RIDGE

THE MANNINGS
SHOREHAM-BY-SEA
BN43 6RP

BELOW GROUND DRAINAGE STRATEGY

RL51001-RDG-XX-XX-RP-C-9000

November 2021

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Real

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BELOW GROUND DRAINAGE STRATEGY

November 2021

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SECTION 1
INTRODUCTION

1. INTRODUCTION

1.1. Appointment and Brief

This surface and foul water drainage strategy (DS) has been prepared on behalf of Real Places Limited (REAL) for a proposed development at The Mannings, Shoreham-By-Sea, BN43 6RP (hereby referred to as the 'Proposed Development').

The purpose of this document is to outline the development of the proposed DS, providing sufficient detail to enable both a thorough review of design principles adopted and to discharge planning conditions with respect to the Proposed Development.

It aims to demonstrate the foul and surface water management at the Proposed Development, as follows:

- Provide an analysis of the impact of the proposed development on surrounding foul water infrastructure and identify the constraints present on the site in terms of suitability of conventional gravity drainage.
- Demonstrate the principles of surface water management in terms of constraints on discharge, permitted discharge rates and required volumes of attenuation (where required), describing how these can be accommodated within the development proposals.

1.2. Aims and Objectives

The DS has been prepared with reference to the following requirements:

- The DS must:
  - Ensure that flood risk to the Application Site and surrounding area is not increased over the lifetime of the Proposed Development;
  - Conform with all relevant national and local flood risk polices;
  - Adopt current design standards; and
  - Consider long-term maintenance with respect to practicality, ownership and funding.

- The DS should:
  - Mimic the existing drainage characteristics of the site as far as is practical;
  - Look for opportunities to provide a reduction in flood risk to the Proposed Development and the surrounding area;
  - Adhere to current best practice guidance;
  - Contribute to the enhanced amenity and aesthetic value of the Proposed Development; and
  - Propose opportunities for biological enhancement and provide habitats for wildlife in urban areas.

1.3. The Proposed Development

The Proposed Development as outlined on the appended layouts proposes the demolition of the existing building and construction of 74 new homes over 6 No. storeys, with external car park, as outlined below:

- 28 No. 1 bedroom flats.
- 40 No. 2 bedroom flats.
- 6 No. 3 bedroom flats.

1.4. Planning Status & Previous Studies

The Proposed Development is understood to have obtained planning approval on the 15th October 2021 with Adur & Worthing Councils under planning reference AWDM/1281/19.

An existing "Surface Water and SuDS Assessment" produced by Clancy Consulting (see reference documents) was submitted and consulted upon during the planning approval process.

From review of consultation correspondence present on the planning portal website, it is understood that the principles presented within this report have been generally accepted by the statutory consultees.

This report therefore intends to develop further on these principles and outline / document the detailed design which has been adopted in order to discharge planning conditions at the Proposed Development.

1.5. Reference Information

The following information has been obtained and interrogated as part of this study:

- AHR London Limited (2020). Stage 3 – GA – Proposed Ground Floor Plan. Revision G;
- APR Services (2019). Land Survey (Topographical Survey). Revision A;
- APR Services (2019). Underground Survey (GPR Survey);
- Clancy Consulting (2019). Surface Water Drainage & SuDS Assessment;
- Clancy Consulting (2020). Geo-Environmental Appraisal Report;
- REC (2019). Arboricultural Impact Assessment.

In addition, the following documents have been consulted:

- Communities and Local Government Document. (2021). The National Planning Policy Framework;
- Environment Agency. (2016). Flood Risk Assessments: Climate Change Allowances;
- Environment Agency. (2013). Rainfall Runoff Management for Developments;
- Environment Agency. (2019). Flood Risk Assessments: Climate Change Allowances;
- CIRIA. (2015). C753 – The SuDS Manual;
- Secretary of State. (2015). Building Regulations Approved Document H;
- Butler & Davies. (2012). 2nd Ed. Urban Drainage;
- British Geological Survey Online Mapping Tool;
- DEFRA / EA Interactive online mapping (magic.defra.gov.uk);
- Department for Environment, Food and Rural Affairs. (2015). Non-Statutory Technical Standards for
- Sustainable Drainage Systems;
- Department for Environment, Food and Rural Affairs & Environment Agency. (2017). Flood Risk Assessment for Planning Applications;
- Arun District Council. (2016). Surface Water Drainage Proposal Checklist V5.3;
- Arun District Council. (2021). Supplementary Requirements for Surface Water Drainage Proposals;
- West Sussex County Council. (2010). Strategic Flood Risk Assessment;
- West Sussex County Council. (2014). Local Flood Risk Management Strategy (2013 – 2018).

1.6. Limitations

The purpose of this report as outlined in Section 1.2, together with those related matters specifically referred to therein and it is not intended to be used for any other purpose. The report is for the sole benefit and may only be relied upon by the addressee, to whom we will owe a duty of care. The report and any part of it is confidential to the addressee and should not be disclosed to any third party for any purpose, without the prior written consent of Ridge and Partners LLP as to the form and context of such disclosure. The granting of such consent shall not entitle the third party to place reliance on the report, nor shall it confer any third-party rights pursuant to the Contracts (Rights of Third Parties) Act. The report may not be assigned to any third party.

SECTION 2
THE EXISTING SITE

2. THE EXISTING SITE

2.1. Site Location and Existing Land Use

The Proposed Development is located at the junction of Ham Road and Surry Street in Shoreham-By-Sea, West Sussex. The site is bound by Ham Road to the North, Surry Street to the East, a private service road to the South and a car park to the East serving the nearby Co-op Food Store.

The Ordinance Survey (OS) grid reference for the site is 521913 E, 105168 N and the nearest post code is BN43 6RP.

The existing site is residential providing 40 No. homes over 4 No. storeys, with associated car parking and soft landscaped amenity areas.

Rigorous interrogation of the proposed site plan and topographical survey using AutoCAD would suggest the overall site area within the ownership / application boundary to be 2804 m^2, of which 67.8 % is considered to be impermeable.

This is a reduction from the 3648 m^2 stated in the previous study, which appeared to erroneously include areas of the public highway to the North and East boundaries, as well as the Service Road to the South.

2.2. Topography

The existing site is raised above the adjoining street levels by approximately 1.0 m, with low level masonry retaining walls typically to the perimeter of the site.

The site is otherwise generally laid level at an average level of circa 5.75 m above Ordinance Datum (AOD), with typical gradients of 1:94 going West to East and 1:311 going North to South.

2.3. Assessing Flood Risk

The Department for Environment, Food and Rural Affairs & Environment Agency (2017). Flood Risk Assessment for Planning Applications confirms that detailed flood risk assessment is required where the Application Site is:

- Located in Flood Zone 2 or 3, including minor development and change of use; or
- More than 1 hectare (Ha) in Flood Zone 1; or
- Less than 1 Ha in Flood Zone 1, including change of use in a development type to a more vulnerable class, where the development could be affected by sources of flooding other than by rivers and the sea; or
- In an area within Flood Zone 1 that has critical drainage problems as notified by the Environment Agency.

The Government's online Flood Map for Planning indicates that the Proposed Development is situated within Flood Zone 1. In accordance with Table 1 (Flood Zones) of the NPPF, this classifies the site of having a less than 1:1000 annual probability of river or sea flooding.

Further review of detailed Environment Agency mapping indicates the site is not at significant risk from sources of flooding other than by rivers or sea (i.e. pluvial flooding).

Table 2 (Flood Risk Vulnerability Classification) of the NPPF classifies the existing residential usage of the site as 'More Vulnerable', with no change in use proposed as part of the redevelopment of the site.

With reference to the foregoing, the absence of pluvial flood risk in addition to the site area would suggest that a detailed flood risk assessment would not be required.

Table 3 (Flood Risk Vulnerability and Flood Zone Compatibility) of the NPPF states that More Vulnerable development is compatible within Flood Zone 1 and therefore the Sequential Test is considered to be satisfied and an Exception Test is not required for the Application Site.

With this in consideration, it is considered that flood risk does not present a constraint to the development of the below ground drainage design.

2.4. Existing Drainage Infrastructure

The Sewerage Undertaker is understood to be Southern Water and review of their asset records and topographical / GPR survey findings (see appendices) suggests the following public infrastructure to be within close vicinity of the Proposed Development:

- To the South Elevation:
  - 225 mm diameter surface water sewer flowing West to East along service road at a depth of approximately 2.45 m, outfalling into surry Street, where it flows North-West to South-East.
- To the North Elevation:
  - 150 mm diameter combined sewer flowing West to East along Ham Road at unknown depth before changing direction to flow North to South down Surry Street.

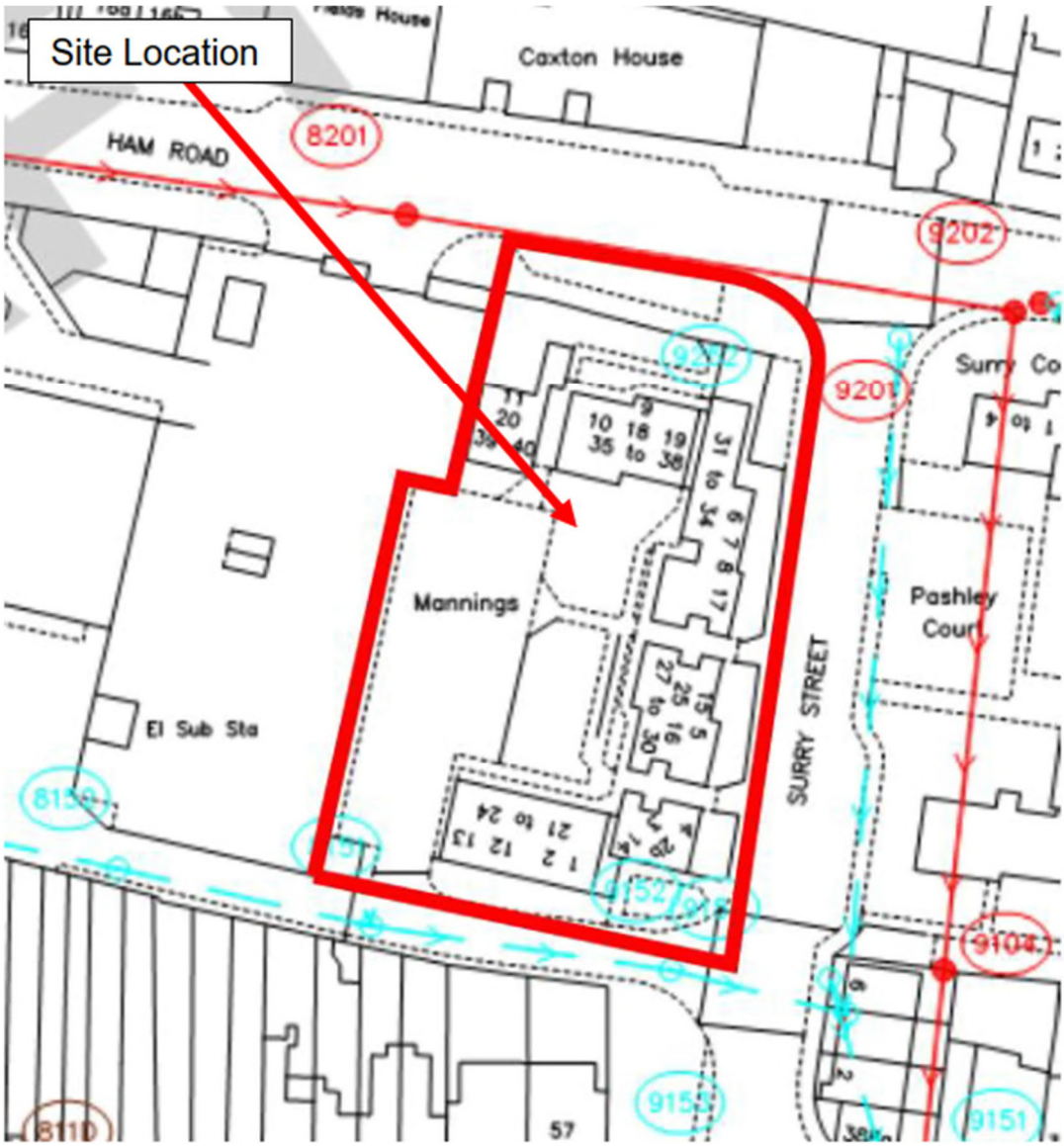


Figure 1 - Extract from previous study showing Southern Water records for the site and surrounding area.

Interrogation of the below ground utilities (GPR) survey suggests the existing site is served by private foul and surface water drainage networks.

Surface water is known to discharge to Southern Water manhole 8151 in Service Road and foul water is known to discharge (via a blind connection) to the Southern Water combined sewer in Ham Road.

No evidence of soakaways or SuDS features were observed as part of the investigative works.

2.5. Diversion & Divestment of Existing Below Ground Drainage

As outlined in the foregoing, existing below ground drainage serving more than 1 property is present within the site curtilage. Review of documents present on the planning portal would however suggest that Southern Water have confirmed this to be private drainage in their letter correspondence dated 29th January 2020.

Subsequently no formal sectional agreements with respect to diversion or divestment are deemed to be required at the Proposed Development.

Notwithstanding this, should any drainage serving other properties be encountered during the course of the works, then this will be maintained and protected.

2.6. Geology and Hydrogeology

British Geological Society (BGS) online mapping indicates the site to be situated on a bedrock of the NEWHAVEN CHALK FORMATION, overlain by HEAD DEPOSITS comprising clays, silts, sands and gravels.

The Environment Agency's online mapping suggests the underlying HEAD DEPOSITS to be a Secondary Undifferentiated Aquifer, with the NEWHAVEN CHALK FORMATION classified as a Principal Aquifer thus comprising geology with high permeability and storage characteristics.

The site is not known to be within a Source Protection Zone (SPZ) and nor are any groundwater abstraction points or groundwater discharge consents recorded within 500 m of the site.

Cable percussive boreholes, window samples and hand dug trial pits recorded in Clancy Consulting report "Geo-Environmental Appraisal Report" (see reference list) confirmed the following stratigraphy:

- MADE GROUND, ranging from 0.25 m – 1.60 m Below Existing Ground Level (BEGL), over;
- NATURAL SUPERFICIAL DEPOSITS, ranging from 2.40 m – 5.60 m BEGL, over;
- CHALK BEDROCK, to extents of investigation.

2.7. Groundwater

A programme of six groundwater monitoring visits were undertaken and recorded within the aforementioned "Geo-Environmental Appraisal Report", with results below:

Table 6 – Groundwater Levels

Hole ID	Water Strike During Drilling (m)	Groundwater (m) 05/06/2019	Groundwater Level (m) 14/06/2019	Groundwater Level (m) 28/06/2019	Groundwater Level (m) 10/07/2019	Groundwater Level (m) 18/07/2019	Groundwater Level (m) 30/07/2019	Groundwater Level (m) 1702/2020
BH1	9.0 rising to 7.1	4.5	4.3	4.4	4.5	DRY	4.5	-
BH2	6.3 rising to 4.9	4.4	4.3	4.5	4.5	4.6	4.4	-
WS3	4.8	4.3	4.2	4.4	4.4	4.5	4.5	-
WS6	DRY	-	-	-	-	-	-	2.2
WS8	DRY	-	-	-	-	-	-	3.5
WS9	4.5	-	-	-	-	-	-	2.9

Figure 2 - Extract from Clancy Consulting "Geo-Environmental Appraisal Report" showing results of groundwater monitoring visits.

Further investigations undertaken by Ridge & Partners LLP within the period 22/11/2021 – 24/11/2021 confirmed groundwater strikes at circa 7.0 m BEGL.

Whilst we acknowledge that previous ground water monitoring was not undertaken through the full winter period, we note that the highest observed levels occurred during the late February 2020 visit (measuring 2.20 m BEGL) and therefore considered to be at 'high season'.

Furthermore, reviewing the hydrographs from the BGS's online groundwater monitoring boreholes for the "Westdean No.3" location (the closest to the site) would suggest that groundwater would be at its highest level in and around the above date.

In addition, the hydrographs appear to suggest groundwater levels to be uncharacteristically high during 2020 and nearing the 95th percentile.

With the foregoing in consideration, it is our opinion that sufficient data has been obtained to be able to satisfactorily consider the influence of groundwater on the proposed below ground drainage design.

2.8. Hydrology

The nearest surface water feature is understood to be the River Adur, which is located approximately 122 m to the South of the site.

2.9. Infiltration & Soil Permeability

Preliminary falling head tests were conducted as part of the initial investigations summarised in the aforementioned "Geo-Environmental Appraisal Report" which confirmed no change in water level within the shallow soils, suggestive that the underlying soils are unsuitable for surface water disposal.

Additional infiltration testing in accordance with BRE 365 was undertaken by Ridge & Partners LLP within the existing car park during the period 22/11/2021 – 24/11/2021, with results summarised below:

LOCATION	INFILTRATION RATE
SA.01 – Test 1	25 % marker not met within 1260 minute period, therefore test failed.
SA.02 – Test 1	4.87E-06 m/s
SA.02 – Test 2	6.70E-06 m/s

Tests were undertaken at a depth of circa 2.60 m below existing ground level and within naturally occurring soils, commensurate with the likely formation of any proposed infiltration feature.

Failure of the test at location SA.01 required relocation of the test hole elsewhere within the existing car park area. Three cycles were not completed at this location due to lack of potable water to conduct the third cycle however based on results, this is not considered critical to the further development of the below ground drainage design.

The results clearly demonstrate the underlying strata to either be unproductive, or of extremely low permeability and on the limit of infiltration viability in accordance with Table 25.1 of The SuDS Manual

2.10. Ground Contamination

The aforementioned "Geo-Environmental Appraisal Report" confirms the underlying soils to be contaminated with LEAD, PAH's (BaP, benzo(b)fluoranthene and dibenzo(ah)anthracene), and hydrocarbons. Contaminants were identified at shallow depths and at depths ranging from 4.30 m to 6.00 m BEGL.

Whilst the study confirms that contamination risk to end-users and migration of contaminants to the ground water table is low, it does highlight that risk nonetheless exists for construction operatives.

Similarly, the significant depth of the contaminants is such that in-situ treatment is considered necessary to further reduce the risk of further migration of contaminants into the Principal Aquifer, as well as to safeguard construction operatives and stability of adjoining structures should a conventional excavation and 'muck away' methodology be used.

The extent of the assumed contamination hotspot is indicated on the strategy drawings as appended to this report.

2.11. Buried Obstructions, Utilities Easements and Other Constraints

Utilities records (and subsequent GPR survey) suggest the presence of existing utilities on, or within the immediate vicinity of the proposed development, the majority of which are believed to be serving the existing building and therefore will be abandoned / diverted as required. With this in consideration, buried utilities are not considered to present a constraint to the development of the below ground drainage design.

The site is however constrained by the presence of several mature Leyland Cypress trees measuring circa 12.0 m in height to the Western boundary of the site, at the junction with the adjoining car park (see figure 3).

As outlined within the Arboricultural Impact Assessment (see references) which accompanied the planning application, it is intended to retain and protect this tree group during the course of the works.

With reference to BS 5857 (2012) Trees in Relation to Design, Demolition and Construction, the approximate 'rule of thumb' for determining the root protection area near trees is "12 x the stem diameter".

Assuming therefore an average stem diameter of 300 mm would suggest an equivalent root protection zone of 3.60 m inside of which excavations should be prohibited.

Figure 3 - Photograph showing mature tree line to the West boundary of the site.

SECTION 3

ANALYSIS OF NATIONAL AND LOCAL POLICY

3. ANALYSIS OF NATIONAL AND LOCAL POLICY

3.1. National Policy

National Planning Policy Framework (NPPF)

Communities and Local Government Document. (2021). The National Planning Policy Framework requires the Planning Application to demonstrate that the Proposed Development will be safe for the duration of its' design life, taking into account the vulnerability of its' users and without increasing flood risk elsewhere, and where possible, reducing flood risk overall.

Non-Statutory Technical Standards for Sustainable Drainage Systems

Department for Environment, Food and Rural Affairs. (2015). Non-Statutory Technical Standards for Sustainable Drainage Systems state that the peak rate of discharge from a redevelopment during the 1:1 year and 1:100 year rainfall events should be as close as reasonably practical to the corresponding greenfield runoff rate, but should never exceed that of the pre-development state.

The standards also recommend that, where reasonably practicable, the runoff volume generated from the 1:100 year, 6 hour rainfall event should be constrained to the corresponding greenfield runoff volume.

Building Regulations Approved Document H

Secretary of State. (2015). Building Regulations Approved Document H establishes a hierarchy for surface water disposal and encourages a SuDS approach. The hierarchy stipulates that surface water runoff which is not collected for re-use must be discharged in the following order of priority:

1. Discharge to ground via infiltration; or, where not reasonably practicable,
2. Discharge to a surface water body (i.e. river, watercourse or the like); or, where not reasonably practicable,
3. Discharge to a surface water sewer, highway drain or other surface water drainage system; or, where not reasonably practicable,
4. Discharge to a combined sewer.

3.2. Local Policy

Adur & Worthing Councils Supplementary Requirements

Adur & Worthing Councils "Supplementary Requirements for Surface Water Drainage Proposals" document confirms:

- Any proposed surface water scheme must consider sustainable drainage principles.
- The hierarchy given in Building Regulations Approved Document H should be followed in selection of SuDS systems and further states that discharge of surface water to the foul sewer system will not be permitted.
- That any infiltration drainage design must include adequate winter groundwater monitoring data to determine the highest winter groundwater table. Subsequently residential developments of greater than 10 properties will require groundwater monitoring to be carried out between October and March.
- In the case of greenfield development, any discharge to watercourses or surface water sewers must be restricted to the estimated mean greenfield runoff rate (Q_{Bar}), using the positively drained area, rather than the greenfield site area, and allowable runoff rate reduced accordingly.

- In the case of brownfield development, these should also attempt to restrict discharge to Q_{Bar} or where this is not achievable, as close as practicable to Q_{Bar} and with a minimum 50% 'betterment' on the existing condition.
- Greenfield runoff rates should be derived using the IH124 methodology.
- A minimum outflow of 2 l/s with appropriate blockage mitigation measures should be adopted, where practical to do so.
- 'Open' attenuation (i.e. basins, ponds, swales etc.) is preferred over below ground attenuation tanks.
- That any submitted design should consider exceedance routes in the event of failure or overwhelming of the SuDS system.
- That any submitted design should contribute to landscape quality, where practical to do so.
- That any submitted design should contain appropriate robustness in the form of (for example) bypass arrangements should blockage occur.
- That any submitted design should set out in writing the site specific maintenance arrangements.

3.3. Opportunities

The redevelopment of the Application Site presents an opportunity to contribute to a reduction in flood risk by reducing the current rate of discharge to the public sewer network.

The incorporation of sustainable drainage systems within the Proposed Development should seek to offer a reduction in peak runoff rates in accordance with both the national and local policies described above.

Subsequently, a reduction in peak flow rates would result in a lower surface water flood risk downstream of the Proposed Development, with larger reductions providing a greater betterment.

Surface water currently generated by the Application Site is believed to discharge un-treated directly to the public surface water network. Subsequently the management of surface water in accordance with the requirements of local policy and CIRIA. (2015). C753 – The SuDS Manual would result in an increase in the quality of the surface water generated by the Proposed Development.

SECTION 4
FOUL WATER MANAGEMENT

4. FOUL WATER MANAGEMENT

4.1. Design Criteria

The design of the foul water drainage network will be undertaken in accordance with BS EN 752 (2008) by:

- Determining the volume of discharge using the assumed number of appliances (Table 2 of BS EN 12056-2 (2000)).
- Applying a frequency factor in accordance with the use / occupancy class of the building (Table 3 of BS EN 12056-2 (2000)).
- Converting the summation of the above into a flow rate using clause 6.3.3 of BS EN 12056-2 (2000).

In residential developments, where the flow rate requires the use of a pipe diameter greater than 150 mm, the Population Method will be used adopting a minimum flow rate of 0.046 l/s/dwelling.

In all instances pipe diameters, gradients etc will be sized to ensure:

- A minimum 'self-cleansing' velocity of 0.75 m/s will be maintained.
- The maximum proportional depth will be no greater than 0.75 at peak (design) flow.

4.2. Existing Discharge Rates and Points of Connection

The site currently features an existing four storey residential building providing 40 No. homes with associated car parking and soft landscaped amenity areas.

As outlined in the foregoing, separate foul and surface water drainage is known to serve the site, with the current foul water point of connection to the public sewer located to the North-East of the site via a 'blind' 150 mm diameter pipe.

Existing foul water discharge estimates have been prepared in accordance with Butler & Davies. (2012). 2nd Ed. Urban Drainage, assuming the following:

- Infiltration Factor: 1.10
- Peak Flow Factor: 6
- Foul Load: 200 l/person/day (Conservatively)

Detailed calculations can be found within the appendices of this report, these however suggest an existing estimated foul water volume of 211,200 l/day corresponding to a peak foul water flow of 2.44 l/s, assuming a 24 hour 'usage period'.

4.3. Proposed Discharge Rates and Points of Connection

The proposed development will provide a total of 74 new residential units, broken down in Section 1.3.

Following similar design assumptions and foul loading criteria in accordance with Butler & Davies. (2012). 2nd Ed. Urban Drainage would suggest an estimated foul water volume of 370,720 l/day corresponding to a peak foul water flow of 4.29 l/s, assuming a 24 hour 'usage period'.

It is proposed to re-use the existing 150 mm diameter foul water connection within Ham Road subject to detailed CCTV condition survey and subsequent repair works.

All new drainage will be constructed in accordance with the Building Regulations Part H and Sewers for Adoption (7th Ed.).

4.4. Analysis

It can be demonstrated therefore that the proposed development will generate a nett increase in foul water volume and peak flow to the public foul water sewer network, as follows:

- Foul Water Volume to Sewer: Increase by 159,520 l/day
- Foul Water Peak Flow to Sewer: Increase by 1.85 l/s

The above values are not considered to demonstrate a significant demand to the public sewer network.

From review of the previous study and planning consultee correspondence, it is understood that Southern Water initially expressed concern that the local sewerage network had insufficient capacity to cater for the proposed increase in foul water flow to the public sewer and therefore recommended that network improvement works would indeed be required.

Review of latest correspondence from Southern Water on the application via letter dated 11th February 2021 (see appendices) would however suggest that network improvement works are now no longer deemed to be required, based upon evidence provided in the previous study.

Notwithstanding the above, any new connections will be subject to a section 106 application with the sewerage undertaker.

SECTION 5
SURFACE WATER MANAGEMENT

5. SURFACE WATER MANAGEMENT

5.1. Design Criteria

The design of the surface water drainage network will be undertaken in accordance with BS EN 752 (2008) to ensure that:

- No significant surcharging (by gravity flow only) of pipework occurs for storm flows with a 1:2 AEP.
- No flooding occurs for storm flows with a 1:30 AEP.
- No off-site flooding occurs or flooding which presents a risk to persons or property for storms with a 1:100 AEP.
- The design accounts for an appropriate climate change allowance, as described below.

5.2. Proposed Drainage Catchments

Owing to the relatively small area of the Application Site, it is proposed to utilise a single drainage catchment in the development of the surface water drainage design.

5.3. Disposal Strategy

Infiltration

Given the highly variable permeability characteristics and presence of proven unproductive strata, it is our opinion that infiltration-based SuDS features (i.e. soakaways, infiltration basins or permeable surfaces) are not considered feasible at the site without presenting an unacceptable increase to flood risk both on and off-site.

Where infiltration rates have been established via in-situ testing, these suggest low permeability which is on the limit of infiltration viability. The surface area required for any infiltration system to be effective in this instance would be vast and given the constraints presented in Section 2 (contamination, root protection zones, buried obstructions etc.), it is considered that insufficient space is present on site for such systems.

In addition, the Building Regulations requirement to site soakaways a minimum of 5 meters from buildings to prevent influence to foundations would further reduce the limited space available.

Finally, there is risk that a minimum 1.0 m 'gap' between the underside of the soakaway and the ground water table may not be able to be maintained owing to the variable nature of the groundwater table in the area.

Water Courses / Surface Water Bodies

No viable means of connection to the nearby River Adur is deemed practical in this instance, as surface water would need to be conveyed across several parcels of third-party land and a minimum of two public highways, for which obtaining legal permissions would be unlikely.

Additionally, there are no appropriate surface water bodies within the immediate vicinity of the Application Site into which surface water should be discharged.

Surface Water Sewers

Subsequently, it is proposed that the proposed development will dispose of surface water to the public surface water sewerage network in Service Road, re-utilising existing connections where possible or via new appropriately designed connections, subject to seeking permissions from the Sewerage Undertaker.

Combined Sewers

The alternative would be to discharge to the existing public combined sewer in Ham Road, however as this is the least desirable option, it has not been considered further.

5.4. Greenfield Runoff Rates

Greenfield runoff rates have been estimated for the site using the Institute of Hydrology Report 124 method, in accordance with the latest Environment Agency Guidance, as summarised below and are included within the appendices of this study:

CATCHMENT	AREA	QBAR	1:1 AEP EVENT	1:30 AEP EVENT	1:100 AEP EVENT
Total Site	0.280 Ha	0.05 l/s	0.04 l/s	0.12 l/s	0.16 l/s

5.5. Peak Existing Runoff Rates

Peak existing runoff rates have been calculated using the Wallingford Procedure for the 1:1 AEP, 1:2 AEP and 1:100 AEP events respectively, assuming a 15 minute storm duration:

CATCHMENT	AREA	% IMPERMEABLE	1:1 AEP EVENT	1:2 AEP EVENT	1:100 AEP EVENT
Total Site	0.280 Ha	68 %	16.1 l/s	20.8 l/s	50.9 l/s

5.6. Catchment Contributing Areas

A breakdown of the contributing areas for the proposed surface water drainage system, are as follows:

CATCHMENT	CATCHMENT AREA	PERMEABLE AREA	IMPERMEABLE AREA	% IMPERMEABLE
Total Site (Existing)	0.280 Ha	0.090 Ha	0.190 Ha	67.9 %
Total Site (Proposed)	0.280 Ha	0.016 Ha	0.264 Ha	94.2 %

Whilst the proposed development presents an increase in impermeable surfaces, this is considered to be offset via the provision of green roofs and permeable surfaces generally which will retard the time to entry of surface water to the surface water drainage network, as well as provide opportunity for evapotranspiration.

5.7. Allowance for Climate Change

Table 2 (Peak Rainfall Intensity Allowance in Small and Urban Catchments) of Environment Agency. (2019). Flood Risk Assessments: Climate Change Allowances confirms the climate change allowance of 40% should be adopted for the Application Site, assuming a lifespan of 100 years for residential development as recommended within the NPPF.

5.8. Allowable Discharge Rates

In accordance with the national and local policies outlined within Section 3, the Proposed Development should seek to limit the peak flow rate to the mean (Q_{Bar}) greenfield runoff rate, wherever practicable. Where this cannot be achieved, a betterment rate of at least 50 % on the existing peak discharge rate should be targeted within the constraints presented by the site.

As presented in the foregoing, the mean greenfield runoff rate (Q_{Bar}) has been determined as 0.05 l/s and it is not considered practicable to limit the discharge rate to such a low value in this instance.
Environment Agency. (2013). Rainfall Runoff Management for Developments stipulates that a minimum discharge rate of 5.0 l/s should be adopted to mitigate risks associated with blockage of the flow control device, which could present an unacceptable increase in flood risk.

In addition, Arun & District Councils Supplementary Guidance Document suggests a minimum discharge rate of 2.0 l/s should be adopted in addition to enhanced blockage mitigation measures.

Notwithstanding the above, a clear balance must be struck between providing a sustainable betterment situation by limiting discharge flows, whilst maintaining practicality of construction, minimising ongoing maintenance requirements and ensuring the scheme remains commercially viable.

Owing to the small and heavily constrained nature of the site, the available space for surface water attenuation is extremely limited without presenting an unacceptable increase in flood risk, problematic future maintenance liabilities, the risk of loss of existing trees and the risk of contaminant migration into the principal aquifer.

With this and both National and Local policy in consideration, it is proposed to limit the discharge from the proposed development to the following:

STORM EVENT	PROPOSED DISCHARGE RATE	EXISTING DISCHARGE RATE	% BETTERMENT
1:1 AEP	8.0 l/s	16.1 l/s	50.3 %
1:100 AEP	25.0 l/s	50.9 l/s	50.9 %

To achieve the above, a complex flow control device will be installed to a hydrobrake manhole to restrict surface water flows to the values stated, with surplus storm water attenuated on site via SuDS features and slowly released to the public sewer network on cessation of the storm event.

5.9. Proposed SUDS Features

Blue Roofs & 'Building' Storage

The use of blue roofs and 'above ground' storage methods such as rainwater harvesting are not considered viable solutions in this instance.

Ponds / Basins & Swales

There is insufficient viable space on site to accommodate 'open' attenuation features.

Permeable External Finishes & Attenuating Sub-Bases

The use of permeable surfaces in car parking bays is considered viable, however due to the impermeable nature of the underlying soils on the site, the sub-bases will be tanked and shall discharge surface water into the surface water drainage network.

In doing so, the system will give added benefit in the form of delayed time to entry of surface water to the drainage network and opportunity for evapotranspiration of surface water, in addition to providing added water quality enhancements due to filtration.

Permeable paving options are not however considered viable for the access road and vehicular circulation areas due to the increased risk of deformation or failure resulting from increased vehicular loading, 'dry maneuvering' of vehicles etc.

Tanked Storage Systems

Owing to the spatial and other constraints present at the site, it is proposed to adopt a below ground geocellular attenuation system, which will be sized for all storm events up to and including the 1:100 AEP event plus climate change allowance.

5.10. Required Attenuation Volumes

A detailed hydraulic simulation module has been produced for the proposed drainage system to determine the required volume of attenuation, as follows:

- Geocelluar Attenuation Tanks: 47.5 m^3
- Permeable Sub-Bases: 17.0 m^3
- Total Attenuation Provided: 64.5 m^3

Detailed calculation outputs are presented within the appendices of this document.

With the above in consideration, the proposed development will therefore contribute to a reduction in flood risk associated with the exceedance of the local public sewerage network by providing a reduction in peak discharge rates and avoiding an increase in total runoff volume.

5.11. Robustness & Exceedance Routes

Flow control chambers will be fitted with appropriate high level 'bypass' overflows to prevent flooding in the event of failure of the flow control devices.

In the event that the SuDS features are overwhelmed by exceptional rainfall then exceedance routes have been considered within the proposed drainage design and illustrated on the proposed drainage schematic as attached to this report.

SECTION 6

OWNERSHIP & MAINTENANCE STRATEGY

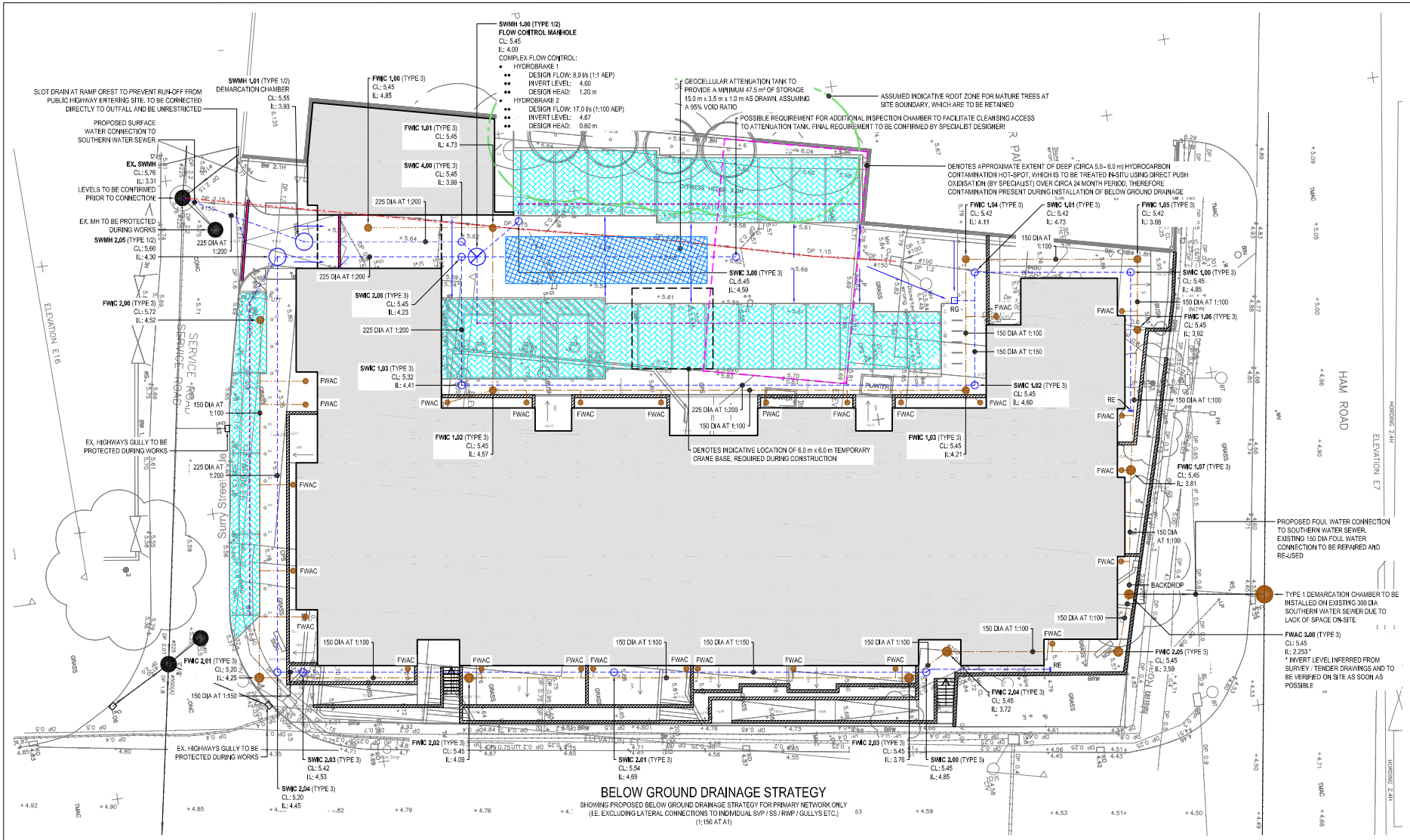
6. OWNERSHIP AND MAINTENANCE STRATEGY

To ensure the long-term performance, the on-site drainage system will be owned and maintained by the site operator or a maintenance company (MC) in accordance with the indicative schedule below:

ELEMENT / DRAINAGE COMPONENT	OWNERSHIP / ADOPTION	MAINTENANCE REQUIREMENTS
Geocellular Attenuation Tank	Site Operator / MC	To be monitored for silt build-up and cleaned as required using suction methods, ensuring no solid material passes through outlet. Monitored for general condition of the tank and system generally, to suit manufacturer's guidance, check for leaks and displacement of 'cells'. Inspection annually and before / after extreme storm events.
Flow Restriction Device & Chamber	Site Operator / MC	To be monitored for silt build-up and cleaned as required using suction methods. Check function of flow restriction componentry to suit manufacturer's guidance. Inspection annually and before / after extreme storm events.
Catchpit Manholes	Site Operator / MC	To be monitored for silt build-up and cleaned as required using suction methods. Inspection annually and before / after extreme storm events.
Rain Water Pipes	Site Operator / MC	Clearance of leaves / debris from guttering and hopper inlets. Rodding points provided to clear blockages via conventional rodding methods. Inspection annually and before / after extreme storm events.
Soil Vent Piles / "Stub Stacks"	Site Operator / MC	Rodding points to be provided to clear blockages via conventional rodding methods. Inspection annually.
Gullies (Internal & External)	Site Operator / MC	To be monitored for silt build-up and cleaned as required. Where provided, ensure air traps are primed and sealed to prevent smells. Inspection quarterly.
Surface Water Drainage Channels	Site Operator / MC	To be monitored and cleaned via jetting when any debris / silt reduces the cross-sectional area by 25% or more. Inspection to include both the channel and silt trap / gulley outlets. Inspection annually and before / after extreme storm events.
Below Ground Pipework Generally	Site Operator / MC	To be inspected for reduction in cross-sectional area (i.e. due to blockage, silt or debris build-up, root ingress etc) general condition of materials, pipe displacement and the like. Inspection annually and where appropriate before / after extreme storm events.
Manholes / Inspection Chambers Generally	Site Operator / MC	To be inspected for debris and integrity of chambers and covers generally. Inspection annually and where appropriate before / after extreme storm events.
Permeable Paving Generally	Site Operator / MC	To be inspected for debris / silting of joints / moss and lichen growth etc. which would impede permeable function. Inspection annually and where appropriate before / after extreme storm events. Non-aggressive brushing annually and top up of grit-stone after cleaning and weed control annually.

APPENDICES

7. APPENDIX A – DRAWINGS



BELOW GROUND DRAINAGE STRATEGY

SHOWING PROPOSED BELOW GROUND DRAINAGE STRATEGY FOR PRIMARY NETWORK ONLY
(I.E. EXCLUDING LATERAL CONNECTIONS TO INDIVIDUAL SVP / SS / RWP / GULLYS ETC.)
(1:150 AT A1)

PIPEWORK

- XXX DIA AT 1:XXX — SURFACE WATER PIPEWORK (100 DIA AT 1:100 U.N.O)
- XXX DIA AT 1:XXX — FOUL WATER PIPEWORK (100 DIA AT 1:80 U.N.O)
- XXX DIA AT 1:XXX — PERFORATED FILTER DRAIN (100 DIA AT 1:100 U.N.O)
- EXISTING PIPEWORK (REFER TO SURVEY)
- PIPEWORK TO BE ABANDONED

ACCESS SYSTEMS

- FWMH (TYPE 1/2)
- FWIC (TYPE 3)
- FWAC (TYPE 4)
- SWMH (TYPE 1/2)
- SWIC (TYPE 3)
- SWAC (TYPE 4)
- EXISTING MANHOLE

SUDS SYSTEMS

- FLOW CONTROL
- ATTENUATION TANK
- PERMEABLE BLOCK PAVING
- OVERLAND FLOW ROUTE (IMPERMEABLE SURFACES ONLY)

INLETS

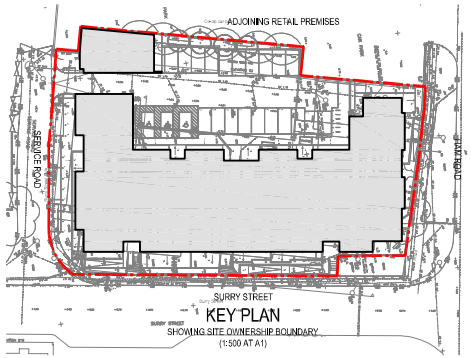
- SLOT DRAINAGE (ACO, GATIC OR SIMILAR)
- RG — ROAD GULLY

EXTERNAL STRUCTURES

- BOUNDARY OR RETAINING WALL
- EXTERNAL STAIR (ARROW POINTS UP)

GENERALLY

REFER TO DRAWINGS 5016599-RDG-XX-XX-SK-C-2003 & 2004 FOR CONSTRUCTION DETAILS!



KEY PLAN

SHOWING SITE OWNERSHIP BOUNDARY
(1:500 AT A1)

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REV	DESCRIPTION	DATE	DRAWN
P1	INITIAL ISSUE - FOR COMMENT	26/11/2021	MCN

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IN ASSOCIATION WITH:

PROJECT:
THE MANNINGS
SHOREHAM-BY-SEA

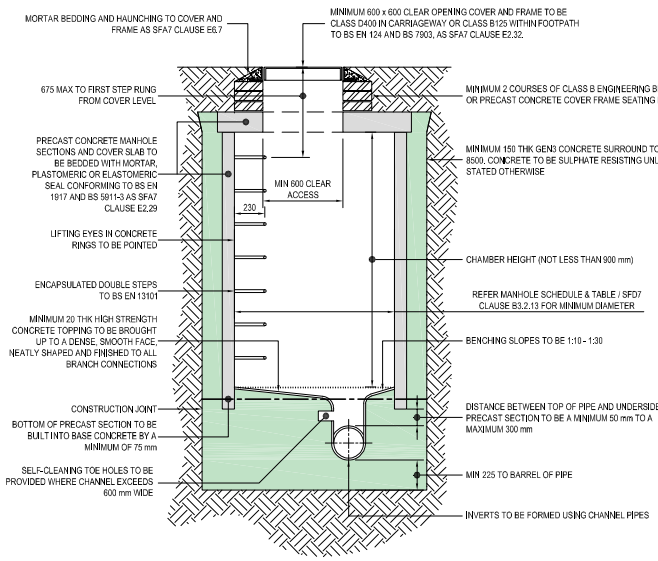
TITLE:
FOUL & SURFACE WATER DRAINAGE STRATEGY

TECH:	CSE:	ICSE:	SCALE: AS SHOWN @ A1
			INITIAL ISSUE: 26/11/2021

STATUS:
S3 - REVIEW & COMMENT

DRAWING No:

PROJECT:	ORG:	ZONE:	LEVEL:	TYPE:	ROLE:	NUMBER:	REV:
RL51001	RDG	XX	XX	SK	C	2002	P1

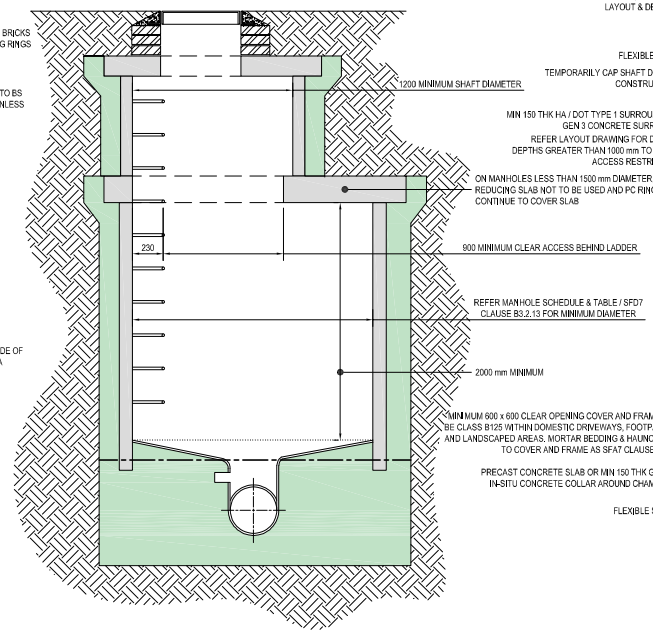


DIAMETER OF LARGEST PIPE IN MANHOLE (mm)	MINIMUM CHAMBER DIAMETER (mm)
<375	1200
375 - 700	1500
750 - 900	1800

NOTE THAT THE SAFETY POLICY OF INDIVIDUAL SEWERAGE UNDERTAKERS MAY REQUIRE A LARGER MINIMUM CLEAR OPENING INTO MANHOLES AND THE FITTING OF GUARD BARS, SAFETY CHAINS AND/OR OTHER SAFETY DEVICES OVER THOSE REQUIRED BY SFA7. THE LOCAL DRAINAGE INSPECTOR SHOULD BE CONSULTED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS ON SITE

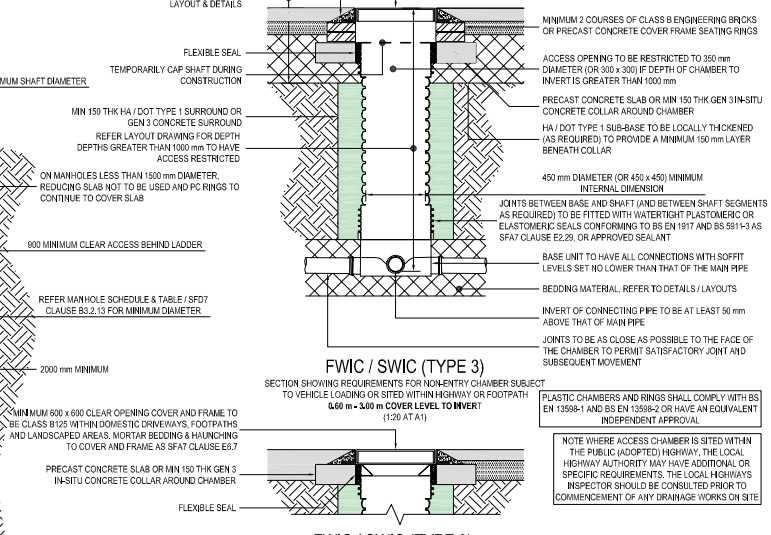
FWMH / SWMH (TYPE 2)

SECTION SHOWING REQUIREMENTS FOR FOUL AND SURFACE WATER MANHOLES
0.90 m - 3.00 m COVER LEVEL TO INVERT
(1:20 AT A1)



FWMH / SWMH (TYPE 1)

SECTION SHOWING REQUIREMENTS FOR FOUL AND SURFACE WATER MANHOLES
3.00 m - 6.00 m COVER LEVEL TO INVERT
(1:20 AT A1)

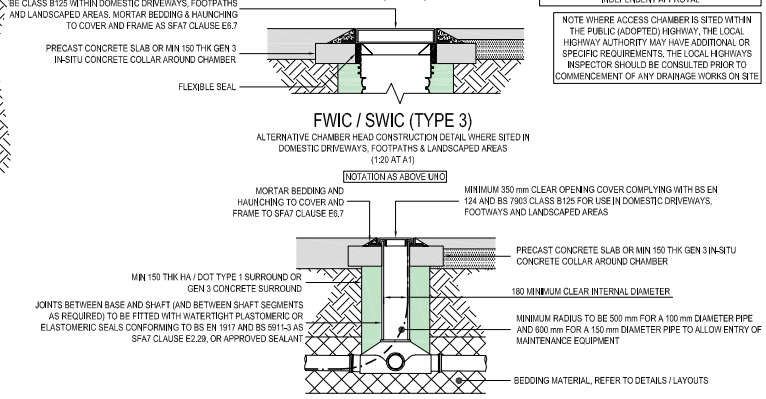


FWIC / SWIC (TYPE 3)

SECTION SHOWING REQUIREMENTS FOR NON-ENTRY CHAMBER SUBJECT TO VEHICLE LOADING OR SITED WITHIN HIGHWAY OR FOOTPATH
0.60 m - 3.00 m COVER LEVEL TO INVERT
(1:20 AT A1)

PLASTIC CHAMBERS AND RINGS SHALL COMPLY WITH BS EN 13598-1 AND BS EN 13598-2 OR HAVE AN EQUIVALENT INDEPENDENT APPROVAL

NOTE WHERE ACCESS CHAMBER IS SITED WITHIN THE PUBLIC (ADOPTED) HIGHWAY, THE LOCAL HIGHWAY AUTHORITY MAY HAVE ADDITIONAL OR SPECIFIC REQUIREMENTS. THE LOCAL HIGHWAYS INSPECTOR SHOULD BE CONSULTED PRIOR TO COMMENCEMENT OF ANY DRAINAGE WORKS ON SITE



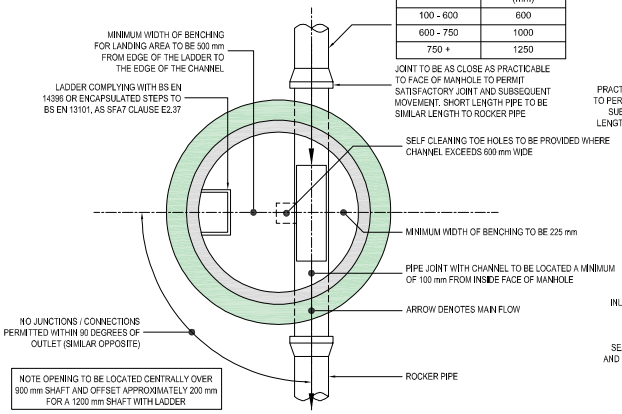
FWIC / SWIC (TYPE 3)

ALTERNATIVE CHAMBER HEAD CONSTRUCTION DETAIL WHERE SITED IN DOMESTIC DRIVEWAYS, FOOTPATHS & LANDSCAPED AREAS
(1:20 AT A1)

NOTATION AS ABOVE UNO

FWAC / SWAC (TYPE 4)

SECTION SHOWING REQUIREMENTS FOR NON-ENTRY ACCESS CHAMBER
0.30 m - 2.00 m COVER LEVEL TO INVERT
(1:20 AT A1)

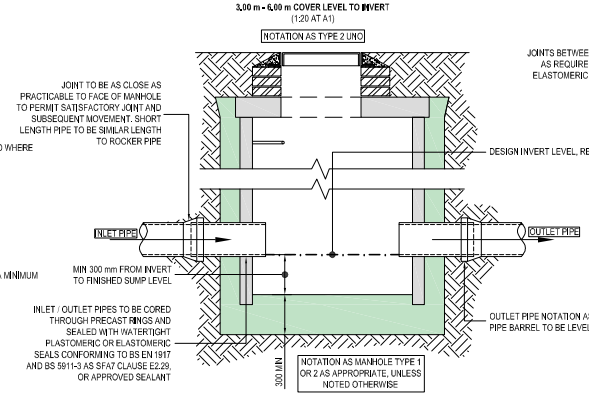


NOMINAL PIPE DIA (mm)	EFFECTIVE LENGTH OF ROCKER PIPE (mm)
100 - 600	600
600 - 750	1000
750 +	1250

NOTE OPENING TO BE LOCATED CENTRALLY OVER 900 mm SHAFT AND OFFSET APPROXIMATELY 200 mm FOR A 1200 mm SHAFT WITH LADDER

TYPE 1 / 2 GENERAL ARRANGEMENT

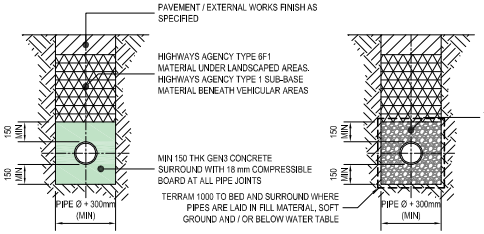
PLAN SHOWING REQUIREMENTS FOR FOUL AND SURFACE WATER MANHOLES
(1:20 AT A1)



NOTATION AS MANHOLE TYPE 1 OR 2 AS APPROPRIATE, UNLESS NOTED OTHERWISE

CATCHPIT MANHOLE

SECTION SIMILAR TO TYPE 1 / TYPE 2 MANHOLE
ADDITIONAL REQUIREMENTS FOR CATCHPIT MANHOLE SHOWN
(1:20 AT A1)



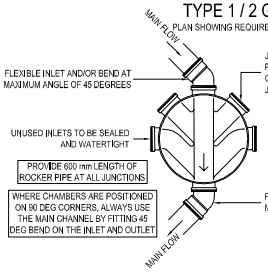
CLASS Z PIPE BEDDING DETAIL

FOR PIPES WITH COVER FROM FINISHED SURFACE TO CROWN LESS THAN 0.9m IN VEHICULAR AREAS OR LESS THAN 0.6m COVER IN LANDSCAPED AREAS OR BENEATH BUILDINGS
(1:20 AT A1)

CLASS S PIPE BEDDING DETAIL

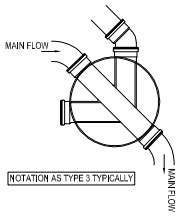
FOR PIPES WITH COVER FROM FINISHED SURFACE TO CROWN GREATER THAN 0.9m IN VEHICULAR AREAS OR GREATER THAN 0.6m COVER IN LANDSCAPED AREAS OR BENEATH BUILDINGS
(1:20 AT A1)

NOTATION AS CLASS Z UNO



TYPE 3 GENERAL ARRANGEMENT

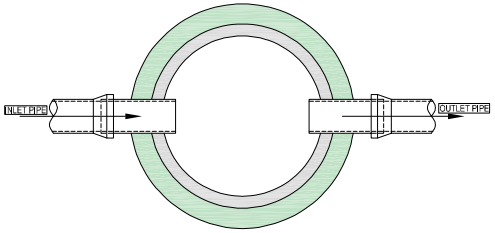
SHOWING REQUIREMENTS FOR FOUL AND SURFACE WATER MANHOLES
(NTS)



NOTATION AS TYPE 3 TYPICALLY

TYPE 4 GENERAL ARRANGEMENT

SHOWING REQUIREMENTS FOR FOUL AND SURFACE WATER MANHOLES
(NTS)



CATCHPIT MANHOLE

PLAN SIMILAR TO TYPE 1 / TYPE 2 MANHOLE
ADDITIONAL REQUIREMENTS FOR CATCHPIT MANHOLE SHOWN
(1:20 AT A1)

uPVC / THERMOPLASTIC PIPE NOTES

1. PIPES LESS THAN OR EQUAL TO 500 mm DIA TO HAVE A NOMINAL SHORT-TERM RING STIFFNESS OF NOT LESS THAN 8 kN/m² (SN8).
2. PIPES GREATER THAN 500 mm DIA TO HAVE NOMINAL SHORT-TERM RING STIFFNESS OF NOT LESS THAN 2 kN/m² (SN2), WHERE ACCOMPANIED BY MANUFACTURER'S DESIGN LOAD CALCULATIONS FOR THE PROPOSED USE.
3. uPVC PIPEWORK TO BS EN 13476 PARTS 1, 2 & 3 AND WIS 4-35-01.
4. uPVC PIPEWORK TO BE BSI KITEMARKED OR HAVE EQUIVALENT THIRD PARTY CERTIFICATION.
5. PIPES MUST BE CAPABLE OF WITHSTANDING 4000 PSI JETTING PRESSURE, WITH EVIDENCE SUPPLIED TO THE ENGINEER PRIOR TO PROCUREMENT.

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REV	DESCRIPTION	DATE	DRAWN
P1	INITIAL ISSUE - FOR COMMENTS	26/11/2021	MCN

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IN ASSOCIATION WITH:

PROJECT:
THE MANNINGS
SHOREHAM-BY-SEA

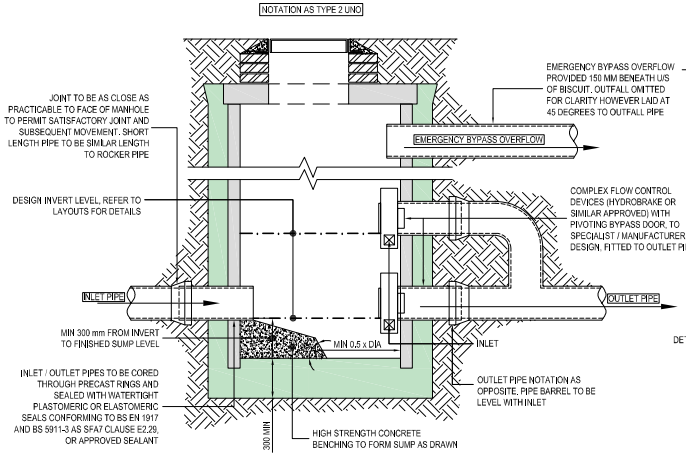
TITLE:
BELOW GROUND DRAINAGE CONSTRUCTION DETAILS
SHEET 01 OF 02

TECH:	CSE:	ICSE:	SCALE: AS DRAWN @ A1
			INITIAL ISSUE: 26/11/2021

STATUS:
S3 - REVIEW & COMMENT

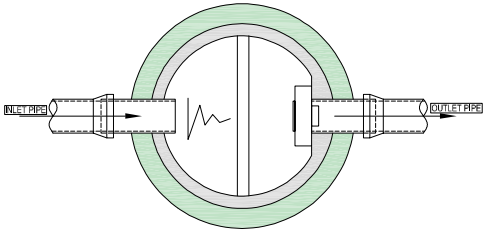
DRAWING No:

PROJECT:	ORG:	ZONE:	LEVEL:	TYPE:	ROLE:	NUMBER:	REV:
RL51001	RDG	XX	XX	SK	C	2003	P1



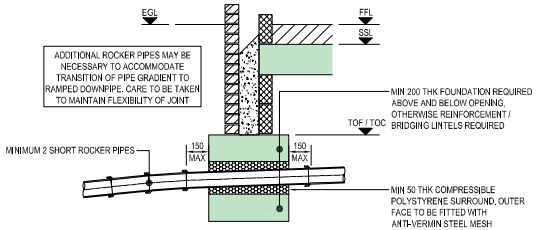
FLOW CONTROL MANHOLE

SECTION SIMILAR TO TYPE 1 / TYPE 2 MANHOLE
ADDITIONAL REQUIREMENTS FOR FLOW CONTROL MANHOLE SHOWN
(1:20 AT A1)



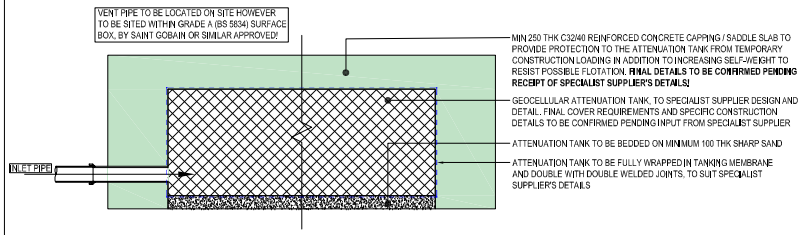
FLOW CONTROL MANHOLE

PLAN SIMILAR TO TYPE 1 / TYPE 2 MANHOLE
ADDITIONAL REQUIREMENTS FOR FLOW CONTROL MANHOLE SHOWN
(1:20 AT A1)



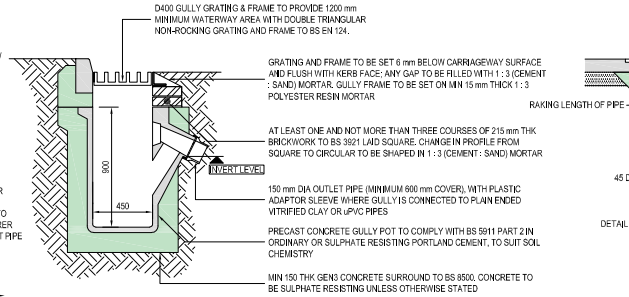
PIPE THROUGH CONCRETE DETAIL

SHOWING CONSTRUCTION REQUIREMENTS WHERE PIPEWORK PENETRATES FOUNDATIONS OR STRUCTURAL CONCRETE
(1:20 AT A1)



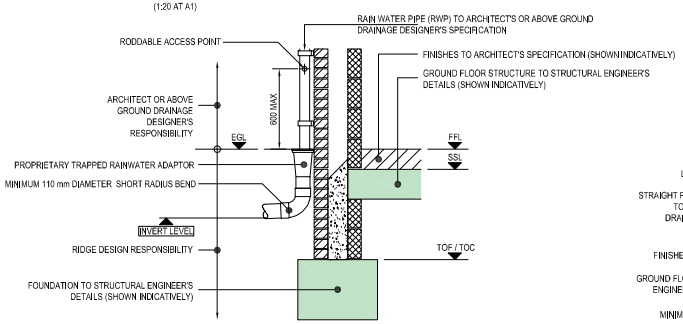
TYPICAL ATTENUATION TANK DETAIL

SHOWING TYPICAL CONSTRUCTION REQUIREMENTS FOR PROPOSED GEOCELLULAR ATTENUATION TANK
(1:20 AT A1)



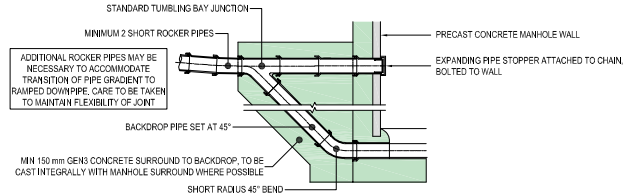
ROAD GULLY

DETAIL SHOWING TRAPPED PRECAST CONCRETE ROAD GULLY REQUIREMENTS
(1:20 AT A1)



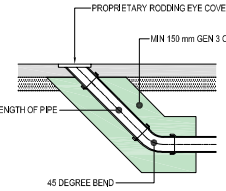
EXTERNAL RWP DETAIL

SHOWING REST BEND REQUIREMENTS, DESIGN RESPONSIBILITIES AND INVERT LEVEL ASSUMPTIONS
(1:20 AT A1)



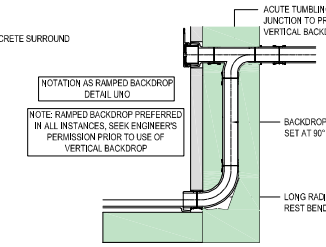
RAMPED BACKDROP

DETAIL SHOWING RAMPED BACKDROP REQUIREMENTS
(1:20 AT A1)



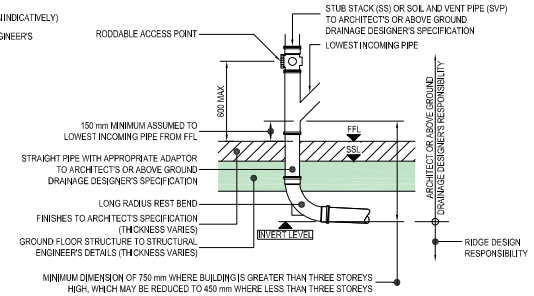
RODDING EYE

DETAIL SHOWING RODDING EYE REQUIREMENTS
(1:20 AT A1)



VERTICAL BACKDROP

DETAIL SHOWING VERTICAL BACKDROP REQUIREMENTS
(1:20 AT A1)



SVP / SS / INTERNAL RWP DETAIL

SHOWING REST BEND REQUIREMENTS, DESIGN RESPONSIBILITIES AND INVERT LEVEL ASSUMPTIONS
(1:20 AT A1)

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REV	DESCRIPTION	DATE	DRAWN
P1	INITIAL ISSUE - FOR COMMENTS	26/11/2021	MCN

ORIGINATOR:

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CLIENT:

Real

IN ASSOCIATION WITH:

PROJECT:
THE MANNINGS
SHOREHAM-BY-SEA

TITLE:
BELOW GROUND DRAINAGE
CONSTRUCTION DETAILS
SHEET 02 OF 02

TECH:	CSE:	ICSE:	SCALE AS DRAWN @ A1
			INITIAL ISSUE: 26/11/2021

STATUS:
S3 - REVIEW & COMMENT

DRAWING No:

PROJECT:	ORG:	ZONE:	LEVEL:	TYPE:	ROLE:	NUMBER:	REV:
RL51001	RDG	XX	XX	SK	C	2004	P1

8. APPENDIX B – CALCULATIONS

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	
Site name:	The Mannings, Shoreham-By-Sea
Site location:	Shoreham-By-Sea

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	50.83341° N
Longitude:	0.27029° W
Reference:	
Date:	2021-11-25 13:16

Methodology	IH124

Site characteristics

Total site area (ha)	0.2804

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	1	1
HOST class	---	---
SPR/SPRHOST	0.1	0.1

Hydrological characteristics

	Default	Edited
SAAR (mm)	740	740
Hydrological region	7	7
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	0.05	0.05
1 in 1 year (l/s)	0.04	0.04
1 in 30 years (l/s)	0.12	0.12
1 in 100 years (l/s)	0.16	0.16

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at http://uksuds.com/terms-and-conditions.htm. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for use of this data in the design or operational characteristics of any drainage scheme.

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.01

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **15** min
Return period	Period = **1** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5_15min_i = Z1 \times M5_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.61**
Rainfall for 15min storm with 1 year return period	$M1_15min = Z2 \times M5_15min_i$ = **7.6** mm
Design rainfall intensity	I_{max} = M1_15min / D = **30.3** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2804** m^2
Percentage of area that is impermeable	p = **68** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **16.1** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.01

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **15** min
Return period	Period = **2** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5_15min_i = Z1 \times M5_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **0.79**
Rainfall for 15min storm with 2 year return period	$M2_15min = Z2 \times M5_15min_i$ = **9.8** mm
Design rainfall intensity	I_{max} = M2_15min / D = **39.2** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2804** m^2
Percentage of area that is impermeable	p = **68** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **20.8** l/s

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.01

Design rainfall intensity

Location of catchment area	Other
Storm duration	D = **15** min
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.350**
5-year return period rainfall of 60 minutes duration	M5_60min = **20.0** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **0** %
Factor Z1 (Wallingford procedure)	Z1 = **0.62**
Rainfall for 15min storm with 5 year return period	$M5_15min_i = Z1 \times M5_60min$ = **12.3** mm
Factor Z2 (Wallingford procedure)	Z2 = **1.95**
Rainfall for 15min storm with 100 year return period	$M100_15min = Z2 \times M5_15min_i$ = **24.0** mm
Design rainfall intensity	I_{max} = M100_15min / D = **96.1** mm/hr

Maximum surface water runoff

Catchment area	A_{catch} = **2804** m^2
Percentage of area that is impermeable	p = **68** %
Maximum surface water runoff	$Q_{max} = A_{catch} \times p \times I_{max}$ = **50.9** l/s

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)	1	PIMP (%)	100
M5-60 (mm)	19.900	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.800
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

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
2.000	2.720	0.013	209.2	0.005	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	10.370	0.069	150.0	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	11.672	0.120	97.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.002	8.298	0.055	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.003	37.195	0.186	200.0	0.039	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.004	9.294	0.046	200.0	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	9.491	0.150	63.3	0.025	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	22.824	0.152	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	23.327	0.160	145.8	0.020	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.003	1.918	0.013	150.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.004	30.499	0.152	200.0	0.021	0.00	0.0	0.600	o	225	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)
2.000	50.00	5.05	4.590	0.005	0.0	0.0	0.0	0.90	35.8	0.6
3.000	50.00	5.21	4.990	0.009	0.0	0.0	0.0	0.82	14.5	1.2
3.001	49.26	5.40	4.850	0.009	0.0	0.0	0.0	1.02	18.0	1.2
3.002	48.61	5.57	4.730	0.009	0.0	0.0	0.0	0.82	14.5	1.2
3.003	46.20	6.24	4.600	0.048	0.0	0.0	0.0	0.92	36.6	6.0
3.004	45.64	6.41	4.414	0.077	0.0	0.0	0.0	0.92	36.6	9.5
4.000	50.00	5.12	5.000	0.025	0.0	0.0	0.0	1.27	22.4	3.4
4.001	48.54	5.59	4.850	0.025	0.0	0.0	0.0	0.82	14.5	3.4
4.002	46.84	6.06	4.698	0.045	0.0	0.0	0.0	0.83	14.7	5.7
4.003	46.70	6.10	4.538	0.045	0.0	0.0	0.0	0.82	14.5	5.7
4.004	44.88	6.65	4.450	0.066	0.0	0.0	0.0	0.92	36.6	8.0

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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
4.005	14.367	0.072	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.005	1.022	0.005	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	1.433	0.007	200.0	0.073	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	12.296	0.061	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.003	9.074	0.045	200.0	0.014	0.00	0.0	0.600	o	225	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)
4.005	44.07	6.91	4.298	0.066	0.0	0.0	0.0	0.92	36.6	8.0
3.005	44.02	6.93	4.226	0.143	0.0	0.0	0.0	0.92	36.6	17.1
2.001	43.94	6.95	4.000	0.221	0.0	0.0	0.0	0.92	36.6	26.2
2.002	43.28	7.18	3.993	0.221	0.0	0.0	0.0	0.92	36.6	26.2
2.003	42.81	7.34	3.931	0.235	0.0	0.0	0.0	0.92	36.6	27.2

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
2.003	EX. SWMH	5.760	3.886	3.310	0	0

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Online Controls for Storm

Complex Manhole: MH1.00, DS/PN: 2.001, Volume (m³): 5.1

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0128-8000-1200-8000
Design Head (m)	1.200
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	128
Invert Level (m)	4.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	8.0
Flush-Flo™	0.357	8.0
Kick-Flo®	0.767	6.5
Mean Flow over Head Range	-	6.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	8.0	3.000	12.3	7.000	18.4
0.200	7.5	1.400	8.6	3.500	13.2	7.500	19.1
0.300	7.9	1.600	9.1	4.000	14.1	8.000	19.7
0.400	8.0	1.800	9.7	4.500	14.9	8.500	20.2
0.500	7.8	2.000	10.2	5.000	15.7	9.000	20.8
0.600	7.6	2.200	10.6	5.500	16.4	9.500	21.4
0.800	6.6	2.400	11.1	6.000	17.1		
1.000	7.3	2.600	11.5	6.500	17.8		

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0190-1700-0600-1700
Design Head (m)	0.600
Design Flow (l/s)	17.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	190
Invert Level (m)	4.674

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Hydro-Brake® Optimum

Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	17.0
Flush-Flo™	0.281	17.0
Kick-Flo®	0.480	15.3
Mean Flow over Head Range	-	13.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.6	1.200	23.6	3.000	36.7	7.000	55.1
0.200	16.6	1.400	25.5	3.500	39.6	7.500	57.1
0.300	17.0	1.600	27.1	4.000	42.2	8.000	59.0
0.400	16.4	1.800	28.7	4.500	44.7	8.500	60.8
0.500	15.6	2.000	30.2	5.000	47.0	9.000	62.6
0.600	17.0	2.200	31.6	5.500	49.3	9.500	64.3
0.800	19.5	2.400	33.0	6.000	51.4		
1.000	21.7	2.600	34.3	6.500	53.1		

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Storage Structures for Storm

Porous Car Park Manhole: IC3.00, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.5
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	31.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.300	Membrane Depth (mm)	0

Porous Car Park Manhole: IC1.03, DS/PN: 3.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.5
Membrane Percolation (mm/hr)	1000	Length (m)	37.0
Max Percolation (l/s)	46.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.120	Membrane Depth (mm)	0

Cellular Storage Manhole: MH1.00, DS/PN: 2.001

Invert Level (m)	4.000	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	50.0	0.0	1.001	0.0	0.0
1.000	50.0	0.0			

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

Simulation Criteria

Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
2.000	IC3.00	240 Winter	1	+0%	100/15 Winter			
3.000	RE	15 Winter	1	+0%				
3.001	IC1.00	15 Winter	1	+0%	100/30 Winter			
3.002	IC1.01	15 Winter	1	+0%	100/15 Winter			
3.003	IC1.02	15 Winter	1	+0%	100/15 Summer			
3.004	IC1.03	15 Winter	1	+0%	30/60 Winter			
4.000	RE	15 Winter	1	+0%				
4.001	IC2.00	15 Winter	1	+0%	100/15 Summer			
4.002	IC2.01	15 Winter	1	+0%	30/15 Summer			
4.003	IC2.03	15 Winter	1	+0%	30/15 Summer			
4.004	IC2.04	15 Winter	1	+0%	100/15 Summer	100/60 Winter		
4.005	IC2.05	15 Winter	1	+0%	30/15 Summer			
3.005	IC2.06	15 Winter	1	+0%	30/15 Summer			
2.001	MH1.00	60 Winter	1	+0%	1/60 Winter			
2.002	IC4.00	60 Winter	1	+0%				
2.003	MH1.01	60 Winter	1	+0%				

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
2.000	IC3.00	4.594	-0.221	0.000	0.00		26	0.1	OK
3.000	RE	5.019	-0.121	0.000	0.08			1.2	OK*

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1 year Return Period 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
3.001	IC1.00	4.877	-0.123	0.000	0.07			1.2	OK
3.002	IC1.01	4.761	-0.119	0.000	0.10			1.2	OK
3.003	IC1.02	4.660	-0.165	0.000	0.16			5.5	OK
3.004	IC1.03	4.496	-0.142	0.000	0.28		8	8.5	OK
4.000	RE	5.039	-0.111	0.000	0.15			3.3	OK*
4.001	IC2.00	4.900	-0.100	0.000	0.24			3.3	OK
4.002	IC2.01	4.763	-0.085	0.000	0.39			5.4	OK
4.003	IC2.03	4.613	-0.075	0.000	0.50			5.4	OK
4.004	IC2.04	4.522	-0.153	0.000	0.22			7.6	OK
4.005	IC2.05	4.377	-0.146	0.000	0.23			7.5	OK
3.005	IC2.06	4.342	-0.109	0.000	0.52			15.7	OK
2.001	MH1.00	4.227	0.002	0.000	0.24		32	7.2	SURCHARGED
2.002	IC4.00	4.066	-0.152	0.000	0.23			7.2	OK
2.003	MH1.01	4.008	-0.148	0.000	0.26			7.7	OK

PN	US/MH Name	Level Exceeded
2.000	IC3.00	
3.000	RE	
3.001	IC1.00	
3.002	IC1.01	
3.003	IC1.02	
3.004	IC1.03	
4.000	RE	
4.001	IC2.00	
4.002	IC2.01	
4.003	IC2.03	
4.004	IC2.04	1
4.005	IC2.05	
3.005	IC2.06	
2.001	MH1.00	
2.002	IC4.00	
2.003	MH1.01	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
2.000	IC3.00	60 Winter	30	+0%	100/15 Winter			
3.000	RE	15 Winter	30	+0%				
3.001	IC1.00	15 Winter	30	+0%	100/30 Winter			
3.002	IC1.01	15 Winter	30	+0%	100/15 Winter			
3.003	IC1.02	15 Winter	30	+0%	100/15 Summer			
3.004	IC1.03	60 Winter	30	+0%	30/60 Winter			
4.000	RE	15 Winter	30	+0%				
4.001	IC2.00	15 Winter	30	+0%	100/15 Summer			
4.002	IC2.01	15 Winter	30	+0%	30/15 Summer			
4.003	IC2.03	15 Winter	30	+0%	30/15 Summer			
4.004	IC2.04	60 Winter	30	+0%	100/15 Summer	100/60 Winter		
4.005	IC2.05	60 Winter	30	+0%	30/15 Summer			
3.005	IC2.06	60 Winter	30	+0%	30/15 Summer			
2.001	MH1.00	60 Winter	30	+0%	1/60 Winter			
2.002	IC4.00	120 Summer	30	+0%				
2.003	MH1.01	30 Summer	30	+0%				

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
2.000	IC3.00	4.636	-0.179	0.000	0.03		13	0.8	OK
3.000	RE	5.036	-0.104	0.000	0.21			3.0	OK*

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30 year Return Period 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
3.001	IC1.00	4.894	-0.106	0.000	0.18			3.0	OK
3.002	IC1.01	4.780	-0.100	0.000	0.24			3.0	OK
3.003	IC1.02	4.709	-0.115	0.000	0.45			15.7	OK
3.004	IC1.03	4.640	0.002	0.000	0.45		21	13.5	SURCHARGED
4.000	RE	5.063	-0.087	0.000	0.36			8.1	OK*
4.001	IC2.00	4.934	-0.066	0.000	0.59			8.1	OK
4.002	IC2.01	4.862	0.014	0.000	0.95			13.2	SURCHARGED
4.003	IC2.03	4.712	0.024	0.000	1.22			13.2	SURCHARGED
4.004	IC2.04	4.648	-0.027	0.000	0.34			11.5	OK
4.005	IC2.05	4.642	0.119	0.000	0.33			10.7	SURCHARGED
3.005	IC2.06	4.637	0.186	0.000	0.80			23.8	SURCHARGED
2.001	MH1.00	4.636	0.411	0.000	0.27		54	8.0	SURCHARGED
2.002	IC4.00	4.069	-0.148	0.000	0.25			8.0	OK
2.003	MH1.01	4.028	-0.128	0.000	0.39			11.6	OK

PN	US/MH Name	Level Exceeded
2.000	IC3.00	
3.000	RE	
3.001	IC1.00	
3.002	IC1.01	
3.003	IC1.02	
3.004	IC1.03	
4.000	RE	
4.001	IC2.00	
4.002	IC2.01	
4.003	IC2.03	
4.004	IC2.04	1
4.005	IC2.05	
3.005	IC2.06	
2.001	MH1.00	
2.002	IC4.00	
2.003	MH1.01	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
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

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
2.000	IC3.00	60 Winter	100	+40%	100/15 Winter			
3.000	RE	60 Winter	100	+40%				
3.001	IC1.00	60 Winter	100	+40%	100/30 Winter			
3.002	IC1.01	60 Winter	100	+40%	100/15 Winter			
3.003	IC1.02	60 Winter	100	+40%	100/15 Summer			
3.004	IC1.03	60 Winter	100	+40%	30/60 Winter			
4.000	RE	15 Summer	100	+40%				
4.001	IC2.00	15 Winter	100	+40%	100/15 Summer			
4.002	IC2.01	15 Winter	100	+40%	30/15 Summer			
4.003	IC2.03	60 Winter	100	+40%	30/15 Summer			
4.004	IC2.04	60 Winter	100	+40%	100/15 Summer	100/60 Winter		
4.005	IC2.05	60 Winter	100	+40%	30/15 Summer			
3.005	IC2.06	60 Winter	100	+40%	30/15 Summer			
2.001	MH1.00	60 Winter	100	+40%	1/60 Winter			
2.002	IC4.00	60 Winter	100	+40%				
2.003	MH1.01	60 Winter	100	+40%				

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
2.000	IC3.00	5.161	0.346	0.000	0.05		24	1.5	FLOOD RISK
3.000	RE	5.140	0.000	0.000	0.21			3.0	SURCHARGED*

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100 year Return Period 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
3.001	IC1.00	5.193	0.193	0.000	0.18			3.0	FLOOD RISK
3.002	IC1.01	5.189	0.309	0.000	0.24			3.0	FLOOD RISK
3.003	IC1.02	5.186	0.361	0.000	0.41			14.3	FLOOD RISK
3.004	IC1.03	5.172	0.533	0.000	0.67		9	20.1	FLOOD RISK
4.000	RE	5.150	0.000	0.000	0.52			11.7	FLOOD RISK*
4.001	IC2.00	5.374	0.374	0.000	0.81			11.1	FLOOD RISK
4.002	IC2.01	5.278	0.430	0.000	1.34			18.7	FLOOD RISK
4.003	IC2.03	5.206	0.518	0.000	1.04			11.2	FLOOD RISK
4.004	IC2.04	5.200	0.525	0.069	0.47			16.1	FLOOD
4.005	IC2.05	5.180	0.657	0.000	0.47			15.0	SURCHARGED
3.005	IC2.06	5.164	0.713	0.000	1.16			34.7	FLOOD RISK
2.001	MH1.00	5.161	0.936	0.000	0.81		74	24.2	FLOOD RISK
2.002	IC4.00	4.142	-0.076	0.000	0.77			24.2	OK
2.003	MH1.01	4.096	-0.060	0.000	0.89			26.7	OK

PN	US/MH Name	Level Exceeded
2.000	IC3.00	
3.000	RE	
3.001	IC1.00	
3.002	IC1.01	
3.003	IC1.02	
3.004	IC1.03	
4.000	RE	
4.001	IC2.00	
4.002	IC2.01	
4.003	IC2.03	
4.004	IC2.04	1
4.005	IC2.05	
3.005	IC2.06	
2.001	MH1.00	
2.002	IC4.00	
2.003	MH1.01	

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9. APPENDIX C – CORRESPONDENCE

Mathew Newman

From: Southern Water Planning <SouthernWaterPlanning@southernwater.co.uk>
Sent: 12 November 2021 10:49
To: Mathew Newman
Cc: Robbie Bushfield; Tom Clark
Subject: FW: 5016599 -The Mannings, Shoreham-by-Sea - Planning Reference: AWDM/1281/19
Attachments: The Mannings - Southern Water FW Capacity Response (2021.02.11).pdf

Importance: High

Follow Up Flag: Follow up
Flag Status: Flagged

Categories: Action Required

Hi Mathew,

Thank you for your email which has just reached my department.

The drainage strategy report for this site stated that the foul flows from the new development are reduced from the existing contributing flows. This shows a betterment in foul flows which is acceptable to us, meaning we no longer require to perform network reinforcements.

The attached letter was issued to the LPA to confirm this which confirms we have no objection to the condition being discharged.

Kind regards

Kayleigh Sharman

Future Growth Planner, Sussex
Developer Services
T. 03303030119
M.
southernwater.co.uk
(My working days are Wednesday – Friday)

From: Developer Services
Sent: 08 November 2021 11:59
To: Southern Water Planning <SouthernWaterPlanning@southernwater.co.uk>
Subject: FW: 5016599 -The Mannings, Shoreham-by-Sea - Planning Reference: AWDM/1281/19
Importance: High

Good morning,

Please see below and attached

Kind regards

Lou Tyrrell

Developer Services Service Desk Advisor
Business Channels

T. 0330 303 0119
southernwater.co.uk

From: Mathew Newman [mailto:MNewman@ridge.co.uk]
Sent: 28 October 2021 17:27
To: Developer Services <Developer.Services@southernwater.co.uk>
Cc: Robbie Bushfield <RBushfield@ridge.co.uk>; Tom Clark <tomclark@ridge.co.uk>
Subject: 5016599 -The Mannings, Shoreham-by-Sea - Planning Reference: AWDM/1281/19
Importance: High

To Whom it May Concern

Dear Sir or Madam,

Construction of 74 Residential Units at Mannings, Surry Street, Shoreham-by-Sea, West Sussex

We write to confirm our appointment as Consulting Civil & Structural Engineers at the above site which we understand has achieved planning permission as of Friday 15th October 2021.

It is understood that several pre-planning enquiries have been made at the above with respect to impact to the local public sewer network, the outcome of which concluded that sufficient capacity exists within the network to cater for the proposed surface water discharge, however insufficient capacity is present for the proposed foul water flows and as such network reinforcement works would be required.

This has been acknowledged within the planning permission by way of a planning condition which requires our client to demonstrate that occupation of the site will not occur until the aforementioned network reinforcement works have been implemented. For clarity, a copy of the condition wording is as follows:

Drainage	
13	With the exception of any demolition works, no development shall take place un a) full details of the proposed means of foul and surface water sewerage dispo including a timetable, to ensure the provision of adequate capacity and that works as part of this development align with sewerage network reinforceme been submitted to, and approved in writing by, the Local Planning Authority consultation with Southern Water;

On reviewing the consultation documents on the planning portal, we have noted the attached correspondence from Southern Water which confirms "*The drainage arrangement should also be such that the flows (sic) there will be no net increase in the flows currently received by the sewer.*".

With this in consideration can we please formally request confirmation that:

1. Foul water network reinforcement works are no longer required for the proposed development.

2. If foul water network reinforcement works are required, an approximate timescale confirming when these will likely be implemented.

We appreciate that a period of 24 months is the usual timeframe for implementation of such works, however in order to discharge the above-mentioned planning condition we need to be able to demonstrate that we have consulted with Southern Water to establish a timeframe for comparison versus the planned build programme. Of course, if a more accurate timeframe (which betters this 24 month figure) can be provided, then this would also be welcomed.

Finally, I must stress that the above is a 'pre-commencement' condition and therefore imperative that we submit evidence to discharge as soon as possible to prevent unnecessary delays. With this in consideration your soonest response and assistance would be appreciated.

I trust you will find the above acceptable and look forward to hearing from you at your soonest convenience. Should you wish to discuss any aspect or require further clarification in the meantime, then please do not hesitate to contact our offices.

Kind regards,

Mathew Christie-Newman BSc(Hons) CEng MIStructE
Associate
Civil & Structural Engineering
For Ridge and Partners LLP

Tel: 01962 834358 Office: 01962 834400 Mobile: 07901 683973
Offices mnewman@ridge.co.uk www.ridge.co.uk email disclaimer

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from Southern Water

Planning Services
Adur and Worthing Councils
Portland House
Richmond Road
Worthing
West Sussex
BN11 1LF

Your ref
AWDM/1281/19

Our ref
PLAN-037406

Date
11/02/2021

Contact
Tel 0330 303 0119

Dear Sir/Madam,

Proposal: Demolition of existing building and structures and construction of building ranging in height from three to six storeys providing 74 residential units comprising 28no. 1 bedroom, 40no. 2 bedroom and 6 no. three bedroom units, including 27 car parking spaces 3 of which are wheelchair accessible, 86 cycle parking spaces, amenity space, soft and hard landscaping and associated ancillary facilities.
Site: AWDM/1281/19: - Mannings Surry Street, Shoreham-By-Sea, West Sussex, BN43 6RP.

Thank you for your letter dated 18/01/2021.

Further to our response dated 12/09/2019 Southern Water has following comments to make.

The drainage strategy report states that the proposed foul flows from the development are reduced from the existing contributing flows which is acceptable to Southern Water. The drainage arrangement should also be such that the flows there will be no net increase in the flows currently received by the sewer.

Southern Water requires a formal application for a connection to the public foul sewer to be made by the applicant or developer.

To make an application visit: southernwater.co.uk/developing and please read our New Connections Services Charging Arrangements documents which are available on our website via the following link: southernwater.co.uk/connection-charging-arrangements

All other comments in our response dated 29/01/2020 remains valid.

For further advice, please contact Southern Water, Southern House, Yeoman Road, Worthing, West Sussex, BN13 3NX (Tel: 0330 303 0119).

Website: southernwater.co.uk or by email at: SouthernWaterPlanning@southernwater.co.uk

Yours faithfully,

Joff Edevane
Growth Planning Lead
Business Channels

RIDGE

www.ridge.co.uk