MOTT MACDONALD

RMG Brighton

Flood Risk Assessment

June 2023

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RMG Brighton

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Issue and Revision Record

Revision	Date	Approver	Description
P01	22/10/21	S2 – For Information	Draft – For Comment
P02	05/06/22	S2 – For Information	RIBA Stage 2 Issue
P03	05/06/23	S2 – For Information	Clarification on impermeably lined SuDS features. Updated to match latest SW correspondence

Document reference: 100103689 | BDO-MMD-XX-00-RP-C-0001 |

Information class: Standard

Contents

Executive summary

Mott MacDonald (MM) was commissioned to carry out a Flood Risk and Runoff Assessment for the proposed development site for RMG Brighton.

This report is to support a Full Planning Application for this site and to incorporate a SuDS based storm water management scheme.

The site is to be assessed with regard to the requirements of the Planning Practice Guidance (PPG) and the associated Technical Guidance to determine the suitability of the proposed development on the site.

As well as fluvial flood risk the report will also assess the risk posed locally by the development itself and the runoff it may generate.

This element will include a general overview of the suitability of Sustainable Drainage Systems (SuDS) type systems.

If required, mitigation measures and recommendations will be made that will enable the site to be suitably developed while actively seeking to reduce flood risk locally.

The following guidelines and references have been used in the preparation of this report:

- Planning Practice Guidance – Technical Guidance (PPG-TG)[1]
- Environment Agency Flood Risk Standing Advice for England[2]
- National Highways HADDMS asset database
- Mott MacDonald archives

The report is also based on additional information received from the Environment Agency (EA), Southern Water (SW) and Brighton & Hove City Council.

The report concludes that the development is suitable for this location and can be safely developed to manage and control all identified long term residual flood risks in this area. The provision of a positive drainage system on the site may also contribute to a reduction in flood risk locally.

Notwithstanding this, it is demonstrated that the layout can be developed to incorporate a SuDS based system that will not only provide adequate runoff protection but will also provide an improvement in the runoff quality.

1 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

2 https://www.gov.uk/flood-risk-assessment-local-planning-authorities

1 Introduction

RMG Brighton is a proposed new delivery office in Patcham, Brighton. The site is proposed to comprise a delivery office, vehicular parking, and soft landscaping. The development site has an area of approximately 1.58ha.

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process, to reduce future damage to property and loss of life. The PPG- Technical Guidance (PPG-TG) identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications.

The purpose of this report is to assist our client and the Local Planning Authority to make an informed decision on the flood risks associated with the site development.

Local Planning Authorities have the powers to control development in accordance with the guidelines contained in PPG-TG, and are expected to apply a risk-based approach to development with the Sequential Test in Table 1.1. This sets out a sequential characterisation of flood risk in terms of annual probability of river, tidal and coastal flooding.

In accordance with the sequential test in the technical guidance, sites are to be classed as follows:[3]

Table 1.1: Flood Zones – PPG-TG Table 1 and 3

Flood Zone	Appropriate Users
Flood Zone 1 - Low Probability This zone comprises land having less than 1 in 1000 annual probability of river or sea flooding (<0.1%)	All uses of land are appropriate in this zone
Flood Zone 2 - Medium Probability This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%- 0.1%) in any year	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this Zone Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test is passed
Flood Zone 3a - High Probability This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	The water-compatible and less vulnerable uses of land in Table D.2 area appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this should be designed and constructed to remain operational and safe for users in time of flood.
Flood Zone 3b - Functional Floodplain This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)	Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to: Remain operational and safe for users in times of flood; Result in no net loss of floodplain storage; Not impede water flows; and not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception Test.

Sourcehttps://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

3 https://www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

Mott MacDonald has followed accepted procedure in providing the services but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, we take no liability for and give no warranty against actual flooding of any property (client's or third party) or the consequences of flooding in relation to the performance of the service. This report has been prepared for the purposes of planning approval only and is to assist our client and the Local Planning Authority to make an informed decision on the flood risks associated with the site redevelopment.

Allowance for the effects of climate change will be made in accordance with government recommendations in place and statistical data available at the time of writing this report. These recommendations may become more onerous, and the statistical data may be revised in the future; we will not make any estimate of what changes may result from this. Please be aware that this, and other issues over which the Mott MacDonald has no control, may affect future flood risk at the development and require further work to be undertaken for which we accept no liability.

2 Existing Site

2.1 Site Location

The proposed development site is centred at National Grid Reference (NGR) TQ 30217 09266 and is located in Patcham, Brighton approximately 5km north of Brighton city centre.

Figure 2.1: Site Location Plan

Source: Google Earth

The carriageway of the A27 is to the north and west of the site, Vale Avenue to the south and allotments to the east. The site is on the periphery of a predominantly residential area located to the south and east.

2.2 Site Description

The existing site consists of seven unoccupied buildings (barns and farmhouses) and one recently tenanted property in the east, as well as access roads and several hard paved areas. The development site area is approximately 1.58ha, with the existing access off Vale Avenue to the south. Topographical data (ref JKK10124-01), included in Appendix A, indicates that the general fall on the site is northeast to southwest, with an approximate 11m level difference between the northern and southern boundaries.

2.3 Existing Site Drainage

No existing drainage records or utilities surveys were available at the time of writing of this report. The topographical survey notes several manholes and inspection chambers on the site which may be part of an existing drainage system.

Sewer records from Southern Water have been obtained and are included in Appendix B for reference. The records show that there is a 150mm diameter combined sewer under Vale Avenue to the south of the site entrance. The manhole to the south of the site on Vale Avenue (ref TQ30092102) is noted to have an invert level of 66.83mAOD and a cover level of 68.81mAOD.

Highway drainage records appear to show a connection from the site to the highway drainage on the A27 to the west of the site, as shown in the extract in Figure 2.2 below. However, no utility or CCTV survey has been able to be completed to date to confirm this connection.

A dye test has been completed to confirm if the existing site communicates with the adopted sewer in Vale Avenue. The existing drainage system was blocked, and no dye made it through to the adopted sewer. More intrusive drainage investigation will be required at detailed design stage to confirm the connection. This activity is currently restricted due to permissions related to planning consent.

Figure 2.2: Highway Drainage

Source: National Highways HADDMS

2.4 Existing Land Drainage

Available topographical data does not appear to show any land drainage within the boundary of the site.

2.5 Existing Watercourse

Ordnance Survey mapping notes there to be a balancing pond 50m west of the western site boundary (immediately west of the A27). The English Channel is located approximately 5km south of the site.

3 Sources and Extents of Flooding

3.1 Summary

Table 3.1: Summary of Sources and Extent of Flooding

Potential Source of Flooding	Is there a risk to the development?	Risk Level	Comment
Fluvial Flooding	No	Very low	In Flood Zone 1
Pluvial Flooding and Overland Flow	No	Very low	Site protected by topography
Ground Water Flooding	No	Low	Groundwater noted to be close to the surface in LLFA guidance, however monitoring boreholes to a depth of 2m bgl did not encounter groundwater
Adopted Drainage	No	Low	Site at a higher level than drainage assets
Highway Drainage	No	Low	Site at a higher level than surrounding roads and highway drainage
Reservoir Flooding	No	Very Low	Mapping shows site outside inundation envelope
Development Drainage	Yes	Medium	Increase in impermeable area requires mitigation using SuDS

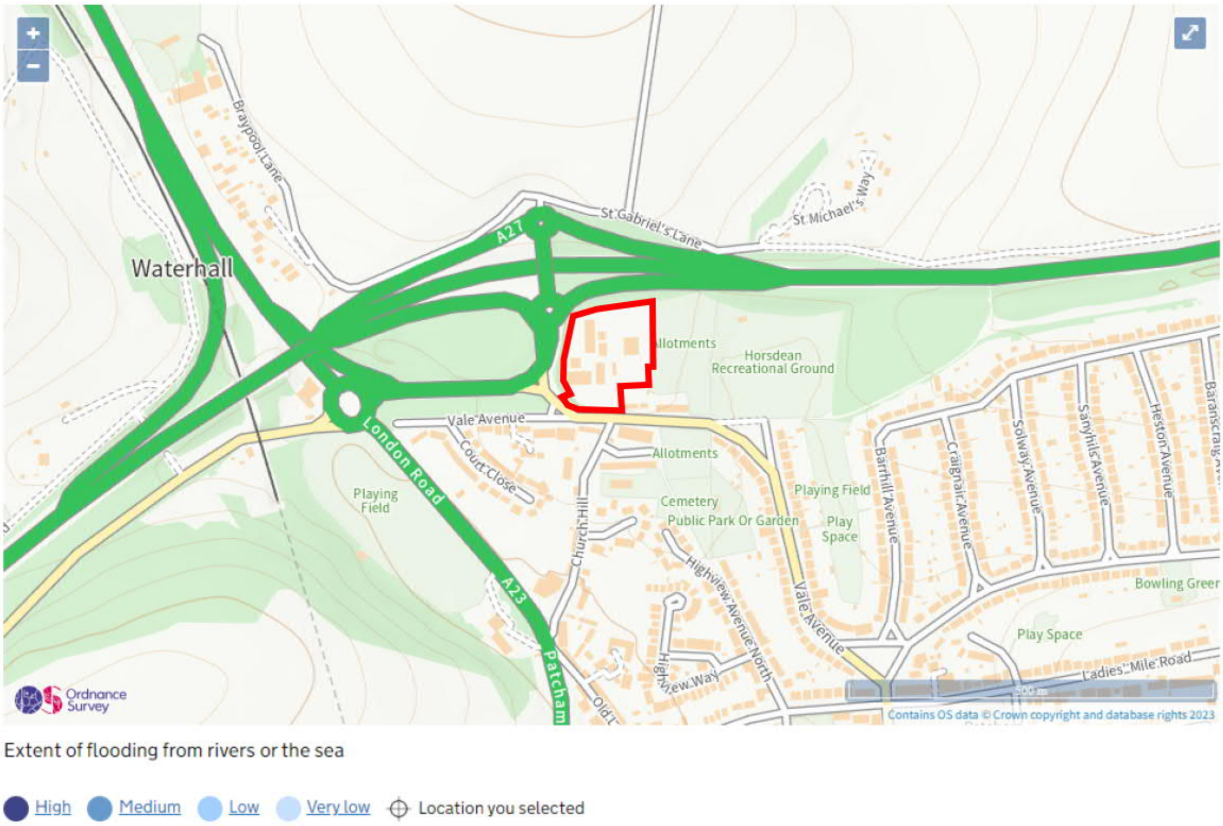
3.2 Natural Drainage

3.2.1 Fluvial Flooding

3.2.1.1 Source and Extent

With reference to the EA's indicative flood maps, accessed June 2023, it can be seen that the whole site lies in Flood Zone 1, which is an area of very low flood risk from fluvial flooding (see Figure 3.1 below).

Figure 3.1: EA Mapping – Fluvial Flood Risk



Source: EA Flood mapping June 2023 © Crown copyright and database rights 2023 OS 100024198.

3.2.1.2 Flood Risk to Development

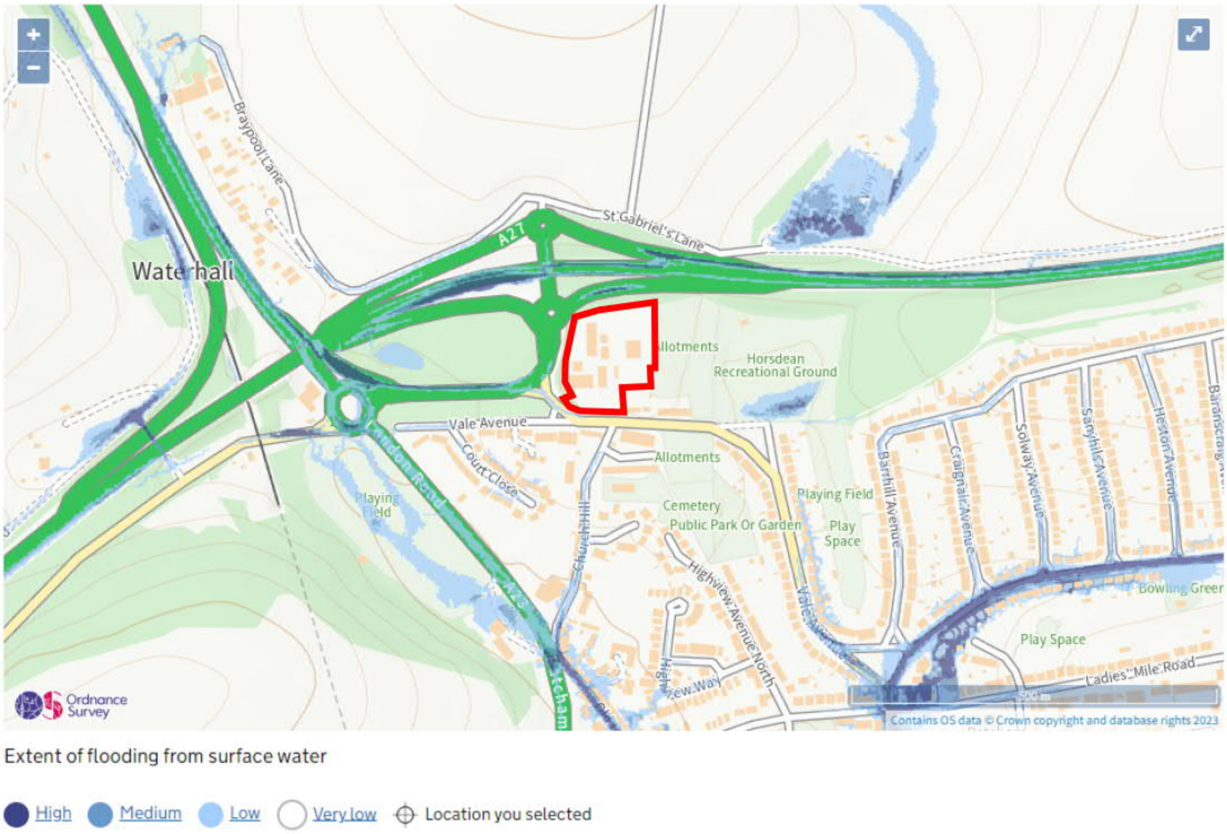
The site is shown to be in Flood Zone 1 and therefore considered to be at very low flood risk, less than 0.1% annual exceedance probability (AEP) from this source.

3.2.2 Pluvial Flooding

3.2.2.1 Source and Extent

With reference to the EA's online mapping, accessed June 2023, data related to the risk of potential surface water inundation or flooding is provided in Figure 3.2 below. This shows that the site lies in an area of very low pluvial flood risk (<0.1% AEP). Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

Figure 3.2: EA Mapping – Pluvial Flood Risk



Source: EA Flood mapping June 2023 © Crown copyright and database rights 2023 OS 100024198.

3.2.2.2 Flood Risk to Development

The site is shown to be in Flood Zone 1 and therefore considered to be at very low flood risk, less than 0.1% annual exceedance probability (AEP) from this source.

3.2.3 Overland Flow

3.2.3.1 Source and Extent

Overland flow is generated by adjacent developments or infrastructure and can be a source of risk in times of extreme rainfall above events their drainage systems are designed for or if they fail or become blocked.

The ground on all sides of the site slopes away from the development site.

3.2.3.2 Flood Risk to Development

As the ground on all sides of the site slopes away from the development site, overland flow is not considered to be a flood risk for this site.

3.2.4 Ground Water Flooding

3.2.4.1 Source and Extent

Topographical data and satellite imagery does not appear to indicate the presence of marshes or ponds within the development site. In addition, the initial site walkover, completed as part of the geotechnical desk study, did not identify any marshes or ponds.

The Brighton & Hove City Council Local Development Framework Supplementary Planning Document 16 on Sustainable Drainage note in Figure 8 of the appendices that groundwater levels in this area are between 0.025m and 0.5m below the ground surface[4].

However, the separately issued Geo-environmental Report reference BDO-MMD-XX-XX-RP-G-0001 notes that groundwater was not encountered in either of the two monitoring boreholes installed at the site, which were installed to depths of 1.50 and 2.00m respectively. Groundwater was encountered in a BGS borehole (historic), located 60m NW of the site, at a depth of 23.80m below ground level (bgl).

3.2.4.2 Flood Risk to Development

It is therefore unclear whether groundwater flooding is an issue on the site due to conflicting information. The monitoring completed on and near the site would appear to indicate that it is unlikely to be an issue, and the steeply sloping nature of the ground profile may also reduce this risk. It is recommended that groundwater monitoring be completed as part of any future ground investigation.

3.2.5 Climate Change

The Environment Agency requires, in accordance with the Government's PPG-TG document, that there should be no increase in the rate of surface water emanating from a newly developed site above that of any previous development. Furthermore, it is the joint aim of the Environment Agency and Local Planning Authorities, to actively encourage a reduction in the discharge of storm water as a condition of Approval for new developments. In addition, all drainage systems should be sized to accommodate the runoff arising from a 1 in 100-year rainfall event, and should include a further allowance to account for the further effects of climate change. Table 3.2 below, shows the anticipated increases in rainfall intensities and river flows with time, and has been reproduced in part from Table 4 of PPG-TG.

Table 3.2: Climate Change Allowances

Type	Event	2050's	2070's
Rainfall	1% Central	20%	25%
	1% Upper End	45%	45%

Source: Climate change allowances for peak rainfall in England (data.gov.uk)

LLFA guidance[4], recommends in LG10 that a minimum 30% increase in rainfall intensity, and ideally a 40% increase in peak rainfall intensity, should be made as an allowance for climate change. The building has a design life of 50 years, which if constructed this year would be until 2073. Therefore, in light of both Table 4 of PPG-TG and the LLFA guidance, a climate change allowance of 45% has been used in the design.

3.3 Artificial Drainage

3.3.1 Adopted Drainage

3.3.1.1 Source and Extent

Sewer records obtained from Southern Water are included in Appendix B for reference.

These records show that there is a 150mm diameter combined sewer flowing west under Vale Avenue to the south of the development site. The sewer is shown to have connections from the adjacent houses to the east of the development. The manhole south of the site on Vale Avenue

[4] https://www.brighton-hove.gov.uk/sites/default/files/migrated/article/inline/SPD%2016%20Sustainable%20Drainage%2010%20October%202019.pdf

(ref TQ30092102) is recorded to have a cover level of 68.81mAOD and an invert level of 66.83mAOD. The sewer then flows south / south west down Church Hill.

3.3.1.2 Flood Risk to Development

As Vale Avenue is at a lower level than the development site, no flood risk is anticipated from this source. There is however a risk that the system could become surcharged as the pipe diameter is small, this could in turn affect the discharge of surface water from the proposed development.

3.3.2 Private Drainage System

3.3.2.1 Source and Extent

No existing drainage records or utilities surveys were available at the time of writing of this report. The topographical survey notes a few manholes and inspection chambers on the site, but it is unclear how the existing site is drained and where the existing site drainage discharges to. Notwithstanding this, as the site was previously developed it is likely that there is an existing drainage system present on site. Survey work completed to date shows that there are two connections to the adopted combined manhole (ref TQ30092102) on Vale Avenue, which are believed to be from the site. Further intrusive survey work is required to confirm this connection and the extents of the existing private drainage system on the site connected to it, however this activity is currently restricted due to permissions related to planning consent.

3.3.2.2 Flood Risk to Development

It has not been possible to fully determine how the current site is drained. The redevelopment of the site will result in the majority, if not all, of the existing on-site drainage being removed / abandoned. As a result, there is not considered to be a flood risk from this source.

3.3.3 Highway Drainage

3.3.3.1 Source and Extent

An extract of the highway drainage records is included in Figure 2.2. The records show that the A27 (to the north and the west) has a positive drainage system, with the section of the A27 to the north of the site flowing east, and the section of the A27 to the west of the site flowing south.

The records appear to show a connection from the development site to the highway drainage. However, no utility records or existing onsite drainage records were available at the time of writing to confirm this.

Vale Avenue to the south of the development site does not appear to have many gullies.

Both Vale Avenue and the A27 to the north and west of the development site are at a lower level than the development site.

3.3.3.2 Flood Risk to Development

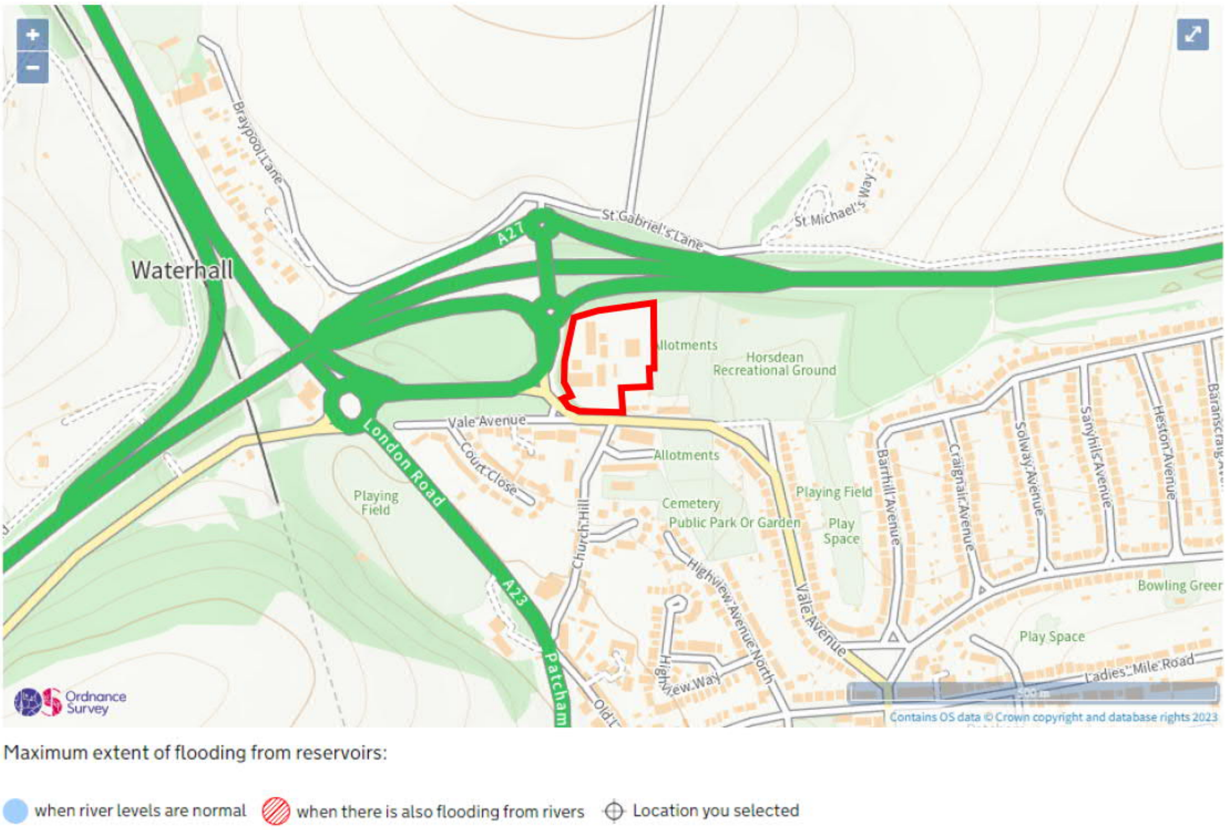
The site is not considered to be at a flood risk from highway drainage as the site is at a higher level than the roads to the north, west and south of the site. Secondary conveyance from the highway drainage system would be retained within the carriageway extents and channelled away from the development site.

3.3.4 Reservoir Flooding

3.3.4.1 Source and Extent

With reference to the EA's online mapping, data related to the risk of potential reservoir flooding is also provided. This is included in Figure 3.3 and shows that the site is not at risk of reservoir inundation.

Figure 3.3: EA Mapping – Reservoir Flood Risk



Source: EA Flood mapping June 2023 © Crown copyright and database rights 2023 OS 100024198.

3.3.4.2 Flood Risk to Development

The site is not at risk of reservoir flooding.

3.3.5 Development Drainage

3.3.5.1 Source and Extent

The current proposed layout for the site is shown in Appendix C.

The total site is approximately 1.58ha in area and includes the following impermeable areas:

- 0.26ha existing buildings
- 0.24ha (approx.) existing hardstanding

For the purpose of this study the remaining area of 1.08ha will be classed as permeable and is predominantly made up of densely vegetated areas and grassland.

The proposed development site is currently planned to include the following impermeable areas:

- 0.40ha proposed delivery office
- 0.92ha proposed hardstanding
- 0.03ha swales (impermeably lined)

For the purpose of this study the remaining area of 0.25ha will be classed as permeable and is proposed to be soft landscaped areas.

A development of this scale is likely to generate relatively large amounts of storm water runoff.

The anticipated unrestricted runoff rate for both the existing and proposed development site is included in Table 3.3. The Lloyd-Davies method has been used (Q=2.78AiC, where A is site area in ha, i is rainfall intensity which for the purpose of this calculation has been taken as 50mm/hr and C is a constant, taken as 1 for this calculation).

Table 3.3: Anticipated Unrestricted Runoff Rate

	Impermeable area (ha)	Anticipated unrestricted runoff rate (l/s)
Existing site	0.50	69.5
Proposed site	1.35	185.6

3.3.5.2 Flood Risk to Development

The development proposals will more than double the impermeable area on the site, this will lead to a notable increase in the runoff rate from the site if left unmitigated.

As the existing drainage routes cannot be proven (at this stage), then the site should be treated as though it were a development on greenfield land. Lead Local Flood Authority (LLFA) guidance[5] states in item NS2 that 'for greenfield developments the peak runoff rate from the development should never exceed the peak greenfield runoff rate for the same event.' This will have a positive impact on flood risk both on the site and in the local area.

As part of the development of the drainage system, consideration needs to be given to the safe exceedance route.

Given the provision of new attenuation on the site, the reduction in runoff post-development and the provision of safe exceedance routing it is considered that the flood risk from this source is low and can be safely managed for the lifetime of the development. More detail on the strategy to achieve this is included in Section 5.

[5] https://www.brighton-hove.gov.uk/sites/default/files/migrated/article/inline/SPD%2016%20Sustainable%20Drainage%2010%20October%202019.pdf

4 Sequential Test

As the development site is shown to be wholly within Flood Zone 1 and outside the influence of any other local flood risk elements, in accordance with table 3 of the PPG it is concluded that the development is suitable for this location and the Sequential Test is deemed to have been passed.

5 Flood Risk Mitigation

5.1 Summary

Of the identified flood risks, the residual risk to be addressed at this stage is:

- Runoff generated by the development site.

5.2 Control of Surface Water Run-off

It should be acknowledged that the satisfactory collection, control and discharge of storm water is now a principal planning and design consideration. This is reflected in recently implemented guidance and the National SuDS Standards.

Part H of the Building Regulations 2015 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

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

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

5.2.1 Infiltration Based Systems

The separately issued Geo-environmental and Geotechnical desk study notes that three soil infiltration tests have been completed but that none of the infiltration tests was completed in the allotted time in accordance with BRE Digest 365. The 2019 Ground Condition Assessment attributed the results to a high proportion of silt content in the underlying materials.

The interpolated infiltration rate from the tests completed in 2019, suggest an infiltration rate in the region of $1x10^{-6}$ m/s. This rate is likely to be too low to be the primary means of surface water discharge for the development.

It should also be noted that the site is located above a Source Protection Zone 1 aquifer[6]. Infiltration into a Source Protection Zone 1 aquifer would require additional measures to improve the water quality prior to infiltrating into the ground.

As the infiltration rate is poor, and as the site is located above a Source Protection Zone 1 aquifer, infiltration for this site has been discounted.

Therefore, other means of surface water discharge shall be considered as the primary means of disposal of surface water.

5.2.2 Watercourses

Ordnance Survey mapping notes there to be a balancing pond 50m west of the western site boundary (immediately west of the A27) which is thought to exclusively serve the carriageway of the A27. The English Channel is located approximately 5km south of the site. A connection to

[6] https://www.brighton-hove.gov.uk/sites/default/files/migrated/article/inline/SPD%2016%20Sustainable%20Drainage%2010%20October%202019.pdf

the balancing pond is considered impractical as this would involve culverting under the A27. It's also not known who owns the balancing pond. Therefore, a connection to a watercourse has been discounted.

5.2.3 Adopted Sewers

As infiltration and a connection to a watercourse do not look like viable options for the site, a connection is proposed to the adopted sewer to the south of the development site. The adopted sewer is shown in the Southern Water maps included in Appendix B. The sewer is noted to be 150mm diameter, with the invert level of the manhole south of the site (ref TQ30092102) at 66.83mAOD. A dye test has been completed to confirm if the existing site communicates with the adopted sewer in Vale Avenue. The existing drainage system was found to be blocked, and no dye made it through to the adopted sewer. A more intrusive drainage investigation is required at detailed design stage to confirm the connection. This activity is currently restricted due to permissions related to planning consent.

Providing that the connection can be confirmed, and that the proposed flows from the site are no greater than historic, Southern Water note in their correspondence, received 15th May 2023 (included in Appendix B), that a surface water connection can be made to the combined sewer south of the development site at manhole TQ30092102 on Vale Avenue at a rate of 1.5l/s. Alternatively, Southern Water note that a surface water connection could be made at a rate of 3.0l/s to the surface water sewer on London Road at manhole reference TQ30081950.

In either case, the connection will be subject to a Section 106 approval at the appropriate time.

The LLFA would also need to approve the connection and flow rate.

It should also be noted that there may be a National Highways drain to the northwest of the site, as shown in Figure 2.2. However, there is a chance this may not be a real connection, and the levels are such that a gravity connection would not be possible to drain the entirety of the site. In addition, the LLFA notes that National Highways (formerly Highways England) specifically state that "no water run off that may arise due to any change of use will be accepted into the highway drainage systems, and there shall be no new connections into those systems from third party development and drainage systems".

Where there is already an existing third-party connection the right for connection may be allowed to continue providing that the input of the contributing catchment to the connection remains unaltered". In light of the guidance from National Highways, a connection to the highway drainage would not be accepted.

5.3 Allowable Site Discharge

As noted in section 5.2.3, historic connections from the site need to be confirmed to Southern Water assets, and providing the proposed discharge rate is no greater than historic rates, Southern Water will allow a discharge of 1.5l/s to the manhole on Vale Avenue (ref TQ30092102) to the south of the site. Alternatively, Southern Water may also allow a surface water discharge rate at 3.0l/s to the surface water sewer on London Road (manhole ref TQ30081950).

A connection to the manhole on Vale Avenue is likely to be more straightforward to connect to due to the proximity to the site, in comparison to a connection to the manhole on London Road which is approximately 300m away from the site.

A flow rate of 1.5l/s is likely to require small orifice diameters (<75mm) to restrict the flow. Systems should pass through permeable paving (impermeably lined), or other robust debris management processes before passing through the orifice, to reduce the risk of blockage. In addition, safe exceedance routes should be incorporated into the site layout/drainage design.

5.4 Site Attenuation

The provision of suitable attenuation on-site to mitigate flood risk resulting from the proposed development will be a key factor in the evolution of the site development layout.

The provision of large volumes of attenuation, as is likely in this case, can be achieved by a number of methods; however, not all systems can be assessed in direct comparison.

One of the aims of PPG is to provide not only flood risk mitigation but also maximise additional gains such as improvements in runoff quality and provision of amenity and bio-diversity. Systems incorporating these features are often termed Sustainable Drainage Systems (SuDS) and it is a requirement of PPG that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

The volume of attenuation required for the development may be estimated using design software. The proposed impermeable areas taken from the current layout may be used to evaluate the runoff response of the site during varying rainfall events.

Attenuation has been provided using a combination of impermeably lined permeable paving and impermeably lined geocellular storage using orifice and vortex flow controls. Two options are provided in the below table, restricting flows to 3.0l/s and 1.5l/s as noted in section 5.3..

More detail of the surface water drainage strategy is included in Section 5.8, and in the drainage masterplan included in Appendix D.

The software uses the FSR characteristics of M5-60 = 19.9 mm and ratio R = 0.342.

	Impermeable Area	Anticipated Unrestricted Run-off	Flow Restriction	Estimated Attenuation Volume (1 in 100 + 45% CC
	ha	ls^{-1}	ls^{-1}	m^3
Whole Site (drained by private system)	1.31	182.1	3.0	1620
Whole Site (drained by private system)			1.5	2100

Source: Microdrainage Calculation

Undeveloped areas within the site boundary have not been considered as it is assumed that drainage of these areas will be as existing.

5.5 Sustainable Drainage Systems (SuDS) and Water Quality

The most appropriate attenuation system should satisfy four main characteristics:

- Provide the required volume of storage to satisfy water quantity requirements
- Provide the required level of treatment to satisfy water quality requirement
- Maximise biodiversity
- Provide local amenity

A summary of the various types of attenuation is included below.

The application of the 'SuDS Manual' CIRIA report C753 for new developments requires that the runoff from sites is not only restricted to meet the pre-development runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses.

The manual and EA guidance applies a sustainability hierarchy to the various types of SuDS systems, this is summarised in Table 5.1.

Table 5.1: SuDS Hierarchy

	SuDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
Most Sustainable	Living Roofs	√	√	√
↑	Basins and Ponds - Constructed Wetlands - Balancing Ponds - Detention Basins - Retention Ponds	√	√	√
	Filter strips and swales - Infiltration devices - Soakaways - Infiltration trenches and basins	√	√	√
↓	Permeable surfaces and filter drains - Gravelled areas - Solid paving blocks - Porous paviours	√	√	
Least Sustainable	Tanked Systems - Oversized pipes/ tanks - Cellular Storage	√		

Source: CIRIA SuDS Manual C753

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where some systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy. However, included below are summaries of some of the main types of SuDS systems that may be applied to the development outlining the main benefits and constraints to their application.

5.5.1 Living or Green Roofs

Larger areas of roof may be designated as living or green roofs to provide both point water treatment and significant enhancement of local biodiversity. The assessed gains are such that these systems are the preferred EA option for the provision of SuDS.

If considered at the outset of the design of a unit, a green roof can be integrated within the provision of a roof terrace area to multiply the benefits, alternatively, a maintained roof can be installed that may require specialised access.

There are numerous propriety systems available on the market to suit various specific applications and it is recommended that if these systems are being considered discussion with several suppliers is instigated as soon as possible.

Green roofs are proposed on the smaller northern and southern roofs. The green roofs would improve water quality, enhance biodiversity and provide amenity benefits. They will also provide interception for small rainfall events (typically the first 5mm of rainfall would be intercepted).

5.5.2 Ponds and Basins

The nature of these systems is such that the run-off from the development can be treated by biological action and stilling to significantly improve the quality of water discharged from the system.

Basins also provide large areas of open space that can be developed for recreational uses or as new habitat for wildlife.

Both systems do, however, take up developable land and have residual maintenance and liability issues attached to their implementation.

The steeply sloping nature of the site, and proposed layout would make ponds and basins difficult to economically incorporate on the site and have therefore been discounted.

5.5.3 Filter Strips and Swales

Often used adjacent to roads and footpaths, swales and filter strips can be used to collect water directly from linear features, percolate some of the flow, attenuate and then discharge the flow to either a traditional system or a secondary SuDS device.

The use of these systems is more suited to linear applications such as roads as the typical cross section is relatively small and longer runs are required to provide attenuation volume.

Filter strips will be smaller in plan area than a swale although the swale can be landscaped to be incorporated into the verge of the carriageway, combining two functions.

Land take can be relatively small in comparison to other systems and both types perform well in improving water quality. They are also ideally suited for disposal of water via secondary infiltration, however as the site is located above a SPZ1 aquifer, secondary infiltration is not suitable and such swales will need to be lined with an impermeable membrane.

Impermeably lined swales are proposed immediately west and east of the building and along the eastern site boundary. The use of this system would have significant biodiversity and habitat creation benefits, as well as providing improvements to water quality.

5.5.4 Rain Gardens

Rain gardens are designed to mimic the natural water retention of undeveloped land and reduce the volume of rainwater running off into drains from impervious areas. They also have the added benefit that they are able to treat low levels of pollution. In construction, they are shallow depressions with absorbent, yet free draining soil which are populated with plants that are able to withstand temporary flooding conditions.

This type of system not only has the advantage of meeting the requirements of SuDS but could also provide additional educational benefits for certain sites.

A rain garden would be difficult to incorporate on the site, due to the steeply sloping nature of the site. In addition, a rain garden would not be suitable as the site is located above a SPZ1 aquifer and therefore systems should not infiltrate into the ground.

5.5.5 Permeable Paving

Larger areas of block paved hardstanding can easily be converted to provide significant volumes of storage. These systems also encourage biological treatment of flow and extraction of oils and heavy metals from the run-off.

Land take is reduced as storage is located under car parks and access roads. However, maintenance is potentially a long-term issue and the possibility of the paving being damaged, dug up and not properly reinstated or not regularly swept could lead to compromising the future capacity of the system.

This system will negate the need for a separate collection system such as kerbs and gullies. It will also assist in reducing the flood profile of the site by significantly attenuating the run-off from the development within the sub-base material.

There is no specific amenity provided by the system other than enabling other areas to be utilised for development rather than potentially sterilizing area with an easement for a sewer or stand-off for a basin.

These systems may be incorporated into normal car-parking areas and driveways but may not be suitable for areas accessed by larger vehicles. These systems can also be used in conjunction with geo-cellular attenuation where attenuation volume requirements are large.

Much of the site area is proposed to be taken up with car parking areas. Permeable paving has therefore been proposed in the majority of the car parking areas. All the permeable paving is proposed to be lined with an impermeable membrane to prevent infiltration, due to the site being located above a SPZ1 aquifer. Consideration has been given to the anticipated loadings as permeable pavements may not be suitable in areas with high vehicular loading, and therefore permeable paving has not been included in areas with high vehicular loading. The topography of the site is quite steep, and therefore recommended that a permeable paving system should be connected to flow controls at different levels, with the base of the permeable paving laid flat so as to utilise a greater proportion of sub-base for attenuation.

5.5.6 Cellular Storage

Large volumes of storage can be provided under grassed and lightly trafficked areas by using proprietary geo-cellular systems. This will maximise the developable area of the site.

There are no specific mechanisms within the system designed to treat flow, but extended detention times will allow sedimentation reducing the suspended solids within the discharge.

There is no creation of amenity by the installation of these types of systems, indeed by maintaining access to the system small areas may need to be reserved.

If the developable footprint is constrained then these systems may be advantageous, however, to ensure suitability it is recommended that the use of these systems is discussed with the maintaining body as they are not always preferred.

The installation of cellular storage requires significant excavation and therefore where space is not a critical issue other forms of attenuation should be considered. These systems will also require occasional maintenance to remove sediments which can be difficult depending on the design and access arrangements.

Cellular storage has been proposed towards the southern boundaries of the site to provide additional volumes of attenuation.

5.5.7 Tank or Culvert Storage

Hard engineered tank storage systems have traditionally been used for attenuation structures for the past decade and are often specified where large volumes of storage are required (>200m^3) and available space is an issue.

These systems have no inherent water treatment properties except potential sedimentation of the attenuated flow and offer no additional amenity benefits. In some cases, the easement to the tank or culvert is such that a significant portion of land area is sterilized from development as are certain types of landscape planting.

There are also significant costs associated with these systems in production, transportation, and installation. However, once installed the long-term maintenance requirement of the system is relatively low.

With a proven record of successful installation, tanks and culverts are regularly adopted by water authorities across the country, albeit with a large associated easement that will sterilise that portion of the site. It should be noted however, that these systems will require occasional maintenance to remove sediments which can be difficult depending on the design and access arrangements.

As systems further up the SuDS hierarchy should be viable for this site, tank or culvert storage has been discounted at this stage.

5.5.8 Surface Storage

The use of roads, public areas and even landscaped areas as additional storage for an extreme rainfall event is becoming a widely accepted form of attenuation.

Water spilling from the drainage systems can be collected via roads and kerbs and channelled to lower lying areas where it would be stored until the capacity in the existing system returns.

These systems have the advantage of requiring little additional infrastructure merely detailing of the proposed roads and grassed areas.

As these systems will only by used in extreme events when the adopted drainage system is exceeded (>1 in 30 years), they provide a very efficient way of catering for these events rather than providing permanent capacity.

There is no inherent water treatment capability in this system nor any particular increase in amenity, however, the costs associated with this provision are relatively small.

Surface storage would be difficult to incorporate on the site due to the steeply sloping nature of the development. Significant adjustments to the levels would be required for this to be a viable option on any sort of scale.

5.5.9 Oversized Pipework

It is often possible to provide the required volume of storage within the existing collection pipework of the proposed system. This may be incorporated by using oversized pipework designed to act as inline storage.

As the diameter of larger pipes readily available is limited the applicability of these types of systems is more suited to <200m^3 of attenuation. Above this volume, the length of pipe required is excessive and difficult to suitably fit into a normal site layout.

There is no intrinsic amenity provided by the use of this system neither is there any specific level of run-off treatment over and above that of a standard pipe and gully system.

However, due to their traditional nature, the adoption of these types of systems by water companies is straightforward and does not require any specialist input. The pipes are generally available direct from suppliers with little or no lead time and the satisfactory long term performance of these systems is well documented.

As the site is steeply sloping oversized pipework would not be an efficient method for surface water storage, with this system unlikely to be suitable to provide the required volume of attenuation. In addition, there are other SuDS methods that are higher up the SuDS hierarchy, as such these types of systems have been discounted.

5.6 Runoff Quality

Receiving watercourses are sensitive to water quality in varying degrees. Discharges to ground and watercourses will require more treatment than to a public sewer.

In this case the site is proposed to discharge to the Southern Water combined sewer.

Therefore, the receiving watercourse is classified as having a low sensitivity and the runoff as high pollutant hazard potential based on the proposed land use.

Table 5.2: Summary of Pollution Index Table from SuDS Manual

Land use	Pollution Hazard level	Total Suspend ed Solids (TSS)	Metals	Hydro-carbons
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

Source: SuDS Manual C753 Table 26.2

Total SuDS Mitigation index = mitigation $index_1$ + 0.5 (mitigation $index_2$)

Table 5.3: Indicative SuDS mitigation indices for discharges to surface waters

Land use	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Bioretention system	0.8	0.8	0.8
Impermeably lined permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment system	These must demonstrate that they can address each of the containment types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Source: SuDS Manual C753 Table 26.3

The above tables note that the impermeably lined permeable paving on its own would be able to provide the required level of treatment for surface water runoff for all but the HGV access area of the site. Additional measures are also proposed, including impermeably lined swales and green roofs.

The HGV access area is proposed to have a separate drainage collection system to the rest of the site due to the higher pollution hazard level. The surface water runoff from this area is proposed to pass through a full retention interceptor, before discharging into the attenuation system.

5.7 SuDS Summary

The application of a SuDS based system needs to be considered as the primary measures for dealing with surface water for any proposals, these systems are the only ones that provide the required level of treatment.

The natural topography and nature of the site is such that a combination of SuDS features are proposed to provide a wealth of SuDS benefits. These include impermeably lined permeable paving in the car parking areas, green roofs, impermeably lined swales adjacent to the building and to the east of the site boundary, as well as geocellular storage to provide additional attenuation.

The HGV access area has an increased pollution hazard level and is proposed to be drained by a separate drainage collection system, with surface water passing through a full retention interceptor.

The Ground investigation indicates that infiltration is not viable for the primary means of surface water discharge for the site. In addition, as the site is located above a Source Protection Zone 1 aquifer it is proposed that infiltration is not included in the discharge strategy and that all SuDS features will be lined to prevent infiltration on the site.

This type of system described above will not only provide the required attenuation for the site but would also enable the features to be integrated with the existing natural habitat and also provide water quality improvements to the flow prior to discharge.

5.8 Design Example

In order to give some idea of the size of attenuation features that may be required and thus begin the process of integration, a preliminary drainage design has been completed and is included in Appendix D based upon the assumptions discussed previously. The calculations for which are included in Appendix E.

The design makes use of green roofs, permeable paving, geo-cellular storage and swales. Permeable paving, geo-cellular storage and swales are to be lined with an impermeable membrane to ensure runoff from impermeable areas on the development site does not infiltrate into the ground. Multiple flow controls have been utilised due to the steeply sloping nature of the site. With source control measures utilised where possible, including green roofs, swales and permeable paving. The design, illustrated in Appendix D, limits the peak flow rate using a series of orifice plates and vortex flow controls to limit the flow to 1.5l/s in the critical 1 in 100yr + 45% Climate Change event, before discharging to the adopted combined sewer under Vale Avenue. Restricting flows to 1.5l/s requires a total attenuation volume of approximately 2100m^3. An alternative option is to limit flows to 3.0l/s for the 1 in 100yr + 45 Climate Change event, discharging to the sewer under London Road to the south (approximately 300m away from the site), this option requires approximately 1620m^3 of attenuation.

Pollution is managed through the use of impermeably lined permeable paving and impermeably lined swales for all but the HGV area of the site. Runoff from the HGV area is to be drained using a separate collection system and is proposed to pass through a full retention interceptor.

The levels of the access road along the southern boundary are such that a gravity connection to the adopted sewer on Vale Avenue is not possible. As such, this area is proposed to be pumped to the geocellular storage upstream of the final flow control. The area to the south of the site is designed to pass through a full retention interceptor outfalling to geocellular storage upstream of the pump. The geocellular storage has a dual purpose, both to reduce the pump rate required and also to act as secondary storage in the event of pump failure.

5.9 Exceedance Routing

The performance of the system during extreme events (>1 in 100 years) should also be considered at this stage.

The routing of potential storm water run-off, should the capacity of the proposed site drainage system be exceeded, needs to be built into the layout of the site such that the residual risk of flooding from this element can be easily mitigated.

Due to the steeply sloping nature of the site, surface storage of flood water is difficult to achieve, as such the system has been designed to the 1 in 100yr + 45% Climate Change event. In the event that the drainage system is exceeded, flood water would run down the access road off the site onto Vale Avenue to the south. Available level information would indicate that the water would head west along Vale Avenue. Runoff would likely be picked up in the highway drainage system if there is spare capacity.

5.10 Foul Drainage

The proposed development includes toilets, cleaning and kitchen facilities inside the new building which will require foul drainage. Externally, the proposals include an oil, air and water unit and jet wash station which will require foul drainage.

The drainage masterplan included in Appendix D shows a provisional foul drainage layout that discharges to the combined sewer on Vale Avenue to the south of the development site. A pre-development enquiry has been completed for the development, and Sothern Water have confirmed that a gravity connection to the adopted assets in Vale Avenue is permissible.

Trade effluent discharges may be required from the site and will need to be agreed with the wholesale provider in due course.

5.11 Flood Resilience and Resistance

Notwithstanding the flood classification of the site, the development of any new building should consider measures that will make the development more flood resilient in the event of an unforeseen or ultra-extreme flood scenario.

If considered at the genesis of the design process, relatively simple and inexpensive measures can be taken to enhance the flood resilience of any building. These include things such as first floor down power and data, locating meters and distribution equipment at high-level and the use of solid or drained floor slabs and resilient finishes such as tiles screed on ground floors.

More information is available in the DEFRA publication *'Improving the flood performance of new buildings: flood resilient construction'*[7].

5.12 Adoption and Maintenance

The system is to remain private upstream of the demarcation chamber at the south of the site. The demarcation chamber and the connection to the Southern Water assets should be adopted by Southern Water.

Maintenance of all the system, bar those adopted by Southern Water, is the responsibility of Royal Mail.

To assist in the preparation of the operation and maintenance manual of these systems which will be issued at the practical completion stage of the scheme, a typical inspection and maintenance regime has been included for the proposed SuDS features in this report. This

[7] https://www.gov.uk/government/publications/flood-resilient-construction-of-new-buildings

maintenance regime should be reviewed and updated as the design progresses and after the systems have been constructed and tested on site. An example maintenance regime is included in Appendix F.

6 Conclusions and Recommendations

The report concludes that the existing site is located in an area of very low fluvial flood risk and can be considered to be in Flood Zone 1.

Pluvial flood risk on site is not noted to be an issue, according to Environment Agency mapping. The Less Vulnerable development type is therefore appropriate for this site.

The residual flood risk associated with the development is the management of surface water from the development site itself.

The report concludes that this risk can be mitigated for the lifetime of the development.

It is unlikely that infiltration will be a viable means of primary surface water discharge on this site, based on soakaway test results noted in the geo-environmental and geotechnical desk study.

It should also be noted that the site is located above a Source Protection Zone 1 aquifer. As the infiltration rate is poor, and as the site is located above a Source Protection Zone 1 aquifer, infiltration for this site has been discounted and all proposed SuDS features are to be lined with an impermeable membrane to prevent infiltration.

A dye test has been completed to attempt to confirm if the existing site communicates with the adopted sewer in Vale Avenue. The existing drainage system was blocked, and no dye made it through to the adopted sewer. A more intrusive drainage investigation is required at detailed design stage to confirm the connection. This activity is currently restricted due to permissions related to planning consent. If a connection from the site can be proven and providing the proposed discharge rate is lower than the historic rate, Southern Water have confirmed that a surface water discharge rate of 1.5l/s is permissible to the manhole in Vale Avenue (ref TQ30092102), alternatively a connection is also permissible at a surface water discharge rate of 3.0l/s to the manhole on London Road (ref TQ30081950).

The development will result in an increase in impermeable area. A SuDS based system has been proposed using a number of SuDS features, and both orifice and vortex flow controls to limit flows during the critical 1 in 100yr + 45% Climate Change event to 1.5l/s if connecting to the manhole in Vale Avenue (ref TQ30092102) or to 3.0l/s if connecting to the manhole on London Road (ref TQ30081950). The proposed flow restrictions are in accordance with the correspondence received to date from Southern Water (see Appendix B). The proposed point of discharge will require an S106 application to Southern Water and approval from the LLFA.

It is proposed that runoff from the proposed adopted highway at the site entrance and the proposed adopted footpath in the south falls towards the carriageway and is drained by the existing highway drainage system.

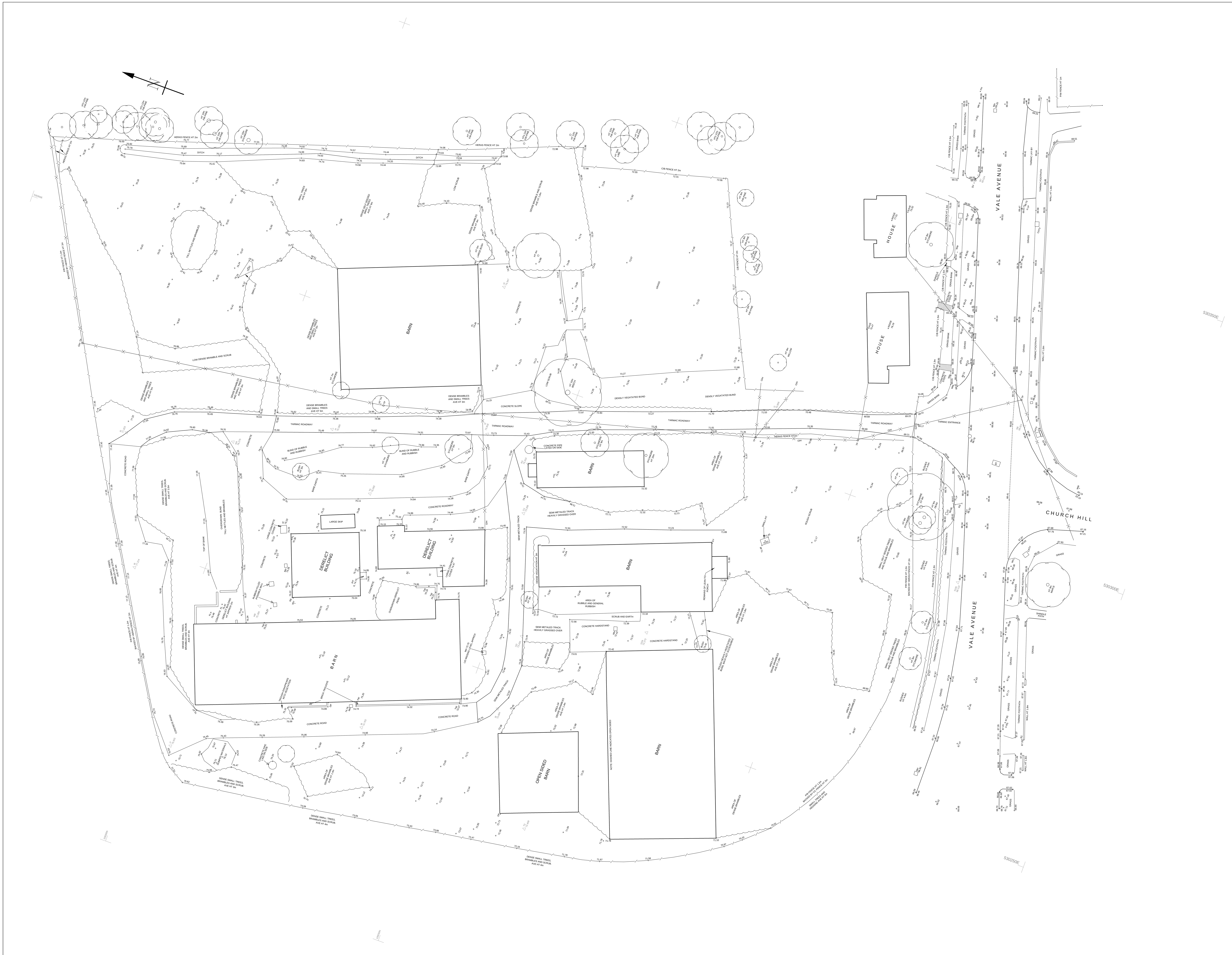
The drainage design included in Appendix D, includes green roofs, swales, permeable paving and geocellular storage. This system will provide water quality, biodiversity and amenity benefits in line with the requirements of the SuDS manual. Permeable paving, geo-cellular storage and swales are to be lined with an impermeable membrane to ensure runoff from impermeable areas on the development site does not infiltrate into the ground.

The HGV areas are to drain using a separate collection system to the rest of the site and should pass through a full retention interceptor to provide the required level of treatment.

Foul drainage for the scheme should discharge via gravity to the combined sewer on Vale Avenue, which Southern Water have confirmed is permissible.

The system is to remain private upstream of the demarcation chamber at the south of the site. The demarcation chamber and the connection to the Southern Water assets should be adopted by Southern Water. Maintenance of the private drainage system is the responsibility of Royal Mail. An example maintenance regime is included in Appendix F.

A. Topographical Data



Notes

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2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

SURVEY KEY

AV	AIR VALVE	LB	LETTER BOX
BL	BOLLARD	LP	LAMP POST
BM	BENCH MARK	L/L	LARCH LAP
BN	BEACON	MB	MULTI BORE
BS	BUS STOP SIGN	MH	MANHOLE
BT	BRITISH TELECOM COVER	MK	MARKER POST
B/W	BARBED WIRE	MW	MONITORING WELL
CB	CONTROL BOX	NP	NAME PLATE
CCTV	CLOSED CIRCUIT TV	O/H	OVERHEAD CABLE
CL	COVER LEVEL	P	POST
C/I	CORRUGATED IRON	PM	PARKING METER
C/L	CHAIN LINK	P/R	POST AND RAIL
CONC	CONCRETE	P/W	POST AND WIRE
CPS	CONCRETE PAVING SLABS	RE	RODDING EYE
COL	COLUMN	RS	ROAD SIGN
C/B	CLOSE BOARDED	RWP	RAIN WATER PIPE
CNP	CHESTNUT PALING	SC	STOP COCK
C/P	CONCRETE PANEL	SF	SOFFIT LEVEL
CTV	CABLE TV	SP	SIGN POST
D	TRUNK DIAMETER	S/R	STEEL RAILING
DP	DOWN PIPE	ST	STUMP
DPC	DAMP PROOF COURSE	SV	STOP VALVE
EB	ELECTRICITY BOX	SW	SURFACE WATER
EC	ELECTRICITY COVER	TACT	TACTILE PAVING
EP	ELECTRICITY POLE	TCB	TELEPHONE CALL BOX
ER	EARTH ROD	TLC	TRAFFIC LIGHT IC COVER
FL	FINISHED FLOOR LEVEL	TP	TELEPHONE POLE
FH	FIRE HYDRANT	TW	TOP OF WALL LEVEL
FW	FOUL WATER	UTL	UNABLE TO LIFT
GL	GROUND LIGHT	VC	UNKNOWN VALVE COVER
GM	GAS METER	VP	VENT PIPE
GP	GATE POST	WCL	WINDOW CILL LEVEL
GV	GAS VALVE	WHL	WINDOW HEAD LEVEL
GY	GULLY	WL	WATER LEVEL
IC	INSPECTION COVER	WM	WATER METER
IL	INVERT LEVEL	W/M	WIRE MESH
INV	DITCH INVERT LEVEL	WO	WASH OUT VALVE
I/R	IRON RAIL	W/P	WOOD PANEL
KO	KERB OUTLET		

1. UNDERGROUND DRAINAGE INFORMATION HAS BEEN MEASURED FROM SURFACE INSPECTION ONLY AND SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CONFIRMED BY SPECIALISTS IF CRITICAL.
3. SURVEY GRID & LEVELS RELATED TO ORDNANCE SURVEY NATIONAL GRID. OBTAINED THROUGH REAL TIME GPS OBSERVATIONS.

Station	Easting	Northing	Level
I1	530309.268	109216.708	70.856
I2	530288.407	109262.296	73.818
I3	530313.196	109268.270	74.347
I4	530280.021	109287.681	75.390
I5	530267.347	109320.731	77.203
I6	530246.004	109311.482	77.214
I7	530219.245	109295.120	75.631
I8	530233.489	109265.306	74.702
I9	530244.586	109244.395	73.664
I10	530257.709	109244.749	73.435
I11	530277.717	109251.744	73.358
I10A	530265.688	109224.806	72.273
I4A	530272.122	109302.977	76.275
I4B	530247.122	109288.979	75.284
I96	530321.426	109175.871	68.621
I97	530359.262	109198.042	69.524
II100	530292.209	109177.421	68.122

Rev	Description	By	Ckd	Date
C	ROAD LEVELS AMENDED	IMS	DR	30.08.18
B	ADDITION OF VALE AVENUE AND EXTRA BOUNDARY DETAIL	IMS	DR	23.08.18
A	ORIGINAL DRAWING ISSUE	IMS	JL	17.8.18

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Client

Project PATCHAM COURT FARM, VALE AVENUE, BRIGHTON, BN1 8YF

Title TOPOGRAPHICAL SURVEY

Status	Scale	Date Created
FINAL	1:200 @A0	17.08.2018
Project Leader	**Drawn By**	**Checked by**
AHP	IMS	JL

Document Number	Revision	Suitability
JKK10124- 01	C	
Project Number / Originator - Zone - Level - Type - Role - Drawing Number		

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B. Southern Water Maps and Correspondence

(c) Crown copyright and database rights 2021 Ordnance Survey 100031673 | Date: 03/08/21 | Scale: 1:500 | Map Centre: 530233,109256 | Data updated: 19/07/21 | Our Ref: 613837 - 1 | Wastewater Plan A0

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2021 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer | Combined Gravity Sewer | Culverted Water Course or Treated Effluent | Surface Water Gravity Sewer | Rising Main, Vacuum or Syphon | Combined Outfall | Foul Outfall | Surface Water Outfall | Surface Water Inlet | Combined Pumping Station | Surface Water Pumping Station | Foul Pumping Station | Water Treatment Works | Section 104 Area | Building Over Agreement Area | Foul Manhole | Combined Manhole | Surface Water Manhole | Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

john.lea-wilson@mottmac.com

A27 / Vale Ave

WATER for LIFE from Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
1002	C	62.27	60.63	
2101	C	69.18	67.94	
2102	C	68.81	66.83	
9001	C	50.02	47.19	
0101	F	58.43	55.23	
1001	F	58.77	55.57	
3101	F	59.59	58.65	
3102	F	59.60	58.70	
3103	F	59.83	58.89	
4005	F	56.91	56.07	
4006	F	57.00	56.18	
4011	F	56.23	54.97	
4012	F	56.26	55.06	
4018	F	57.42	56.54	
4019	F	56.38	55.37	
4102	F	56.51	56.01	
4103	F	56.68	56.28	
9101	F	56.02	53.04	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

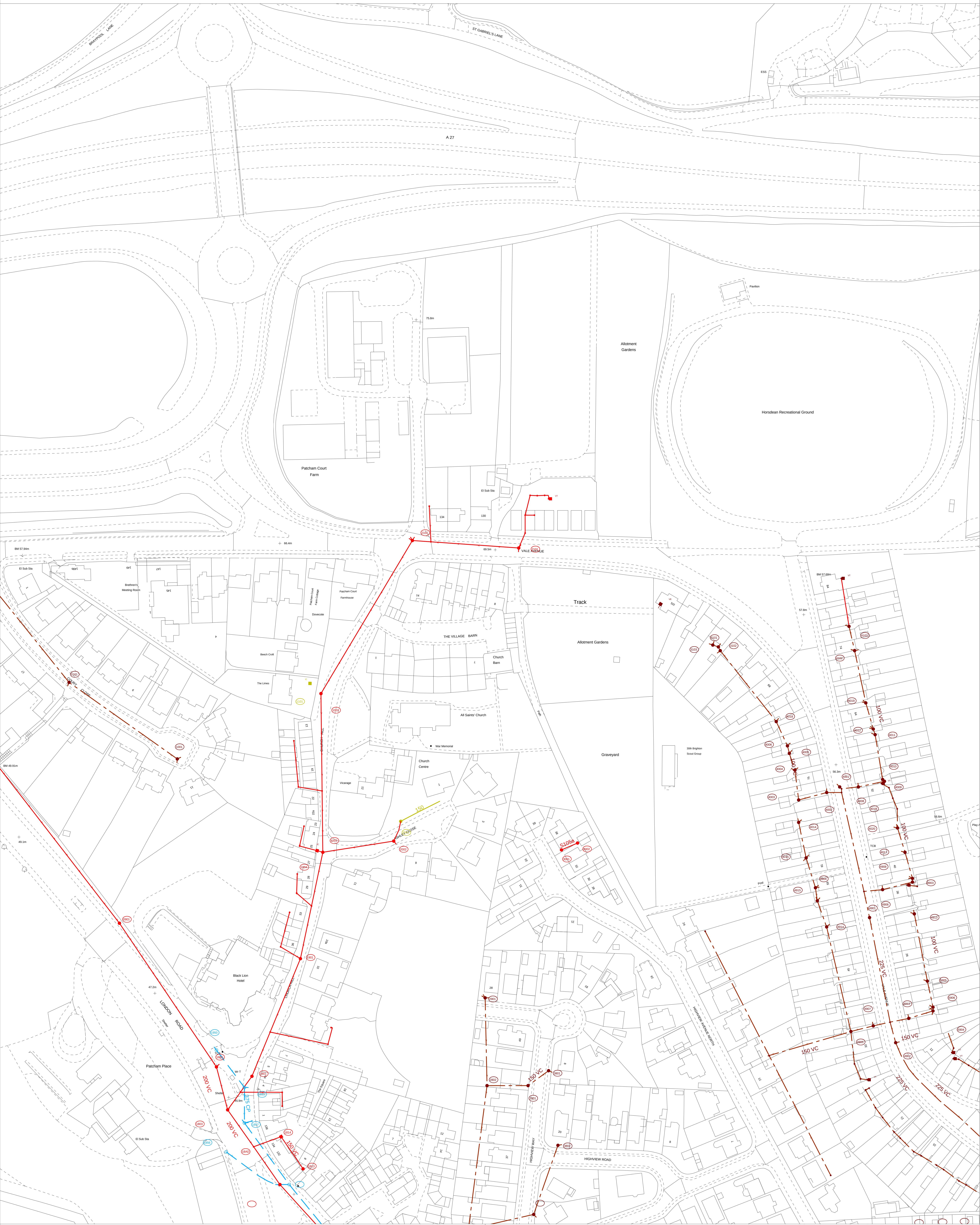
Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert



Southern Water

From: Southern Water Planning <SouthernWaterPlanning@southernwater.co.uk>
Sent: 15 May 2023 13:04
To: Andrew Precious <Andrew.Precious@mottmac.com>
Subject: RE: 2023 0123 - DSA000018192

Good Afternoon Andrew,

I hope you are well? It has been established that;

- The enquiry has been reassessed to determine the capacity for the surface flow at manhole reference TQ30081950.
- The assessment indicates that there is sufficient capacity in the local surface network to accommodate a surface flow no greater than 3 l/s at manhole reference TQ30081950.
- The enquiry has been assessed to determine the capacity for the surface flow at manhole reference TQ30092102.
- The assessment indicates that there is sufficient capacity in the local surface network to accommodate a surface flow no greater than 1.5 l/s at manhole reference TQ30092102.

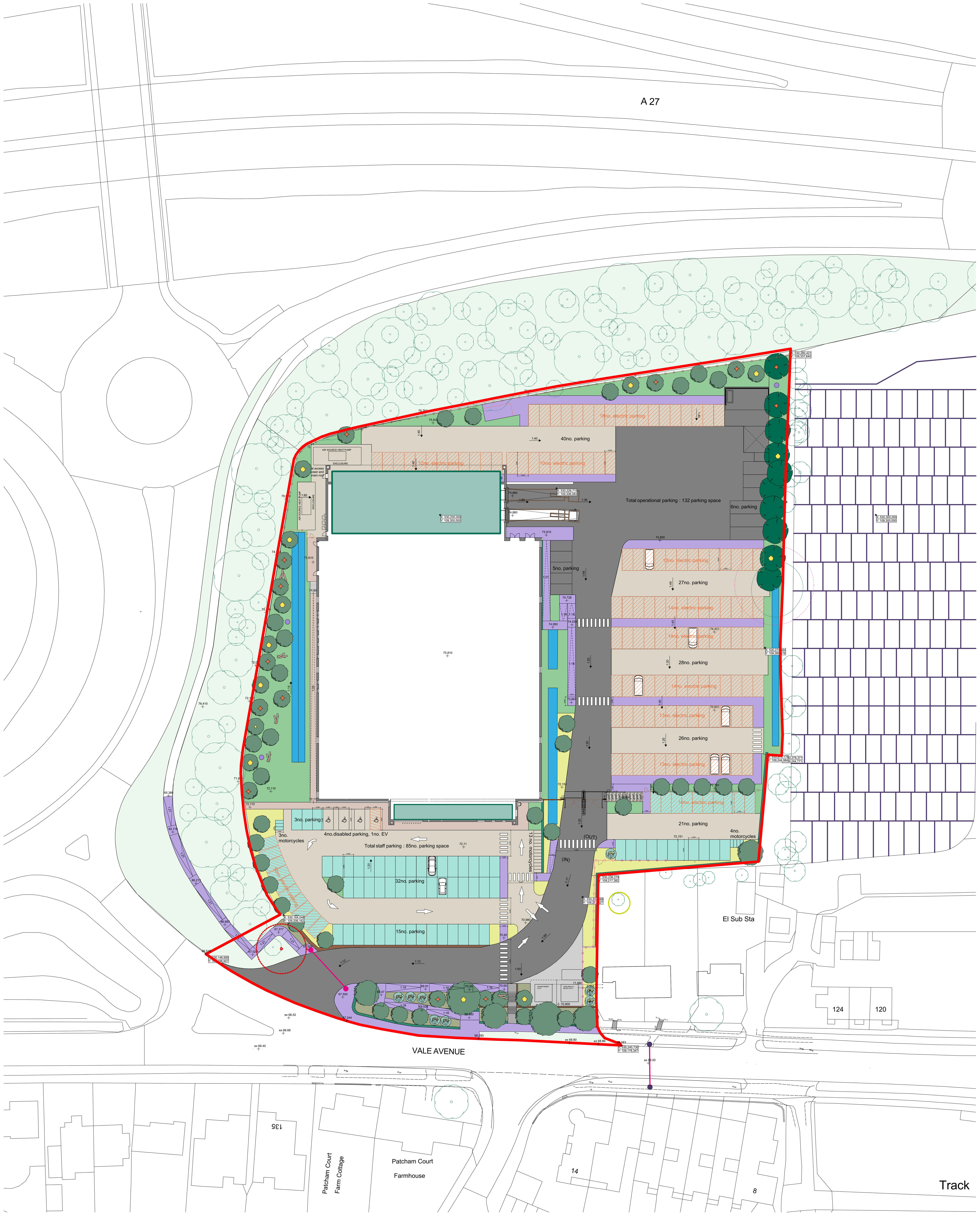
Obviously, we need for you to prove the historic surface water connection for us to consider the surface water connection for the development and for the new flows to be no greater than historic.

Kind Regards

Rachael Powys-Keck
Future Growth Planner, South East Region

T. 03303030119

C. Proposed Development Layout



Key

Red Line Boundary

Proposed Spot Levels

Proposed Gradients

Exisiting Dropped Kerbs & Proposed Potential Crossings

Proposed Dropped Kerbs & Proposed Potential Crossings

Soft Landscape

Exisiting trees to be retained

Exisiting grass to be retained

Indicative Root Protection Area

Proposed Fruit Tree
Typical species include:
Malus sylvestris
Prunus avium sunburst
Prunus cerasifera

Proposed Native Species Trees (Standard Trees)
Typical evergreen species include:
Corylus avellana
Ilex aquifolia
Pinus sylvestris
Prunus avium
Quercus ilex
Taxus baccata

Proposed Specimens
Typical evergreen species include:
Juniperus communis
Sambucus nigra
Viburnum opulus

Proposed Native Hedge
Double staggered row planting at 5 plants/ lin.m to be maintained at 1,800mm high. To be planted with 300mm depth topsoil & 300mm loosened sub-soil and 75mm depth mulch.
Typical species include:
Rosa pimpinellifolia
Taxus baccata
Ulex europaeus
Ulex gallii

Proposed Native Species Shrub Plantings
Typical species include:
Calluna vulgaris
Erica herbacea
Helianthemum nummularium
Rosa canina
Salix reticulata
Vaccinium myrtillus

Proposed Swale Planting Wildflower Meadow
Emorsgate Seeds EG8 meadow grass mixture for wet soils or similar, to be planted with 150mm depth topsoil & 150mm loosened sub-soil. To be managed as meadow.
Typical species include:
Agrostis Capillaris
Alopecurus Pratensis 'Aureovariegatus'
Anthoxanthum Odoratum
Briza Media 'Limouzi'
Cynosurus Cristatus
Deschampsia Cespitosa
Festuca Rubra
Festuca Pratensis Rubra
Salvia Pratensis 'Indigo'

Proposed Species Rich Wildflower Meadow
Emorsgate Seeds EM2 - standard general-purpose meadow mixture or similar, to be planted with 150mm depth topsoil & 150mm loosened sub-soil. To be managed as meadow.
Typical species include:
Betonia officinalis
Centaurea nigra
Daucus carota
Filipendula ulmaria
Galium verum
Leucanthemum vulgare
Lotus corniculatus
Malva moschata
Plantago lanceolata
Primula veris
Prunella vulgaris
Ranunculus acris
Vicia cracca
Agrostis capillaris
Cynosurus cristatus
Festuca rubra
Poa pratensis

Proposed Low Sunny Planting Mix
Low maintenance, low level planting mix. To be planted with 300mm Depth Topsoil & 300mm loosened sub-soil and 75mm Depth Mulch.
Typical species include:
Bergenia 'Silberlicht'
Convolvulus cneorum
Geranium x cantabrigiense
Hebe 'Margret'
Scilla verna

Proposed Green Roofing System
Extensive green roofs are an ecological alternative to conventional surface protection
Achillea Millefolium 'McVities'
Armeria Maritima
Echium vulgare
Primula veris
Origanum vulgare
Saxifraga Granulate
Scabiosa succisa
Viola tricolor

Ecological Enhancement

Proposed Bird boxes
Bird Nest comprising of Schwegler 2B,Schwegler starling box, Schwegler 2H, Treecreeper box, Woodpecker box

Proposed Bat boxes
Bat Boxes, comprising of Schwegler 1FF and Schwegler 2FN or similar

Proposed Bee boxes
Open mesh floor with entrance block and removable plastic 'varroa' board brood box with frames and wax foundation 2 x poly supers, complete with frames and wax foundation plastic queen excluder flexible, clear, plastic crown board roof hive strap - The Bee Centre

Proposed Log Pile
A log pile is created from trees which are being removed to provide an ecological habitat. It prefects for a wide range of wildlife, including moss, fungi and insects and other invertebrates

Hard Landscape

Proposed Walls

Proposed Car Parks Routes
Permeable vehicle block paving in a heather finish, materials will be coordinated with the engineer to ensure they align with the attenuation strategy proposed.

Proposed EV Electric Car Parking Space
Permeable vehicle block paving in a heather finish with EV charger installed. Materials will be coordinated with the engineer to ensure they align with the attenuation strategy proposed.

Proposed Visitor Car Park Spaces
Grasscrete with pre-cast blocks, materials will be coordinated with the engineer to ensure they align with the attenuation strategy proposed.

Proposed Visitor EV Electric Car Park Spaces
Grasscrete with pre-cast blocks with EV charger installed. Materials will be coordinated with the engineer to ensure they align with the attenuation strategy proposed.

Proposed Primary Vehicle Access Route
Heavy vehicular non-permeable base up to approximately 7.5 toner gross vehicle weight in grey finish, materials will be coordinated with the engineer to ensure they align with the attenuation strategy proposed.

Proposed Pedestrian Crossing Routes
Permeable pedestrian grade asphalt, materials will be coordinated with the engineer to ensure they align with the attenuation strategy proposed.

Proposed Emergency Generator
Refer to MEP Engineer drawing for further information

Proposed Pedestrian Area
Impermeable paving slabs, 400mm x 400mm concrete flag paving in a buff finish.

Proposed Zebra Crossing Road Paint
White matt finish meaning to provide safe and clear demarcation for pedestrians crossings need.

Boundary Treatment

Proposed Palisade Fencing
Palisade security fencing is manufactured from cold rolled steel and has been galvanised with a protective zinc coating to help prevent rust with 2.4m high in black powder coating colours.

Proposed Single Security Gate
Pedestrian palisadesecuirty gate is manufactured from cold rolled steel and has been galvanised with a protective zinc coating to help prevent rust with 2.4m high x 1.2m wide in black powder coating colours.

Proposed Double Security Gate
Double leaf palisade secuirty gate is manufactured from cold rolled steel and has been galvanised with a protective zinc coating to help prevent rust with 2.4m high x 2.0m wide in black powder coating colours.

Proposed Green Acoustic Fence
Refer to WSP Acoustics drawing and report for further information. Planting details to be agreed.

Proposed Green Acoustic Fence
Refer to WSP Acoustics drawing and report for further information

Street Furniture

Proposed Cycle Shelter
The cycle storage accommodates 40 bikes utilising 2 x 20 spaces double stack cycle rack - the size of these is: 4100mm width x 2100mm deep.

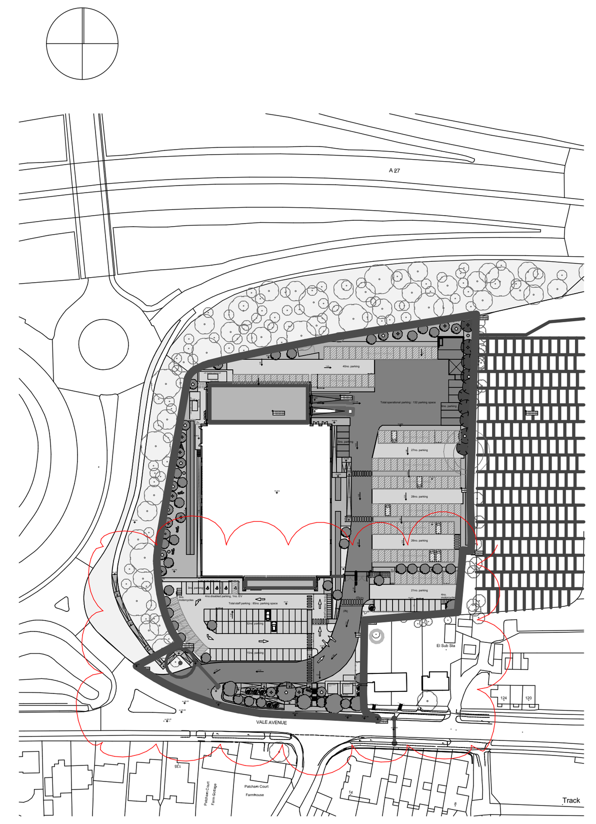
1:500 1:100 50 M 10 M

Notes

Check all dimensions on site. Do not scale from this drawing
Report any discrepancies and omissions to HLM Architects
This Drawing is Copyright ©

50 M 10 M 1:500 1:100

N



Refer to BDO-HLM-01-00-DR-L-0006 Landscape General Arrangement - Southern Boundary

Rev	Description	Date	By	Chk
P10	ISSUE FOR EAIA	12.05.23	SL	AM
P09	ISSUE FOR COMMENT	28.04.23	SL	AM
P08	DETAILED LANDSCAPE PACK FOR PLANNING	04.11.22	SL	AM
P07	ISSUED FOR PLANNING	05.07.22	SL	OJ
P06	ISSUED FOR PLANNING	01.07.22	SL	NI
P05	ISSUED FOR PLANNING	30.06.22	SL	NI
P04	ISSUED FOR COMMENT	23.06.22	SL	NI
P03	ISSUED FOR COMMENT	10.06.22	SL	NI
P02	ISSUED FOR CO-ORDINATION	22.12.21	SL	NI
P01	DRAFT ISSUE	29.10.21	SL	NI

Revisions | Suitability

Project | S0 WORK IN PROGRESS

RMG Brighton MPU

Client

Royal Mail Group

Title

Landscape General Arrangement Plan

Drawing No.	Revision
BDO-HLM-01-00-DR-L-0001	P10

Scale @ A1	Drawn
1:500	SL
Date	**Checked**
29/10/21	NI

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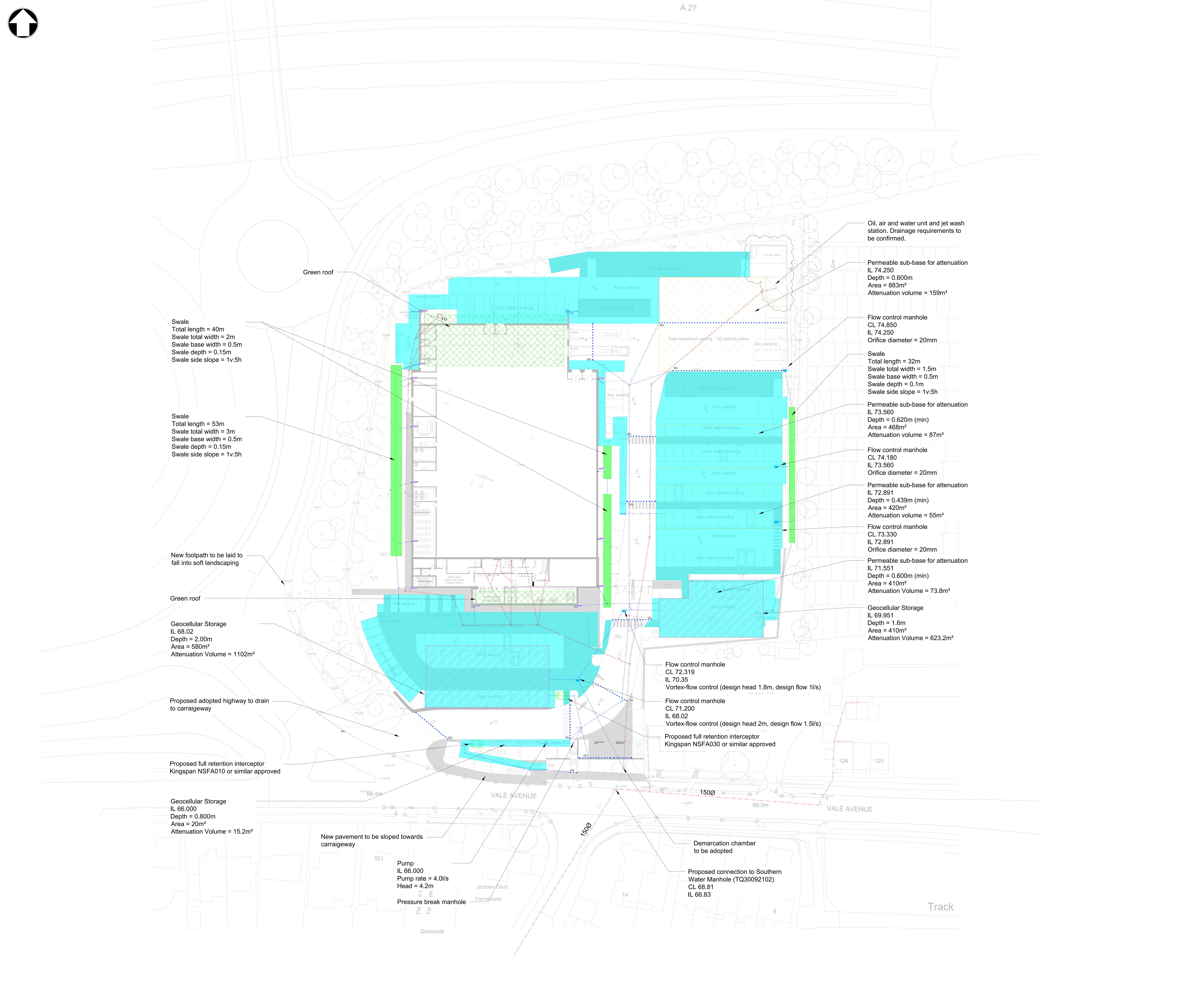
D. Indicative Drainage Masterplan



Notes

1. This drawing is to be read in conjunction with all relevant drawings.
2. Do not scale from this drawing.
3. All measurements are in metres (m), unless noted otherwise
4. All levels are shown in metres above ordnance datum (mAOD) unless noted otherwise.
5. All layouts are preliminary only and subject to review and are to be printed in colour.
6. Proposed drainage designed in accordance with Building Regulations Part H and Sewerage Sector Guidance (SSG) Appendix C.
7. Details of Southern Water Sewer based on information given on Southern Water mapping.
8. Pipe bedding to be Type 'S' unless pipe cover is less than 1.2m; whereupon concrete surround shall be used.
9. Minimum buried under slab foul gradients to be 1v:40h.
10. Offsite discharge rate and location to be agreed with Southern Water and LLFA. Providing an existing connection can be proven from the site, and providing the proposed discharge rate is no greater than the historic rate, Southern Water permit a discharge of 1.5l/s to manhole ref TQ3009102 on Vale Avenue. Alternatively, Southern Water permit a connection to manhole ref TQ30081950 on London Road. The design shown is for the 1.5l/s surface water discharge to manhole ref TQ3009102 on Vale Avenue.
11. Site levels likely and layout likely to change as design develops. Drainage drawing will need to be updated to suit.
12. Permeable paving, swales and geocellular storage to be lined with an impermeable membrane to ensure runoff from impermeable areas on the development site does not infiltrate into the ground.

Key to symbols

- Existing Adopted Combined Water Sewer
- Proposed Surface Water
- Proposed Perforated Pipe
- Proposed Pumped Surface Water Pipe
- Proposed Foul Water
- Proposed Combined Water
- Proposed Lined Geocellular Storage
- Proposed Lined Permeable Paving
- Proposed Lined Fixed Depth Permeable Sub-base For Attenuation
- Proposed Green Roof
- Rainwater Pipe (position t.b.c.)
- SVP (position t.b.c.)
- Proposed Lined Swale
- Proposed Linear Drain
- Proposed Linear Drainage Outlet Unit
- Proposed Surface Water Manhole
- Proposed Flow Control Manhole
- Proposed Pump Chamber
- Proposed Foul Water Manhole
- Proposed Combined Water Manhole
- Proposed Floor Gully
- Proposed Full Retention Interceptor

Reference drawings

BDO-HLM-01-00-DR-A-0011 GROUND FLOOR PLAN
BDO-HLM-01-LG-DR-A-0011 LOWER GROUND FLOOR PLAN
BDO-MMD-01-XX-DR-S-0160 PROPOSED LEVELS
BDO-HLM-01-00-DR-L-0001 Landscape General Arrangement Plan

Rev	Date	Drawn	Description	Ch'k'd	App'd
P05	30.05.2023	ND	Revision due to SW guidance and new layout	JLW	AJS
P04	20.03.2023	TAF	For Information	JLW	AJS
P03	08.06.2022	JLW	For Information	AJP	AJS
P02	01.06.2022	TAF	RIBA Stage 2 Design	JLW	AJS
P01	18.10.2021	JLW	Draft for Comment	AJP	AJS

Status Stamp

PRELIMINARY

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Title
RMG Brighton MPU
Drainage Masterplan

Designed	J Lea-Wilson	JLW	Eng check	A Precious	AJP
Drawn	J Lea-Wilson	JLW	Coordination	A Simpson	AJS
Dwg check	A Precious	AJP	Approved	A Simpson	AJS

MMD Project Number	Scale at A1	Security
100103689	1:500	STD

Suitability Description	Suit. Code
Suitable For Information	S2

Drawing Number	Revision
BDO-MMD-XX-00-DR-C-0001	P05

E. MicroDrainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.338	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	13.134	0.600	21.9	0.036	4.00	0.0	0.600	o	150	Pipe/Conduit	🔒
S2.001	26.892	2.033	13.2	0.099	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒
S3.000	16.392	0.120	136.6	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	🔒
S3.001	3.519	0.963	3.7	0.093	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒
S2.002	18.032	0.451	40.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S4.000	18.257	0.099	184.4	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	🔒
S4.001	3.600	0.724	5.0	0.061	0.00	0.0	0.600	o	150	Pipe/Conduit	🔓

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	50.00	4.10	74.850	0.036	0.0	0.0	0.0	2.16	38.2	4.9
S2.001	50.00	4.26	74.250	0.134	0.0	0.0	0.0	2.78	49.2	18.2
S3.000	50.00	4.32	73.680	0.000	0.0	0.0	0.0	0.86	15.2	0.0
S3.001	50.00	4.33	73.560	0.093	0.0	0.0	0.0	5.31	93.8	12.5
S2.002	50.00	4.45	72.517	0.227	0.0	0.0	0.0	2.49	176.2	30.7
S4.000	50.00	4.41	72.990	0.000	0.0	0.0	0.0	0.74	13.0	0.0
S4.001	50.00	4.43	72.891	0.061	0.0	0.0	0.0	4.55	80.4	8.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.003	2.556	0.080	31.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.004	7.169	0.200	35.8	0.006	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.005	42.433	1.835	23.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	23.090	1.931	12.0	0.310	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.000	15.219	0.200	76.1	0.003	4.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	4.176	0.300	13.9	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.002	20.712	1.400	14.8	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.003	13.757	0.900	15.3	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.004	19.625	0.800	24.5	0.055	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.005	4.085	0.200	20.4	0.051	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.006	57.137	2.230	25.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S6.000	2.808	0.075	37.4	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	
S6.001	26.768	0.458	58.4	0.039	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.007	32.097	0.570	56.3	0.429	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.003	50.00	4.47	72.066	0.288	0.0	0.0	0.0	2.79	197.3	39.0
S2.004	50.00	4.51	71.986	0.294	0.0	0.0	0.0	2.63	186.2	39.7
S2.005	50.00	4.73	71.786	0.294	0.0	0.0	0.0	3.28	232.1	39.7
S2.006	50.00	4.86	69.951	0.603	0.0	0.0	0.0	2.93	51.8«	81.7
S5.000	50.00	4.17	74.600	0.003	0.0	0.0	0.0	1.50	59.7	0.5
S5.001	50.00	4.19	74.400	0.048	0.0	0.0	0.0	3.53	140.2	6.4
S5.002	50.00	4.29	74.100	0.087	0.0	0.0	0.0	3.42	136.0	11.8
S5.003	50.00	4.36	72.700	0.132	0.0	0.0	0.0	3.36	133.8	17.8
S5.004	50.00	4.46	71.725	0.187	0.0	0.0	0.0	3.19	225.3	25.3
S5.005	50.00	4.48	70.925	0.237	0.0	0.0	0.0	3.49	247.0	32.1
S5.006	50.00	4.79	70.725	0.237	0.0	0.0	0.0	3.12	220.4	32.1
S6.000	50.00	4.03	70.000	0.000	0.0	0.0	0.0	1.65	29.2	0.0
S6.001	50.00	4.37	69.925	0.039	0.0	0.0	0.0	1.32	23.3	5.3
S2.007	50.00	5.26	68.020	1.309	0.0	0.0	0.0	1.34	23.7«	177.2

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	5	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.338		

Online Controls for Storm

Orifice Manhole: S2, DS/PN: S2.001, Volume (m^3): 0.9

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 74.250

Orifice Manhole: S4, DS/PN: S3.001, Volume (m^3): 1.0

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 73.560

Orifice Manhole: S7, DS/PN: S4.001, Volume (m^3): 0.8

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 72.891

Hydro-Brake® Optimum Manhole: S11, DS/PN: S2.006, Volume (m^3): 5.6

Unit Reference	MD-SHE-0039-1000-2200-1000
Design Head (m)	2.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	39
Invert Level (m)	69.951
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.200	1.0	Kick-Flo®	0.347	0.4
Flush-Flo™	0.171	0.5	Mean Flow over Head Range	-	0.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.5	1.200	0.8	3.000	1.1	7.000	1.7
0.200	0.5	1.400	0.8	3.500	1.2	7.500	1.7
0.300	0.5	1.600	0.9	4.000	1.3	8.000	1.8
0.400	0.5	1.800	0.9	4.500	1.4	8.500	1.9
0.500	0.5	2.000	1.0	5.000	1.4	9.000	1.9
0.600	0.6	2.200	1.0	5.500	1.5	9.500	1.9
0.800	0.6	2.400	1.0	6.000	1.6		
1.000	0.7	2.600	1.1	6.500	1.6		

Hydro-Brake® Optimum Manhole: S21, DS/PN: S2.007, Volume (m^3): 8.4

Unit Reference	MD-SHE-0049-1500-2000-1500
Design Head (m)	2.000
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	68.020
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	1.5	Kick-Flo®	0.438	0.8
Flush-Flo™	0.212	0.9	Mean Flow over Head Range	-	1.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.2	3.000	1.8	7.000	2.7
0.200	0.9	1.400	1.3	3.500	1.9	7.500	2.8
0.300	0.9	1.600	1.4	4.000	2.1	8.000	2.8
0.400	0.8	1.800	1.4	4.500	2.2	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.3	9.000	3.0
0.600	0.9	2.200	1.6	5.500	2.4	9.500	3.1
0.800	1.0	2.400	1.6	6.000	2.5		
1.000	1.1	2.600	1.7	6.500	2.6		

Storage Structures for Storm

Porous Car Park Manhole: S2, DS/PN: S2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	29.7
Membrane Percolation (mm/hr)	1000	Length (m)	29.7
Max Percolation (l/s)	245.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	74.250	Membrane Depth (mm)	0

Porous Car Park Manhole: S4, DS/PN: S3.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	13.0
Membrane Percolation (mm/hr)	1000	Length (m)	36.0
Max Percolation (l/s)	130.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	73.560	Membrane Depth (mm)	0

Porous Car Park Manhole: S7, DS/PN: S4.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.0
Membrane Percolation (mm/hr)	1000	Length (m)	35.0
Max Percolation (l/s)	116.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	72.891	Membrane Depth (mm)	0

Complex Manhole: S11, DS/PN: S2.006

Cellular Storage

Invert Level (m)	69.951	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	410.0	0.0	1.601	0.0	0.0
1.600	410.0	0.0			

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Invert Level (m)	71.551
Membrane Percolation (mm/hr)	1000	Width (m)	39.0
Max Percolation (l/s)	113.8	Length (m)	10.5
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Depression Storage (mm)	5

Porous Car Park

Evaporation (mm/day) 3 Membrane Depth (mm) 0

Cellular Storage Manhole: S21, DS/PN: S2.007

Invert Level (m) 68.020 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	580.0	0.0	2.001	0.0	0.0
2.000	580.0	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	5	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.338
Region	England and Wales	Cv (Summer)	0.950
M5-60 (mm)	19.900	Cv (Winter)	0.950

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440, 2880, 5760, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S2.000	S1	15 Summer	100	+45%				
S2.001	S2	2880 Summer	100	+45%	30/120 Summer			
S3.000	S3	960 Winter	100	+45%	30/480 Summer			
S3.001	S4	960 Winter	100	+45%	30/60 Summer			
S2.002	S5	1440 Winter	100	+45%				
S4.000	S6	1440 Summer	100	+45%	100/120 Summer			
S4.001	S7	1440 Summer	100	+45%	30/240 Summer			
S2.003	S8	10080 Winter	100	+45%				
S2.004	S9	10080 Winter	100	+45%				
S2.005	S10	10080 Winter	100	+45%	100/10080 Summer			
S2.006	S11	10080 Winter	100	+45%	1/240 Summer			
S5.000	S12	15 Summer	100	+45%				
S5.001	S13	15 Summer	100	+45%				
S5.002	S14	15 Summer	100	+45%				
S5.003	S15	15 Summer	100	+45%				
S5.004	S16	15 Summer	100	+45%	100/15 Summer			
S5.005	S17	15 Summer	100	+45%	100/15 Summer			

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S1	74.956	-0.044	0.000	0.84			29.3	OK	
S2.001	S2	74.762	0.362	0.000	0.01		2856	0.6	FLOOD RISK	
S3.000	S3	74.140	0.310	0.000	0.00			0.0	FLOOD RISK	
S3.001	S4	74.140	0.430	0.000	0.01			0.6	FLOOD RISK	
S2.002	S5	72.528	-0.289	0.000	0.01			1.2	OK	
S4.000	S6	73.284	0.144	0.000	0.00			0.0	SURCHARGED	
S4.001	S7	73.284	0.243	0.000	0.01		1272	0.5	FLOOD RISK	
S2.003	S8	72.141	-0.225	0.000	0.02			1.4	OK	
S2.004	S9	72.141	-0.145	0.000	0.01			1.4	OK	
S2.005	S10	72.140	0.054	0.000	0.01			1.4	SURCHARGED	
S2.006	S11	72.139	2.038	0.000	0.02		8976	1.0	FLOOD RISK	
S5.000	S12	74.633	-0.192	0.000	0.05			2.8	OK	
S5.001	S13	74.513	-0.112	0.000	0.50			38.9	OK	
S5.002	S14	74.223	-0.102	0.000	0.58			71.3	OK	
S5.003	S15	72.871	-0.054	0.000	0.93			107.7	OK	
S5.004	S16	72.081	0.056	0.000	0.77			149.9	SURCHARGED	
S5.005	S17	71.595	0.370	0.000	1.67			187.6	FLOOD RISK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.006	S18	15 Summer	100	+45%					70.949
S6.000	S19	15 Summer	100	+45%	100/15 Summer				70.366
S6.001	S20	15 Summer	100	+45%	100/15 Summer				70.373
S2.007	S21	10080 Winter	100	+45%	1/60 Summer				70.010

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.006	S18	-0.076	0.000	0.91			189.7	OK	
S6.000	S19	0.216	0.000	0.23			3.9	SURCHARGED	
S6.001	S20	0.298	0.000	1.27			28.3	SURCHARGED	
S2.007	S21	1.840	0.000	0.07			1.5	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.338	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	13.134	0.600	21.9	0.036	4.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	26.892	2.033	13.2	0.099	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	16.392	0.120	136.6	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	
S3.001	3.519	0.963	3.7	0.093	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	18.032	0.451	40.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	18.257	0.099	184.4	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	
S4.001	3.600	0.724	5.0	0.061	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	50.00	4.10	74.850	0.036	0.0	0.0	0.0	2.16	38.2	4.9
S2.001	50.00	4.26	74.250	0.134	0.0	0.0	0.0	2.78	49.2	18.2
S3.000	50.00	4.32	73.680	0.000	0.0	0.0	0.0	0.86	15.2	0.0
S3.001	50.00	4.33	73.560	0.093	0.0	0.0	0.0	5.31	93.8	12.5
S2.002	50.00	4.45	72.517	0.227	0.0	0.0	0.0	2.49	176.2	30.7
S4.000	50.00	4.41	72.990	0.000	0.0	0.0	0.0	0.74	13.0	0.0
S4.001	50.00	4.43	72.891	0.061	0.0	0.0	0.0	4.55	80.4	8.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.003	2.556	0.080	31.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.004	7.169	0.200	35.8	0.006	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.005	42.433	1.835	23.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	23.090	1.931	12.0	0.310	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.000	15.219	0.200	76.1	0.003	4.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	4.176	0.300	13.9	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.002	20.712	1.400	14.8	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.003	13.757	0.900	15.3	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.004	19.625	0.800	24.5	0.055	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.005	4.085	0.200	20.4	0.051	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.006	57.137	2.230	25.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S6.000	2.808	0.075	37.4	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	
S6.001	26.768	0.458	58.4	0.039	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.007	32.097	0.570	56.3	0.429	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.003	50.00	4.47	72.066	0.288	0.0	0.0	0.0	2.79	197.3	39.0
S2.004	50.00	4.51	71.986	0.294	0.0	0.0	0.0	2.63	186.2	39.7
S2.005	50.00	4.73	71.786	0.294	0.0	0.0	0.0	3.28	232.1	39.7
S2.006	50.00	4.86	69.951	0.603	0.0	0.0	0.0	2.93	51.8«	81.7
S5.000	50.00	4.17	74.600	0.003	0.0	0.0	0.0	1.50	59.7	0.5
S5.001	50.00	4.19	74.400	0.048	0.0	0.0	0.0	3.53	140.2	6.4
S5.002	50.00	4.29	74.100	0.087	0.0	0.0	0.0	3.42	136.0	11.8
S5.003	50.00	4.36	72.700	0.132	0.0	0.0	0.0	3.36	133.8	17.8
S5.004	50.00	4.46	71.725	0.187	0.0	0.0	0.0	3.19	225.3	25.3
S5.005	50.00	4.48	70.925	0.237	0.0	0.0	0.0	3.49	247.0	32.1
S5.006	50.00	4.79	70.725	0.237	0.0	0.0	0.0	3.12	220.4	32.1
S6.000	50.00	4.03	70.000	0.000	0.0	0.0	0.0	1.65	29.2	0.0
S6.001	50.00	4.37	69.925	0.039	0.0	0.0	0.0	1.32	23.3	5.3
S2.007	50.00	5.26	68.020	1.309	0.0	0.0	0.0	1.34	23.7«	177.2

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	5	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.338		

Online Controls for Storm

Orifice Manhole: S2, DS/PN: S2.001, Volume (m^3): 0.9

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 74.250

Orifice Manhole: S4, DS/PN: S3.001, Volume (m^3): 1.0

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 73.560

Orifice Manhole: S7, DS/PN: S4.001, Volume (m^3): 0.8

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 72.891

Hydro-Brake® Optimum Manhole: S11, DS/PN: S2.006, Volume (m^3): 5.6

Unit Reference	MD-SHE-0048-1500-2200-1500
Design Head (m)	2.200
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	48
Invert Level (m)	69.951
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.200	1.5	Kick-Flo®	0.428	0.7
Flush-Flo™	0.212	0.9	Mean Flow over Head Range	-	1.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.1	3.000	1.7	7.000	2.6
0.200	0.9	1.400	1.2	3.500	1.9	7.500	2.6
0.300	0.9	1.600	1.3	4.000	2.0	8.000	2.7
0.400	0.8	1.800	1.4	4.500	2.1	8.500	2.8
0.500	0.8	2.000	1.4	5.000	2.2	9.000	2.9
0.600	0.8	2.200	1.5	5.500	2.3	9.500	2.9
0.800	1.0	2.400	1.6	6.000	2.4		
1.000	1.1	2.600	1.6	6.500	2.5		

Hydro-Brake® Optimum Manhole: S21, DS/PN: S2.007, Volume (m^3): 8.4

Unit Reference	MD-SHE-0070-3000-2000-3000
Design Head (m)	2.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	68.020
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.0	Kick-Flo®	0.630	1.8
Flush-Flo™	0.310	2.2	Mean Flow over Head Range	-	2.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.6	7.000	5.4
0.200	2.1	1.400	2.5	3.500	3.9	7.500	5.6
0.300	2.2	1.600	2.7	4.000	4.1	8.000	5.7
0.400	2.2	1.800	2.9	4.500	4.4	8.500	5.9
0.500	2.1	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.9	2.200	3.1	5.500	4.8	9.500	6.2
0.800	2.0	2.400	3.3	6.000	5.0		
1.000	2.2	2.600	3.4	6.500	5.2		

Storage Structures for Storm

Porous Car Park Manhole: S2, DS/PN: S2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	29.7
Membrane Percolation (mm/hr)	1000	Length (m)	29.7
Max Percolation (l/s)	245.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	74.250	Membrane Depth (mm)	0

Porous Car Park Manhole: S4, DS/PN: S3.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	13.0
Membrane Percolation (mm/hr)	1000	Length (m)	36.0
Max Percolation (l/s)	130.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	73.560	Membrane Depth (mm)	0

Porous Car Park Manhole: S7, DS/PN: S4.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.0
Membrane Percolation (mm/hr)	1000	Length (m)	35.0
Max Percolation (l/s)	116.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	72.891	Membrane Depth (mm)	0

Complex Manhole: S11, DS/PN: S2.006

Cellular Storage

Invert Level (m)	69.951	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	315.0	0.0	1.601	0.0	0.0
1.600	315.0	0.0			

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Invert Level (m)	71.551
Membrane Percolation (mm/hr)	1000	Width (m)	39.0
Max Percolation (l/s)	87.8	Length (m)	8.1
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Depression Storage (mm)	5

Porous Car Park

Evaporation (mm/day) 3 Membrane Depth (mm) 0

Cellular Storage Manhole: S21, DS/PN: S2.007

Invert Level (m) 68.020 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m^2)	Inf. Area (m^2)	Depth (m)	Area (m^2)	Inf. Area (m^2)
0.000	435.0	0.0	2.001	0.0	0.0
2.000	435.0	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 5 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.338
Region England and Wales Cv (Summer) 0.950
M5-60 (mm) 19.900 Cv (Winter) 0.950

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440, 2880, 5760, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S1	15 Summer	100	+45%					74.956
S2.001	S2	2880 Summer	100	+45%	30/120 Summer				74.761
S3.000	S3	1440 Summer	100	+45%	30/480 Summer				74.140
S3.001	S4	1440 Summer	100	+45%	30/60 Summer				74.140
S2.002	S5	1440 Winter	100	+45%					72.528
S4.000	S6	1440 Summer	100	+45%	100/120 Summer				73.284
S4.001	S7	1440 Summer	100	+45%	30/240 Summer				73.284
S2.003	S8	5760 Winter	100	+45%					72.109
S2.004	S9	5760 Winter	100	+45%					72.107
S2.005	S10	5760 Winter	100	+45%	100/5760 Winter				72.107
S2.006	S11	5760 Winter	100	+45%	1/120 Summer				72.105
S5.000	S12	15 Summer	100	+45%					74.633
S5.001	S13	15 Summer	100	+45%					74.513
S5.002	S14	15 Summer	100	+45%					74.223
S5.003	S15	15 Summer	100	+45%					72.871
S5.004	S16	15 Summer	100	+45%	100/15 Summer				72.081
S5.005	S17	15 Summer	100	+45%	100/15 Summer				71.595

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S1	-0.044	0.000	0.84			29.3	OK	
S2.001	S2	0.361	0.000	0.01		2856	0.6	FLOOD RISK	
S3.000	S3	0.310	0.000	0.00			0.0	FLOOD RISK	
S3.001	S4	0.430	0.000	0.01		1560	0.6	FLOOD RISK	
S2.002	S5	-0.289	0.000	0.01			1.2	OK	
S4.000	S6	0.144	0.000	0.00			0.0	SURCHARGED	
S4.001	S7	0.243	0.000	0.01		1272	0.5	FLOOD RISK	
S2.003	S8	-0.257	0.000	0.02			1.6	OK	
S2.004	S9	-0.179	0.000	0.01			1.6	OK	
S2.005	S10	0.021	0.000	0.01			1.6	SURCHARGED	
S2.006	S11	2.004	0.000	0.03		5808	1.5	FLOOD RISK	
S5.000	S12	-0.192	0.000	0.05			2.8	OK	
S5.001	S13	-0.112	0.000	0.50			38.9	OK	
S5.002	S14	-0.102	0.000	0.58			71.3	OK	
S5.003	S15	-0.054	0.000	0.93			107.7	OK	
S5.004	S16	0.056	0.000	0.77			149.9	SURCHARGED	
S5.005	S17	0.370	0.000	1.67			187.6	FLOOD RISK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.006	S18	15 Summer	100	+45%					70.949
S6.000	S19	15 Summer	100	+45%	100/15 Summer				70.366
S6.001	S20	15 Summer	100	+45%	100/15 Summer				70.373
S2.007	S21	2880 Winter	100	+45%	1/30 Summer				69.997

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.006	S18	-0.076	0.000	0.91			189.7	OK	
S6.000	S19	0.216	0.000	0.23			3.9	SURCHARGED	
S6.001	S20	0.298	0.000	1.27			28.3	SURCHARGED	
S2.007	S21	1.827	0.000	0.13			3.0	SURCHARGED	

F. Typical SuDS Maintenance Regime

Schedule	Required Action	Geocellular Storage	Permeable Paving	Flow Control	Collection Systems	Swale
Regular	Visual Inspection	Monthly for three months after installation	Monthly for three months after installation	Monthly	Monthly	Monthly or as required
	Remove Litter and Debris	Monthly removal of litter from catchment area	Once a year after Autumn leaves fall, or reduced frequency as required	Once a year after Autumn leaves fall, or reduced frequency as required	Monthly	Monthly or as required
	Inspect and Identify Any Areas Not Operating Correctly.	Monthly or 3 months, then annually	Every month for first year, then annually	-	Monthly	Monthly
	Cut Grass	-	-	-	-	Mow amenity grass access paths and verges surrounding swales at 35-50mm minimum and 75mm maximum or as specified Mow swales at 10mm with 150mm maximum to filter and control runoff in normal grass swales, removing first and last cut in season, and if grass is longer than 150mm removing cuttings to wildlife piles on site.
	Manage Other Vegetation and Remove Nuisance Plants	-	As required - once per year	-	Monthly	As required
	Inspect Inlets, Outlets and Overflows for Blockages/Damage	Monthly for first year then annually	-	Monthly	Monthly	Monthly
	Inspect Water Bodies for Signs of Poor Quality	-	-	-	-	-
	Inspect Vegetation Coverage	-	-	-	-	As required
	Inspect Banksides, Pipework and Structures for Physical Damage	-	-	-	-	As required
	Inspect Inlets and facility surface for silt accumulation	-	-	-	-	Half Yearly until appropriate removal frequency is established
	Tidy All Dead Growth Before Start of Growing Season	-	-	-	-	Remove visible dead material
	Remove Sediment from Inlets, Outlets and Forebays	-	-	Annually	Annually	As required
	Check surface of permeable paving for blockages and clear	Annually	Annually	-	-	-
	Manage Wetland Plants	-	-	-	-	-
Occasional	Reseed Areas of Poor Vegetation Growth	-	-	-	-	As required or if bare soil is exposed over 10% or more of treatment area
	Remove Sediment from Main Body	Every 5 years or as required	Inspect annually, repair as required	-	-	As required
	Remove Sediment from Inlets, Outlets and Forebays	-	Inspect annually, repair as required	-	Annually	As required
Remedial Actions	Repair Erosion or other Damage by Reseeding or Re-turfing	-	-	-	-	As required
	Repair /Rehabilitation of Inlets, Outlets and Overflows	Visual inspection after storm, replace as required	-	-	-	-
	Relevel Uneven Surfaces and Reinstate Design Levels	-	As required to remove or replace cracked blocks and remediate surrounding landscape	-	-	As required
	Rehabilitate of surface and upper substructure by vacuum sweeping	-	every 5 years or as required	-	-	-
	Remove and dispose of oils or petrol residues using safe practices	-	-	Annually	Annually	As required - dig out and replace growing medium and reseed

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