19.458		OK
S2	15 min Summer	8	98.821	0.083	37.827		OK
S3	15 min Summer	8	97.568	0.096	37.641		OK
S4	15 min Summer	8	97.386	0.070	16.687		OK
S5	15 min Summer	8	97.140	0.119	59.456		OK
S6	15 min Summer	8	96.688	0.112	67.202		OK
S7	15 min Summer	9	94.951	0.147	97.202		OK
S8	15 min Winter	7	94.545	0.049	5.410		OK
S9	15 min Winter	7	94.577	0.287	83.664		OK
S10-HW	15 min Summer	7	94.560	0.560	85.337		Surcharged
S11	15 min Summer	8	96.607	0.060	10.673		OK
S12	15 min Summer	8	96.338	0.063	16.858		OK
S13	15 min Summer	8	96.045	0.093	31.836		OK
S14	15 min Summer	8	94.689	0.116	45.833		OK
S15	15 min Summer	8	94.490	0.076	9.961		OK
S16	15 min Summer	8	94.333	0.212	63.751		OK
S17	15 min Summer	7	94.308	0.264	53.021		OK
S18-HW	15 min Winter	7	94.286	0.286	48.093		OK
S19-HW	480 min Summer	292	94.259	0.259	15.641		OK
S20-HB	480 min Summer	292	94.259	0.273	15.756		Surcharged
S21-OUTFALL	480 min Summer	292	93.994	0.090	15.757		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	8	S1	S2	0.071	1.785	19.389	0.165	OK
1.001	15 min Summer	8	S2	S3	0.090	2.551	37.641	0.299	OK
1.002	15 min Summer	8	S3	S5	0.093	2.410	37.404	0.364	OK
2.000	15 min Summer	8	S4	S5	0.068	1.633	16.602	0.207	OK
1.003	15 min Summer	8	S5	S6	0.116	2.355	59.274	0.320	OK
1.004	15 min Summer	9	S6	S7	0.111	2.815	66.666	0.295	OK
1.005	15 min Winter	9	S7	S9	0.208	2.212	90.112	0.296	OK
3.000	15 min Winter	8	S8	S9	0.093	0.417	1.554	0.039	OK
1.006	15 min Winter	8	S9	S10-HW	0.331	1.384	113.112	0.341	OK
1.007	480 min Summer	291	S10-HW	S19-HW	0.260	0.342	23.707	1.687	OK
4.000	15 min Summer	8	S11	S12	0.061	1.207	10.605	0.159	OK
4.001	15 min Summer	8	S12	S13	0.078	1.374	16.765	0.183	OK
4.002	15 min Summer	8	S13	S14	0.092	2.047	31.322	0.357	OK
4.003	15 min Summer	8	S14	S16	0.112	1.885	45.519	0.304	OK
5.000	15 min Summer	8	S15	S16	0.074	0.862	9.857	0.246	OK
4.004	15 min Winter	8	S16	S17	0.238	0.904	61.490	0.376	OK
4.005	15 min Winter	8	S17	S18-HW	0.275	0.913	71.301	0.359	OK
4.006	480 min Summer	292	S18-HW	S19-HW	0.259	0.550	14.654	0.780	OK
1.008	480 min Summer	292	S19-HW	S20-HB	0.266	0.192	15.758	0.102	OK
1.009	480 min Summer	292	S20-HB		0.092	1.025	15.757	0.373	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 6	1440 min Summer	2878	100.841	0.105	0.000			OK
Permeable Paving 117	120 min Summer	69	100.747	0.011	0.188			OK
Permeable Paving 118	120 min Summer	69	100.747	0.011	0.190			OK
Permeable Paving 119	120 min Summer	70	100.748	0.013	0.208			OK
Permeable Paving 1	1440 min Summer	2878	99.892	0.105	0.000			OK
Permeable Paving 7	1440 min Summer	2879	98.684	0.105	0.000			OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 43	1440 min Summer	2878	98.684	0.105	0.000			OK
Permeable Paving 44	1440 min Summer	2878	98.684	0.105	0.000			OK
Permeable Paving 37	1440 min Summer	2879	98.467	0.105	0.000			OK
Permeable Paving 38	1440 min Summer	2878	98.467	0.105	0.000			OK
Permeable Paving 39	1440 min Summer	2879	98.467	0.105	0.000			OK
Permeable Paving 40	1440 min Summer	2878	98.467	0.106	0.000			OK
Permeable Paving 41	1440 min Summer	2878	98.467	0.106	0.000			OK
Permeable Paving 42	1440 min Summer	2879	98.467	0.105	0.000			OK
Permeable Paving 36	1440 min Summer	2879	98.305	0.105	0.000			OK
Permeable Paving 21	1440 min Summer	2878	96.328	0.106	0.000			OK
Permeable Paving 34	1440 min Summer	2878	96.328	0.105	0.000			OK
Permeable Paving 35	1440 min Summer	2878	96.328	0.105	0.000			OK
Permeable Paving 18	1440 min Summer	2879	95.725	0.105	0.000			OK
Permeable Paving 19	1440 min Summer	2878	95.725	0.105	0.000			OK
Permeable Paving 20	1440 min Summer	2879	95.725	0.105	0.000			OK
Permeable Paving 32	1440 min Summer	2878	95.725	0.105	0.000			OK
Permeable Paving 33	1440 min Summer	2878	95.725	0.105	0.000			OK
Permeable Paving 31	1440 min Summer	2879	95.725	0.105	0.000			OK
Permeable Paving 120	120 min Summer	70	95.632	0.012	0.186			OK
Permeable Paving 8	1440 min Summer	2878	97.705	0.105	0.000			OK
Permeable Paving 22	1440 min Summer	2878	97.705	0.106	0.000			OK
Permeable Paving 9	1440 min Summer	2878	97.433	0.105	0.000			OK
Permeable Paving 27	1440 min Summer	2878	97.433	0.105	0.000			OK
Permeable Paving 116	120 min Summer	72	97.342	0.014	0.264			OK
Permeable Paving 23	1440 min Summer	2878	97.140	0.105	0.000			OK
Permeable Paving 45	1440 min Summer	2878	97.140	0.105	0.000			OK
Permeable Paving 47	120 min Summer	71	97.048	0.013	0.220			OK
Permeable Paving 11	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 12	1440 min Summer	2879	95.837	0.105	0.000			OK
Permeable Paving 24	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 26	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 28	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 29	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 46	1440 min Summer	2879	95.837	0.105	0.000			OK
Permeable Paving 25	1440 min Summer	2878	95.837	0.105	0.000			OK
Permeable Paving 14	1440 min Summer	2879	95.437	0.105	0.000			OK
Permeable Paving 15	1440 min Summer	2879	95.437	0.105	0.000			OK
Permeable Paving 13	1440 min Summer	2878	95.592	0.105	0.000			OK
Permeable Paving 16	1440 min Summer	2878	95.464	0.105	0.000			OK
Permeable Paving 17	1440 min Summer	2878	95.464	0.105	0.000			OK

Return Period (yrs) + Climate Change (%):

2yr+0%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	8	99.755	0.065	22.520		OK
S2	15 min Summer	8	98.828	0.090	43.784		OK
S3	15 min Summer	8	97.577	0.105	43.576		OK
S4	15 min Summer	8	97.392	0.076	19.313		OK
S5	15 min Summer	8	97.151	0.130	68.835		OK
S6	15 min Summer	8	96.698	0.122	77.801		OK
S7	15 min Summer	9	94.963	0.160	112.438		OK
S8	15 min Winter	7	94.641	0.145	0.522		OK
S9	15 min Summer	7	94.605	0.315	105.902		OK
S10-HW	15 min Winter	7	94.567	0.567	103.930		Surcharged
S11	15 min Summer	8	96.612	0.065	12.353		OK
S12	15 min Summer	8	96.343	0.068	19.515		OK
S13	15 min Summer	8	96.053	0.101	36.847		OK
S14	15 min Summer	8	94.699	0.126	53.076		OK
S15	15 min Summer	8	94.496	0.082	11.528		OK
S16	15 min Winter	7	94.355	0.234	61.107		OK
S17	15 min Winter	7	94.310	0.266	61.014		OK
S18-HW	480 min Summer	293	94.292	0.292	6.897		OK
S19-HW	480 min Summer	293	94.291	0.291	17.555		OK
S20-HB	480 min Summer	293	94.291	0.305	17.551		Surcharged
S21-OUTFALL	480 min Summer	293	93.999	0.096	17.551		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	8	S1	S2	0.077	1.855	22.444	0.192	OK
1.001	15 min Summer	8	S2	S3	0.097	2.639	43.576	0.346	OK
1.002	15 min Summer	8	S3	S5	0.101	2.498	43.309	0.422	OK
2.000	15 min Summer	8	S4	S5	0.074	1.698	19.219	0.240	OK
1.003	15 min Summer	8	S5	S6	0.126	2.439	68.625	0.370	OK
1.004	15 min Summer	9	S6	S7	0.120	2.926	77.101	0.342	OK
1.005	15 min Summer	8	S7	S9	0.234	2.288	113.492	0.372	OK
3.000	15 min Winter	8	S8	S9	0.153	0.222	0.751	0.019	OK
1.006	15 min Summer	8	S9	S10-HW	0.345	1.489	132.461	0.400	OK
1.007	480 min Summer	292	S10-HW	S19-HW	0.292	0.584	27.277	1.941	OK
4.000	15 min Summer	8	S11	S12	0.066	1.251	12.278	0.185	OK
4.001	15 min Summer	8	S12	S13	0.085	1.421	19.404	0.212	OK
4.002	15 min Summer	8	S13	S14	0.100	2.127	36.281	0.413	OK
4.003	15 min Summer	8	S14	S16	0.122	1.957	52.737	0.352	OK
5.000	15 min Summer	8	S15	S16	0.080	0.896	11.412	0.285	OK
4.004	15 min Winter	8	S16	S17	0.250	0.948	68.782	0.420	OK
4.005	15 min Winter	8	S17	S18-HW	0.279	0.958	76.893	0.387	OK
4.006	480 min Summer	293	S18-HW	S19-HW	0.292	0.557	16.809	0.895	OK
1.008	480 min Summer	293	S19-HW	S20-HB	0.298	0.202	17.555	0.114	OK
1.009	480 min Summer	293	S20-HB		0.098	1.054	17.551	0.415	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 6	1440 min Summer	2878	100.856	0.121	0.000			OK
Permeable Paving 117	120 min Summer	69	100.749	0.013	0.219			OK
Permeable Paving 118	120 min Summer	69	100.749	0.013	0.221			OK
Permeable Paving 119	120 min Summer	70	100.750	0.015	0.251			OK
Permeable Paving 1	1440 min Summer	2878	99.907	0.121	0.000			OK
Permeable Paving 7	1440 min Summer	2878	98.699	0.121	0.000			OK
Permeable Paving 43	1440 min Summer	2878	98.699	0.121	0.000			OK
Permeable Paving 44	1440 min Summer	2878	98.699	0.121	0.000			OK
Permeable Paving 37	1440 min Summer	2878	98.482	0.121	0.000			OK
Permeable Paving 38	1440 min Summer	2878	98.482	0.121	0.000			OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 39	1440 min Summer	2878	98.482	0.121	0.000			OK
Permeable Paving 40	1440 min Summer	2879	98.482	0.121	0.000			OK
Permeable Paving 41	1440 min Summer	2879	98.482	0.121	0.000			OK
Permeable Paving 42	1440 min Summer	2879	98.482	0.121	0.000			OK
Permeable Paving 36	1440 min Summer	2878	98.320	0.121	0.000			OK
Permeable Paving 21	1440 min Summer	2878	96.343	0.121	0.000			OK
Permeable Paving 34	1440 min Summer	2878	96.343	0.121	0.000			OK
Permeable Paving 35	1440 min Summer	2879	96.343	0.120	0.000			OK
Permeable Paving 18	1440 min Summer	2878	95.740	0.121	0.000			OK
Permeable Paving 19	1440 min Summer	2878	95.740	0.121	0.000			OK
Permeable Paving 20	1440 min Summer	2879	95.740	0.121	0.000			OK
Permeable Paving 32	1440 min Summer	2878	95.740	0.121	0.000			OK
Permeable Paving 33	1440 min Summer	2878	95.740	0.121	0.000			OK
Permeable Paving 31	1440 min Summer	2879	95.740	0.121	0.000			OK
Permeable Paving 120	120 min Summer	69	95.634	0.014	0.247			OK
Permeable Paving 8	1440 min Summer	2879	97.720	0.121	0.000			OK
Permeable Paving 22	1440 min Summer	2878	97.720	0.121	0.000			OK
Permeable Paving 9	1440 min Summer	2878	97.448	0.121	0.000			OK
Permeable Paving 27	1440 min Summer	2879	97.448	0.121	0.000			OK
Permeable Paving 116	120 min Summer	71	97.345	0.017	0.338			OK
Permeable Paving 23	1440 min Summer	2879	97.156	0.121	0.000			OK
Permeable Paving 45	1440 min Summer	2879	97.156	0.121	0.000			OK
Permeable Paving 47	120 min Summer	70	97.050	0.015	0.271			OK
Permeable Paving 11	1440 min Summer	2879	95.852	0.121	0.000			OK
Permeable Paving 12	1440 min Summer	2879	95.852	0.121	0.000			OK
Permeable Paving 24	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 26	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 28	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 29	1440 min Summer	2879	95.852	0.121	0.000			OK
Permeable Paving 46	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 25	1440 min Summer	2878	95.852	0.121	0.000			OK
Permeable Paving 14	1440 min Summer	2879	95.452	0.121	0.000			OK
Permeable Paving 15	1440 min Summer	2878	95.452	0.121	0.000			OK
Permeable Paving 13	1440 min Summer	2878	95.607	0.121	0.000			OK
Permeable Paving 16	1440 min Summer	2878	95.480	0.121	0.000			OK
Permeable Paving 17	1440 min Summer	2878	95.480	0.121	0.000			OK

Return Period (yrs) + Climate Change (%):
10yr+0%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	8	99.768	0.078	31.618		OK
S2	15 min Summer	8	98.847	0.109	61.485		OK
S3	15 min Summer	8	97.603	0.131	61.211		OK
S4	15 min Summer	8	97.408	0.092	27.116		OK
S5	15 min Summer	8	97.181	0.160	96.697		OK
S6	15 min Summer	8	96.724	0.148	109.301		OK
S7	15 min Summer	8	95.004	0.200	160.080		OK
S8	15 min Winter	6	94.685	0.189	8.347		OK
S9	15 min Winter	6	94.678	0.388	108.759		Surcharged
S10-HW	15 min Winter	6	94.627	0.627	85.485		Surcharged
S11	15 min Summer	8	96.625	0.078	17.344		OK
S12	15 min Summer	8	96.358	0.083	27.409		OK
S13	15 min Summer	8	96.076	0.124	51.748		OK
S14	15 min Summer	8	94.727	0.154	74.603		OK
S15	15 min Summer	8	94.513	0.099	16.186		OK
S16	480 min Summer	306	94.402	0.281	6.930		OK
S17	480 min Summer	303	94.402	0.358	7.622		OK
S18-HW	480 min Summer	305	94.402	0.402	7.279		OK
S19-HW	480 min Summer	304	94.402	0.402	16.952		OK
S20-HB	480 min Summer	305	94.401	0.416	18.448		Surcharged
S21-OUTFALL	480 min Summer	304	94.002	0.098	18.461		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	8	S1	S2	0.093	2.020	31.524	0.269	OK
1.001	15 min Summer	8	S2	S3	0.120	2.841	61.211	0.486	OK
1.002	15 min Summer	8	S3	S5	0.124	2.698	60.847	0.593	OK
2.000	15 min Summer	8	S4	S5	0.089	1.852	26.994	0.337	OK
1.003	15 min Summer	8	S5	S6	0.154	2.637	96.419	0.520	OK
1.004	15 min Summer	8	S6	S7	0.146	3.188	108.363	0.480	OK
1.005	15 min Winter	8	S7	S9	0.265	2.378	147.465	0.484	OK
3.000	15 min Winter	7	S8	S9	0.207	0.221	4.812	0.120	OK
1.006	15 min Winter	8	S9	S10-HW	0.375	1.658	162.712	0.491	Surcharged
1.007	360 min Summer	224	S10-HW	S19-HW	0.408	0.741	45.542	3.241	OK
4.000	15 min Summer	8	S11	S12	0.080	1.352	17.249	0.259	OK
4.001	15 min Summer	8	S12	S13	0.103	1.528	27.257	0.298	OK
4.002	15 min Summer	8	S13	S14	0.122	2.311	51.022	0.581	OK
4.003	15 min Summer	8	S14	S16	0.149	2.126	74.179	0.495	OK
5.000	15 min Summer	8	S15	S16	0.097	0.979	16.034	0.400	OK
4.004	480 min Summer	306	S16	S17	0.320	0.443	23.740	0.145	OK
4.005	480 min Summer	305	S17	S18-HW	0.380	0.390	23.848	0.120	OK
4.006	480 min Summer	305	S18-HW	S19-HW	0.402	0.624	23.275	1.239	OK
1.008	480 min Summer	305	S19-HW	S20-HB	0.409	0.236	18.693	0.121	OK
1.009	480 min Summer	304	S20-HB		0.101	1.068	18.461	0.436	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 6	1440 min Summer	2878	100.899	0.164	0.000			OK
Permeable Paving 117	60 min Summer	37	100.755	0.020	0.401			OK
Permeable Paving 118	60 min Summer	37	100.755	0.020	0.406			OK
Permeable Paving 119	60 min Summer	37	100.757	0.021	0.506			OK
Permeable Paving 1	1440 min Summer	2877	99.950	0.164	0.000			OK
Permeable Paving 7	1440 min Summer	2878	98.743	0.164	0.000			OK
Permeable Paving 43	1440 min Summer	2879	98.743	0.164	0.000			OK
Permeable Paving 44	1440 min Summer	2878	98.743	0.164	0.000			OK
Permeable Paving 37	1440 min Summer	2877	98.526	0.164	0.000			OK
Permeable Paving 38	1440 min Summer	2879	98.526	0.164	0.000			OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 39	1440 min Summer	2877	98.526	0.164	0.000			OK
Permeable Paving 40	1440 min Summer	2877	98.526	0.164	0.000			OK
Permeable Paving 41	1440 min Summer	2877	98.526	0.164	0.000			OK
Permeable Paving 42	1440 min Summer	2878	98.526	0.164	0.000			OK
Permeable Paving 36	1440 min Summer	2878	98.364	0.164	0.000			OK
Permeable Paving 21	1440 min Summer	2877	96.387	0.164	0.000			OK
Permeable Paving 34	1440 min Summer	2878	96.386	0.164	0.000			OK
Permeable Paving 35	1440 min Summer	2877	96.387	0.164	0.000			OK
Permeable Paving 18	1440 min Summer	2878	95.784	0.164	0.000			OK
Permeable Paving 19	1440 min Summer	2877	95.784	0.164	0.000			OK
Permeable Paving 20	1440 min Summer	2878	95.784	0.164	0.000			OK
Permeable Paving 32	1440 min Summer	2878	95.784	0.164	0.000			OK
Permeable Paving 33	1440 min Summer	2879	95.784	0.164	0.000			OK
Permeable Paving 31	1440 min Summer	2879	95.784	0.164	0.000			OK
Permeable Paving 120	60 min Summer	37	95.640	0.021	0.452			OK
Permeable Paving 8	1440 min Summer	2878	97.764	0.164	0.000			OK
Permeable Paving 22	1440 min Summer	2877	97.764	0.164	0.000			OK
Permeable Paving 9	1440 min Summer	2878	97.492	0.164	0.000			OK
Permeable Paving 27	1440 min Summer	2878	97.492	0.164	0.000			OK
Permeable Paving 116	120 min Summer	69	97.352	0.024	0.567			OK
Permeable Paving 23	1440 min Summer	2878	97.199	0.164	0.000			OK
Permeable Paving 45	1440 min Summer	2877	97.199	0.164	0.000			OK
Permeable Paving 47	60 min Summer	38	97.057	0.022	0.426			OK
Permeable Paving 11	1440 min Summer	2879	95.896	0.164	0.000			OK
Permeable Paving 12	1440 min Summer	2877	95.896	0.164	0.000			OK
Permeable Paving 24	1440 min Summer	2879	95.896	0.164	0.000			OK
Permeable Paving 26	1440 min Summer	2879	95.896	0.164	0.000			OK
Permeable Paving 28	1440 min Summer	2877	95.896	0.164	0.000			OK
Permeable Paving 29	1440 min Summer	2878	95.896	0.164	0.000			OK
Permeable Paving 46	1440 min Summer	2878	95.896	0.164	0.000			OK
Permeable Paving 25	1440 min Summer	2878	95.896	0.164	0.000			OK
Permeable Paving 14	1440 min Summer	2878	95.496	0.164	0.000			OK
Permeable Paving 15	1440 min Summer	2878	95.496	0.164	0.000			OK
Permeable Paving 13	1440 min Summer	2878	95.651	0.164	0.000			OK
Permeable Paving 16	1440 min Summer	2878	95.523	0.164	0.000			OK
Permeable Paving 17	1440 min Summer	2877	95.523	0.164	0.000			OK

Return Period (yrs) + Climate Change (%):
30yr+40%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	8	99.797	0.106	55.835		OK
S2	15 min Summer	8	98.897	0.159	108.575		OK
S3	15 min Summer	9	97.736	0.264	105.101		Surcharged
S4	15 min Summer	8	97.450	0.134	47.863		OK
S5	15 min Summer	9	97.260	0.239	166.960		OK
S6	15 min Summer	9	96.800	0.224	189.062		OK
S7	15 min Summer	9	95.465	0.662	276.771		Surcharged
S8	15 min Summer	9	95.004	0.508	0.658		Surcharged
S9	15 min Summer	9	95.003	0.713	284.212		Surcharged
S10-HW	15 min Winter	5	94.750	0.750	113.909		Surcharged
S11	15 min Summer	8	96.655	0.108	30.615		OK
S12	15 min Summer	8	96.396	0.121	48.411		OK
S13	15 min Summer	8	96.145	0.193	91.344		OK
S14	15 min Summer	9	94.810	0.237	130.541		OK
S15	480 min Summer	345	94.721	0.307	0.979		Surcharged
S16	480 min Summer	345	94.721	0.600	6.624		Surcharged
S17	480 min Summer	345	94.721	0.677	6.829		Surcharged
S18-HW	480 min Summer	345	94.721	0.721	6.827		Surcharged
S19-HW	480 min Summer	346	94.721	0.721	17.198		Surcharged
S20-HB	480 min Summer	346	94.720	0.735	17.177		Surcharged
S21-OUTFALL	960 min Summer	985	94.002	0.098	18.481		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	8	S1	S2	0.132	2.288	55.688	0.475	OK
1.001	15 min Summer	8	S2	S3	0.192	3.082	108.085	0.859	OK
1.002	15 min Summer	9	S3	S5	0.200	2.960	105.927	1.032	OK
2.000	15 min Summer	8	S4	S5	0.148	1.822	47.788	0.597	OK
1.003	15 min Summer	9	S5	S6	0.231	2.952	167.264	0.902	OK
1.004	15 min Summer	9	S6	S7	0.262	3.129	189.256	0.839	OK
1.005	15 min Winter	9	S7	S9	0.375	2.391	257.785	0.846	Surcharged
3.000	30 min Summer	19	S8	S9	0.225	0.296	6.146	0.153	OK
1.006	15 min Winter	9	S9	S10-HW	0.375	2.419	267.131	0.806	Surcharged
1.007	60 min Winter	40	S10-HW	S19-HW	0.450	1.336	158.017	11.246	OK
4.000	15 min Summer	8	S11	S12	0.114	1.500	30.467	0.458	OK
4.001	15 min Summer	8	S12	S13	0.157	1.652	48.105	0.526	OK
4.002	15 min Summer	9	S13	S14	0.206	2.539	90.637	1.032	OK
4.003	15 min Summer	9	S14	S16	0.249	2.173	131.112	0.874	OK
5.000	360 min Summer	208	S15	S16	0.225	0.775	7.701	0.192	OK
4.004	120 min Winter	80	S16	S17	0.450	0.753	65.850	0.403	OK
4.005	60 min Winter	44	S17	S18-HW	0.450	0.835	100.950	0.509	OK
4.006	60 min Winter	40	S18-HW	S19-HW	0.450	1.181	99.350	5.289	OK
1.008	120 min Summer	65	S19-HW	S20-HB	0.450	0.423	19.816	0.128	OK
1.009	960 min Summer	985	S20-HB		0.101	1.068	18.481	0.437	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 6	1440 min Winter	1043	100.990	0.255	0.048			Surcharged
Permeable Paving 117	60 min Summer	39	100.765	0.030	0.778			OK
Permeable Paving 118	60 min Summer	39	100.766	0.030	0.785			OK
Permeable Paving 119	60 min Summer	40	100.769	0.034	0.911			OK
Permeable Paving 1	1440 min Winter	1043	100.044	0.258	0.099			Surcharged
Permeable Paving 7	1440 min Winter	1043	98.833	0.255	0.044			Surcharged
Permeable Paving 43	1440 min Winter	1043	98.835	0.256	0.065			Surcharged
Permeable Paving 44	1440 min Winter	1043	98.832	0.253	0.027			Surcharged
Permeable Paving 37	1440 min Winter	1043	98.615	0.254	0.033			Surcharged
Permeable Paving 38	1440 min Winter	1043	98.616	0.254	0.039			Surcharged

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 39	1440 min Winter	1043	98.615	0.254	0.033			Surcharged
Permeable Paving 40	1440 min Winter	1043	98.615	0.253	0.029			Surcharged
Permeable Paving 41	1440 min Winter	1043	98.615	0.253	0.029			Surcharged
Permeable Paving 42	1440 min Winter	1043	98.616	0.255	0.045			Surcharged
Permeable Paving 36	1440 min Winter	1043	98.453	0.254	0.032			Surcharged
Permeable Paving 21	1440 min Winter	1043	96.476	0.253	0.028			Surcharged
Permeable Paving 34	1440 min Winter	1043	96.478	0.255	0.056			Surcharged
Permeable Paving 35	1440 min Winter	1043	96.476	0.253	0.028			Surcharged
Permeable Paving 18	1440 min Winter	1043	95.874	0.254	0.039			Surcharged
Permeable Paving 19	1440 min Winter	1043	95.875	0.255	0.052			Surcharged
Permeable Paving 20	1440 min Winter	1043	95.875	0.255	0.056			Surcharged
Permeable Paving 32	1440 min Winter	1043	95.874	0.255	0.047			Surcharged
Permeable Paving 33	1440 min Winter	1043	95.875	0.255	0.054			Surcharged
Permeable Paving 31	1440 min Winter	1042	95.876	0.256	0.076			Surcharged
Permeable Paving 120	60 min Summer	40	95.652	0.032	0.813			OK
Permeable Paving 8	1440 min Winter	1043	97.853	0.254	0.032			Surcharged
Permeable Paving 22	1440 min Winter	1043	97.854	0.254	0.037			Surcharged
Permeable Paving 9	1440 min Winter	1043	97.581	0.254	0.032			Surcharged
Permeable Paving 27	1440 min Winter	1043	97.583	0.255	0.054			Surcharged
Permeable Paving 116	60 min Summer	42	97.368	0.040	1.155			OK
Permeable Paving 23	1440 min Winter	1042	97.289	0.254	0.033			Surcharged
Permeable Paving 45	1440 min Winter	1043	97.289	0.254	0.040			Surcharged
Permeable Paving 47	60 min Summer	40	97.070	0.035	0.982			OK
Permeable Paving 11	1440 min Winter	1043	95.987	0.255	0.057			Surcharged
Permeable Paving 12	1440 min Winter	1043	95.987	0.255	0.055			Surcharged
Permeable Paving 24	1440 min Winter	1043	95.985	0.253	0.027			Surcharged
Permeable Paving 26	1440 min Winter	1043	95.986	0.254	0.039			Surcharged
Permeable Paving 28	1440 min Winter	1042	95.991	0.259	0.127			Surcharged
Permeable Paving 29	1440 min Winter	1043	95.987	0.255	0.058			Surcharged
Permeable Paving 46	1440 min Winter	1043	95.986	0.254	0.041			Surcharged
Permeable Paving 25	1440 min Winter	1043	95.985	0.253	0.027			Surcharged
Permeable Paving 14	1440 min Winter	1043	95.587	0.255	0.054			Surcharged
Permeable Paving 15	1440 min Winter	1043	95.587	0.255	0.056			Surcharged
Permeable Paving 13	1440 min Winter	1043	95.742	0.255	0.057			Surcharged
Permeable Paving 16	1440 min Winter	1043	95.617	0.258	0.096			Surcharged
Permeable Paving 17	1440 min Winter	1042	95.614	0.255	0.047			Surcharged

Return Period (yrs) + Climate Change (%):
100yr+50%

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Summer	10	100.069	0.379	62.329		Surcharged
S2	15 min Summer	10	99.770	1.032	122.933		Surcharged
S3	15 min Summer	10	98.495	1.023	124.237		Surcharged
S4	15 min Summer	10	98.016	0.700	52.800		Surcharged
S5	15 min Summer	10	97.913	0.893	190.702		Surcharged
S6	15 min Summer	10	97.401	0.825	213.785		Surcharged
S7	15 min Summer	9	95.885	1.082	324.058		Surcharged
S8	15 min Summer	10	95.271	0.775	0.000		Surcharged
S9	15 min Summer	10	95.271	0.981	328.772		Surcharged
S10-HW	960 min Summer	681	94.992	0.992	10.460		Surcharged
S11	15 min Summer	10	96.996	0.449	33.772		Surcharged
S12	15 min Summer	10	96.921	0.646	54.256		Surcharged
S13	15 min Summer	10	96.795	0.844	102.433		Surcharged
S14	30 min Summer	17	95.044	0.471	148.485		Surcharged
S15	960 min Summer	684	94.991	0.577	0.992		Surcharged
S16	960 min Summer	684	94.991	0.870	6.783		Surcharged
S17	960 min Summer	684	94.991	0.948	7.157		Surcharged
S18-HW	960 min Summer	684	94.991	0.991	7.160		Surcharged
S19-HW	960 min Summer	682	94.991	0.991	17.675		Surcharged
S20-HB	960 min Summer	682	94.991	1.005	17.613		Surcharged
S21-OUTFALL	480 min Winter	945	94.002	0.098	18.481		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Max Velocity (m/s)	Max Flow (l/s)	Flow / Capacity	Status
1.000	15 min Summer	9	S1	S2	0.225	2.285	73.913	0.631	OK
1.001	30 min Summer	16	S2	S3	0.225	3.174	126.183	1.003	OK
1.002	30 min Summer	18	S3	S5	0.225	3.056	121.507	1.184	OK
2.000	30 min Summer	16	S4	S5	0.225	1.838	59.892	0.748	OK
1.003	30 min Summer	15	S5	S6	0.300	2.918	188.231	1.015	Surcharged
1.004	30 min Summer	19	S6	S7	0.300	3.318	211.392	0.937	Surcharged
1.005	30 min Summer	17	S7	S9	0.375	2.816	311.055	1.021	Surcharged
3.000	15 min Winter	13	S8	S9	0.225	0.520	15.823	0.395	OK
1.006	30 min Summer	17	S9	S10-HW	0.375	2.907	321.080	0.969	Surcharged
1.007	60 min Summer	33	S10-HW	S19-HW	0.450	1.866	296.002	21.067	OK
4.000	30 min Summer	17	S11	S12	0.225	1.513	40.221	0.605	OK
4.001	30 min Summer	16	S12	S13	0.225	1.662	54.502	0.596	OK
4.002	30 min Summer	18	S13	S14	0.225	2.516	100.043	1.139	OK
4.003	30 min Summer	17	S14	S16	0.300	2.208	147.558	0.984	Surcharged
5.000	15 min Winter	8	S15	S16	0.225	0.923	36.680	0.916	OK
4.004	15 min Winter	10	S16	S17	0.450	1.322	209.647	1.282	OK
4.005	15 min Winter	10	S17	S18-HW	0.450	1.403	216.063	1.089	OK
4.006	60 min Summer	33	S18-HW	S19-HW	0.450	1.391	186.758	9.942	OK
1.008	30 min Winter	20	S19-HW	S20-HB	0.450	0.598	21.154	0.137	OK
1.009	15 min Summer	22	S20-HB		0.101	1.068	18.481	0.437	OK

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 6	1440 min Summer	798	100.998	0.262	0.205			Surcharged
Permeable Paving 117	60 min Summer	38	100.774	0.038	1.128			OK
Permeable Paving 118	60 min Summer	38	100.774	0.039	1.138			OK
Permeable Paving 119	60 min Summer	39	100.779	0.043	1.306			OK
Permeable Paving 1	1440 min Summer	796	100.056	0.270	0.417			Surcharged
Permeable Paving 7	1440 min Summer	798	98.840	0.262	0.188			Surcharged
Permeable Paving 43	1440 min Summer	796	98.844	0.265	0.276			Surcharged
Permeable Paving 44	1440 min Summer	798	98.837	0.258	0.115			Surcharged
Permeable Paving 37	1440 min Summer	798	98.621	0.260	0.143			Surcharged
Permeable Paving 38	1440 min Summer	798	98.622	0.261	0.166			Surcharged

Permeable Paving Storage

Permeable Paving	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Surface Runoff (m3)	Status
Permeable Paving 39	1440 min Summer	798	98.621	0.260	0.141			Surcharged
Permeable Paving 40	1440 min Summer	798	98.620	0.259	0.122			Surcharged
Permeable Paving 41	1440 min Summer	798	98.620	0.259	0.122			Surcharged
Permeable Paving 42	1440 min Summer	798	98.623	0.262	0.191			Surcharged
Permeable Paving 36	1440 min Summer	798	98.459	0.259	0.137			Surcharged
Permeable Paving 21	1440 min Summer	798	96.481	0.259	0.120			Surcharged
Permeable Paving 34	1440 min Summer	798	96.486	0.264	0.240			Surcharged
Permeable Paving 35	1440 min Summer	798	96.481	0.259	0.120			Surcharged
Permeable Paving 18	1440 min Summer	798	95.880	0.261	0.166			Surcharged
Permeable Paving 19	1440 min Summer	798	95.883	0.263	0.221			Surcharged
Permeable Paving 20	1440 min Summer	798	95.883	0.264	0.240			Surcharged
Permeable Paving 32	1440 min Summer	798	95.882	0.262	0.201			Surcharged
Permeable Paving 33	1440 min Summer	796	95.883	0.263	0.229			Surcharged
Permeable Paving 31	1440 min Summer	796	95.886	0.266	0.305			Surcharged
Permeable Paving 120	60 min Summer	38	95.660	0.041	1.272			OK
Permeable Paving 8	1440 min Summer	798	97.859	0.259	0.137			Surcharged
Permeable Paving 22	1440 min Summer	798	97.860	0.260	0.157			Surcharged
Permeable Paving 9	1440 min Summer	798	97.587	0.259	0.138			Surcharged
Permeable Paving 27	1440 min Summer	796	97.591	0.263	0.230			Surcharged
Permeable Paving 116	60 min Summer	40	97.380	0.052	1.747			OK
Permeable Paving 23	1440 min Summer	798	97.294	0.259	0.133			Surcharged
Permeable Paving 45	1440 min Summer	798	97.296	0.261	0.171			Surcharged
Permeable Paving 47	60 min Summer	39	97.080	0.045	1.409			OK
Permeable Paving 11	1440 min Summer	796	95.996	0.264	0.242			Surcharged
Permeable Paving 12	1440 min Summer	798	95.995	0.263	0.234			Surcharged
Permeable Paving 24	1440 min Summer	798	95.990	0.258	0.115			Surcharged
Permeable Paving 26	1440 min Summer	798	95.992	0.261	0.165			Surcharged
Permeable Paving 28	1440 min Summer	796	96.005	0.273	0.509			Surcharged
Permeable Paving 29	1440 min Summer	796	95.996	0.264	0.243			Surcharged
Permeable Paving 46	1440 min Summer	798	95.993	0.261	0.174			Surcharged
Permeable Paving 25	1440 min Summer	798	95.990	0.258	0.115			Surcharged
Permeable Paving 14	1440 min Summer	798	95.595	0.263	0.232			Surcharged
Permeable Paving 15	1440 min Summer	798	95.596	0.264	0.241			Surcharged
Permeable Paving 13	1440 min Summer	798	95.750	0.264	0.242			Surcharged
Permeable Paving 16	1440 min Summer	796	95.629	0.270	0.407			Surcharged
Permeable Paving 17	1440 min Summer	798	95.621	0.262	0.189			Surcharged