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STATION HILL, READING
PHASE 1 DRAINAGE STRATEGY AND SUDS REPORT

RAMBOLL

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Prepared by	**MARYAM SALAM**
Checked by	**GARY CHISHOLM**
Approved by	**GARY CHISHOLM**

Ramboll
Terrington House
13-15 Hills Road
Cambridge CB2 1NL
United Kingdom

T +44 (0)1223 321 195
https://uk.ramboll.com

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Ramboll UK Limited
Registered in England & Wales
Company No: 03659970
Registered office:
240 Blackfriars Road
London
SE1 8NW

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1. INTRODUCTION

1.1 Objective

The objective of this document is to provide a detailed description of foul and surface water drainage systems for Phase 1 of the proposed development at Station Hill, Reading RG1 1NF, Grid Reference (GR): N 471370, E 173710. Phase 1 (Plots E and F), comprising land between Friar Street (south) and Garrard Street (north), bisected by Friars Walk. The proposed Block E is situated to the west of Friars Walk, and Block F to the east.

This report is submitted for planning, it references the proposed drainage strategy principles set out in the Flood Risk Assessment (Ref. CIV13174 ES 003) prepared by Waterman in March 2013. The report further references the revised surface water drainage strategy summarised in the Storm Water Drainage Strategy report prepared by Hoare Lea dated 13 July 2015.

The document is to be presented to key project stakeholders to confirm that they understand the current proposals and are in agreement that the philosophy will be adopted during future design phases. The document is prepared in support of the Planning Application, and thereon the development of the scheme.

1.2 Constraints and Limitations

This report has been prepared for exclusive use by Lincoln MGT for the purpose of explaining the proposed drainage strategy and associated constraints and opportunities that have been integrated within this development. The information presented in this report is based on the information outlined in the sections below.

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2. SITE INFORMATION

2.1 Records Review

The key reports and websites reviewed as part of this study are listed in Table 2.1, below.

Table 2.1 – Key Documents and Reports

Title	Author	Date
Site Topographical Survey	Plowman Craven	21 September 2018
Utility Search Report / Survey (Ref. PK/40652-001)	Plowman Craven	30 October 2018
Block E & F Layout Drawings	CallisonRTKL	14 September 2020
Flood Risk Assessment (Ref. CIV13174 ES 003)	Waterman	March 2013
Storm Water Drainage Strategy	Hoare Lea	13 July 2015
Contaminated Land Desk Study Document	Ramboll	October 2018
Party Wall Below Ground Drainage Report (Ref. 1620004716-SHR-RAM-RP-C-000001)	Ramboll	28 February 2019

2.2 Consultation

Following initial discussion with Thames Water, a pre-planning application was submitted outlining the principles of the proposed drainage strategy. Thames Water indicated that the outfall connections proposed appear satisfactory, subject to further assessment by Thames Water in respect of the Foul Sewage Network. An impact assessment is currently being undertaken by Thames Water.

The Lead Local Flood Authority, Reading Borough Council, has been contacted to obtain their comment on the proposed drainage strategy. The Lead Local Flood Authority has stated in email correspondence dated 12 February 2019 that they have no objection in principle to the proposal considering an allowance of 40% for climate change and the pre-development rates previously agreed.

An existing services survey was undertaken by Plowman Craven in October 2018. A separate report has been prepared by Ramboll assessing the impact of the proposed development on existing drainage in the site boundary, and adjacent to the development site.

Where identified in the existing foul and surface water report prepared by Ramboll, existing drainage, identified as relevant, are to be maintained live for the duration of the proposed works and following completion. Several existing drainage connections from the adjacent site has been identified to be included in the proposed surface and foul water drainage strategy.

It is proposed to develop a foul and surface water drainage strategy utilising existing Thames Water assets in Garrard Street and Friar Street. New connections are proposed to the existing large diameter Thames Water foul water sewer to the north of Garrard Street, and a new connection to the existing Thames Water surface water sewer in Garrard Street.

It is assumed that the foul water drainage will outfall unattenuated to the aforementioned Thames Water infrastructure. Surface water flows will be attenuated to pre-development discharge rates

previously agreed with Thames Water as outlined in the Storm Water Drainage Strategy report prepared by Hoare Lea, dated 13 July 2015, appended to this report for information.

2.3 Site Topography and Geology

The brownfield site that forms Phase 1 of the proposed development is located to the south of Station Hill, Reading, and comprised the disused Telecoms House and the Friars Walk Shopping Centre. These buildings have been demolished to lowest slab level as part of the demolition works.

The overall proposed Project site is circa 2.56ha, however, this Drainage Strategy covers Phase 1 only, which has an approximate are of 0.9 ha.

The topography of the site generally ranges in levels from circa 39.0m AOD in Garrard Street to the north, and circa 45.7m AOD in Friar Street to the south. Site levels fall toward the northwest of the site.

Figure 2.1 – Site Extents of Phase 1

Extract from CRTKL drawing SHR-CRL-BE-GF-DR-A-810-322

2.4 Surface Waters

The River Thames and river Kennet are in close proximity to the site, with the Thames approximately 420m to the northwest and the Kennett approximately 500m southeast of the development site.

The Environment Agency (EA) website has been interrogated to determine the hydrogeology of the area. The EA classifies the Alluvium and Taplow Gravel Formation as Secondary A aquifers and the Upper Chalk formation as a Principle Aquifer.

The EA[1] defines these as follows;

Principal Aquifer: *layers of bedrock or drift deposits with high intergranular and/or fracture permeability able to provide a high level of water storage. These aquifers may support water supply and/or river base flow on a strategic scale.*
Secondary Aquifer: *permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.*

Although the site is not located within a Source Protection Zone, 12 groundwater extraction sites were recorded within a 1km radius of the development site. The closest borehole is 0.16km southwest of the development and is understood to be used as drinking and washing water.

2.5 Ground Conditions and Groundwater

The geology of the site comprises superficial deposits of Alluvium and Taplow Gravel Formation, underlain by the Upper Chalk Formation. The upper layers of the Upper Chalk Formation comprise variable and significant thicknesses of Structureless Chalk.

Shallow groundwater was found within the Alluvium, Taplow Gravel Formation and Upper Chalk Formation, at depths between 2.7m bgl and 5.3m bgl, usually at or near the boundary of the Alluvium and Taplow Gravel Formation, or within the Structureless Chalk when the other forms of geology were absent.

The storm water attenuation tanks serving the proposed site will be located above the ground water table and is not expected to increase the risk of ground water flooding. The proposed invert level of the lowest attenuation tank proposed to the north of Phase 1 of the development is 37.7m AOD. From ground water monitoring the ground water levels encountered were between 2.15m bgl and 2.75m bgl, corresponding to 36.07m AOD and 36.44m AOD. Isolated perched groundwater bodies may also be present within parts of the Made Ground or Fill.

As advised in Sustainable Design and Construction Supplementary Planning Guidance, where the ground water is close to the surface, special considerations must be given when designing drainage systems such as inclusions of SuDS, soft landscaping as well as provision of adequate drainage. These parameters were all taken into consideration and implemented in the drainage strategy.

[1] From Environment Agency website, accessed 06 December 2018

2.6 Existing Site Foul and Surface Water Drainage

As discussed above, the development site comprised the disused Telecoms Building and Friars Walk Shopping Centre, including several small retail outlets. This has subsequently been demolished.

From Thames Asset maps, included in Appendix 4, and a separate report discussing existing drainage systems, several existing drainage sewers were identified in Garrard Street, Merchants Place and Friar Street. The demolition of the existing buildings is covered under a separate application.

A trunk foul water sewer north of Garrard Street is noted on the Thames Water Asset Plan as 1100 x 750, depth and condition unknown. The foul water sewer in Friar Street and Merchants Place are noted as 225mm diameter and 150mm diameter, respectively.

The existing surface water sewers in Garrard Street and Friar Street is noted on the Thames Water asset plans as 375mm diameter and 225mm diameter, respectively, depth and condition unknown.

The site-wide drainage assessments and recommendations of this report are based on the information provided below;

- Architectural General Arrangements by Callison RTKL

2.7 Existing Drainage Consideration

The existing foul and surface water drainage from the proposed development site is discharged into below ground public sewers within Garrard Street and Friar Street. A conditional site investigation and associated CCTV survey works were undertaken to validate and identify the existing utility sewage drainage infrastructure on, and adjacent to, the site, particularly to identify the location of discharge points for both Foul and Surface Water systems. The findings of this survey are included in a separate report entitled Party Wall Below Ground Drainage Report (ref. SHR-RAM-XX-XX-RP-C-000001), dated 28 February 2019.

The total development comprising Phase 1 and Phase 2 is circa 2.56 ha, of which the northern site, identified as Phase 2, will be developed under a separate planning application. The Phase 1 application site boundary includes an area to the south of Garrard Street approximately 0.9 ha. 0.9 ha was used for all hydraulic network calculations and greenfield/brownfield run-off estimates.

The peak foul water discharge rate from previous buildings are not known. For the purpose of this Drainage Strategy report, peak flow discharge was estimated based on the gross internal floor area (GIA). Estimating a GIA circa 25,680 m^2 for assumed office and amenity use, the existing peak flow discharge was estimated.

Existing Land-use	No. Floors (Approx.)	Area (m^2)	Land Use	Approx. Peak Foul Water Discharge (l/s)
Telecoms House	Basement Level 1	1,510	Office	1.75
	Basement Level 2	1,370	Office	
	Ground Floor	1,570	Office	
	First Floor	1,840	Office	
	Basement	4,730	Retail	2.69

Existing Land-use	No. Floors (Approx.)	Area (m^2)	Land Use	Approx. Peak Foul Water Discharge (l/s)
Friars Walk Shopping Centre	Ground Floor	5,270	Retail	
	First Floor	5,190	Retail	
	Second Floor	2,290	Retail	
	Third Floor	1,360 (350 + 1,010)	Office	
	Fourth Floor	550	Office	
			Total (l/s)	**4.44**

The previous peak foul water discharge rate into the public sewer from the site has been calculated as 4.4l/s, based on GIA in accordance with Sewers for Adoption (7th Edition).

- Surface Water - The greenfield run-off calculated using Micro-Drainage Quick Storage calculation returned a surface water discharge from the site (area 0.9 ha) approximately 0.3l/s. Given the extent of the development site is located on brownfield site, it is not considered feasible using the calculated greenfield run-off rate. Therefore, the discharge from the site will be limited as discussed in Section 2.10 of this report.

For reference, brownfield run-off was estimated using Modified Rational Method for 0.9 ha site and rainwater intensity of 76mm/hr. The calculated runoff is 190 l/s:
Q = 2.78 CiA, where
C = permeable coefficient, taken as 1
i = rainfall intensity (mm/hr), taken as 76mm/hr
A = area (ha), taken as 0.9 ha

2.8 Existing Site Constraints with Public Sewers

Existing drainage connections with public sewers will be retained and utilised where possible to reduce the need for excavation near existing services and in the public highway. The precise size, location and levels are subject to verification and confirmation from CCTV survey investigations.

The ability and suitability of on-site infiltration of surface water was discounted given the extent of development proposed, which includes a podium level with two levels of basement car park. It is intended that surface water run-off from the development site will be attenuated in below ground storage tanks.

2.9 Stakeholder Consultations

Thames Water

Following initial communication with Thames Water, a Pre-Planning application was submitted detailing the potential outfall locations to the existing Thames Water drainage network. The application enables Thames Water to carry out a capacity assessment of the connections proposed from the development to the existing Thames Water sewers adjacent to the proposed development site. The pre-planning application included options to re-use existing connections into the public sewer network where such arrangements are found to be of a suitable size, location, condition and level for re-use, as well as new connections to existing Thames Water

sewers. The purpose of this application is to verify and establish capacity available in the existing public sewers to accommodate the proposed discharge from the development site.

In a previous section of this report, assessing the greenfield run-off rate at the proposed development site, it was not considered feasible to restrict the surface water discharge from the development site to greenfield rates. It is proposed that surface water run-off is restricted to the proposed pre-development run-off rates agreed in the Storm Water Drainage Strategy prepared by Hoare Lea, dated 13 July 2015. Surface water run-off will be attenuated on-site prior to discharging, at the restricted peak discharge rate, into the existing Thames Water sewers.

The foul water drainage from the development site is proposed to be discharged unattenuated into existing Thames Water sewers.

The proposed surface water and foul water connections to the Thames Water sewers will need to be confirmed with the Lead Local Flood Authority and Thames Water, NPPF guidelines and referenced within Reading Borough Council guidance on flooding and climate change. Confirmation of the public sewer for networks capacity to cater for the proposed foul and surface water rates from the proposed development is required.

2.10 Proposed Surface Water Drainage

The proposed drainage strategy is based on the discharge rates agreed in the Storm Water Drainage Strategy produced by Hoare Lea, dated 13 July 2015; Bock E 42.47 l/s and Block F 20.16 l/s. It is proposed that the surface water run-off is attenuated within under-ground cellular storage tanks and above ground podium-level cellular storage reservoirs located below the proposed vehicle and pedestrian hard landscaping and paving prior to discharging into the existing Thames Water sewerage network. The discharge from the attenuation structures will be restricted prior to discharge.

The Surface Water Discharge rate for Phase 1 development is restricted to a total rate of 62.5 l/s. A flow control device, hydrobrake or similar approved, is proposed in the chamber upstream of each outfall location to the Thames Water sewer.

The peak discharge rate for the proposed development for a 1 in 100-year return period will include an allowance for climate change in accordance with the guidance published in NPPF 2012. The considered national standard approach of 40% allowance due to climate change has been included in the design at this stage

The Industry standard Micro-Drainage software, version 2018.1, has been used to model the site in its geographical location. Refer to Appendix 3 for the relevant calculation reference documents.

Please refer to the table below for the proposed surface water flow rates.

Storm Event	**$Q_{1\ year}$**	**Q_{bar}**	**$Q_{30\ year}$**	**$Q_{100\ year}$**
Discharge Rates (l/s)	0.3	0.3	0.8	1.1
Block E Quick Storage Estimate (m^3) = 223				
Block F Quick Storage Estimate (m^3) = 94				

The proposed podium storm water attenuation storage systems located at the northern and southern parts of the development site will collect water from rainwater pipes and external landscaped areas. Where found as part of the assessment carried out to produce the Party Wall

Below Ground Drainage Report (ref. SHR-RAM-XX-XX-RP-C-000001), surface water drainage from identified existing adjacent structures will be considered as part of the development site drainage strategy.

For proposed connections into the existing public sewers, application will be made to Thames Water under a Section 106 Consent to Discharge application of the Water Industry Act 1991, at later detail design stage.

The Sustainable Design and Construction Supplementary Planning Document, adopted July 2011, does not specifically advise a value for climate change and instead advocates climate change principles in accordance with the NPPF – 40% climate change was used as per flood risk assessment guidance.

Following hydraulic modelling, no surcharging occurs in the 1:5 storm event, and no flooding occurs for 1:30, 1:100 and 1:100+40% CC storms.

The hydraulic surface water and storm analysis undertaken ensures that the Non-Statutory Standards for Sustainable Drainage Systems and flood risk on the site are satisfied and adhered to.

2.11 Proposed Foul Water Drainage

The proposed foul water drainage strategy assumes unrestricted discharge from the development into existing Thames Water sewers in Garrard Street and Friar Street. The proposed location and discharge rate has been confirmed to Thames Water as part of the pre-development enquiry.

Based on the proposed site layout, the peak foul water discharge is as per table below. The calculations were undertaken by others as part of the above ground drainage design. At the time of writing this report, the same for the retail component was not known, and an assessment made based on the area of retail space and anticipate use. An unattenuated foul water discharge rate was assumed, based on the information provided in the Waterman FRA (Ref. CIV13174 ES 003) dated 2013.

	Optimisation	
Load	Block E	Block F
Residential	3326.8 DU (28.84 l/s)	1503.3 DU (19.39 l/s)
Amenity	31 DU (2.78 l/s)	23.6 DU (2.43 l/s)
Comm and retail	15 DU (1.94 l/s)	15 DU (1.94 l/s)
Trapped floor gullies		(15 l/s)
Outflow	**4914.7 DU (35 l/s) + (15 l/s TFG) = 50 l/s**	

As per Hoare Lea information – Optimisation FW Loads, 17.08.2020

Connection point	**Discharge rate l/s**
Existing Thames Water Manhole ref: 3502	5
Existing Thames Water Trunk Sewer via manholes ref: FWMH 19 and 36.	45

It is envisaged that all building drainage will discharge to lower ground level, via gravity, to private external foul water networks, prior to discharging via gravity off site to the existing Thames Water public sewers.

2.12 SuDS Analysis

Surface water drainage systems need to be developed in line with sustainable development collectively referred to as Sustainable Urban Drainage Systems (SuDS). The objective of SuDS is to minimise the impact of the development on the quantity and quality of site run-off and maximise amenity and biodiversity opportunities. Surface water sustainable drainage systems will be designed and installed in accordance with current National Planning Policy Frameworks (NPPF) requirements and Planning Policy Statement 25 (Note: Retracted, but still referenced PPS25) and associated CIRIA 521, 522, 523, 625, 626, 609, 697 and 753, and associated reference documents.

It has been calculated that the proposed combined attenuation system will require circa 317m^3 of attenuation storage volume design to contain a 1 in 100-year 24hr storm event (including 40% allowance for climate change) without causing any flooding on site. The attenuation volume is based on the proposed hardstanding areas being drained at a restricted discharge rate (as agreed in the Hoare Lea Storm Water Drainage Strategy dated 13 July 2015). The required storm water attenuation storage will be provided by means of a podium-level attenuation system and below ground attenuation system, together with the appropriate drainage collection pipework and chambers. The following attenuation medium and volumes have been identified;

- Below ground attenuation (3no. proposed)
- Above-ground Podium attenuation reservoirs (3no proposed)

Phase 1 Development Site	Attenuation Storage Type	Attenuation Storage Volume (m^3)
Block E (North), including external area (Tank A)	Below ground/slab level Storage (cellular units, or similar)	68
Block E (South), including part of Friars Walk and external area (Tank B)	Below ground/slab level Storage (cellular units, or similar)	94
Block F, including part of Friars Walk and part of external area (Tank C)	Below ground/slab level Storage (cellular units, or similar)	65
		Total = 227

Phase 1 Development Site	Attenuation Storage Type	Attenuation Storage Volume (m^3)
Block E (North), including external area (Tank D)	Podium level Storage (cellular units, or similar)	48
Block E (South), including part of Friars Walk and external area (Tank E)	Podium level Storage (cellular units, or similar)	13

Block F, including part of Friars Walk and part of external area (Tank F)	Podium level Storage (cellular units, or similar)	29 Total = 90

The gravity drainage system will convey surface water to the storm water management and attenuation systems. These systems restrict the flows by means of control devices, prior to discharging off-site by gravity into the Thames Water public sewerage network.

The total impermeable area for the site identified in the SuDS analysis report is 0.9 ha. Further hydraulic modelling in the following design stages is required to determine the precise network capacity and surface water attenuation volumes. The hydraulic analysis and modelling criteria for the surface water drainage design to be undertaken at detailed design stage is;

- FSR Rainfall Data
- M5-60(mm) – 18.9
- Ration (R) – 0.40
- Climate Change (CC) – 40% for 1 in 100-year return period
- Area (ha) – 0.9ha (planning area with 100% PIMP)
- Maximum Allowable Discharge – Block E 42.47 l/s and Block F 20.16l/s

The above criteria are to be input into the industry standard, Micro-Drainage hydraulic modelling Software;

- To achieve the pre-development run-off rates previously agreed, a sustainable urban drainage system is proposed, and drainage hierarchy is followed as outlined in the Lead Local Flood Authority’s guidance. Current SuDS measures includes attenuation. The benefit of attenuation is to reduce the impact on the local sewer network and the risk of flooding. This clearly is in line with Sustainable Design and Construction Supplementary Planning Guidance.

3. LEGISLATION

Design Standards and Criteria

It is proposed that all below ground surface and foul water drainage from the development site will be collected in separate gravity drainage networks and discharged off site to the existing Thames Water sewerage network in Garrard Street (for Block E (north) and Block F) and, Friar Street for Block E (south). The precise location and levels of the existing sewerage network and outfall systems are subject to verification and confirmation from intrusive CCTV survey investigations.

The proposed surface water and foul water drainage networks will be designed and installed to achieve self-cleansing velocity. Flows will generally be kept above 0.75m/s and 1 m/s, respectively, within the pipelines to ensure that self-cleansing velocities are achieved. This is subject to the condition, location and level of the existing off-site below ground drainage and sewerage network.

The development will be drained by dedicated and fully segregated surface and foul water systems designed in accordance with the following documents (where appropriate);

- Building Regulations - Approved Document Part H;
- BS EN 12056: Parts 1-5: Gravity Drainage Systems Inside Buildings
- BS EN 752: Drain and Sewer Systems outside buildings
- Sustainable Drainage Systems - Design manual for England and Wales (CIRIA)
- Sewers for Adoption - 7th edition
- BS 8000-14: Workmanship on Building Sites: Code of Practice for Below Ground Drainage
- The Local Authorities guidelines, rules and regulations (such as Lead Local Flood Authority Representative (LLFA).
- Sustainable Design and Construction Supplementary Planning Guidance, April 2014
- Non-statutory Technical Standards for Sustainable Drainage Systems, S5 and S6
- Reading Borough Council (Lead Local Flood Authority) requirements.

To give a long design life, with minimum embodied energy, the buried pipework will generally be;

- Vitrified clay, where possible; and
- Cast iron when laid below or cast within or through foundations or building structures.

Chambers will generally be either (subject to availability of space);

- Polypropylene inspection chambers (if less than 1.2m to invert level), or
- Pre-cast manholes (if deeper than 1.2m to invert and in areas subject to vehicle over-run)
- In-situ concrete manholes (cast within the basement slab in basement car parking level)
- Non-entry polypropylene inspection chamber will be used, where required, up to a depth of 3.0m.

Pipe diameters will generally be as follows;

- Foul water drainage – DN150 to minimise the risk of blockage; and
- Connections from appliances and stacks – DN100 to maintain self-cleansing flows.

4. SITE AND PROJECT CONSTRAINTS

Table 4.1 below, details the site-specific constraints which have been evaluated in order to determine the most appropriate drainage solution. Where elements are yet to be fully considered, this is noted alongside any additional comments. If the constraints lead to a specific risk, this have been highlighted and transferred to the Risk Register within Section 6.

Table 4.1 – Site and Project Constraints

Site / Project Constraints	Potential Impact on Development	Considered in Current Drainage Strategy	Comments	Linked to Risk Register
Environment				
Sensitive environmental receptors	Restrictions on foul and surface water discharge location and quality; inclusion of additional polishing techniques such as separators, reed beds etc.	~~Yes~~/No	Discharge is to local utility sewerage systems.	~~Yes~~/No
Presence of contamination	Restricts the use of infiltration for surface water disposal	~~Yes~~/No	Proposed drainage strategy comprises attenuation storage – no infiltration considered.	~~Yes~~/No
Presence of shallow aquifers	Restricts the use of infiltration for surface water disposal	Yes/~~No~~	Shallow groundwater in some locations of the site are present.	Yes/~~No~~
Presence of nearby watercourses	Restrictions on discharging water quality	~~Yes~~/No	Discharge to nearby watercourses not considered. Discharge to existing Thames Water sewers	~~Yes~~/No
Flood zone/flood relief areas	Limitations on SUDS systems that can be used (retention of attenuation capacity during flood events)	Yes/~~No~~	Known high water table and sensitivity requires significant storm water management and control.	Yes/~~No~~
Ground Conditions				

Site / Project Constraints	Potential Impact on Development	Considered in Current Drainage Strategy	Comments	Linked to Risk Register
Infiltrations rates (at required location/depth)	Applicability of infiltration devices for surface water disposal; size of infiltration devices	~~Yes~~/No	Proposed drainage strategy comprises attenuation storage – no infiltration considered.	Yes/~~No~~
Groundwater level	Restricts infiltration potential; authorities may prevent discharge from potential sources of pollution, i.e. paved areas. Pumping in excavations.	Yes/~~No~~	High water table. Location/depth of proposed attenuation structures located above ground water level.	Yes/~~No~~
Buried obstructions	May require localised removal within drainage locations or drainage to be re-routed around obstruction	Yes/~~No~~	Existing obstructions to be surveyed and where applicable grubbed out and removed.	Yes/~~No~~
Existing Infrastructure				
Foul water discharge point locations and invert levels	May require pumping; restrictions on pipe routing (shortest length); additional protection to shallow drains	Yes/~~No~~	Levels subject to survey works to be defined during detailed design for the drainage systems.	Yes/~~No~~
Surface water discharge point locations and invert levels	May require pumping; restrictions on pipe routing (shortest length); additional protection to shallow drains	Yes/~~No~~	Pumping station may be required/proposed. Levels subject to survey works to be defined during detailed design for the drainage systems	Yes/~~No~~
Availability of foul water infrastructure nearby	May require 'self sufficiency' i.e. packaged treatment units, reed beds etc.	~~Yes~~/No	Existing drainage outfall systems to be utilised for disposal to utility sewerage systems.	~~Yes~~/No
Off-site drainage infrastructure capacity	Upgrading of water company assets; use of flow restrictors; additional storage/attenuation	Yes/~~No~~	Existing drainage outfall systems to be utilised for disposal to utility sewerage systems. Flows thus assumed capacity is available.	Yes/~~No~~
Authority Requirements				
Allowable discharging flow rates	Impacts on volume of attenuation required	Yes/~~No~~	Pre-development discharge rates agreed in FRA by Waterman dated March 2013 used (use of greenfield rates not considered feasible for development site) to calculate proposed storm water flows and attenuation capacity. It is proposed that foul flows will discharge off-site unattenuated.	Yes/~~No~~

Site / Project Constraints	Potential Impact on Development	Considered in Current Drainage Strategy	Comments	Linked to Risk Register
Allowable discharging flow volumes	Allowable impermeable area/volume of long-term attenuation	Yes/~~No~~	Pre-development discharge rates agreed in FRA by Waterman dated 2013 proposed for storm water flows and attenuation capacity.	Yes/~~No~~
Specific authority requirements	Limits SUDS systems/materials specifications that can be used	Yes/~~No~~	Not advised as any specific requirements from Local Authority.	~~Yes~~/No
Easements for services, rivers, critical infrastructure	Reduces available space; restricts drainage element locations	Yes/~~No~~	Known service routes and existing infrastructure does not affect the drainage systems.	~~Yes~~/No
BREAAM/CfSH credit requirement	Enhanced restriction of surface water discharge requiring additional controls and increased attenuation	Yes/~~No~~	Attenuation and surface water management targeted for BREEAM Excellent.	~~Yes~~/No
Site Requirements				
Available external area (space for SUDS)	Limits SUDS systems that can be used (low land take)	Yes/~~No~~	Attenuation tanks located below the proposed building.	~~Yes~~/No
Land use (appropriateness for open water)	Limits SUDS systems that can be used (health and safety)	~~Yes~~/No	Not considered within development site.	~~Yes~~/No
Traffic level type/volume	Pervious paving foundation thickness	Yes/~~No~~	Infrequent use by traffic; i.e. maintenance and or fire tender access, usage. Loading for access and manoeuvring requires suitable surface and sub-grade arrangements.	~~Yes~~/No
Construction phasing	Position of attenuation; pipe routing; temporary oversizing of elements due to temporary retention of buildings	Yes/~~No~~	Not anticipated as required. Works contractor to programme drainage installations as required.	~~Yes~~/No
Construction hoarding lines/access routes	Position of attenuation; pipe routing	Yes/~~No~~	Not anticipated as required. Works contractor to programme drainage installations as required.	~~Yes~~/No
Future development (i.e. extensions)	Oversizing of elements to provide additional capacity	~~Yes~~/No	Proposed development occupies the total site available.	~~Yes~~/No
Need for new outlets/headwalls to watercourses	Additional correspondence (fees) with authorities; construction of headwall to approved standards; issues relating to banks/bed (scour)	~~Yes~~/No	Not applicable.	~~Yes~~/No

Site / Project Constraints	Potential Impact on Development	Considered in Current Drainage Strategy	Comments	Linked to Risk Register
Abnormal foul water discharge requirements (i.e. laboratories)	Separate laboratory waste; chemically and temperature resistant pipework; inclusion of sample chambers; inclusion of grease separators.	~~Yes~~/No	Not applicable, domestic foul waste water discharge only.	~~Yes~~/No
Retained trees	Limitation in excavation location/depth to prevent root damage	~~Yes~~/No	Not applicable, brownfield site (100% impermeable). Details covered in appropriate report with the Application.	~~Yes~~/No
Maintenance requirements	Required maintenance regime is not acceptable to client requiring amendments to proposed drainage scheme	Yes/~~No~~	Maintenance of drainage and pumping systems (where required) and storm water attenuation tanks required.	Yes/~~No~~

5. SURFACE WATER DRAINAGE OPTIONS

The use of sustainable urban drainage systems (SUDS) is mandatory for most new surface water drainage systems within the UK. SUDS can be used as source control (interception of surface water), conveyance, storage and discharge dependent on various site conditions. Table 5.1 below describes many of the SUDS approaches that are available and explains their advantages, disadvantages and appropriateness for use on the proposed development site.

Table 5.1 – Sustainable Urban Drainage (SuDS) Options

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Retention	Balancing pond		Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation.	Good removal of pollutants, can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits.	No reduction in runoff volume, land take may limit use in high density sites.	☐☐X No
	Subsurface storage		Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.	Modular and flexible, dual usage (infiltration/storage, high void ratios, can be installed beneath trafficked and soft landscaped areas.	No water quality treatment.	X☐☐ Yes
	Shallow wetland					☐☐X

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Wetland	Extended detention wetland Pond wetland Pocket wetland Submerged gravel wetland Wetland channel		Wetlands provide stormwater attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants They can provide significant ecological benefits.	Good pollutant removal and if lined can be used where groundwater is vulnerable. Good community acceptability, ecological and amenity benefits.	Land take is high, requires baseflow, little reduction in runoff volume, not suitable for steep sites.	No

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Infiltration	Infiltration trench Infiltration basin Soakaway		Surface water runoff can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated.	Reduces the volume of runoff, effective at pollutant removal, contributes to groundwater recharge, simple and cost-effective, easy performance observation.	Requires appropriate pre-treatment, basins require a large flat area, offset from foundations.	☐☐X No – High water table
Filtration	Surface sand filter Sub-surface sand filter Perimeter sand filter		Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required.	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations.	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2m required, possible odour problems, high capital and maintenance cost.	☐☐X No – High water table

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
	Bioretention/filter swale		Vegetated strips of land designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system.	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit capability, effective pre-treatment option	Requires landscaping and management, large land requirement, not suitable for steep sites, no significant attenuation or reduction of flows.	☐☐X No – High water table
	Filter trench/drain		Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water runoff. Receive lateral inflow from an adjacent impermeable surface.	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site landscaping and fit well beside roads and car parks.	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material.	☐☐X No –Not suitable for development site (land constraints)
Detention	Detention basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility.	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain.	Land take, little reduction in runoff volume, detention depths constrained by levels.	☐☐X No – Not suitable for development site (land constraints)

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Conveyance	Enhanced dry swale Enhanced wet swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces runoff rates and volumes, low cost.	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking.	X□□ Yes – Not suitable for development site (land constraints)
	Conveyance swales Rills		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation. Possible reduction in runoff volume via plant uptake and infiltration.	Potential trip/wheel hazard, disabled access issues.	□□X No – Space Constraints.
Source control	Green/Brown roof		Multi-layered system that covers the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption.	Additional weight, not appropriate for steep roofs, maintenance of roof vegetation.	□□X No – Space Constraints.

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
	Rainwater harvesting		Uses rainwater coming from roofs to supply toilets, washing machines and irrigation systems. Harvested rainwater is stored underground and is substituted for potable water mains supply, reducing both site discharge and water consumption.	Can provide source control of storm water runoff, reduces demand on mains water.	Use is dependent on demand requirements, contributing surface area, and seasonal rainfall characteristics	☐☐X No – Not suitable for development site (land constraints)

6. RISK REGISTER

Table 6.1 below details the site specific drainage related risks which are currently outstanding, and the implication on the project should that risk transpire. The action required in order to mitigate the risk is also stated alongside the proposed owner of that action. Should a 'closed' item retain an agreed residual risk to the client, this will be described within the drainage strategy section and should be included within any operation and maintenance manual documentation.

Table 6.1 – Risk Register

Risk	Implication	Action to close out risk	By	Status
Specialist sub-contractor design input required (i.e. pervious paving)	Late selection of preferred supplier prevents incorporation of proprietary information. May impact on associated elements i.e. kerb setting out, formation levels, drainage connections etc.	Preferred specialist sub-contractor to be nominated/selected during design stage.	Cli/Con	~~Live~~/Closed Not applicable
Condition of existing drainage system (recent CCTV surveys complete)	Existing system may require significant remedial works. Routing of pipework may differ from that expected requiring modification to the proposed system.	CCTV survey to be commissioned of proposed retained drains.	Cli/Con	Live/~~Closed~~ Surveys required
Local Authority approvals	Local authorities may request changes to proposed scheme at planning.	Pre-planning discussions to be held with all relevant Local Authorities, where appropriate.	Ram	Live/~~Closed~~
Existing drainage connection point invert levels are different to that anticipated.	Requirement for pumping; shallow drains requiring additional protection; use of backdrops.	Level survey to be undertaken of proposed connection point drainage inverts.	Cli/Con	Live/~~Closed~~ Surveys required
Movement/addition of foul water drain points	Additional drain runs/manholes required. Possible requirement to pump if distance to discharge point increases.	Frozen above ground drainage layouts to be issued to Ramboll prior to issue of project stage information.	Arch/M&E	Live/~~Closed~~ Surveys required
Change of legislation during project	Reduced allowable flow rates/volumes leading to greater volumes of attenuation. Change of material specifications.	Ramboll to keep abreast of proposed legislation changes and inform Client, design team of possible implications where appropriate.	Ram	Live/~~Closed~~ Subject to consultation with Local Authority
Change of building drainage strategy (i.e. move to siphonic rainwater pipes)	Siphonic break manholes/drainage laterals required. Possible need to introduce velocity reducing measures to prevent erosion of SUDS.	Preferred roof rainwater strategy to be agreed and design team informed.	Arch/M&E	~~Live~~/Closed Design principles agreed
Client/design team approval of philosophy (i.e. acceptability/inclusion of open water)	Addition/increased volume of below ground attenuation. Lack of SUDS train may require introduction of additional cleansing measures.	Present drainage philosophy to design team and inform client of residual H&S risks, maintenance risks. Obtain Client approval to proceed.	Ram/Cli	~~Live~~/Closed Design principles agreed

Risk	Implication	Action to close out risk	By	Status
Co-ordination with foundations/other below ground services	Additional drain runs/manholes required. Realignment of pipework. Increased embedment of pipework.	Co-ordinated below ground services and foundation drawings to be produced and agreed by design team.	Arch/Ram/ M&E	~~Live~~/Closed
CBR values lower than anticipated	Increased subbase depth/hydraulically bound subbase required for pervious paving.	CBR testing at proposed pervious paving locations.	~~Cli~~/Con	Live/~~Closed~~ Site CBR testing required by Contractor
Previously unidentified contamination found on site	Infiltration devices restricted. Drainage philosophy re-evaluated.	Detailed assessment of contamination risk to be undertaken during design stages.	Cli/Con	Live/~~Closed~~
Buried Obstructions	Localised removal required at proposed drainage locations or drainage to be re-routed around obstruction.	Detailed desk study of construction history to be undertaken during design stages. Possible use of geophysical maps.	Cli/Con	Live/~~Closed~~

Action by:

- Client (Cli)
- Contractor (Con)
- Architect (Arch)
- M&E Engineer (M&E)
- Ramboll (RAM)

7. CONSTRUCTION APPROACH

Table 7.1 below details the site specific approach to construction of the below ground drainage system. In order to provide the most cost efficient solution, the preferred design option or material specification for each element of the system has been determined in accordance with Clients and/or contractors requirements.

Table 7.1 – Construction Method

Element	Standard Options	Selected Option
Pipework Below Ground	Clay Plastic Ductile iron HDPE Concrete	Clay Ductile Iron Concrete (300mm dia and above)
Pipework External	Clay Plastic Ductile iron HDP Concrete	Clay Plastic Ductile Iron Concrete (300mm dia and above)
Access chambers	Concrete rings Brick chambers PPIC Reduced access	Concrete rings PPIC
Building Drain Point Connection	Below slab 'y' connections External 'y' connections Connect to internal manholes Connect to external manholes	Below slab 'y' connections External 'y' connections Connect t internal Manholes Connect to external manholes
Repair to existing drainage systems	No re-use of existing drains Localised pipe replacement Pipe lining/patching	No re-use of existing Drains (exception of final outfall systems of-site)
Pipework through foundations/floor slabs	Cast within rafts/ground beams/pile caps Cast below rafts/ground beams/pile caps	Cast below raft/ground Beams/pile caps
Below ground attenuation	Oversized pipework Geocellular modular storage units GRP tanks Gravel filled pits	Oversized pipework Geo-cellular modular storage units
Infiltration devices	Granular pits/trenches Concrete ring chambers Geocellular modular storage units Borehole soakaways	N/A
Pervious Paving Finishes	Interlocking blocks Pervious asphalt Reinforced gravel/grass	N/A
Pipe Bedding	Standard single sized aggregate Recycled aggregate	Standard single size Aggregate Recycled aggregate (Contractors choice)
Significant invert level changes	Backdrops (at what level change) Steep graded pipework	N/A
Point Drainage Preference	Gullies	Gullies

Element	Standard Options	Selected Option
	Channel drains Channel drains at door thresholds	Channel drains Channel drains at door thresholds
Pump Stations	Preferred supplier Single/dual pumps Storage time period/volume	N/A

8. MAINTENANCE REQUIREMENTS OF DRAINAGE COMPONENTS

The long term maintenance of the below ground drainage network within the site boundary is the responsibility of the Estate Management Company.

8.1 Cellular Tanks and Catchpits

Regular Maintenance

- A system of regular inspections should be established to prevent siltation of the system which, if allowed to develop, would reduce effectiveness.
- Inspection of the tank structures should be carried out via the manufacturer's inspection regime and on a monthly basis for the first three months following commission. This can then be reduced to once every six months and following every major storm event.
- The pipe work, gullies, manhole chambers and catch-pits should be inspected on a monthly basis for the first three months following commission. This can then be reduced to once every six months and following every major storm event.
- Debris removal from the catchment (where may cause a risk to performance) should be undertaken on a monthly basis.

Inspection/Testing

- Inspect all inlets, outlets, vents, overflows and chambers to ensure that they are in good condition and operating as designed.
- Inspect all catch-pit sumps for any sediment, trash, debris and any other pollutant.

Remediation

- Silt accumulation within pipework, gullies, manhole chambers and catch-pits should be removed in order to ensure correct performance of the system.
- Repair inlets, outlets, vents, overflows and chambers as required.

9. APPROVALS

This form is part of the Drainage Philosophy Document. It should be signed and dated by the Project Drainage Engineers to confirm that the content of this report has been read, explained and is understood.

The signed form should be returned to Ramboll and appended to the Project File.

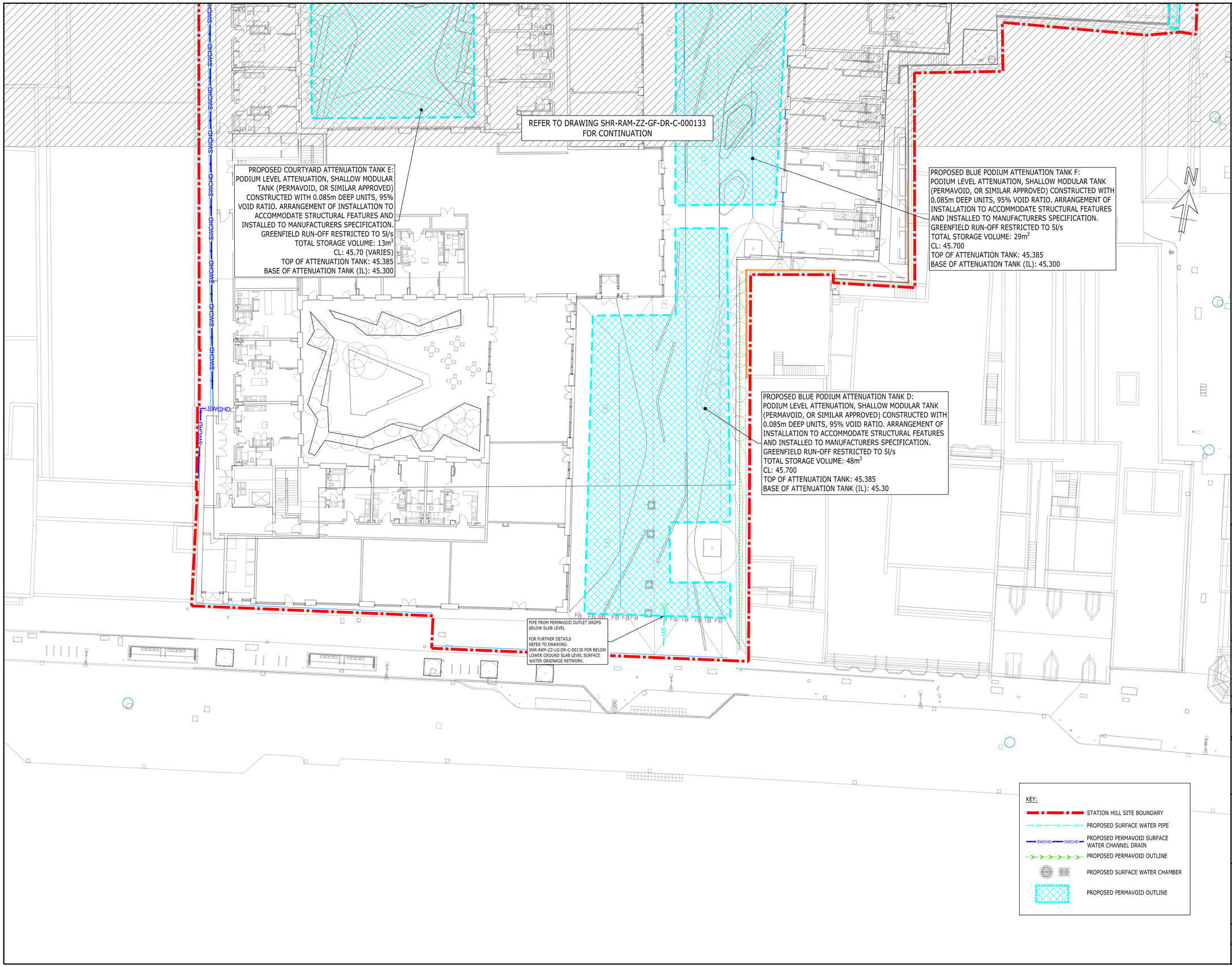
PROJECT No: 1620004716 **PROJECT Title: Station Hill Reading (Phase 1)**

STAGE: Planning Issue **DATE of SUBMISSION: 24.09.2020**

Project Engineer: Date 06.10.2020	Printed Name: M. Salam
I have read and understood the content of this report and the impact of the drainage philosophy on the development.	Signature:

Project Manager: Date: 06.10.2020	Printed Name: G. Chisholm
I have read and understood the content of this report and the impact of the drainage philosophy on the development.	Signature:

APPENDIX 1
DRAINAGE STRATEGY PLAN



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4. THIS DRAWING IS BASED ON,
   - PLOWMAN CRAVEN UNDERGROUND SERVICES SURVEY '40652-01T-01', REVISION A, DATED 13.11.2018.
   - ARCHITECTURAL LAYOUT: SHR-CRL-BE-GF-DR-A-810-322, REV P05 DATED 14.09.2020.
5. WHERE PROPOSED DRAINAGE IS SHOWN EXITING THE BUILDING , THE PIPE INVERT LEVEL AND GRADIENTS AT THESE LOCATIONS HAVE BEEN DESIGNED BASED ON THE AVAILABLE INFORMATION.
6. THE UNDERCOVER CAR PARK AREAS ARE NOT PROVIDED WITH POSITIVE DRAINAGE, EXCEPT FOR THE PROPOSED CAR WASHING BAY. REFER TO FOUL WATER DRAINAGE LAYOUTS.
7. THE PROPOSED BELOW GROUND DRAINAGE DESIGN IS SUBJECT TO ONGOING DISCUSSIONS WITH THAMES WATER TO AGREE THE PROPOSED OUTFALL LOCATIONS, AND THAMES WATER APPROVAL.
8. PRE-DEVELOPMENT ENQUIRY HAS BEEN SUBMITTED TO THAMES WATER TO CONFIRM THE CAPACITY OF EXISTING SEWER.
9. PRESENCE AND SIZE OF EXISTING DOWNPIPES SERVING ADJOINING SITE TO BE CONFIRMED. DEDICATED DRAINAGE TO BE INSTALLED AS REQUIRED. TYPICAL ARRANGEMENT SHOWN.
10. FOR OTHER DRAINAGE LAYOUTS REFER TO RAMBOLL DRAWINGS:
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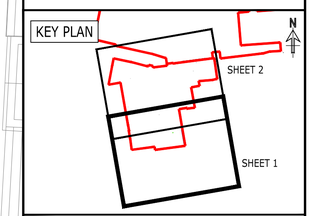
    - SHR-RAM-ZZ-LG-DR-C-000121
    - SHR-RAM-ZZ-LG-DR-C-000130
    - SHR-RAM-ZZ-LG-DR-C-000131
    - SHR-RAM-ZZ-GF-DR-C-000133

KEY PLAN



Rev	Description	Date	By / Chk	App
P01	PLANNING ISSUE	22.09 2020	MES MS	GC

PRELIMINARY

STATION HILL
READING

RAMBOLL

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www.ramboll.co.uk

BLOCK E & F PROPOSED SURFACE WATER PERMAVOID LAYOUT SHEET 1 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
1620004716	1:200	MES	SEP 2020

Drawing No:	Rev:
SHR -RAM-ZZ-GF-DR-C-000132	P01

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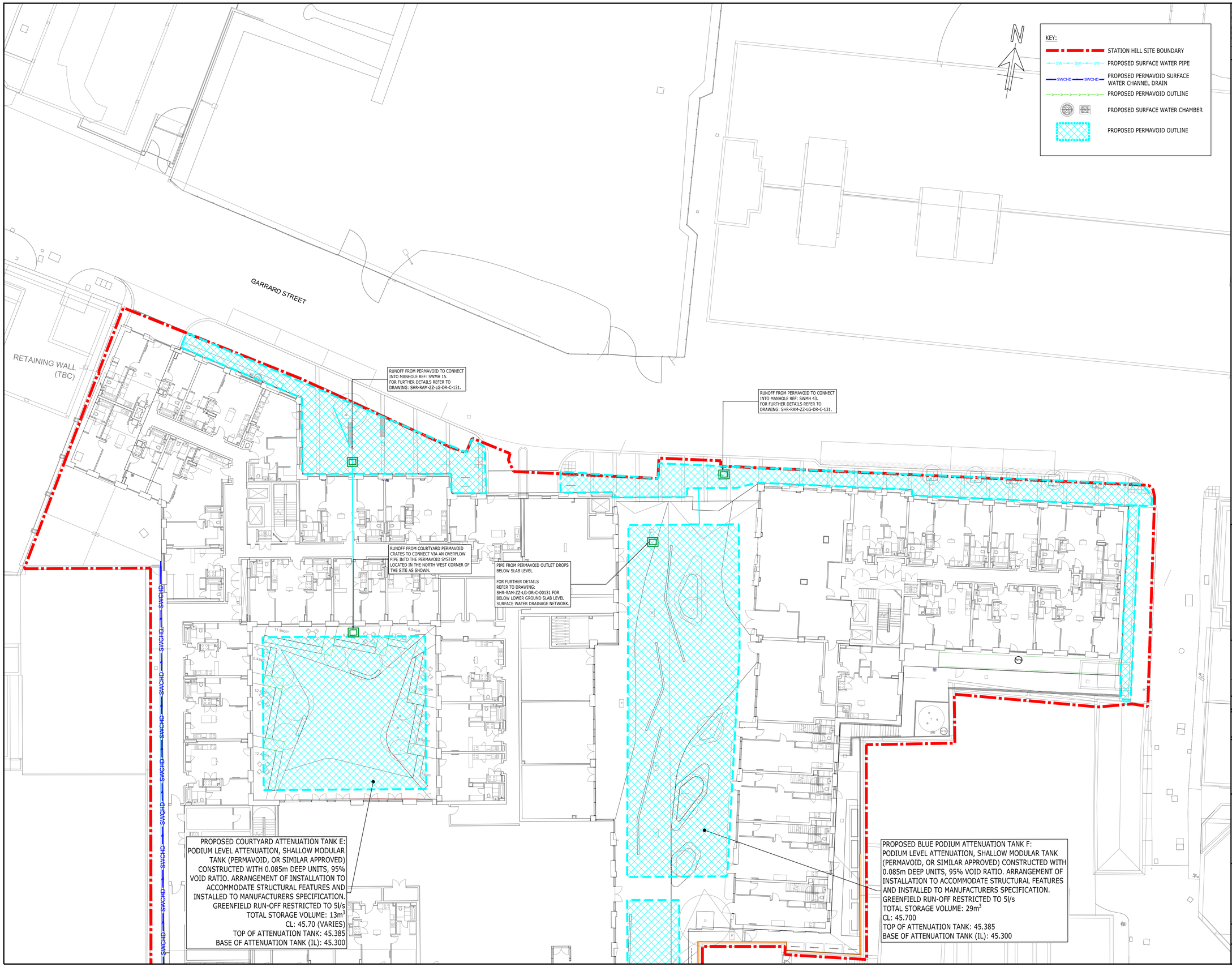

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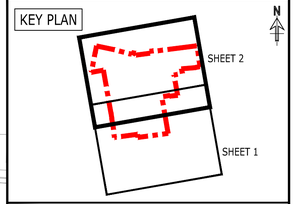
    - SHR-RAM-ZZ-GF-DR-C-000132

KEY PLAN



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P01	PLANNING ISSUE	22.09 2020	MES MS	GC

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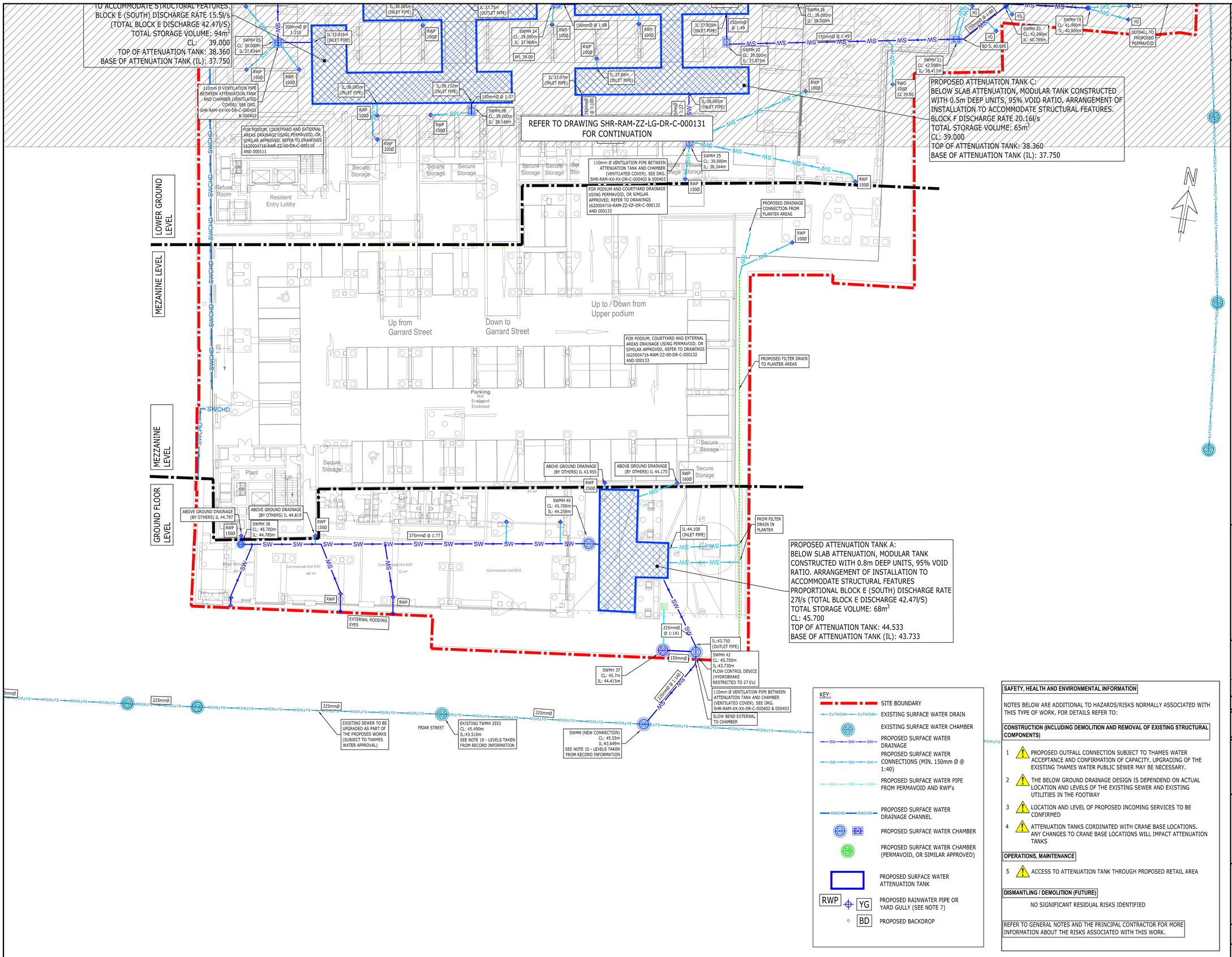
BLOCK E & F
PROPOSED SURFACE WATER
PERMAVOID LAYOUT
SHEET 2 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
1620004716	1:200	MES	SEP 2020

Drawing No:	Rev:
SHR -RAM-ZZ-GF-DR-C-000133	P01

22/09/2020 13:57:45



KEY:

- SITE BOUNDARY
- EXISTING SURFACE WATER DRAIN
- EXISTING SURFACE WATER CHAMBER
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED SURFACE WATER CONNECTIONS (MIN. 150mm Ø @ 1:40)
- PROPOSED SURFACE WATER PIPE FROM PERMAVOID AND RWP's
- PROPOSED SURFACE WATER DRAINAGE CHANNEL
- PROPOSED SURFACE WATER CHAMBER
- PROPOSED SURFACE WATER CHAMBER (PERMAVOID, OR SIMILAR APPROVED)
- PROPOSED SURFACE WATER ATTENUATION TANK
- RWP / YG — PROPOSED RAINWATER PIPE OR YARD GULLY (SEE NOTE 7)
- BD — PROPOSED BACKDROP

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

NOTES BELOW ARE ADDITIONAL TO HAZARDS/RISKS NORMALLY ASSOCIATED WITH THIS TYPE OF WORK. FOR DETAILS REFER TO:

CONSTRUCTION (INCLUDING DEMOLITION AND REMOVAL OF EXISTING STRUCTURAL COMPONENTS)

1. PROPOSED OUTFALL CONNECTION SUBJECT TO THAMES WATER ACCEPTANCE AND CONFIRMATION OF CAPACITY. UPGRADING OF THE EXISTING THAMES WATER PUBLIC SEWER MAY BE NECESSARY.
2. THE BELOW GROUND DRAINAGE DESIGN IS DEPENDEND ON ACTUAL LOCATION AND LEVELS OF THE EXISTING SEWER AND EXISTING UTILITIES IN THE FOOTWAY
3. LOCATION AND LEVEL OF PROPOSED INCOMING SERVICES TO BE CONFIRMED
4. ATTENUATION TANKS CORDINATED WITH CRANE BASE LOCATIONS. ANY CHANGES TO CRANE BASE LOCATIONS WILL IMPACT ATTENUATION TANKS

OPERATIONS, MAINTENANCE

5. ACCESS TO ATTENUATION TANK THROUGH PROPOSED RETAIL AREA

DISMANTLING / DEMOLITION (FUTURE)

NO SIGNIFICANT RESIDUAL RISKS IDENTIFIED

REFER TO GENERAL NOTES AND THE PRINCIPAL CONTRACTOR FOR MORE INFORMATION ABOUT THE RISKS ASSOCIATED WITH THIS WORK.

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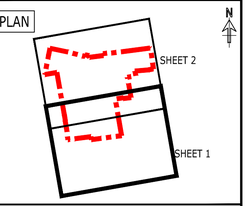
    - SHR-RAM-ZZ-LG-DR-C-000131
    - SHR-RAM-ZZ-GF-DR-C-000132
    - SHR-RAM-ZZ-GF-DR-C-000133
11. PROPOSED ATTENUATION TANK IS LOCATED BELOW PODIUM LEVEL. SUBJECT TO DESIGN BY OTHERS, CONNECTIONS MAY BE PROVIDED THROUGH RETAIL SPACES

KEY PLAN



Rev	Description	Date	By / Chk	App
P01	PLANNING ISSUE	24.09 2020	MES MS	GC

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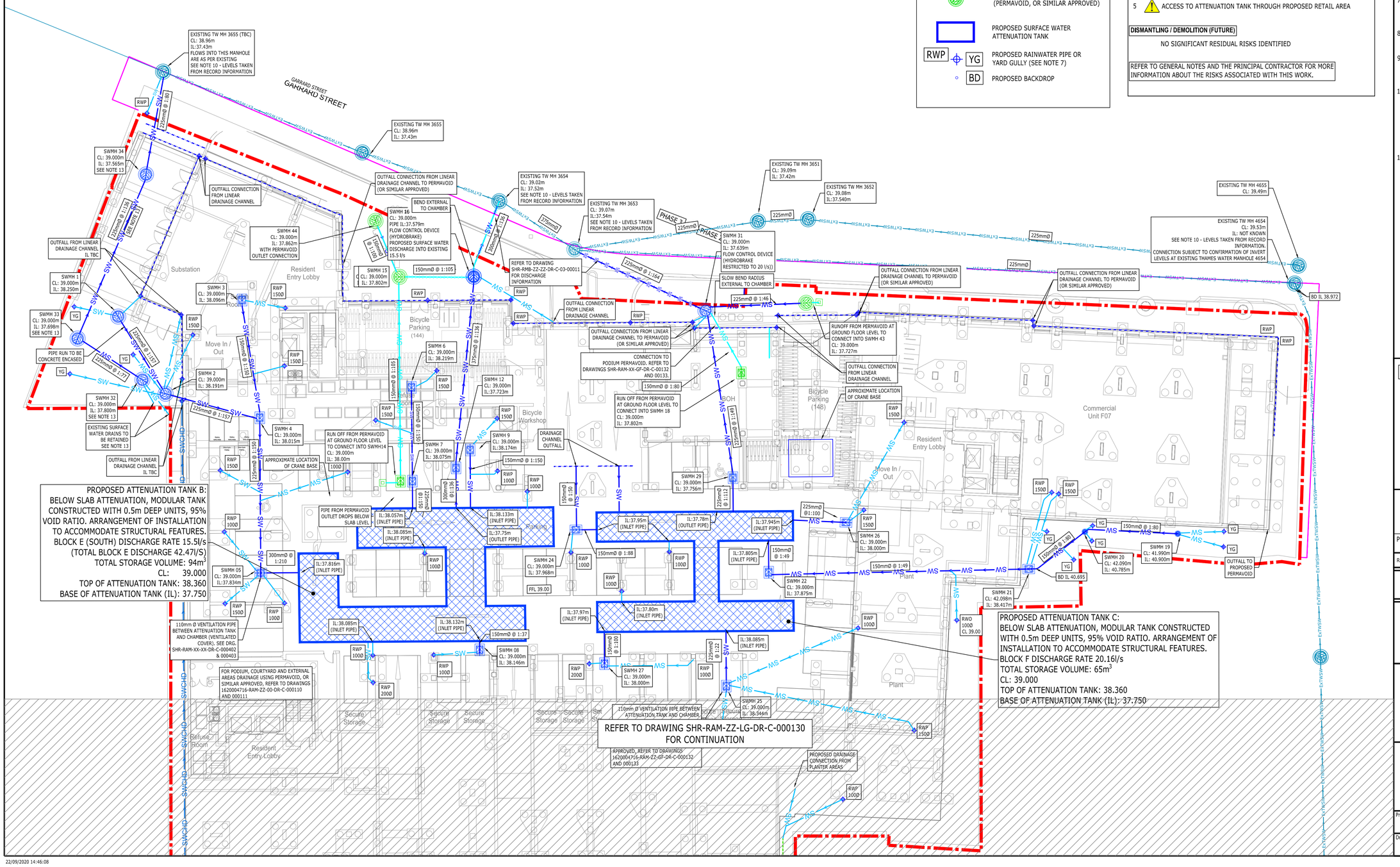
BLOCK E & F PROPOSED SURFACE WATER LAYOUT SHEET 1 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
1620004716	1:200	MES	SEP 2020

Drawing No: SHR -RAM-ZZ-LG-DR-C-000130

Rev: P01

24/09/2020 19:02:31



KEY:

- STATION HILL SITE BOUNDARY
- PROPOSED EXTENTS OF S278 WORKS
- EXISTING SURFACE WATER DRAIN
- EXISTING SURFACE WATER CHAMBER
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED SURFACE WATER CONNECTIONS (MIN. 150mm Ø @ 1:40)
- PROPOSED SURFACE WATER PIPE FROM PERMAVOID AND RWP's
- PROPOSED SURFACE WATER DRAINAGE CHANNEL
- PROPOSED SURFACE WATER CHAMBER
- PROPOSED SURFACE WATER CHAMBER (PERMAVOID, OR SIMILAR APPROVED)
- PROPOSED SURFACE WATER ATTENUATION TANK
- RWP / YG — PROPOSED RAINWATER PIPE OR YARD GULLY (SEE NOTE 7)
- BD — PROPOSED BACKDROP

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

NOTES BELOW ARE ADDITIONAL TO HAZARDS/RISKS NORMALLY ASSOCIATED WITH THIS TYPE OF WORK. FOR DETAILS REFER TO:

CONSTRUCTION (INCLUDING DEMOLITION AND REMOVAL OF EXISTING STRUCTURAL COMPONENTS)

1. PROPOSED OUTFALL CONNECTION SUBJECT TO THAMES WATER ACCEPTANCE AND CONFIRMATION OF CAPACITY. UPGRADING OF THE EXISTING THAMES WATER PUBLIC SEWER MAY BE NECESSARY.
2. THE BELOW GROUND DRAINAGE DESIGN IS DEPENDEND ON ACTUAL LOCATION AND LEVELS OF THE EXISTING SEWER AND EXISTING UTILITIES IN THE FOOTWAY
3. LOCATION AND LEVEL OF PROPOSED INCOMING SERVICES TO BE CONFIRMED
4. ATTENUATION TANKS CORDINATED WITH CRANE BASE LOCATIONS. ANY CHANGES TO CRANE BASE LOCATIONS WILL IMPACT ATTENUATION TANKS

OPERATIONS, MAINTENANCE

5. ACCESS TO ATTENUATION TANK THROUGH PROPOSED RETAIL AREA

DISMANTLING / DEMOLITION (FUTURE)

NO SIGNIFICANT RESIDUAL RISKS IDENTIFIED

REFER TO GENERAL NOTES AND THE PRINCIPAL CONTRACTOR FOR MORE INFORMATION ABOUT THE RISKS ASSOCIATED WITH THIS WORK.

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3. THIS IS NOT AN INSTALLATION DRAWING NOR A CO-ORDINATION DRAWING.
4. THIS DRAWING IS BASED ON,
   - PLOWMAN CRAVEN UNDERGROUND SERVICES SURVEY '40652-01T-01', REVISION A, DATED 13.11.2018.
   - ARCHITECTURAL LAYOUT SHR-CRL-BE-LG-DR-A-810-320, REV P05, DATED 14.09.2020.
5. WHERE PROPOSED DRAINAGE IS SHOWN EXITING THE BUILDING , THE PIPE INVERT LEVEL AND GRADIENTS AT THESE LOCATIONS HAVE BEEN DESIGNED BASED ON THE AVAILABLE INFORMATION.
6. THE UNDERCOVER CAR PARK AREAS ARE NOT PROVIDED WITH POSITIVE DRAINAGE, EXCEPT FOR THE PROPOSED CAR WASHING BAY. REFER TO FOUL WATER DRAINAGE LAYOUTS.
7. THE PROPOSED BELOW GROUND DRAINAGE DESIGN IS SUBJECT TO ONGOING DISCUSSIONS WITH THAMES WATER TO AGREE THE PROPOSED OUTFALL LOCATIONS, AND THAMES WATER APPROVAL.
8. PRE-DEVELOPMENT ENQUIRY HAS BEEN SUBMITTED TO THAMES WATER TO CONFIRM THE CAPACITY OF EXISTING SEWER.
9. PRESENCE AND SIZE OF EXISTING DOWNPIPES SERVING ADJOINING SITE TO BE CONFIRMED. DEDICATED DRAINAGE TO BE INSTALLED AS REQUIRED. TYPICAL ARRANGEMENT SHOWN.
10. FOR OTHER DRAINAGE LAYOUTS REFER TO RAMBOLL DRAWINGS:
    - SHR-RAM-ZZ-LG-DR-C-000120
    - SHR-RAM-ZZ-LG-DR-C-000121
    - SHR-RAM-ZZ-LG-DR-C-000130
    - SHR-RAM-ZZ-LG-DR-C-000131
    - SHR-RAM-ZZ-GF-DR-C-000132
    - SHR-RAM-ZZ-GF-DR-C-000133
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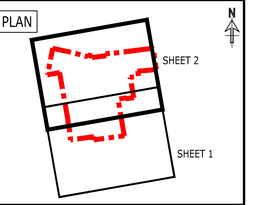
KEY PLAN



Rev	Description	Date	By / Chk	App
P01	PLANNING ISSUE	22.09 2020	MES MS	GC

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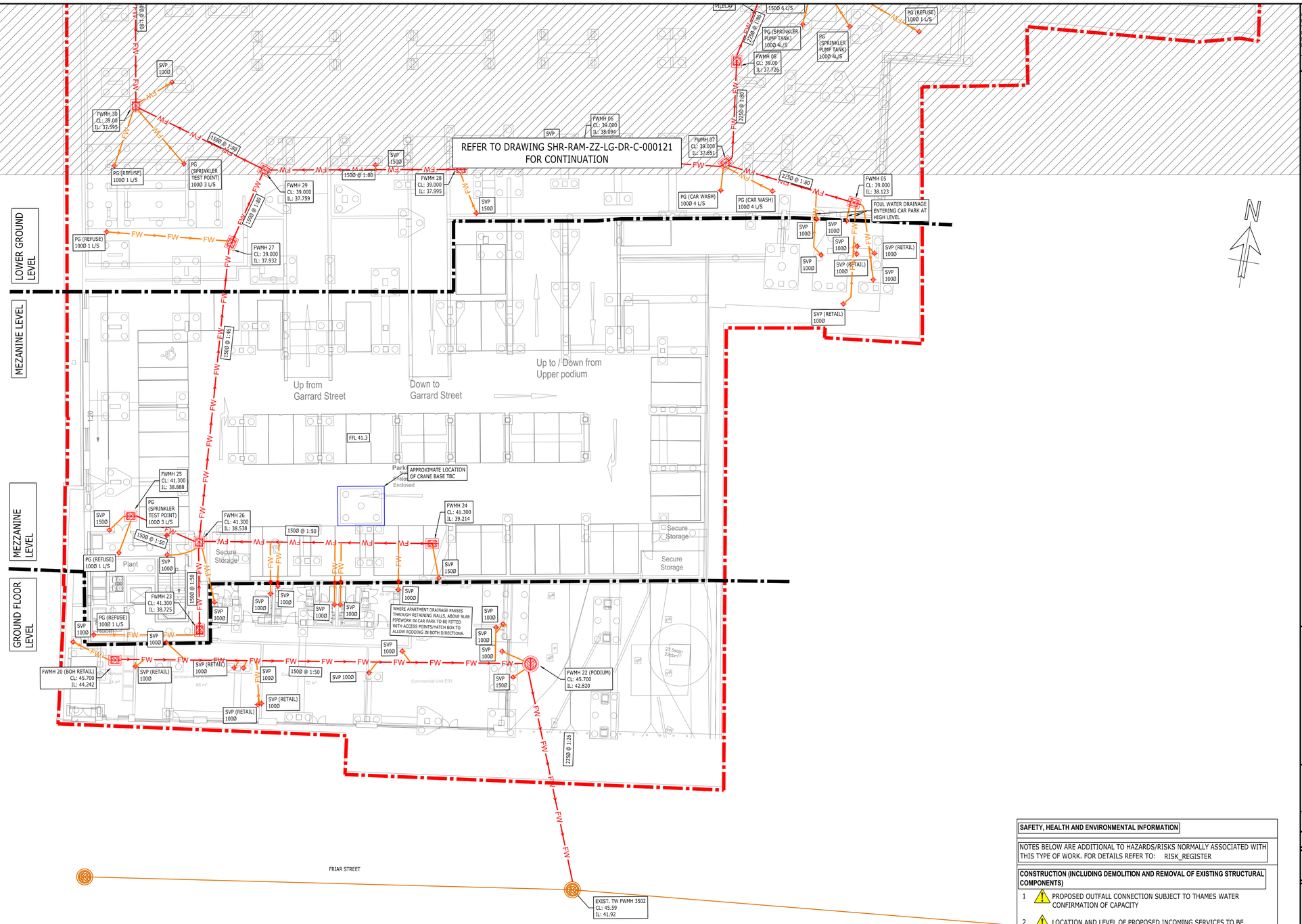
BLOCK E & F PROPOSED SURFACE WATER DRAINAGE LAYOUT SHEET 2 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
1620004716	1:200	MES	SEP 2020

Drawing No: SHR -RAM-ZZ-LG-DR-C-000131

Rev: P01

22/09/2020 14:46:08



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10. FOR OTHER DRAINAGE LAYOUTS REFER TO RAMBOLL DRAWINGS:
    - SHR-RAM-ZZ-LG-DR-C-000121
    - SHR-RAM-ZZ-LG-DR-C-000130
    - SHR-RAM-ZZ-LG-DR-C-000131
    - SHR-RAM-ZZ-GF-DR-C-000132
    - SHR-RAM-ZZ-GF-DR-C-000133

KEY:

- SITE BOUNDARY
- PROPOSED EXTENT OF S278 WORKS
- EXISTING FOUL WATER CHAMBER
- EXISTING FOUL WATER DRAIN
- PROPOSED FOUL WATER CHAMBER
- PROPOSED FOUL WATER DRAINAGE
- PROPOSED FOUL WATER CONNECTIONS (BELOW GROUND DRAINAGE
- DP PG — PROPOSED DOWN PIPE OR PLANT ROOM GULLY (SEE NOTE 7)
- PROPOSED FOUL WATER CHAMBER - INTERNAL

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

NOTES BELOW ARE ADDITIONAL TO HAZARDS/RISKS NORMALLY ASSOCIATED WITH THIS TYPE OF WORK. FOR DETAILS REFER TO: RISK_REGISTER

CONSTRUCTION (INCLUDING DEMOLITION AND REMOVAL OF EXISTING STRUCTURAL COMPONENTS)

1 ⚠ PROPOSED OUTFALL CONNECTION SUBJECT TO THAMES WATER CONFIRMATION OF CAPACITY

2 ⚠ LOCATION AND LEVEL OF PROPOSED INCOMING SERVICES TO BE CO-ORDINATED WITH PROPOSED DRAINAGE

OPERATIONS, MAINTENANCE

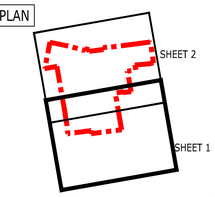
3 ⚠ PROPOSED (ABOVE GROUND) DRAINAGE ACCESS VIA PROPOSED RETAIL AREA

DISMANTLING / DEMOLITION (FUTURE)

C1 NO SIGNIFICANT RESIDUAL RISKS IDENTIFIED

REFER TO GENERAL NOTES AND THE PRINCIPAL CONTRACTOR FOR MORE INFORMATION ABOUT THE RISKS ASSOCIATED WITH THIS WORK.

KEY PLAN



Rev	Description	Date	By / Chk	App
P01	PLANNING ISSUE	24.09 2020	MES MS	GC

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BLOCK E & F PROPOSED FOUL WATER DRAINAGE LAYOUT SHEET 1 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
1620004716	1:200	MES	SEP 2020

Drawing No:	Rev:
SHR -RAM-ZZ-LG-DR-C-000120	P01

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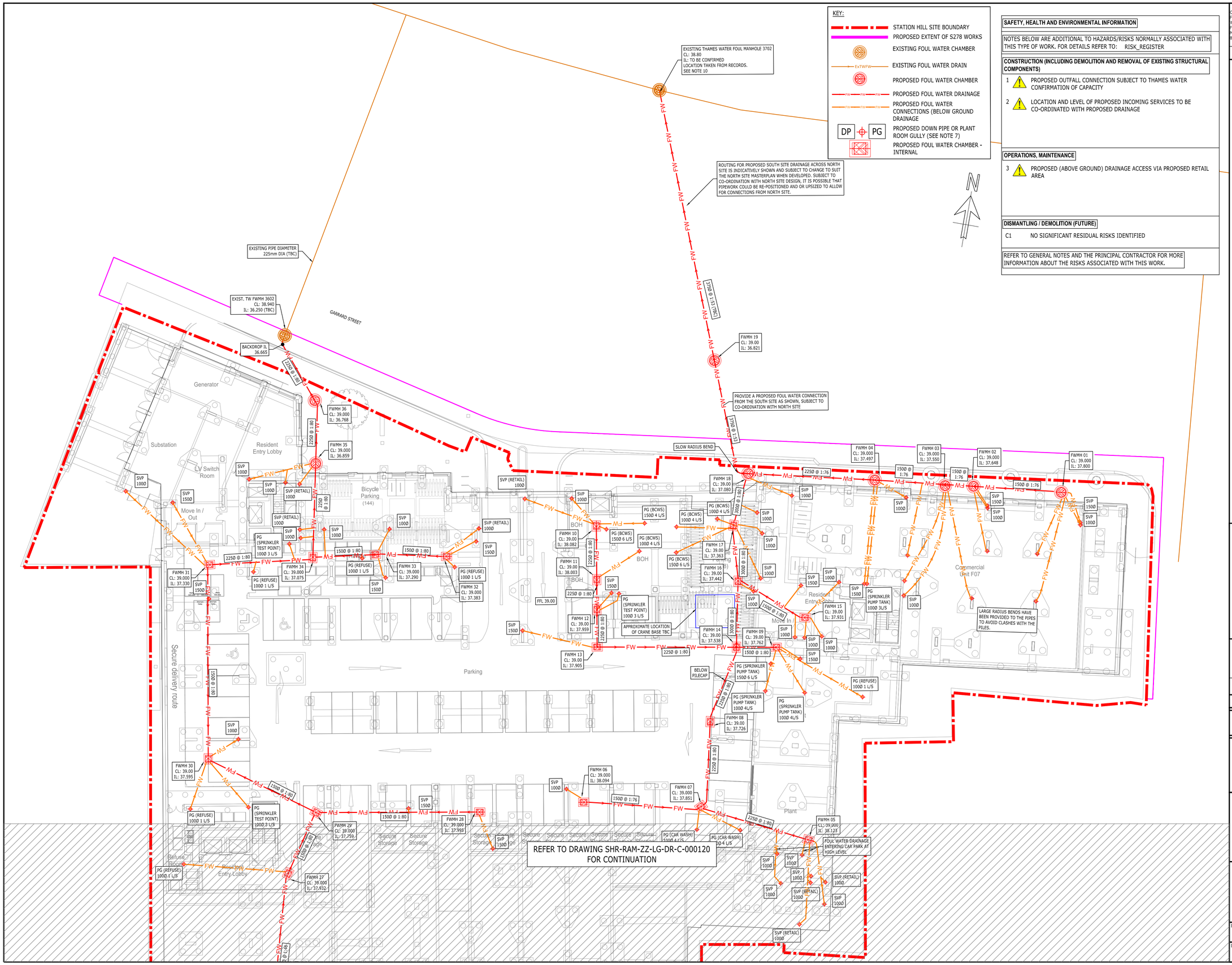

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OPERATIONS, MAINTENANCE

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DISMANTLING / DEMOLITION (FUTURE)

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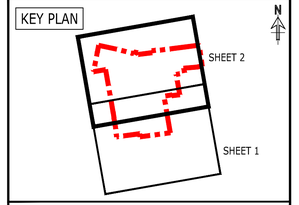
    - SHR-RAM-ZZ-LG-DR-C-000130
    - SHR-RAM-ZZ-LG-DR-C-000131
    - SHR-RAM-ZZ-GF-DR-C-000132
    - SHR-RAM-ZZ-GF-DR-C-000133

KEY PLAN



Rev	Description	Date	By / Chk	App
P01	PLANNING ISSUE	22.09 2020	MES MS	GC

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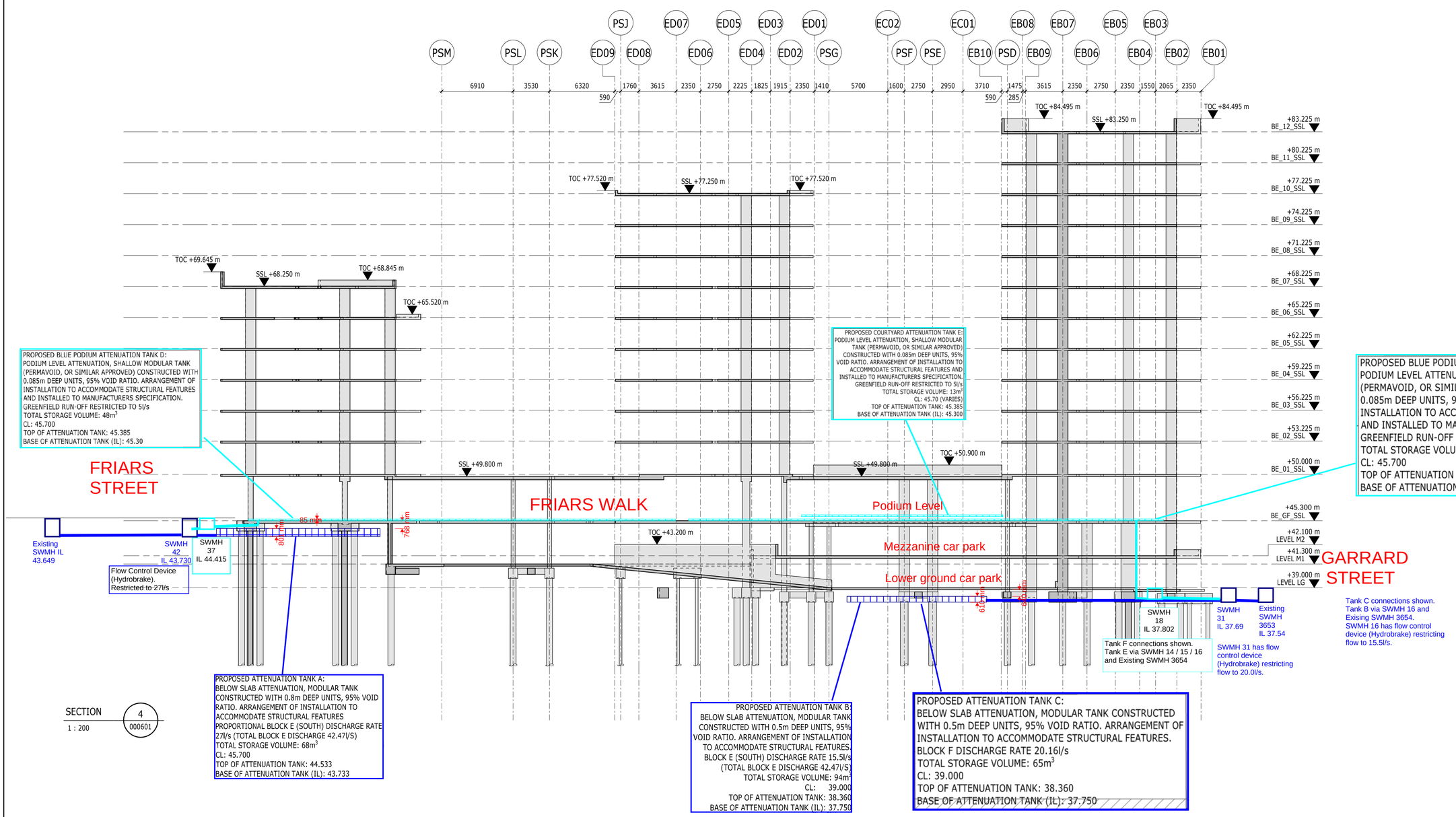
BLOCK E & F PROPOSED FOUL WATER DRAINAGE LAYOUT SHEET 2 OF 2

Project No:	Scale (@A1):	Drawn:	Date:
1620004716	1:200	MES	SEP 2020

Drawing No:	Rev:
SHR -RAM-ZZ-LG-DR-C-000121	P01

22/09/2020 13:23:49



SECTION 4 / 000601
1 : 200

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3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O.
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REV	DESCRIPTION	DATE	BY / CHK	APP
P01	ISSUED FOR COMMENTS	21/02 2020	AC / HI	KJ

FOR COMMENT

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SOUTH SITE
BUILDING SECTIONS
SHEET 04

Project No:	Scale (@ A1):	Date:	Drawn:
1620004716	1 : 200	SEP 2018	AC

Drawing No:	Rev:
SHR-RMB-ZZ-ZZ-DR-S-23-030004	P01

APPENDIX 2
SURFACE WATER (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)	18.900	Add Flow / Climate Change (%)	0
Ratio R	0.400	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

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
S1.000	6.596	0.073	90.0	0.020	5.00	0.0	0.600	o	375	Pipe/Conduit	
S1.001	9.966	0.111	90.0	0.012	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.000	4.636	0.046	100.8	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	22.379	0.149	150.0	0.097	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	18.061	0.072	250.0	0.070	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	10.290	0.153	67.3	0.034	5.00	0.0	0.600	o	375	Pipe/Conduit	
S3.001	9.824	0.219	44.9	0.034	0.00	0.0	0.600	o	375	Pipe/Conduit	
S4.000	9.106	0.187	48.7	0.073	5.00	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)
S1.000	50.00	5.06	38.380	0.020	0.0	0.0	0.0	1.91	211.0	2.8
S1.001	50.00	5.14	38.307	0.033	0.0	0.0	0.0	1.91	211.0	4.4
S2.000	50.00	5.08	38.243	0.000	0.0	0.0	0.0	1.00	17.7	0.0
S1.002	50.00	5.40	37.972	0.129	0.0	0.0	0.0	1.48	163.1	17.5
S1.003	50.00	5.66	37.823	0.199	0.0	0.0	0.0	1.14	126.1	26.9
S3.000	50.00	5.08	38.128	0.034	0.0	0.0	0.0	2.21	244.3	4.6
S3.001	50.00	5.14	37.975	0.069	0.0	0.0	0.0	2.71	299.5	9.3
S4.000	50.00	5.08	37.968	0.073	0.0	0.0	0.0	1.88	74.7	9.9

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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
S5.000	13.315	0.064	208.0	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
S6.000	5.293	0.106	49.9	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.977	0.123	89.2	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	19.568	0.097	201.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S7.000	2.070	6.476	0.3	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	20.819	0.205	101.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S8.000	14.235	0.071	200.0	0.014	5.00	0.0	0.600	o	225	Pipe/Conduit	
S7.002	7.574	0.216	35.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	8.103	0.060	135.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.000	2.033	7.168	0.3	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S9.001	6.513	0.163	40.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S10.000	9.232	0.115	80.0	0.028	5.00	0.0	0.600	o	225	Pipe/Conduit	
S10.001	5.880	0.070	84.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.002	8.401	0.210	40.0	0.003	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)
S5.000	50.00	5.25	37.820	0.000	0.0	0.0	0.0	0.90	35.9	0.0
S6.000	50.00	5.05	38.060	0.000	0.0	0.0	0.0	1.86	73.8	0.0
S1.004	50.00	5.76	37.800	0.341	0.0	0.0	0.0	1.92	211.9	46.1
S1.005	50.00	6.01	37.677	0.341	0.0	0.0	0.0	1.27	140.5	46.1
S7.000	50.00	5.00	45.300	0.000	0.0	0.0	0.0	17.99	317.9	0.0
S7.001	50.00	5.35	38.000	0.000	0.0	0.0	0.0	1.00	17.6	0.0
S8.000	50.00	5.26	37.800	0.014	0.0	0.0	0.0	0.92	36.6	1.9
S7.002	50.00	5.41	37.720	0.014	0.0	0.0	0.0	2.22	88.2	1.9
S1.006	50.00	6.10	37.580	0.355	0.0	0.0	0.0	1.56	172.0	48.0
S9.000	50.00	5.00	45.300	0.000	0.0	0.0	0.0	19.10	337.4	0.0
S9.001	50.00	5.07	37.802	0.000	0.0	0.0	0.0	1.60	28.2	0.0
S10.000	50.00	5.11	40.900	0.028	0.0	0.0	0.0	1.46	58.2	3.7
S10.001	50.00	5.17	40.785	0.057	0.0	0.0	0.0	1.43	56.8	7.8
S10.002	50.00	5.24	38.417	0.061	0.0	0.0	0.0	2.07	82.5	8.2

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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
S10.003	5.613	0.072	78.0	0.013	0.00	0.0	0.600	o	375	Pipe/Conduit	
S10.004	13.903	0.136	101.9	0.015	0.00	0.0	0.600	o	375	Pipe/Conduit	
S10.005	6.379	0.227	28.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S11.000	3.849	0.128	30.1	0.000	5.00	0.0	0.600	SPA	150	Pipe (Slotdrain®)	
S12.000	7.052	0.176	40.0	0.000	5.00	0.0	0.600	SPA	150	Pipe (Slotdrain®)	
S11.001	3.679	0.122	30.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S11.002	15.577	0.177	88.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S13.000	18.966	0.237	80.0	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
S14.000	17.018	0.217	78.5	0.024	5.00	0.0	0.600	o	225	Pipe/Conduit	
S14.001	7.314	0.082	89.0	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
S14.002	8.216	0.092	89.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S14.003	16.380	0.184	89.0	0.040	0.00	0.0	0.600	o	225	Pipe/Conduit	
S15.000	7.350	0.159	46.2	0.031	5.00	0.0	0.600	o	225	Pipe/Conduit	
S15.001	9.306	0.062	150.0	0.033	0.00	0.0	0.600	o	375	Pipe/Conduit	
S10.006	5.006	0.068	73.6	0.000	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)
S10.003	50.00	5.29	38.057	0.074	0.0	0.0	0.0	2.05	226.8	10.0
S10.004	50.00	5.42	37.985	0.089	0.0	0.0	0.0	1.79	198.2	12.0
S10.005	50.00	5.45	37.849	0.089	0.0	0.0	0.0	3.43	378.8	12.0
S11.000	50.00	5.03	38.822	0.000	0.0	0.0	0.0	1.04	21.4	0.0
S12.000	50.00	5.07	38.822	0.000	0.0	0.0	0.0	0.93	19.2	0.0
S11.001	50.00	5.10	38.599	0.000	0.0	0.0	0.0	2.39	95.1	0.0
S11.002	50.00	5.28	37.968	0.000	0.0	0.0	0.0	1.39	55.4	0.0
S13.000	50.00	5.22	38.000	0.000	0.0	0.0	0.0	1.46	58.2	0.0
S14.000	50.00	5.19	44.915	0.024	0.0	0.0	0.0	1.48	58.7	3.2
S14.001	50.00	5.28	38.140	0.043	0.0	0.0	0.0	1.39	55.1	5.8
S14.002	50.00	5.38	38.058	0.043	0.0	0.0	0.0	1.39	55.1	5.8
S14.003	50.00	5.58	37.966	0.083	0.0	0.0	0.0	1.39	55.1	11.3
S15.000	50.00	5.06	38.122	0.031	0.0	0.0	0.0	1.93	76.7	4.3
S15.001	50.00	5.17	37.813	0.065	0.0	0.0	0.0	1.48	163.1	8.8
S10.006	50.00	5.63	37.800	0.237	0.0	0.0	0.0	1.53	60.7	32.1

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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
S10.007	15.923	0.095	168.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.008	1.066	0.006	168.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.002	15.262	0.091	168.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S16.000	7.947	0.103	77.2	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
S16.001	18.107	0.133	136.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S16.002	10.626	0.133	79.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S17.000	8.258	0.083	99.5	0.103	5.00	0.0	0.600	o	375	Pipe/Conduit	
S17.001	31.290	0.313	100.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S18.000	4.847	0.032	151.5	0.084	5.00	0.0	0.600	o	375	Pipe/Conduit	
S17.002	13.623	0.107	127.0	0.076	0.00	0.0	0.600	o	375	Pipe/Conduit	
S17.003	4.328	0.013	345.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S19.000	7.554	0.085	89.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S19.001	3.791	0.043	89.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S17.004	10.268	0.073	140.7	0.000	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)
S10.007	50.00	5.89	37.732	0.237	0.0	0.0	0.0	1.01	40.0	32.1
S10.008	50.00	5.91	37.637	0.237	0.0	0.0	0.0	1.01	40.0	32.1
S9.002	50.00	6.16	37.639	0.237	0.0	0.0	0.0	1.01	40.0	32.1
S16.000	50.00	5.09	37.800	0.000	0.0	0.0	0.0	1.49	59.3	0.0
S16.001	50.00	5.36	37.697	0.000	0.0	0.0	0.0	1.12	44.5	0.0
S16.002	50.00	5.48	37.564	0.000	0.0	0.0	0.0	1.46	58.2	0.0
S17.000	50.00	5.08	44.261	0.103	0.0	0.0	0.0	1.82	200.6	13.9
S17.001	50.00	5.36	44.178	0.103	0.0	0.0	0.0	1.81	200.1	13.9
S18.000	50.00	5.05	43.905	0.084	0.0	0.0	0.0	1.47	162.3	11.4
S17.002	50.00	5.50	43.865	0.263	0.0	0.0	0.0	1.61	177.4	35.6
S17.003	50.00	5.58	43.733	0.263	0.0	0.0	0.0	0.97	107.1	35.6
S19.000	50.00	5.12	44.500	0.000	0.0	0.0	0.0	1.06	18.8	0.0
S19.001	50.00	5.18	44.415	0.000	0.0	0.0	0.0	1.06	18.8	0.0
S17.004	50.00	5.73	43.720	0.263	0.0	0.0	0.0	1.10	43.8	35.6

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.020	0.020	0.020
1.001	User	-	100	0.006	0.006	0.006
	User	-	100	0.007	0.007	0.012
2.000	-	-	100	0.000	0.000	0.000
1.002	User	-	100	0.097	0.097	0.097
1.003	User	-	100	0.070	0.070	0.070
3.000	User	-	100	0.034	0.034	0.034
3.001	User	-	100	0.034	0.034	0.034
4.000	User	-	100	0.073	0.073	0.073
5.000	-	-	100	0.000	0.000	0.000
6.000	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.000	0.000	0.000
7.001	-	-	100	0.000	0.000	0.000
8.000	-	-	100	0.014	0.014	0.014
7.002	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
9.000	-	-	100	0.000	0.000	0.000
9.001	-	-	100	0.000	0.000	0.000
10.000	User	-	100	0.007	0.007	0.007
	User	-	100	0.021	0.021	0.028
10.001	User	-	100	0.007	0.007	0.007
	User	-	100	0.023	0.023	0.030
10.002	User	-	100	0.003	0.003	0.003
10.003	User	-	100	0.013	0.013	0.013
10.004	User	-	100	0.015	0.015	0.015
10.005	-	-	100	0.000	0.000	0.000
11.000	-	-	100	0.000	0.000	0.000
12.000	-	-	100	0.000	0.000	0.000
11.001	-	-	100	0.000	0.000	0.000
11.002	-	-	100	0.000	0.000	0.000
13.000	-	-	100	0.000	0.000	0.000
14.000	User	-	100	0.024	0.024	0.024
14.001	User	-	100	0.019	0.019	0.019
14.002	-	-	100	0.000	0.000	0.000
14.003	User	-	100	0.040	0.040	0.040
15.000	User	-	100	0.031	0.031	0.031
15.001	User	-	100	0.033	0.033	0.033
10.006	-	-	100	0.000	0.000	0.000
10.007	-	-	100	0.000	0.000	0.000
10.008	-	-	100	0.000	0.000	0.000
9.002	-	-	100	0.000	0.000	0.000
16.000	-	-	100	0.000	0.000	0.000
16.001	-	-	100	0.000	0.000	0.000
16.002	-	-	100	0.000	0.000	0.000
17.000	User	-	100	0.103	0.103	0.103
17.001	-	-	100	0.000	0.000	0.000
18.000	User	-	100	0.084	0.084	0.084
17.002	User	-	100	0.076	0.076	0.076
17.003	-	-	100	0.000	0.000	0.000

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
19.000	-	-	100	0.000	0.000	0.000
19.001	-	-	100	0.000	0.000	0.000
17.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.855	0.855	0.855

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)
S1.006	SMH 3654 (EXIST.)	39.020	37.520	37.520	0	0

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)
S9.002	SMH 3653 (EXIST.)	39.070	37.548	37.540	0	0

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)
S16.002	SMH 3655 (EXIST.)	38.960	37.431	0.000	0	0

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)
S17.004	SNew MH	45.550	43.647	43.649	0	0

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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	2.000
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	7
Number of Online Controls	6	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)	18.900	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S14, DS/PN: S7.001, Volume (m³): 1.1

Unit Reference	MD-SHE-0113-5000-0500-5000
Design Head (m)	0.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	38.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.500	5.0
Flush-Flo™	0.179	5.0
Kick-Flo®	0.372	4.4
Mean Flow over Head Range	-	4.1

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	3.9	1.200	7.5	3.000	11.6	7.000	17.4
0.200	5.0	1.400	8.1	3.500	12.5	7.500	18.1
0.300	4.8	1.600	8.6	4.000	13.3	8.000	18.7
0.400	4.5	1.800	9.1	4.500	14.1	8.500	19.2
0.500	5.0	2.000	9.6	5.000	14.8	9.000	19.8
0.600	5.4	2.200	10.0	5.500	15.4	9.500	20.3
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.8		

Hydro-Brake® Optimum Manhole: S16, DS/PN: S1.006, Volume (m³): 4.3

Unit Reference	MD-SCU-0114-1550-1400-1550
Design Head (m)	1.400
Design Flow (l/s)	15.5
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	114
Invert Level (m)	37.580
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: S16, DS/PN: S1.006, Volume (m³): 4.3

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	15.5
Flush-Flo™	0.140	5.9
Kick-Flo®	0.170	5.8
Mean Flow over Head Range	-	10.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	14.4	3.000	22.3	7.000	33.6
0.200	6.2	1.400	15.5	3.500	24.0	7.500	34.7
0.300	7.5	1.600	16.5	4.000	25.6	8.000	35.8
0.400	8.6	1.800	17.5	4.500	27.1	8.500	36.9
0.500	9.5	2.000	18.4	5.000	28.6	9.000	38.0
0.600	10.4	2.200	19.2	5.500	29.9	9.500	39.0
0.800	11.9	2.400	20.1	6.000	31.2		
1.000	13.2	2.600	20.8	6.500	32.4		

Hydro-Brake® Optimum Manhole: S18, DS/PN: S9.001, Volume (m³): 1.4

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	37.802
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.296	5.0
Kick-Flo®	0.637	4.1
Mean Flow over Head Range	-	4.3

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	3.6	0.300	5.0	0.500	4.7	0.800	4.5
0.200	4.8	0.400	4.9	0.600	4.3	1.000	5.0

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Hydro-Brake® Optimum Manhole: S18, DS/PN: S9.001, Volume (m³): 1.4

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	5.4	2.400	7.5	5.000	10.6	8.000	13.3
1.400	5.8	2.600	7.8	5.500	11.1	8.500	13.7
1.600	6.2	3.000	8.4	6.000	11.6	9.000	14.1
1.800	6.6	3.500	9.0	6.500	12.1	9.500	14.5
2.000	6.9	4.000	9.6	7.000	12.5		
2.200	7.2	4.500	10.1	7.500	12.9		

Hydro-Brake® Optimum Manhole: S31, DS/PN: S9.002, Volume (m³): 1.6

Unit Reference	MD-SHE-0195-2020-1300-2020
Design Head (m)	1.300
Design Flow (l/s)	20.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	37.639
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	20.2
Flush-Flo™	0.402	20.1
Kick-Flo®	0.880	16.8
Mean Flow over Head Range	-	17.3

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	6.8	1.200	19.4	3.000	30.1	7.000	45.3
0.200	18.2	1.400	20.9	3.500	32.4	7.500	46.8
0.300	19.8	1.600	22.3	4.000	34.6	8.000	48.3
0.400	20.1	1.800	23.6	4.500	36.6	8.500	49.8
0.500	20.0	2.000	24.8	5.000	38.5	9.000	51.2
0.600	19.6	2.200	25.9	5.500	40.3	9.500	52.5
0.800	18.2	2.400	27.0	6.000	42.0		
1.000	17.8	2.600	28.1	6.500	43.7		

Hydro-Brake® Optimum Manhole: S47, DS/PN: S19.001, Volume (m³): 1.6

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated

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Hydro-Brake® Optimum Manhole: S47, DS/PN: S19.001, Volume (m³): 1.6

Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	44.415
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.500	5.0
Flush-Flo™	0.431	4.9
Kick-Flo®	0.878	3.9
Mean Flow over Head Range	-	4.3

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	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

Hydro-Brake® Optimum Manhole: S53, DS/PN: S17.004, Volume (m³): 3.2

Unit Reference	MD-SHE-0219-2700-1500-2700
Design Head (m)	1.500
Design Flow (l/s)	27.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	219
Invert Level (m)	43.720
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.500	27.0
Flush-Flo™	0.457	27.0
Kick-Flo®	1.005	22.3
Mean Flow over Head Range	-	23.2

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

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Hydro-Brake® Optimum Manhole: S53, DS/PN: S17.004, Volume (m³): 3.2

Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.4	1.200	24.3	3.000	37.6	7.000	56.7
0.200	21.6	1.400	26.1	3.500	40.6	7.500	58.6
0.300	26.2	1.600	27.8	4.000	43.3	8.000	60.5
0.400	26.9	1.800	29.5	4.500	45.8	8.500	62.3
0.500	26.9	2.000	31.0	5.000	48.2	9.000	64.1
0.600	26.7	2.200	32.4	5.500	50.5	9.500	65.8
0.800	25.6	2.400	33.8	6.000	52.6		
1.000	22.5	2.600	35.1	6.500	54.7		

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Storage Structures for Storm

Cellular Storage Manhole: S11, DS/PN: S1.004

Invert Level (m) 37.750 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	176.0	0.0	0.611	0.0	0.0
0.610	176.0	0.0			

Cellular Storage Manhole: S13, DS/PN: S7.000

Invert Level (m) 45.300 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	330.0	0.0	0.086	0.0	0.0
0.085	330.0	0.0			

Cellular Storage Manhole: S15, DS/PN: S8.000

Invert Level (m) 37.800 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	165.0	0.0	0.151	0.0	0.0
0.150	165.0	0.0			

Cellular Storage Manhole: S17, DS/PN: S9.000

Invert Level (m) 45.300 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	320.0	0.0	0.086	0.0	0.0
0.085	320.0	0.0			

Cellular Storage Manhole: S36, DS/PN: S10.006

Invert Level (m) 37.750 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

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Cellular Storage Manhole: S36, DS/PN: S10.006

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	154.0	0.0	0.611	0.0	0.0
0.610	154.0	0.0			

Cellular Storage Manhole: S52, DS/PN: S17.003

Invert Level (m) 43.733 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	100.0	0.0	0.801	0.0	0.0
0.800	100.0	0.0			

Cellular Storage Manhole: S46, DS/PN: S19.000

Invert Level (m) 44.500 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	730.0	0.0	0.086	0.0	0.0
0.085	730.0	0.0			

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1 year Return Period 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 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
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 7
Number of Online Controls 6 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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.900 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 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.	Water Level (m)
S1.000	S1	15 Winter	1	+0%					38.420
S1.001	S2	15 Winter	1	+0%					38.350
S2.000	S3	120 Winter	1	+0%					38.243
S1.002	S4	15 Winter	1	+0%					38.054
S1.003	S5	15 Winter	1	+0%	100/15 Summer				37.940
S3.000	S6	15 Winter	1	+0%					38.170
S3.001	S7	15 Winter	1	+0%					38.026
S4.000	S8	15 Winter	1	+0%	100/30 Winter				38.028
S5.000	S9	60 Winter	1	+0%	100/15 Summer				37.876
S6.000	S10	120 Winter	1	+0%	100/60 Winter				38.060
S1.004	S11	60 Winter	1	+0%	100/30 Winter				37.876
S1.005	S12	60 Winter	1	+0%	100/15 Summer				37.862
S7.000	S13	120 Winter	1	+0%					45.300
S7.001	S14	120 Winter	1	+0%	100/30 Winter				38.000
S8.000	S15	120 Winter	1	+0%	100/30 Summer				37.814
S7.002	S15	60 Winter	1	+0%	30/15 Winter				37.854
S1.006	S16	60 Winter	1	+0%	30/15 Winter				37.857
S9.000	S17	120 Winter	1	+0%					45.300

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1 year Return Period 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)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.335	0.000	0.02		2.7	OK	
S1.001	S2	-0.332	0.000	0.03		4.0	OK	
S2.000	S3	-0.150	0.000	0.00		0.0	OK	
S1.002	S4	-0.293	0.000	0.11		14.7	OK	
S1.003	S5	-0.258	0.000	0.21		22.2	OK	
S3.000	S6	-0.333	0.000	0.03		4.5	OK	
S3.001	S7	-0.324	0.000	0.05		8.2	OK	
S4.000	S8	-0.165	0.000	0.16		9.5	OK	
S5.000	S9	-0.169	0.000	0.00		0.0	OK	
S6.000	S10	-0.225	0.000	0.00		0.0	OK	
S1.004	S11	-0.299	0.000	0.09		11.7	OK	
S1.005	S12	-0.190	0.000	0.09		10.3	OK	
S7.000	S13	-0.150	0.000	0.00		0.0	OK	
S7.001	S14	-0.150	0.000	0.00		0.0	OK	
S8.000	S15	-0.211	0.000	0.01		0.4	OK	
S7.002	S15	-0.091	0.000	0.01		0.7	OK	
S1.006	S16	-0.098	0.000	0.07		7.2	OK	
S9.000	S17	-0.150	0.000	0.00		0.0	OK	

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1 year Return Period 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)
S9.001	S18	120 Winter	1	+0%	100/15 Summer				37.802
S10.000	S19	15 Winter	1	+0%					40.941
S10.001	S20	15 Winter	1	+0%					40.851
S10.002	S21	15 Winter	1	+0%					38.467
S10.003	S22	15 Winter	1	+0%					38.128
S10.004	S23	15 Winter	1	+0%					38.051
S10.005	S24	15 Winter	1	+0%					37.905
S11.000	S25	120 Winter	1	+0%					38.822
S12.000	S26	120 Winter	1	+0%					38.822
S11.001	S27	120 Winter	1	+0%					38.599
S11.002	S28	120 Winter	1	+0%					37.968
S13.000	S29	120 Winter	1	+0%					38.000
S14.000	S30	15 Winter	1	+0%					44.951
S14.001	S31	15 Winter	1	+0%					38.194
S14.002	S32	15 Winter	1	+0%					38.110
S14.003	S33	15 Winter	1	+0%					38.034
S15.000	S34	15 Winter	1	+0%					38.162
S15.001	S35	15 Winter	1	+0%					37.880
S10.006	S36	120 Winter	1	+0%	100/15 Summer				37.862
S10.007	S37	120 Winter	1	+0%	100/15 Summer				37.795
S10.008	S38	120 Winter	1	+0%	30/15 Winter				37.736
S9.002	S31	120 Winter	1	+0%	30/15 Winter				37.734
S16.000	S40	120 Winter	1	+0%					37.800
S16.001	S41	120 Winter	1	+0%					37.697
S16.002	S42	120 Winter	1	+0%					37.564
S17.000	S48	15 Winter	1	+0%					44.347
S17.001	S49	15 Winter	1	+0%					44.247
S18.000	S50	15 Winter	1	+0%	100/15 Winter				44.003
S17.002	S51	15 Winter	1	+0%	100/15 Summer				43.994
S17.003	S52	30 Winter	1	+0%	100/15 Summer				43.859
S19.000	S46	120 Winter	1	+0%					44.500
S19.001	S47	120 Winter	1	+0%					44.415
S17.004	S53	30 Winter	1	+0%	30/15 Summer				43.854

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S9.001	S18	-0.150	0.000	0.00		0.0	OK	
S10.000	S19	-0.184	0.000	0.08		3.6	OK	
S10.001	S20	-0.159	0.000	0.18		6.9	OK	
S10.002	S21	-0.175	0.000	0.11		7.3	OK	
S10.003	S22	-0.304	0.000	0.08		8.8	OK	
S10.004	S23	-0.309	0.000	0.07		10.4	OK	
S10.005	S24	-0.318	0.000	0.06		10.3	OK	
S11.000	S25	-0.178	0.000	0.00		0.0	OK	
S12.000	S26	-0.178	0.000	0.00		0.0	OK	

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1 year Return Period 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)	Pipe Flow (l/s)	Status	Level Exceeded
S11.001	S27	-0.225	0.000	0.00		0.0	OK	
S11.002	S28	-0.225	0.000	0.00		0.0	OK	
S13.000	S29	-0.225	0.000	0.00		0.0	OK	
S14.000	S30	-0.189	0.000	0.06		3.1	OK	
S14.001	S31	-0.171	0.000	0.13		5.2	OK	
S14.002	S32	-0.172	0.000	0.12		5.3	OK	
S14.003	S33	-0.157	0.000	0.20		9.7	OK	
S15.000	S34	-0.185	0.000	0.07		4.1	OK	
S15.001	S35	-0.308	0.000	0.07		7.8	OK	
S10.006	S36	-0.163	0.000	0.17		6.3	OK	
S10.007	S37	-0.162	0.000	0.18		6.3	OK	
S10.008	S38	-0.127	0.000	0.22		6.5	OK	
S9.002	S31	-0.130	0.000	0.18		6.2	OK	
S16.000	S40	-0.225	0.000	0.00		0.0	OK	
S16.001	S41	-0.225	0.000	0.00		0.0	OK	
S16.002	S42	-0.225	0.000	0.00		0.0	OK	
S17.000	S48	-0.289	0.000	0.12		13.4	OK	
S17.001	S49	-0.306	0.000	0.08		13.4	OK	
S18.000	S50	-0.277	0.000	0.11		10.9	OK	
S17.002	S51	-0.246	0.000	0.26		32.8	OK	
S17.003	S52	-0.249	0.000	0.15		12.1	OK	
S19.000	S46	-0.150	0.000	0.00		0.0	OK	
S19.001	S47	-0.150	0.000	0.00		0.0	OK	
S17.004	S53	-0.092	0.000	0.33		12.1	OK	

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30 year Return Period 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 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
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 7
Number of Online Controls 6 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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.900 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 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.	Water Level (m)
S1.000	S1	15 Winter	30	+0%					38.440
S1.001	S2	15 Winter	30	+0%					38.379
S2.000	S3	120 Winter	30	+0%					38.243
S1.002	S4	15 Winter	30	+0%					38.117
S1.003	S5	60 Winter	30	+0%	100/15 Summer				38.046
S3.000	S6	15 Winter	30	+0%					38.194
S3.001	S7	15 Winter	30	+0%					38.063
S4.000	S8	15 Winter	30	+0%	100/30 Winter				38.065
S5.000	S9	60 Winter	30	+0%	100/15 Summer				38.041
S6.000	S10	120 Winter	30	+0%	100/60 Winter				38.060
S1.004	S11	60 Winter	30	+0%	100/30 Winter				38.041
S1.005	S12	60 Winter	30	+0%	100/15 Summer				38.035
S7.000	S13	120 Winter	30	+0%					45.300
S7.001	S14	60 Winter	30	+0%	100/30 Winter				38.013
S8.000	S15	180 Winter	30	+0%	100/30 Summer				37.932
S7.002	S15	60 Winter	30	+0%	30/15 Winter				38.013
S1.006	S16	60 Winter	30	+0%	30/15 Winter				38.027
S9.000	S17	120 Winter	30	+0%					45.300

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30 year Return Period 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)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.315	0.000	0.06		6.5	OK	
S1.001	S2	-0.303	0.000	0.08		10.6	OK	
S2.000	S3	-0.150	0.000	0.00		0.0	OK	
S1.002	S4	-0.230	0.000	0.31		43.6	OK	
S1.003	S5	-0.151	0.000	0.31		32.3	OK	
S3.000	S6	-0.309	0.000	0.07		11.0	OK	
S3.001	S7	-0.287	0.000	0.12		22.7	OK	
S4.000	S8	-0.128	0.000	0.38		23.4	OK	
S5.000	S9	-0.004	0.000	0.00		0.1	OK	
S6.000	S10	-0.225	0.000	0.00		0.0	OK	
S1.004	S11	-0.134	0.000	0.16		21.5	OK	
S1.005	S12	-0.017	0.000	0.15		17.1	OK	
S7.000	S13	-0.150	0.000	0.00		0.0	OK	
S7.001	S14	-0.137	0.000	0.00		0.0	OK	
S8.000	S15	-0.093	0.000	0.17		5.3	OK	
S7.002	S15	0.068	0.000	0.05		3.4	SURCHARGED	
S1.006	S16	0.072	0.000	0.08		9.0	SURCHARGED	
S9.000	S17	-0.150	0.000	0.00		0.0	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S9.001	S18	60 Winter	30	+0%	100/15 Summer				37.890
S10.000	S19	15 Winter	30	+0%					40.966
S10.001	S20	15 Winter	30	+0%					40.900
S10.002	S21	15 Winter	30	+0%					38.504
S10.003	S22	15 Winter	30	+0%					38.178
S10.004	S23	15 Winter	30	+0%					38.100
S10.005	S24	60 Winter	30	+0%					37.951
S11.000	S25	120 Winter	30	+0%					38.822
S12.000	S26	120 Winter	30	+0%					38.822
S11.001	S27	120 Winter	30	+0%					38.599
S11.002	S28	120 Winter	30	+0%					37.968
S13.000	S29	120 Winter	30	+0%					38.000
S14.000	S30	15 Winter	30	+0%					44.972
S14.001	S31	15 Winter	30	+0%					38.233
S14.002	S32	15 Winter	30	+0%					38.148
S14.003	S33	15 Winter	30	+0%					38.088
S15.000	S34	15 Winter	30	+0%					38.186
S15.001	S35	60 Winter	30	+0%					37.951
S10.006	S36	60 Winter	30	+0%	100/15 Summer				37.949
S10.007	S37	60 Winter	30	+0%	100/15 Summer				37.934
S10.008	S38	60 Winter	30	+0%	30/15 Winter				37.898
S9.002	S31	60 Winter	30	+0%	30/15 Winter				37.890
S16.000	S40	120 Winter	30	+0%					37.800
S16.001	S41	120 Winter	30	+0%					37.697
S16.002	S42	120 Winter	30	+0%					37.564
S17.000	S48	15 Winter	30	+0%					44.400
S17.001	S49	15 Winter	30	+0%					44.288
S18.000	S50	15 Winter	30	+0%	100/15 Winter				44.097
S17.002	S51	15 Winter	30	+0%	100/15 Summer				44.091
S17.003	S52	30 Winter	30	+0%	100/15 Summer				44.018
S19.000	S46	120 Winter	30	+0%					44.500
S19.001	S47	120 Winter	30	+0%					44.415
S17.004	S53	30 Winter	30	+0%	30/15 Summer				44.038

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S9.001	S18	-0.062	0.000	0.01		0.2	OK	
S10.000	S19	-0.159	0.000	0.18		8.8	OK	
S10.001	S20	-0.110	0.000	0.51		18.9	OK	
S10.002	S21	-0.138	0.000	0.31		20.0	OK	
S10.003	S22	-0.253	0.000	0.23		24.3	OK	
S10.004	S23	-0.260	0.000	0.20		29.0	OK	
S10.005	S24	-0.272	0.000	0.08		14.6	OK	
S11.000	S25	-0.178	0.000	0.00		0.0	OK	
S12.000	S26	-0.178	0.000	0.00		0.0	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S11.001	S27	-0.225	0.000	0.00		0.0	OK	
S11.002	S28	-0.225	0.000	0.00		0.0	OK	
S13.000	S29	-0.225	0.000	0.00		0.0	OK	
S14.000	S30	-0.168	0.000	0.15		7.7	OK	
S14.001	S31	-0.132	0.000	0.35		14.2	OK	
S14.002	S32	-0.135	0.000	0.33		14.1	OK	
S14.003	S33	-0.103	0.000	0.57		27.7	OK	
S15.000	S34	-0.161	0.000	0.18		10.1	OK	
S15.001	S35	-0.237	0.000	0.10		10.5	OK	
S10.006	S36	-0.076	0.000	0.61		22.5	OK	
S10.007	S37	-0.023	0.000	0.60		21.2	OK	
S10.008	S38	0.036	0.000	0.66		19.8	SURCHARGED	
S9.002	S31	0.026	0.000	0.55		19.4	SURCHARGED	
S16.000	S40	-0.225	0.000	0.00		0.0	OK	
S16.001	S41	-0.225	0.000	0.00		0.0	OK	
S16.002	S42	-0.225	0.000	0.00		0.0	OK	
S17.000	S48	-0.236	0.000	0.29		33.0	OK	
S17.001	S49	-0.265	0.000	0.18		32.8	OK	
S18.000	S50	-0.183	0.000	0.27		26.8	OK	
S17.002	S51	-0.149	0.000	0.66		84.0	OK	
S17.003	S52	-0.090	0.000	0.35		27.3	OK	
S19.000	S46	-0.150	0.000	0.00		0.0	OK	
S19.001	S47	-0.150	0.000	0.00		0.0	OK	
S17.004	S53	0.092	0.000	0.71		25.9	SURCHARGED	

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100 year Return Period 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 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
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 7
Number of Online Controls 6 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 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.900 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 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.	Water Level (m)
S1.000	S1	15 Winter	100	+40%					38.463
S1.001	S2	15 Winter	100	+40%					38.404
S2.000	S3	120 Winter	100	+40%					38.329
S1.002	S4	120 Winter	100	+40%					38.332
S1.003	S5	120 Winter	100	+40%	100/15 Summer				38.330
S3.000	S6	120 Winter	100	+40%					38.327
S3.001	S7	120 Winter	100	+40%					38.327
S4.000	S8	120 Winter	100	+40%	100/30 Winter				38.329
S5.000	S9	120 Winter	100	+40%	100/15 Summer				38.327
S6.000	S10	120 Winter	100	+40%	100/60 Winter				38.327
S1.004	S11	120 Winter	100	+40%	100/30 Winter				38.327
S1.005	S12	120 Winter	100	+40%	100/15 Summer				38.447
S7.000	S13	120 Winter	100	+40%					45.300
S7.001	S14	120 Winter	100	+40%	100/30 Winter				38.340
S8.000	S15	120 Winter	100	+40%	100/30 Summer				38.430
S7.002	S15	120 Winter	100	+40%	30/15 Winter				38.443
S1.006	S16	120 Winter	100	+40%	30/15 Winter				38.483
S9.000	S17	120 Winter	100	+40%					45.300

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100 year Return Period 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)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.292	0.000	0.11		11.8	OK	
S1.001	S2	-0.278	0.000	0.15		19.3	OK	
S2.000	S3	-0.064	0.000	0.01		0.1	OK	
S1.002	S4	-0.015	0.000	0.17		23.9	OK	
S1.003	S5	0.132	0.000	0.34		35.0	SURCHARGED	
S3.000	S6	-0.176	0.000	0.04		6.5	OK	
S3.001	S7	-0.023	0.000	0.07		12.1	OK	
S4.000	S8	0.136	0.000	0.22		13.3	SURCHARGED	
S5.000	S9	0.282	0.000	0.00		0.1	SURCHARGED	
S6.000	S10	0.042	0.000	0.00		0.1	SURCHARGED	
S1.004	S11	0.152	0.000	0.29		40.4	SURCHARGED	
S1.005	S12	0.395	0.000	0.31		36.8	SURCHARGED	
S7.000	S13	-0.150	0.000	0.00		0.0	OK	
S7.001	S14	0.190	0.000	0.02		0.3	SURCHARGED	
S8.000	S15	0.405	0.000	0.09		2.8	SURCHARGED	
S7.002	S15	0.498	0.000	0.04		2.8	SURCHARGED	
S1.006	S16	0.528	0.000	0.11		11.5	SURCHARGED	
S9.000	S17	-0.150	0.000	0.00		0.0	OK	

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100 year Return Period 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)
S9.001	S18	60 Winter	100	+40%	100/15 Summer				38.086
S10.000	S19	15 Winter	100	+40%					40.990
S10.001	S20	15 Winter	100	+40%					40.956
S10.002	S21	15 Winter	100	+40%					38.539
S10.003	S22	15 Winter	100	+40%					38.226
S10.004	S23	60 Winter	100	+40%					38.150
S10.005	S24	60 Winter	100	+40%					38.146
S11.000	S25	120 Winter	100	+40%					38.822
S12.000	S26	120 Winter	100	+40%					38.822
S11.001	S27	120 Winter	100	+40%					38.599
S11.002	S28	60 Winter	100	+40%					38.144
S13.000	S29	60 Winter	100	+40%					38.144
S14.000	S30	15 Winter	100	+40%					44.994
S14.001	S31	15 Winter	100	+40%					38.272
S14.002	S32	15 Winter	100	+40%					38.202
S14.003	S33	15 Winter	100	+40%					38.172
S15.000	S34	15 Winter	100	+40%					38.211
S15.001	S35	60 Winter	100	+40%					38.146
S10.006	S36	60 Winter	100	+40%	100/15 Summer				38.144
S10.007	S37	60 Winter	100	+40%	100/15 Summer				38.135
S10.008	S38	60 Winter	100	+40%	30/15 Winter				38.106
S9.002	S31	60 Winter	100	+40%	30/15 Winter				38.097
S16.000	S40	120 Winter	100	+40%					37.800
S16.001	S41	120 Winter	100	+40%					37.697
S16.002	S42	120 Winter	100	+40%					37.564
S17.000	S48	15 Winter	100	+40%					44.457
S17.001	S49	15 Winter	100	+40%					44.336
S18.000	S50	30 Winter	100	+40%	100/15 Winter				44.327
S17.002	S51	30 Winter	100	+40%	100/15 Summer				44.325
S17.003	S52	30 Winter	100	+40%	100/15 Summer				44.311
S19.000	S46	120 Winter	100	+40%					44.500
S19.001	S47	30 Winter	100	+40%					44.419
S17.004	S53	60 Winter	100	+40%	30/15 Summer				44.397

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S9.001	S18	0.134	0.000	0.01		0.4	SURCHARGED	
S10.000	S19	-0.135	0.000	0.34		16.1	OK	
S10.001	S20	-0.054	0.000	0.92		34.4	OK	
S10.002	S21	-0.103	0.000	0.56		36.3	OK	
S10.003	S22	-0.206	0.000	0.41		44.1	OK	
S10.004	S23	-0.210	0.000	0.19		27.3	OK	
S10.005	S24	-0.078	0.000	0.14		25.7	OK	
S11.000	S25	-0.178	0.000	0.00		0.0	OK	
S12.000	S26	-0.178	0.000	0.00		0.0	OK	

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100 year Return Period 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)	Pipe Flow (l/s)	Status	Level Exceeded
S11.001	S27	-0.225	0.000	0.00		0.0	OK	
S11.002	S28	-0.049	0.000	0.00		0.1	OK	
S13.000	S29	-0.081	0.000	0.00		0.1	OK	
S14.000	S30	-0.146	0.000	0.27		13.9	OK	
S14.001	S31	-0.093	0.000	0.64		25.7	OK	
S14.002	S32	-0.081	0.000	0.60		25.5	OK	
S14.003	S33	-0.019	0.000	1.00		48.8	OK	
S15.000	S34	-0.136	0.000	0.33		18.3	OK	
S15.001	S35	-0.042	0.000	0.18		19.2	OK	
S10.006	S36	0.119	0.000	0.68		25.0	SURCHARGED	
S10.007	S37	0.178	0.000	0.65		23.0	SURCHARGED	
S10.008	S38	0.243	0.000	0.69		20.7	SURCHARGED	
S9.002	S31	0.233	0.000	0.57		20.1	SURCHARGED	
S16.000	S40	-0.225	0.000	0.00		0.0	OK	
S16.001	S41	-0.225	0.000	0.00		0.0	OK	
S16.002	S42	-0.225	0.000	0.00		0.0	OK	
S17.000	S48	-0.179	0.000	0.53		59.8	OK	
S17.001	S49	-0.217	0.000	0.33		59.2	OK	
S18.000	S50	0.047	0.000	0.39		37.8	SURCHARGED	
S17.002	S51	0.084	0.000	0.91		116.0	SURCHARGED	
S17.003	S52	0.203	0.000	0.39		30.9	SURCHARGED	
S19.000	S46	-0.150	0.000	0.00		0.0	OK	
S19.001	S47	-0.147	0.000	0.00		0.0	OK	
S17.004	S53	0.452	0.000	0.73		26.8	SURCHARGED	

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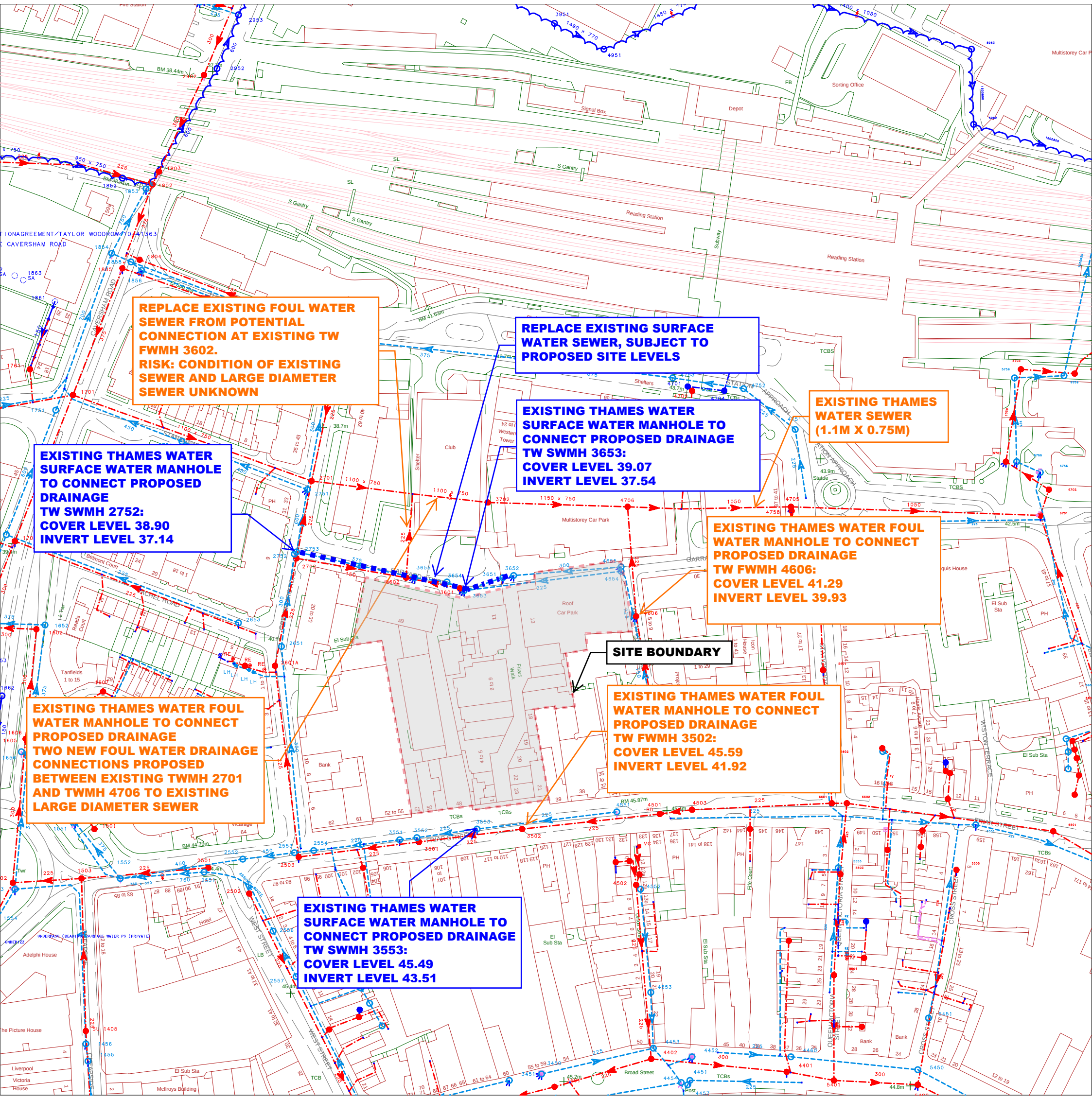
APPENDIX 4
THAMES WATER ASSET PLAN

Based on the Ordnance Survey map with the Sanction of the controller of H.M. Stationery Office, licence no. WU298557. Crown Copyright Reserved.

ALS/ALS Standard/2009_1444288



The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

100 metre intervals

EAGLE hardcopy facility - Normal Map.
The plot is centred on (471378 , 173707), which is in SU7173NW. Printed on 9 April 2009 at 15:34:49 by RIMISSON.

Comments:
Sewer plan

PROPOSED SURFACE WATER DRAINAGE

PROPOSED FOUL WATER DRAINAGE