PRICE & MYERS

1 Rushmead
London

Civil Engineering
Sustainable Drainage Report

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Reviewed by: **Thomas Quigg BSc MSc CEng MICE**

Job Number: **29189**

Date	Revision	Notes/Amendments/Issue Purpose
February 2021	1	For Information

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Contents

Appendices:

Acronyms	
AOD	Above Ordnance Datum
CIRIA	Construction Industry Research and Information Association
EA	Environment Agency
FRA	Flood Risk Assessment
LBTH	London Borough of Tower Hamlets
NPPF	National Planning Policy Framework
NTSSUDS	Non-Statutory Technical Standards for Sustainable Drainage Systems
PPG	Planning Practice Guidance
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water Management Plan
TW	Thames Water

1 Introduction

Price & Myers have been commissioned to prepare this Sustainable Drainage Strategy to support the planning application for the redevelopment of 1 Rushmead in the London Borough of Tower Hamlets (LBTH).

This report has been carried out in accordance with the National Planning Policy Framework (NPPF) and DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems (NTSSUDS). LBTH's policies and guidance have also been referred to, including the LBTH's Drainage Sustainable Evaluation, SuDS Design Requirements for LLFA Technical Assessment, the LBTH's Surface Water Management Plan (SWMP) and LBTH's Strategic Flood Risk Assessment (SFRA). This report also incorporates advice and guidance from the Environment Agency and CIRIA documents.

This report will outline the proposed drainage strategy for the site including a detailed SUDS assessment. The NTSSUDS states that *"for developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event".*

This report aims to adopt the most sustainable drainage solution for the proposed development, aiming to reduce the run-off from the proposed development to Greenfield rates.

2 Site Description and Location

The site is located within the London Borough of Tower Hamlets (LBTH) just north of Bethnal Green Road. It is bounded by Rushmead to the east, a three-storey residential block to the west, and Florida Street to the north. The site comprises of a single building currently used as a shop.

The site has approximate OS coordinates of 534521, 182692 at Grid Reference TQ345826, and the postcode is E2 6NE.

Figure 2.1: Existing site, showing site boundary

Site location:

2.1 Existing Drainage

Thames Water sewer records show that there are public combined sewers surrounding the site. There is a 1143 x 762mm sewer running along Rushmead to the east of the site and a 3048mm diameter trunk sewer running along Florida Street to the north of the site. Refer to Appendix A for the sewer records.

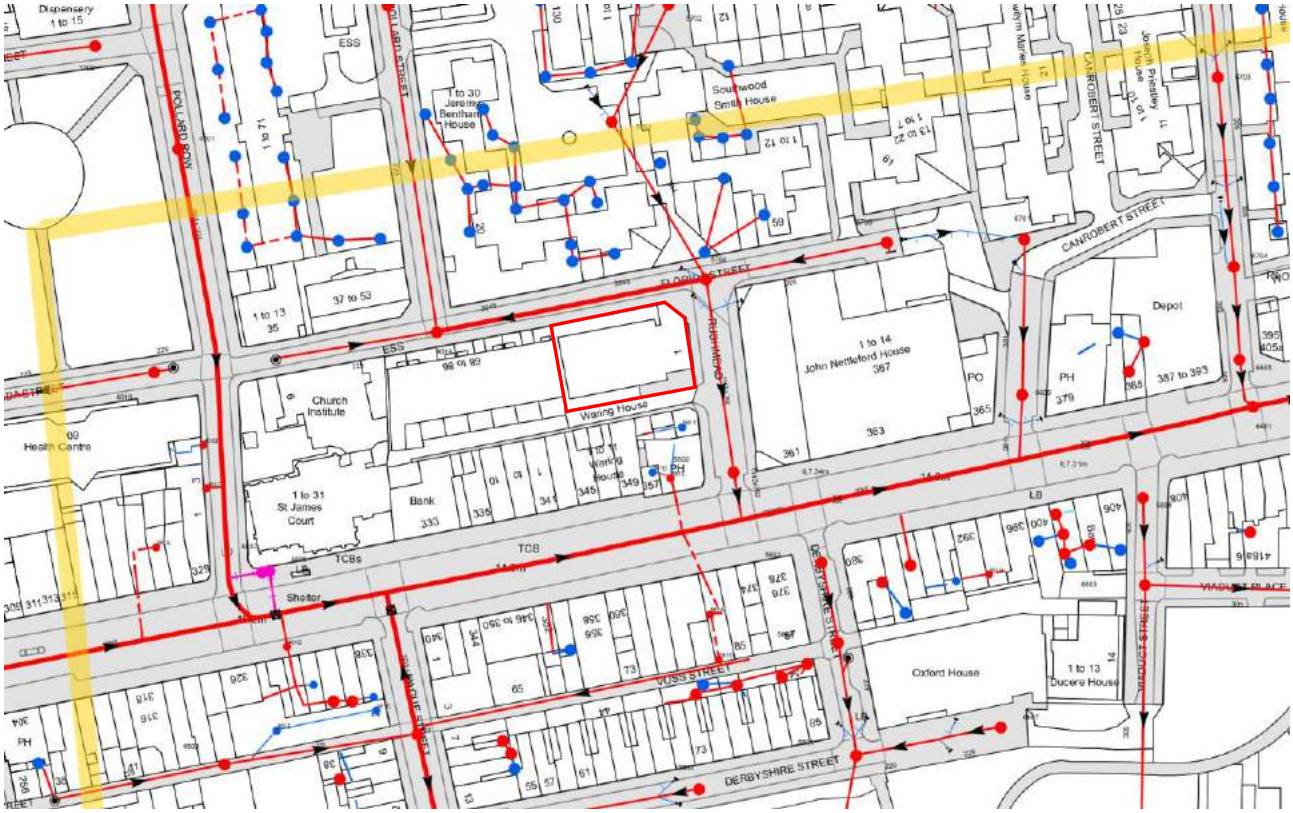


Figure 2.2: Thames Water Sewer Records

Site location:

A CCTV drainage survey was undertaken to confirm the sites existing drainage routes, levels, condition and final connection points. The survey found that the site drains surface and foul water at unrestricted rates to the combined public sewer in Florida Street via a 150mm connection in the northwest corner of the site.

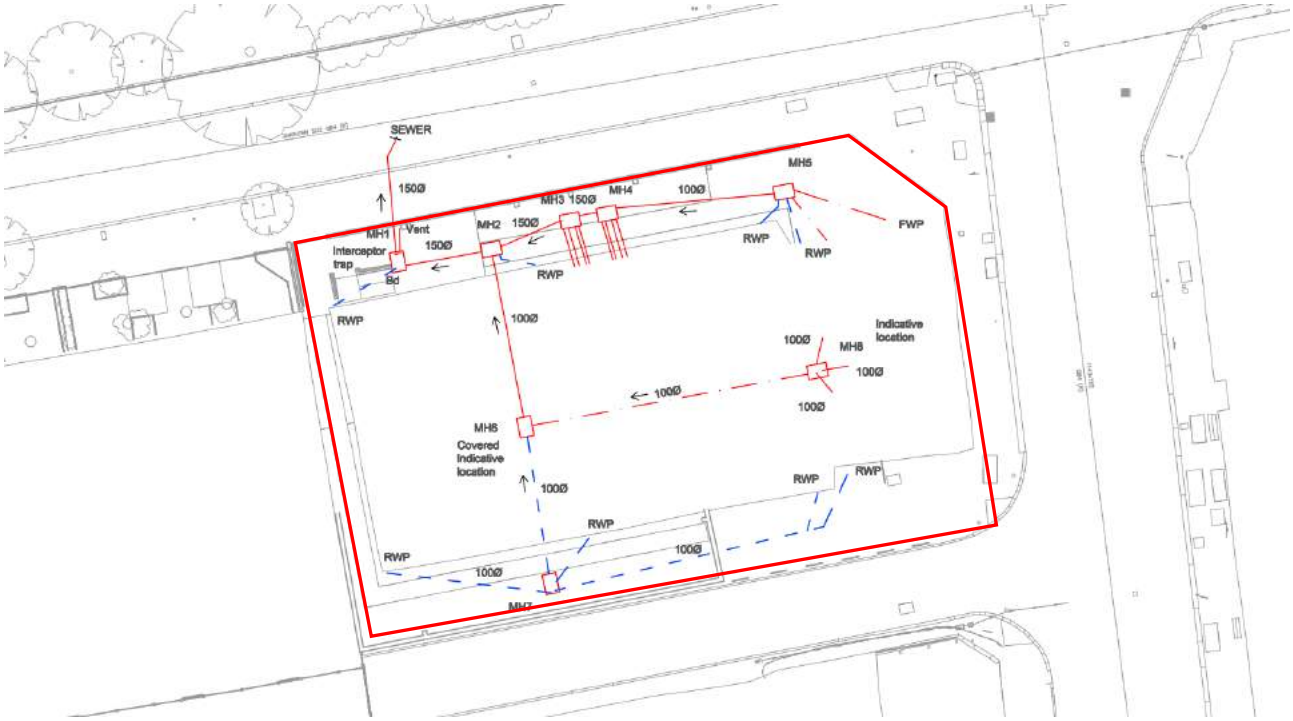


Figure 2.3: CCTV Drainage Survey Plan (TDL, 2020)

Site location:

2.2 Other Existing Utilities

A Utility Plan was carried out by Inside Outside Engineering Ltd, refer to Appendix B.

3 Development Proposal

The development proposals include the construction of 5 houses, as well as associated new footpaths and soft landscaping, refer to Appendix C.

Figure 3.1: Proposed ground floor plan

4 Flood Risk Assessment

4.1 Flood Risk from Watercourses and Tidal Flooding

The EA's indicative floodplain map shows that the site is located within Flood Zone 1 and is not at risk of tidal and or fluvial flooding. Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere. Therefore, the impact of the proposed development on watercourses should be assessed to ensure the surface water drainage proposals will not increase the flood risk elsewhere.

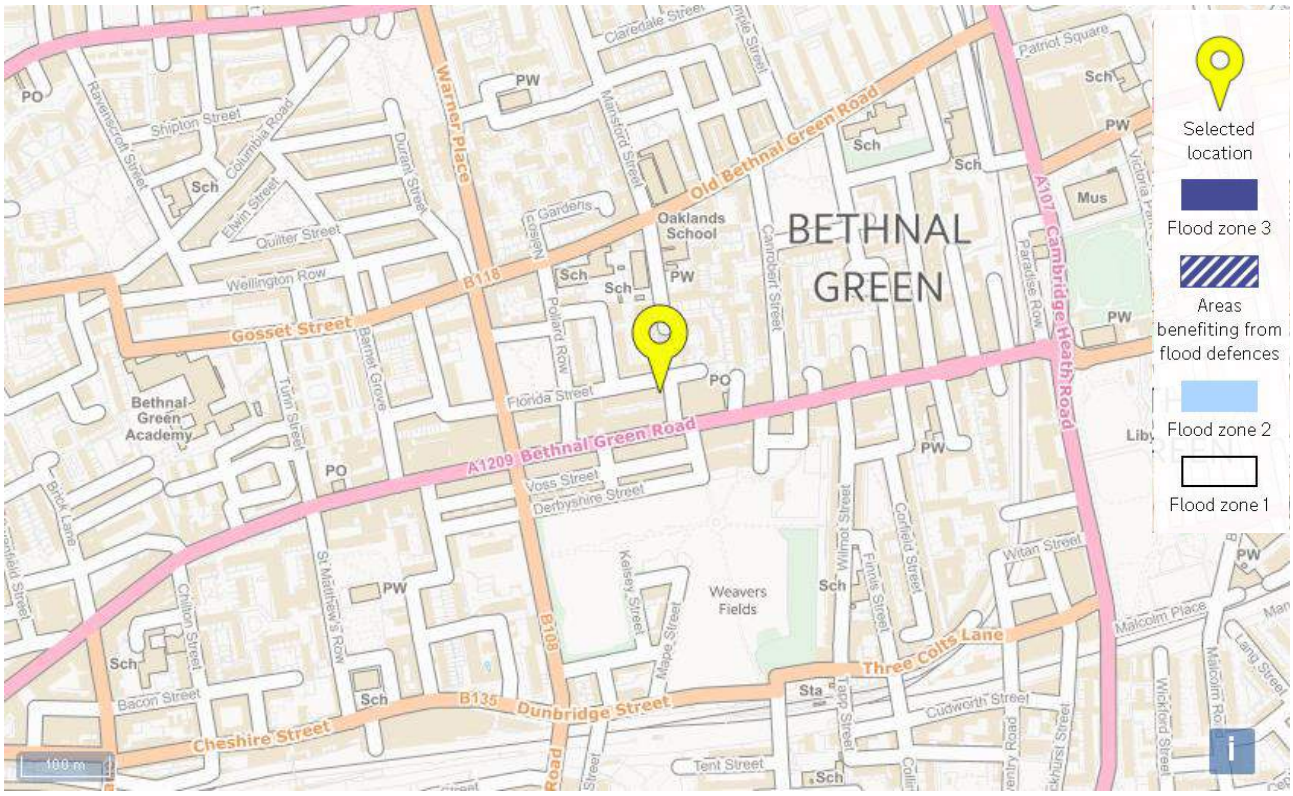


Figure 4.1: from EA Flood Map for Planning

4.2 Flood Risk from Groundwater

Groundwater flooding occurs when water originating from sub-surface permeable strata emerges from the ground, typically after prolonged rainfall.

The British Geological Survey map shown in Figure 4.2, shows that the site is underlain by Hackney Gravel Formation which consists of sand and gravels which is underlain by bedrock of London Clay Formation – Clay, Silt and Sand.

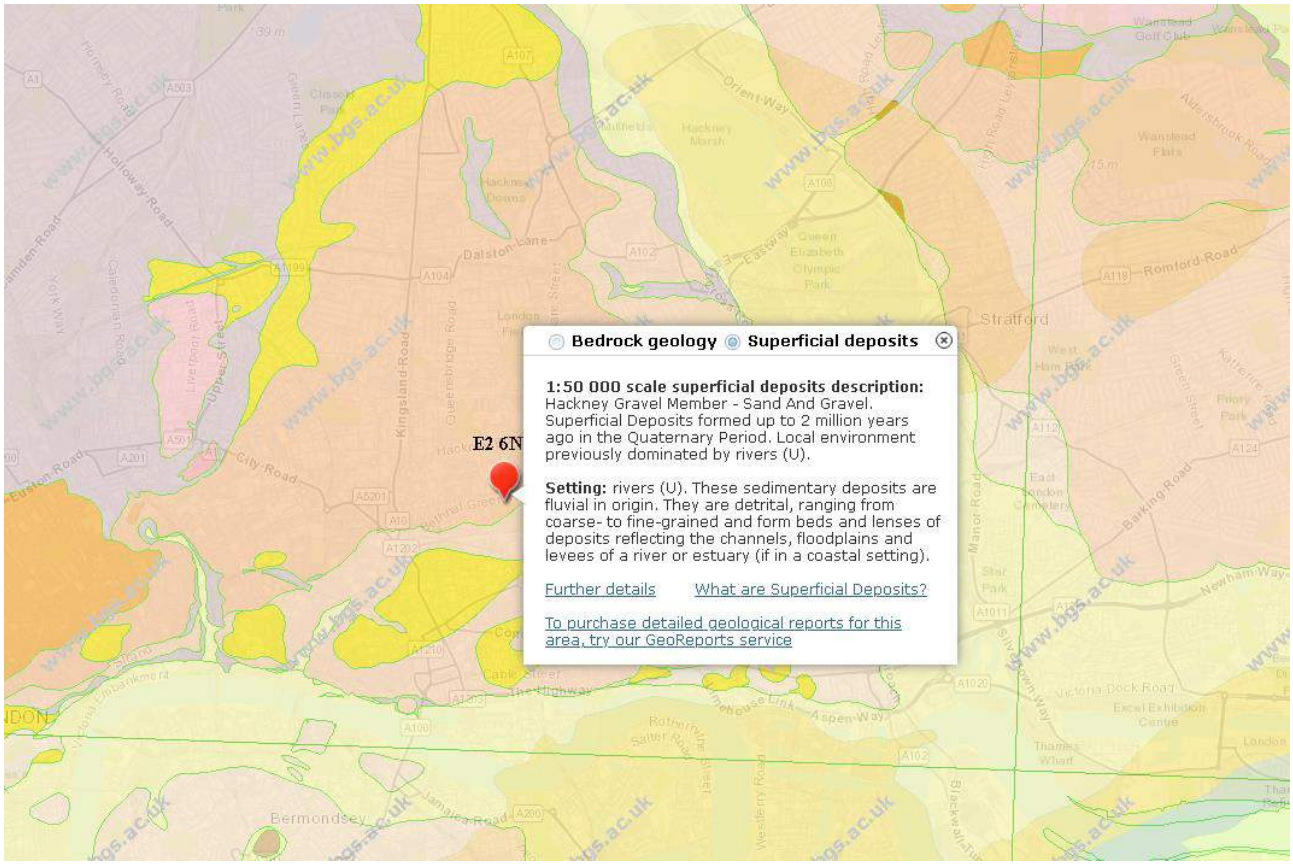


Figure 4.2: Local geology (BGS, 2020)

The SFRA groundwater flood risk map confirms there is potential for elevated groundwater levels in the vicinity of the site, refer to Figure 4.3.

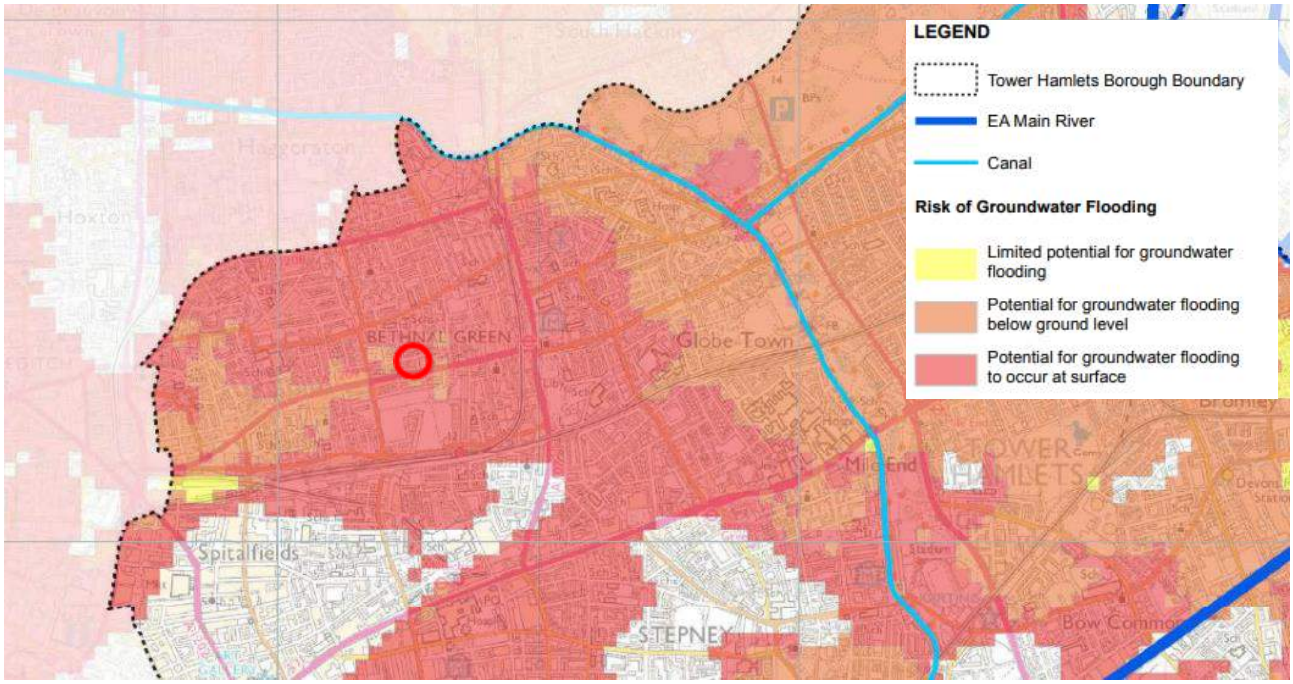


Figure 4.3: Potential for elevated groundwater map (SFRA, 2016)

Site location

However, Figure 4.4 shows that there are no recorded incidents of groundwater flooding in the area surrounding the site.

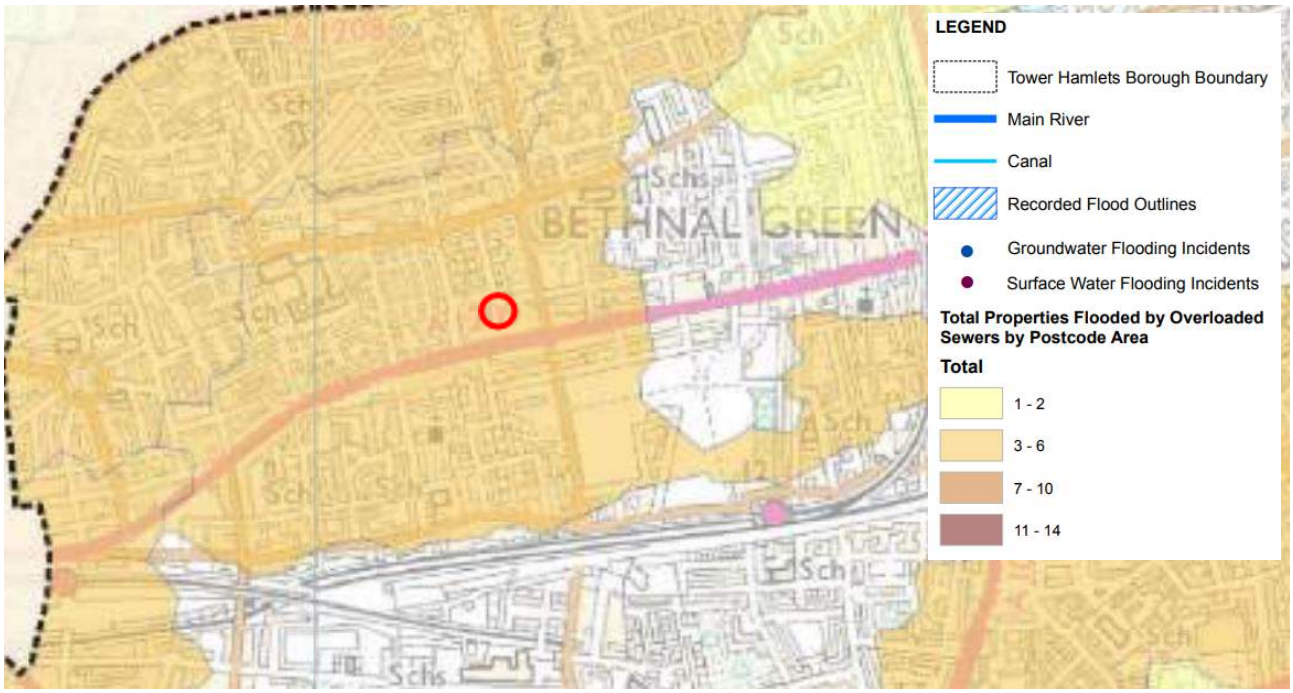


Figure 4.4: Flooding History Map (SFRA, 2016)

Site location

No basements are proposed, which are typically more vulnerable to groundwater flooding.

Therefore, the risk posed to the development due to groundwater flooding is considered low and the proposed development will not have a negative effect on the local hydrology.

4.3 Flood Risk from Surface Water and Overland Flows

Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter a drainage system due to blockages or the capacity of the system being exceeded. Overland flows can also be generated by burst water mains, failed dams and any failure in a system storing or transferring water.

The EA's indicative Surface Water Flooding Map, Figure 4.5, shows that the site is at very low risk of surface water flooding.

Figure 4.5 Environment Agency Surface Water Flood Risk Map

Therefore, the risk posed to the development due to surface water flooding is considered low.

4.4 Flood Risk from Reservoir and Infrastructure Failure

The EA provides information on flood risk from reservoirs. Figure 4.6 below shows that the site is at very low risk of flooding from reservoir failure.

Figure 4.6 Environment Agency Risk of Reservoir Flooding Map

Figure 4.4 shows data provided by Thames Water on postcodes where properties are known to have experienced internal or external flooding prior to June 2016. The site is located in the postcode E2 6 which indicates 3 incidents of internal flooding. To protect the proposed development from sewer flooding non-return valves will be fitted to all connections to the public sewer.

Therefore, the risk from Reservoirs and Infrastructure failure is considered low.

5 Surface Water Run-off Assessment

5.1 Existing Run-off

The total site area is approximately 678m^2 or 0.068 ha and all of this is impermeable.

The existing run-off rate for the design storm events was calculated using the modified rational method as shown below:

$Q_x = 2.78 \times i \times A$

Where 'x' is the return period in years, 'A' is the catchment area in ha and 'i' is the rainfall intensity in mm/hr as estimated from MicroDrainage software.

$Q1_{ex}$ = 2.78 x 0.068 x 30.99 = 5.86 l/s
$Q30_{ex}$ = 2.78 x 0.068 x 76.04 = 14.37 l/s
$Q100_{ex}$ = 2.78 x 0.068 x 98.68 = 18.65 l/s

5.2 Proposed Run-off

The proposed development will decrease the area of hardstanding by approximately 380m^2, however, to prevent infiltration, all soft landscaped areas will be tanked. Therefore, the total area of 0.068 ha is used to calculate the unrestricted run-off rate.

Using the Climate change allowance (+40%) given in Section 5.3, the proposed peak run off rate for the 1 in 100 year storm event is shown below:

$Q100_{+40\%} = 2.78 \times 0.043 \times 98.68 \times 1.4 = 26.11$ l/s

5.3 Climate Change

The current EA guidance states that for the years 2070 to 2115 there is a 50% chance the peak rainfall intensity will increase by 20% or more and that there is a 10% change it will increase by 40% or more. For this building, which is classed as More Vulnerable with a design life of 100 years an allowance of an additional 40% is considered appropriate. The climate change allowance is included in the volume calculations for the design of SuDS measures, which are given in Section 6.

6 SUDS Assessment

In accordance with the London Plan, EA guidelines, the SFRA, and CIRIA documents, surface water run-off should be managed as close to its source as possible. The London Plan states that all new developments should aim to reduce run-off to greenfield rates "utilising SUDS unless there are practical reasons for not doing so".

The possibility of implementing SUDS at the site was assessed using a hierarchy of preferred surface water management methods. The following paragraphs discuss the various methods in order of that hierarchy and evaluate the site's suitability for each method.

6.1 Store Rainwater for Later Use

Rainwater harvesting promotes the storage and re-use of rainwater collected from roofs and hard surfaced areas. This type of system contributes to the reduction of runoff rates and volumes within a development.

The capacity of rainwater harvesting systems to attenuate rainwater depends on the water use within the building. If there is no activity in the building and the harvester is full, no attenuation will be provided during a subsequent storm event. In the worst-case scenario, the rainwater harvester will provide no attenuation. Therefore, any surface water attenuation benefits these systems provide cannot be included in the drainage calculations.

Individual rainwater butts were found to be more appropriate for the scale and use of the buildings and are proposed for each property.

Sedum roofs are proposed for each of the bike stores. The CIRIA SUDS manual states that *"the hydraulic performance of green roofs during extreme events tends to be fairly similar to standard roofs"*. This means that green roofs will reduce the run-off rates in small storm event such as the annual and the 1 in 2 year events. However, these systems provide no attenuation benefits in high storm events such as the 1 in 30 year and 1 in 100 year storms which are considered in the design of surface water drainage systems. The benefits of these systems therefore cannot be considered in the design of any attenuation systems.

6.2 Infiltration

The British Geological Survey Maps show that superficial deposits of sand and gravel underlie the site. However, the LBTH SuDS Guidance states *"The LB of Tower Hamlets is characterised as having contaminated land throughout the borough, because of this certain SuDS which rely on infiltration are not applicable anywhere within the borough, these being soakaways and borehole soakaways"*.

Therefore, infiltration techniques such as soakaways are not considered suitable for the site.

6.3 Attenuation

It is proposed to attenuate surface water runoff using below ground attenuation tanks, permeable paving and a rain garden.

LBTH advice is that surface water is to be attenuated as close to Greenfield run-off rates as practicable and not exceeding existing peak run-off rates. The Greenfield run off-rate was calculated using the UKSuds Greenfield Run-off Rate Calculator (Appendix D) for the roof and hardstanding areas. The calculation showed that Qbar for the site is 0.14 l/s and the 1 in 100 year rate is 2.44 l/s.

However, Building Regulations Part H states that a minimum pipe size of 75mm must be provided for surface water drainage, in order to avoid the risk blockages. A flow control of at least 75mm was therefore used in Microdrainage software to calculate the minimum peak rate for the development during the design storm event; this was found to be 2.3 l/s.

Initial calculations in Microdrainage software showed that an attenuation volume of 25.5m^3 is required to restrict the flow rate to 2.3 l/s. It is not practical to provide this volume of attenuation due to a lack of space on site. A total attenuation volume of 23.5m^3 can be provided on the site. Below ground tanks positioned within the rear gardens provide 11.4m^3 (void ratio 95%), permeable paving provides 10.8m^3 (void ratio 30%), and the rain garden provides 1.3m^3 (void ratio 30%). Preliminary calculations in Microdrainage show that in order to prevent runoff from leaving the site the flow would need to be restricted to 3.1 l/s.

The drainage strategy drawings are available in Appendix E and the Microdrainage calculations are available in Appendix F.

6.4 Discharge to Combined Sewer

As there are no nearby watercourses, it is proposed that the site discharges to the local sewer network.

The impermeable area is not increased in the post development scenario. Attenuation and a flow restriction is proposed and when compared with the critical storm event for the existing site this equates to an 83% reduction in the run-off rate from the site. When the soft landscaped areas are not saturated prior to a storm event, additional volume is provided.

7 Surface Water Maintenance Strategy

The successful implementation and operation of a SUDS system depends on a robust and clear maintenance strategy being implemented. The following measures should form part of the site's proposed management plan.

SUDS Element	Maintenance		
	Activity	**Required Action**	**Typical Frequency**
Green Roofs	**Monitoring / Inspections**	Inspect all components including soil substrate, vegetation, drains, irrigation systems, membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
		Inspect soil substrate for evidence of erosion channels and identify any sediment sources	
		Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	
		Inspect underside of roof for evidence of leakage	
	Regular Maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Half yearly and annually or as required
		During establishment i.e. year one, replace dead plants as required	Monthly -but usually responsibility of manufacturer
		Post establishment, replace dead plants where > 5% of coverage	Annually in autumn
		Remove fallen leaves and debris from deciduous plant foliage	Half yearly or as required
		Remove nuisance and invasive vegetation, including weeds	
		Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	
	Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
		If drain inlet has settled, cracked or moved, investigate and repair as appropriate	

SUDS Element	Maintenance		
	Activity	**Required Action**	**Typical Frequency**
Bioretention Systems	**Monitoring / Inspections**	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain to determine if maintenance is necessary	Quarterly
		Assess plants for disease infection, poor growth, invasive species etc. and replace as necessary	
		Inspect inlets and outlets for blockage	
		Check operation of underdrains by inspection of flows after rain	Annually
	Regular Maintenance	Remove litter and surface debris and weeds	Quarterly
		Replace any plants, to maintain planting density	As required
		Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to half yearly
	Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
		Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
	Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years
Trees	**Monitoring / Inspections**	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly
	Regular Maintenance	Remove litter and debris	Monthly, or as required)
		Manage other vegetation and remove nuisance plants	Monthly at start, then as required
		Inspect inlets and outlets	Monthly
	Occasional Maintenance	Check tree health and manage tree appropriately	Annually
		Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
		Water	As required - in periods of drought
Permeable Paving	**Monitoring / Inspections**	Initial inspection	Monthly for three months after installation
		Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 hours after large storms in first six months
		Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
		Monitor inspection chambers	Annually

SUDS Element	Maintenance		
	Activity	**Required Action**	**Typical Frequency**
	Regular Maintenance	Brushing and vacuuming -standard cosmetic sweep over whole surface	Once a year after autumn leaf fall
		Rubbish and litter removal	As required
	Remedial Actions	Remediate any landscaping which through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
		Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	
		Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required
Attenuation Tank	**Monitoring / Inspections**	Inspect all inlets, outlets, vents, overflows and control structures to ensure they are working as they should	Annually or after severe storms
		Inspect and identify any elements that are not operating correctly.	Monthly for three months, then half yearly or as required.
	Regular Maintenance	Remove sediments / debris from catch pits / gullies and control structures	Annually, after severe storms or as required
	Remedial Actions	Repair inlets, outlets, vents, overflows and control structures.	As required

Table 7.1 SUDS Maintenance Strategy as taken from the CIRIA SUDS Manual

Effective SUDS design must assess all foreseeable risks during construction and maintenance. These must be mitigated during the detailed design stages where effective design will aim to avoid, reduce and mitigate risks.

This process will also require input from the principal contractor who will ensure the construction of SUDS components are carried out in a safe and sustainable manner.

8 Foul Water Assessment

As outlined in Section 2.1, the site has an existing combined drainage network serving the site which eventually outfalls to the public sewers in Florida Street.

It is proposed to re-use this existing connection to the public sewers with a new foul water network constructed to serve the proposed buildings.

All proposed networks will be designed to Adoptable Standards as outlined in Sewers for Adoption – 7th Edition and in accordance with Building Regulations Part H.

The proposed peak foul water flows from the site are calculated using the figure of 4000 l/dwelling/day as outlined in Sewers for Adoption 7th Edition.

The development will include the construction of 5 houses. Using Building Regulations Part H, Table 5, based on 5 dwellings the peak flow rate from the proposed development is estimated to be 3.5 l/s.

A Section 106 application will be made to the Water Authority for consent to connect to the public sewer.

9 Conclusions

I. It has been demonstrated that the site is at low risk of flooding from watercourses, the sea, groundwater, surface water and overland flows, and reservoir failure;

II. The site is in a postcode that has several internal flood events recorded, to protect the site from sewer flood risk, non-return valves will be fitted in connections to the public sewer;

III. The CCTV drainage survey has confirmed that the site currently drains to the public sewers in Florida Street via a combined connection;

IV. Published information shows the site is underlain by superficial deposits which could be suitable for infiltration techniques. However, due to the risk of contamination the use of infiltration techniques such as soakaways are not proposed;

V. The site will remain impermeable to prevent infiltration in accordance with LBTH's guidance, however, tanked soft landscaping is proposed. Surface water run-off will be attenuated to as close to Greenfield runoff rates as reasonably practicable as per LBTH's requirements;

VI. The SUDS assessment concludes that the opportunity for the implementation of SUDS is limited at this site and has demonstrated the practical reasons why. However, attenuation is proposed which will restrict surface water to 3.1 l/s, for the 1 in 100 year rainfall event plus climate change. Providing an 83% betterment when compared with the existing critical storm storm event.

VII. Surface and foul water systems will re-use the existing drainage connection to the combined sewer in Florida Street to the north of the site.

Appendix A
Thames Water Sewer Records

Asset location search

Property Searches

Milton Keynes Surveys Limited
1Potters Lane
KILN FARM
MILTON KEYNES
MK11 3HE

Search address supplied Rushmead
Bethnal Green
London
E2 6NE

Your reference 29001

Our reference ALS/ALS Standard/2020_4244922

Search date 1 September 2020

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

Asset location search

Thames Water Property Searches

Search address supplied: Rushmead, Bethnal Green, London, E2 6NE

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Asset location search

Thames Water Property Searches

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

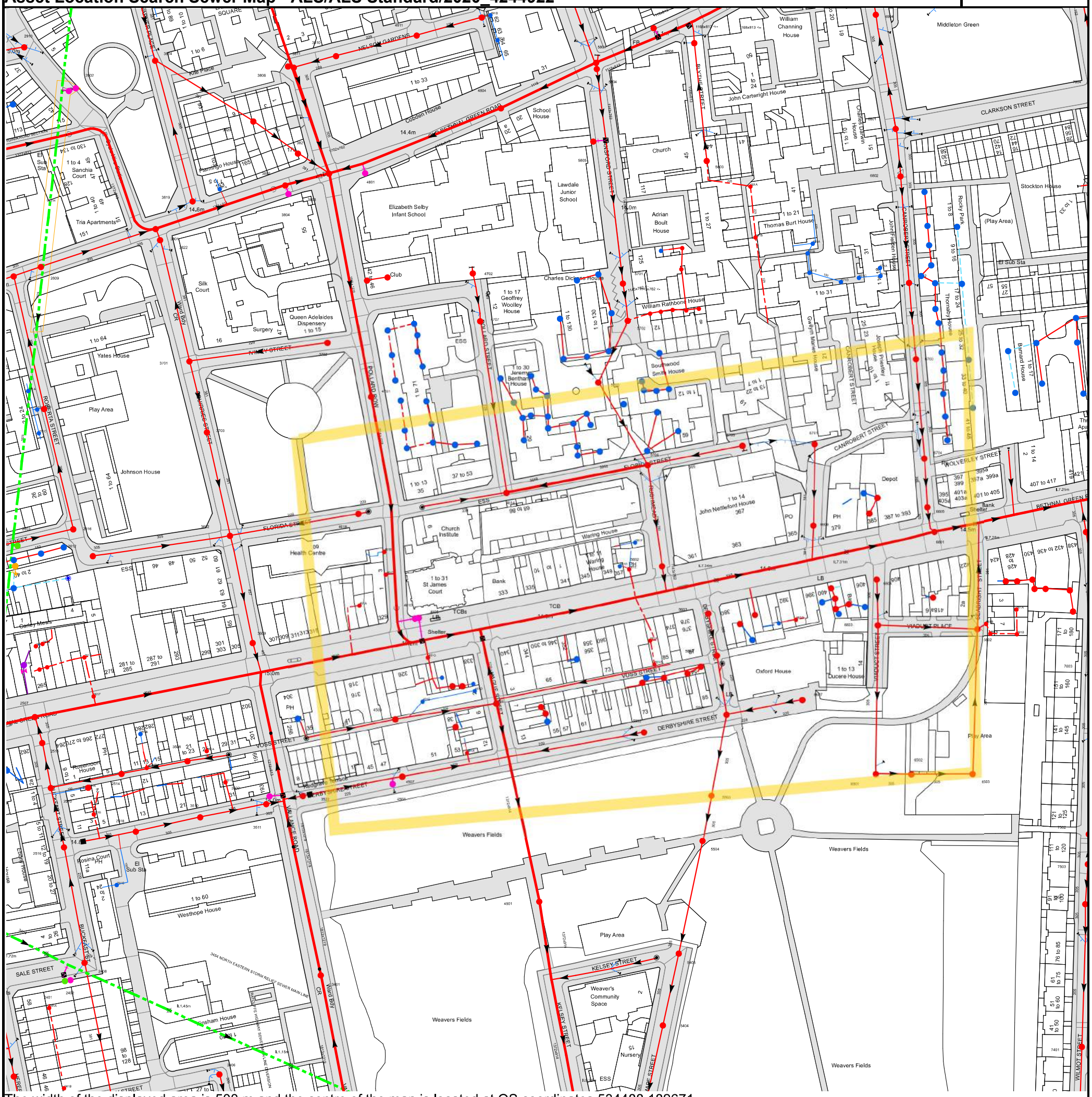
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2020_4244922



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 534488,182671

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.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
25DJ	n/a	n/a
2407	n/a	n/a
2515	n/a	n/a
241A	n/a	n/a
2510	n/a	n/a
2516	n/a	n/a
241B	n/a	n/a
2401	14.45	n/a
2402	14.45	n/a
2408	n/a	n/a
251A	n/a	n/a
251B	n/a	n/a
251C	n/a	n/a
2514	n/a	n/a
2518	n/a	n/a
351C	n/a	n/a
3508	n/a	n/a
3510	n/a	n/a
351A	n/a	n/a
3406	n/a	n/a
351D	n/a	n/a
3511	n/a	n/a
3502	13.96	n/a
3522	13.88	11.04
3401	13.33	7.73
4504	n/a	n/a
391A	n/a	n/a
3814	n/a	n/a
3806	n/a	n/a
3811	n/a	n/a
3810	n/a	n/a
2910	n/a	n/a
2803	15.06	n/a
2802	n/a	n/a
271A	n/a	n/a
47CI	n/a	n/a
3701	n/a	n/a
47CJ	n/a	n/a
3702	n/a	n/a
47DA	n/a	n/a
47CG	n/a	n/a
47CF	n/a	n/a
2701	n/a	n/a
2809	n/a	n/a
3822	n/a	n/a
3801	14.47	10.8
3819	n/a	n/a
3804	14.98	n/a
381A	n/a	n/a
3802	n/a	10.75
3803	15.02	8.21
4801	14.82	n/a
3821	n/a	n/a
3820	n/a	n/a
28BD	n/a	n/a
26EI	n/a	n/a
26ED	n/a	n/a
2603	n/a	n/a
261E	n/a	n/a
2507	15.47	7.45
261A	n/a	n/a
271B	n/a	n/a
271C	n/a	n/a
2617	n/a	n/a
26EE	n/a	n/a
261B	n/a	n/a
2706	n/a	n/a
2618	n/a	n/a
26EF	n/a	n/a
2616	n/a	n/a
261C	n/a	n/a
2612	n/a	n/a
261F	n/a	n/a
351B	n/a	n/a
3703	n/a	n/a
3602	n/a	n/a
3609	n/a	n/a
35EB	n/a	n/a
4618	n/a	n/a
461A	n/a	n/a
4701	n/a	n/a
461B	n/a	n/a
461C	n/a	n/a
4503	n/a	n/a
4911	n/a	n/a
4910	n/a	n/a
491B	n/a	n/a
491A	n/a	n/a
4804	13.88	10.51
5805	n/a	n/a
5801	13.78	10.58

Manhole Reference	Manhole Cover Level	Manhole Invert Level
5804	n/a	n/a
5901	14.15	n/a
5908	n/a	n/a
68BG	n/a	n/a
68BJ	n/a	n/a
68CA	n/a	n/a
581A	n/a	n/a
6802	n/a	n/a
5803	n/a	n/a
6801	n/a	n/a
6904	n/a	n/a
4702	n/a	n/a
47AI	n/a	n/a
57BF	n/a	n/a
57BH	n/a	n/a
5701	n/a	n/a
57FB	n/a	n/a
57FA	n/a	n/a
58CA	n/a	n/a
57EJ	n/a	n/a
57FD	n/a	n/a
58BI	n/a	n/a
57EI	n/a	n/a
57EH	n/a	n/a
581B	n/a	n/a
681B	n/a	n/a
671E	n/a	n/a
681A	n/a	n/a
671D	n/a	n/a
671C	n/a	n/a
671A	n/a	n/a
671B	n/a	n/a
6702	n/a	n/a
67DD	n/a	n/a
68BI	n/a	n/a
68BH	n/a	n/a
67CI	n/a	n/a
67CH	n/a	n/a
67BI	n/a	n/a
57CE	n/a	n/a
57CI	n/a	n/a
57CJ	n/a	n/a
47BI	n/a	n/a
47DE	n/a	n/a
47EA	n/a	n/a
47BD	n/a	n/a
57DC	n/a	n/a
57DB	n/a	n/a
47BC	n/a	n/a
57DD	n/a	n/a
5703	n/a	n/a
57DA	n/a	n/a
47BH	n/a	n/a
47BB	n/a	n/a
47DD	n/a	n/a
47AJ	n/a	n/a
57BJ	n/a	n/a
57DE	n/a	n/a
47DC	n/a	n/a
57BI	n/a	n/a
47DJ	n/a	n/a
47DB	n/a	n/a
4707	n/a	n/a
5702	n/a	n/a
47BA	n/a	n/a
66EA	n/a	n/a
76GJ	n/a	n/a
76HA	n/a	n/a
6604	n/a	n/a
6601	14.51	7.3
6606	n/a	n/a
66DE	n/a	n/a
6605	n/a	n/a
66DF	n/a	n/a
66DD	n/a	n/a
6704	n/a	n/a
5705	n/a	n/a
6701	n/a	n/a
67CB	n/a	n/a
67CC	n/a	n/a
67BJ	n/a	n/a
67CD	n/a	n/a
77CC	n/a	n/a
77CD	n/a	n/a
67CE	n/a	n/a
67CA	n/a	n/a
6703	n/a	n/a
67CF	n/a	n/a
67BH	n/a	n/a
77CE	n/a	n/a
67CG	n/a	n/a
77CH	n/a	n/a
7602	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
77CF	n/a	n/a
77CG	n/a	n/a
4610	15.2	n/a
4605	15.22	n/a
5603	n/a	n/a
561E	n/a	n/a
5602	n/a	n/a
561D	n/a	n/a
561F	n/a	n/a
4614	n/a	n/a
5704	n/a	n/a
47CD	n/a	n/a
57CF	n/a	n/a
57DH	n/a	n/a
47EC	n/a	n/a
47CC	n/a	n/a
47DH	n/a	n/a
47DI	n/a	n/a
47DG	n/a	n/a
47CB	n/a	n/a
57CH	n/a	n/a
47EB	n/a	n/a
47BF	n/a	n/a
57CD	n/a	n/a
47DF	n/a	n/a
47BG	n/a	n/a
47BJ	n/a	n/a
47BE	n/a	n/a
47CA	n/a	n/a
6502	n/a	n/a
6503	n/a	n/a
6501	n/a	n/a
6607	n/a	n/a
56FB	n/a	n/a
761B	n/a	n/a
661A	n/a	n/a
6602	n/a	n/a
6603	n/a	n/a
661B	n/a	n/a
56FC	n/a	n/a
56EH	n/a	n/a
661C	n/a	n/a
5614	n/a	n/a
66EG	n/a	n/a
76HE	n/a	n/a
761A	n/a	n/a
66EF	n/a	n/a
66ED	n/a	n/a
66EE	n/a	n/a
66EH	n/a	n/a
66FE	n/a	n/a
66FG	n/a	n/a
76HD	n/a	n/a
76HB	n/a	n/a
76HC	n/a	n/a
66EI	n/a	n/a
4507	13.63	10.41
461E	n/a	n/a
461G	n/a	n/a
46CI	n/a	n/a
46DJ	n/a	n/a
45CG	n/a	n/a
46DI	n/a	n/a
451A	n/a	n/a
46DH	n/a	n/a
461D	n/a	n/a
4608	14.35	10.42
45BB	n/a	n/a
45BE	n/a	n/a
45AC	n/a	n/a
56BH	n/a	n/a
56DI	n/a	n/a
5502	n/a	n/a
56BJ	n/a	n/a
561A	n/a	n/a
561G	n/a	n/a
56EC	n/a	n/a
56ED	n/a	n/a
56CB	n/a	n/a
5504	n/a	n/a
5503	n/a	n/a
5604	n/a	n/a
5501	n/a	n/a
7503	n/a	n/a
7502	n/a	n/a
7501	n/a	n/a
7603	n/a	n/a
7401	n/a	n/a
7504	n/a	n/a
5404	n/a	n/a
5403	n/a	n/a
4501	13.55	10.14

Manhole Reference	Manhole Cover Level	Manhole Invert Level

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.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Trunk Surface Water
- Trunk Foul
- Storm Relief
- Trunk Combined
- Vent Pipe
- Bio-solids (Sludge)
- Proposed Thames Surface Water Sewer
- Proposed Thames Water Foul Sewer
- Gallery
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Sludge Rising Main
- Proposed Thames Water Rising Main
- Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

- Air Valve
- Dam Chase
- Fitting
- Meter
- Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

- Control Valve
- Drop Pipe
- Ancillary
- Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

- Outfall
- Undefined End
- Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

- Public/Private Pumping Station
- Change of characteristic indicator (C.O.C.I.)
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Operational Site
- Chamber
- Tunnel
- Conduit Bridge

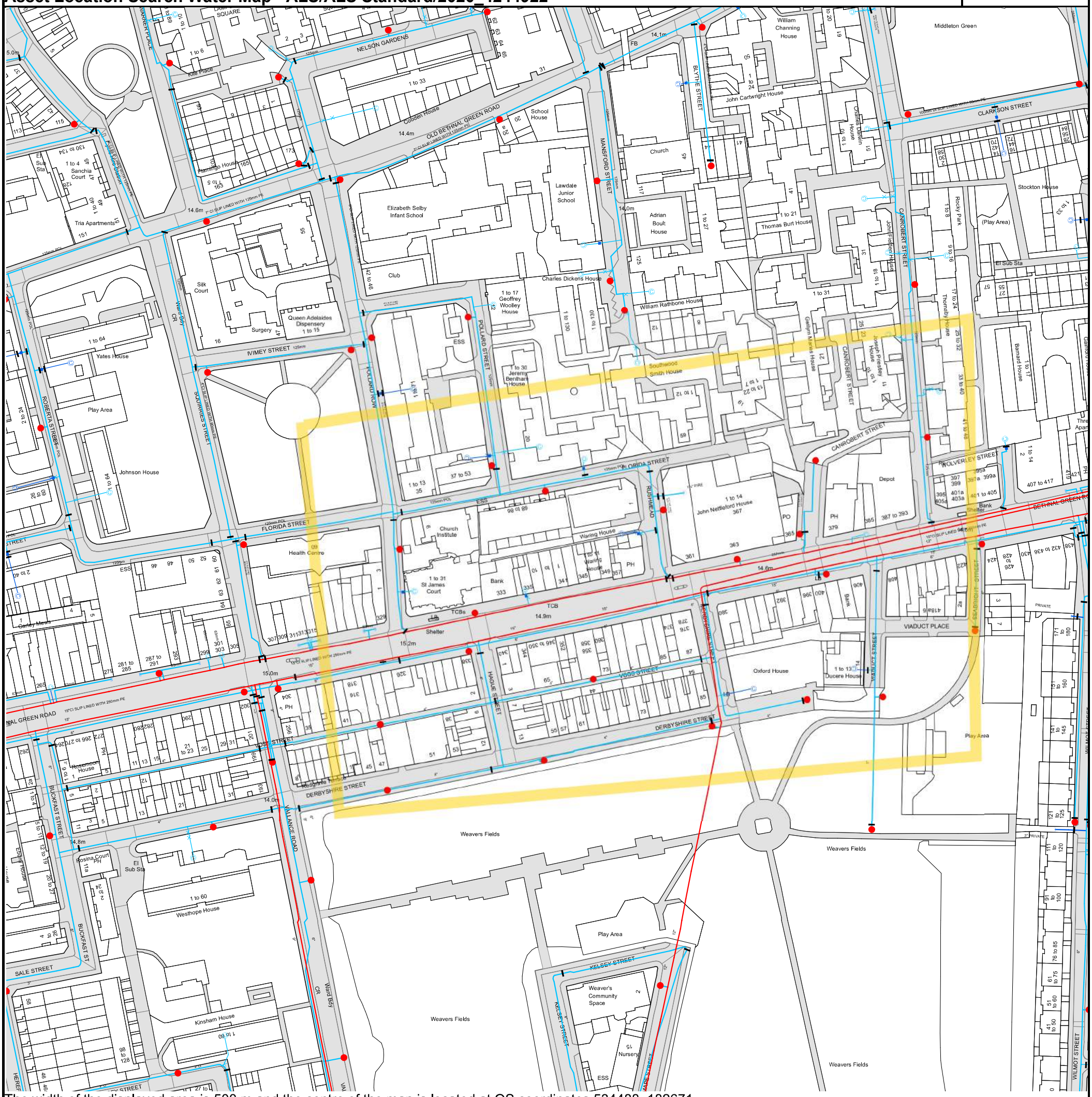
Other Sewer Types (Not Operated or Maintained by Thames Water)

- Foul Sewer
- Surface Water Sewer
- Combined Sewer
- Gulley
- Culverted Watercourse
- Proposed
- Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2020_4244922



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 534488, 182671.

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.

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Appendix B
Utility Plan by Inside Outside Engineering Ltd

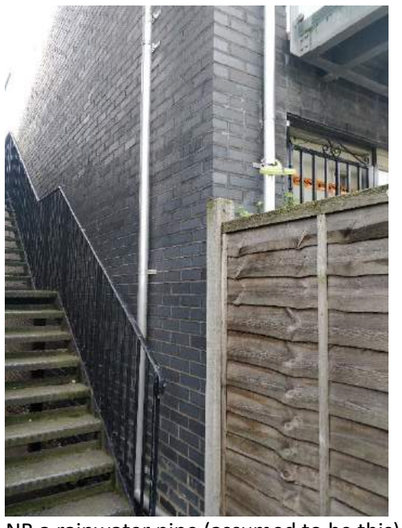
J0027 Rushmead

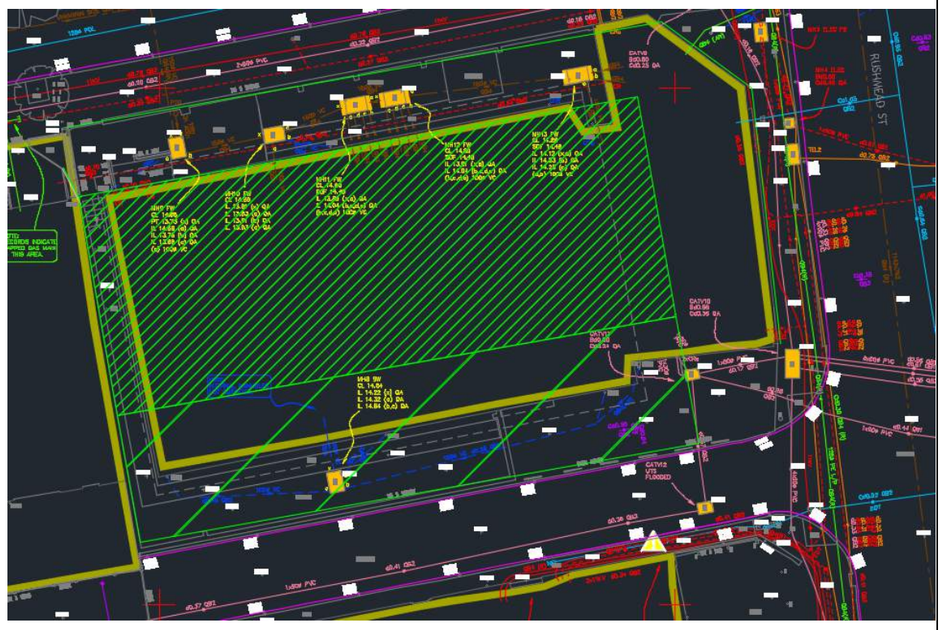
19/11/2020

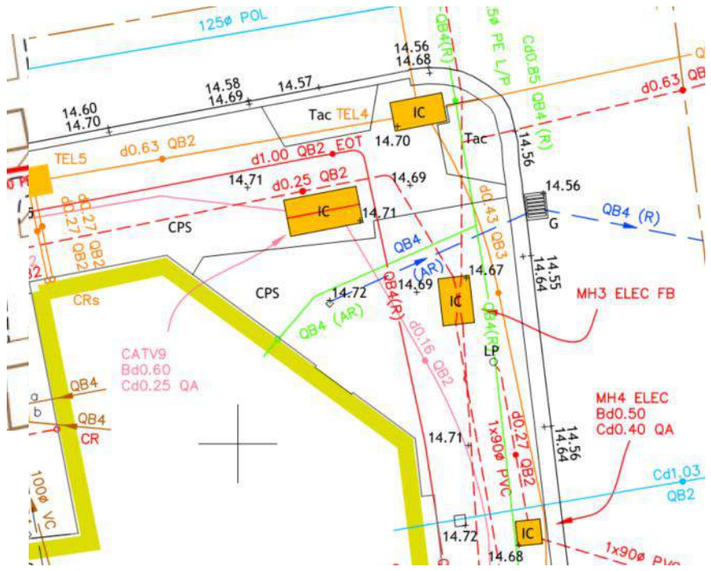
Utility plan for planning

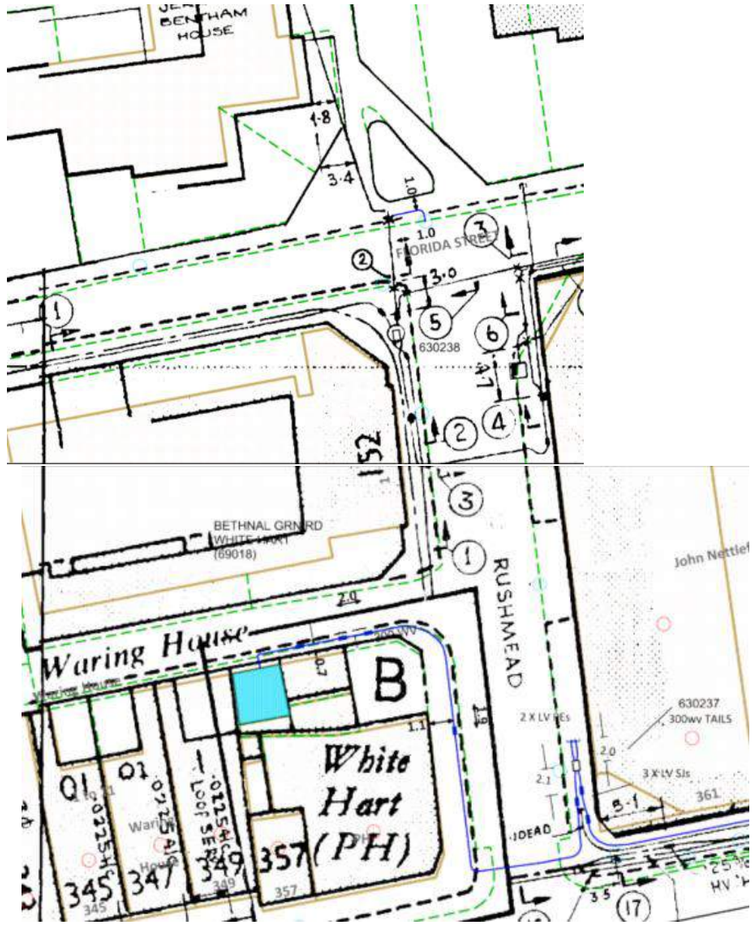
Rev1 BD

Inside Outside Engineering MEP contribution for comment & inclusion in Drainage & utility plan.

Utility	Existing	Disconnections	Diversions/New connections
Above ground drainage	 NB a rainwater pipe (assumed to be this) is surface mounted to the east wall; the party/boundary wall of the adjacent apartment building	To be relocated as part of main works.	-
Below Ground Drainage	By others	By others	By others

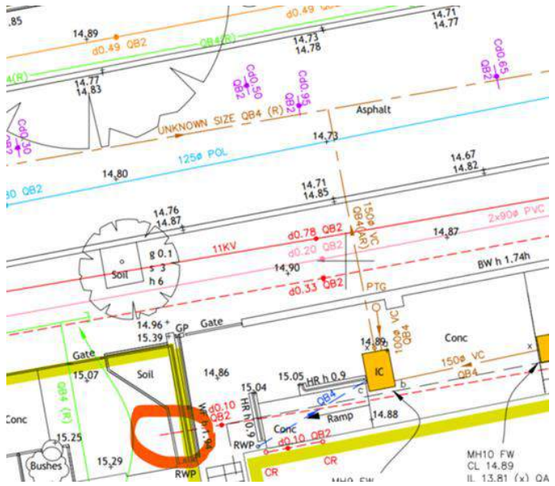
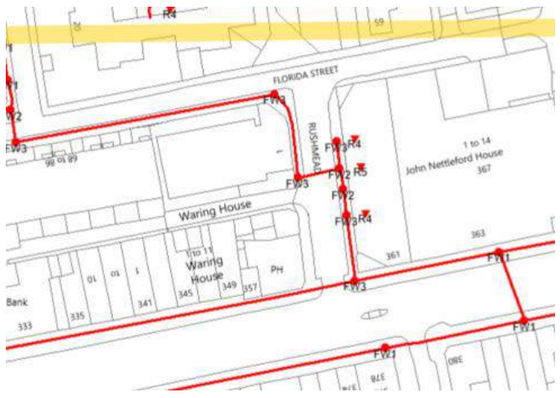
Generally	Although the West end of the site is quite congested with services: this is managed by limiting the works away from this area.  	Note	Note The below ground services survey, shown with the new build overlaid (green close hatching) and the new gardens (green wide hatch). By keeping the new construction almost entirely within the boundary of the existing building (thick green line), impact on the existing services is minimised. 

Water	1no existing incoming mains water pipe to the East end of the site. 	Existing service will be retained for site supply. No impact to utility/network	New mains services will be provided to each home. An application will be made to the water utility to make this connection.
Gas	Existing gas service entres at the east end of site. 	All gas services to be stripped out as part of demolition.	N/A
Electric	1no Incoming supply incoming to site from South East corner	Existing power supply to be utilised a s site power supply. Cable to North east to be identified, and disconnected once safety and impact has been determined.	Each property is to be provided with a 100A 1 phase domestic supply. Meter to be located at low level in MVHR cupboard (Accessible from outside). The utility has already been informed of the demolition & new connections, a quotation is underway.



Some existing UKPN services below ground at east end of site, see above.

An unidentified incoming/outgoing electrical supply has been identified in the North East boundary with the neighbouring property highlighted below. This is being investigated and will be managed carefully by the demolition contractor.

			
Telecom	Extensive incoming telecom services from North. Also buried services in pavement to all sides especially to the.East  Virgin media	All equipment shall be removed. To allow demolition to take place. Inspection chamber in South east corner of site to be removed/relocated as necessary as part of demolition works.	Provide a new fibre to the property service to each home.

Vodafone

Site survey showing new garden wall (thin green line) will interfere with an existing inspection chamber for telecoms. This inspection chamber shall be removed/relocated as art of enabling works.

Appendix C
Development Proposals

A — A
B — B
C — C
D — D

+14.90 FFL

WB

Features to improve biodiversity to include loggery

insect bricks in brick wall

Sparrow terraces along garden wall

Individual seat

Fence edge to mark entrance

0 5 10 M

N

Proposed Tree

Proposed Hedge maintain at 1.3m

Proposed Shrubs and Perennials

Proposed Nectar Rich Planting

Sedum roof to bike store

Proposed permeable sett paving to park

Proposed reinforced gravel

Surfacing to make good edge of public footpath, to match existing

Proposed permeable block paving to gardens

Post and wire fence 1.3m set in hedge to divide rear gardens

Brick Wall 1.8m with trellis 0.3m

+14.73 / 14.65+ Existing level retained / Proposed level

WB Water butt for private garden

ISSUE	REASON FOR ISSUE	DATE

STATON COHEN
Landscape Architecture
The Studio,
34 Warwick Road
Barnet
EN5 5EH
www.statoncohen.com
office@statoncohen.com
0208 441 8629

PROJECT
Rushmead Street

PROJECT CODE	CLIENT
P161	London Borough of Tower Hamlets

DRAWING TITLE
External Works | with section lines

SCALE	DATE OF FIRST ISSUE
1:100 @ A3	Nov 2020

DRAWING NUMBER	REVISION	STATUS
L01 _3		DRAFT STAGE 3

Appendix D
Greenfield Run-off Rate Calculation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Dominic Heyna-Francis

Site name: 1 Rushmead

Site location: Tower Hamlets

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

Site Details

Latitude: 51.52721° N

Longitude: 0.06211° W

Reference: 487594749

Date: Nov 17 2020 10:48

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.5

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	602	602
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

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

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

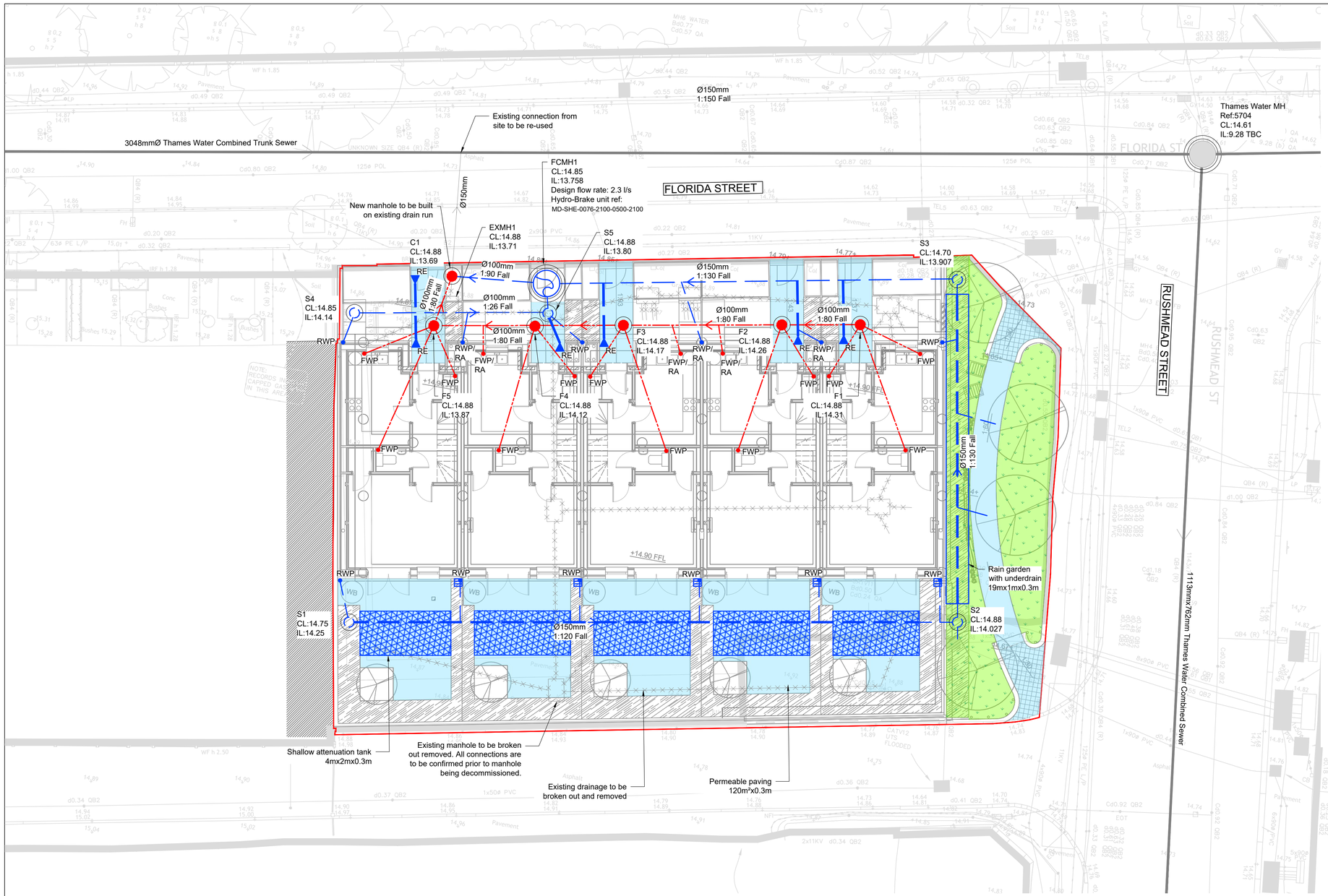
(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.76	0.76
1 in 1 year (l/s):	0.65	0.65
1 in 30 years (l/s):	1.76	1.76
1 in 100 year (l/s):	2.44	2.44
1 in 200 years (l/s):	2.86	2.86

Appendix E
Below Ground Drainage Layout



DRAINAGE LEGEND

- New FW Drain
- New SW Drain
- Underdrain
- Existing Combined Drain
- Existing Combined Sewer
- Demolished/Abandoned

DRAINAGE KEY

RWP	Rainwater Down Pipe
FWP	Foul Waste Pipe
	Gully
S1	Surface Water Manhole Chamber
F1	Foul Water Manhole Chamber
C1	Combined Water Manhole Chamber
FCMH1	Flow Control Chamber (SW only)
	Storage or Attenuation Cells
	Rain garden
	Permeable paving

ABBREVIATIONS

IL - Invert Level
CL - Cover Level
RA - Above Ground Rodding Access

HEALTH & SAFETY

List of site specific or unusual hazards relevant to the drawing: (Must be read in conjunction with the CDM risk register.)

Excavations	Excavation for manholes Contractor to ensure adequate edge protection to excavations for workers and plant and to ensure sides of excavations are sufficiently stable or shored up. Contractor to restrict access into areas where excavations are being carried out.
Sewer Connections	Working with live sewers Extra care must be taken when dealing with live sewers to ensure there is no adverse effect to the existing drainage.
Existing Services	Working alongside/near existing services. Extra care must be taken when working/digging near existing services. A survey should be carried out prior to works commencing to determine the exact location of existing services.

NOTES :

1. This drawing is to be read in conjunction with all relevant Architect's, Engineer's and specialists' drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check that this drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
3. Health & Safety : All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".
4. Tree pit volume assumed and TBC by others
5. All drainage to be vitrified clay in external areas and cast iron within the building foot print.
6. For general notes refer to Drawing No. 29189-0001.

Surface Water Manhole Schedule

Manhole / IC	Cover Level m	Invert Level m	Chamber Type	Chamber depth (m)	Internal Chamber Size	Cover Clear Opening and Cover Grade	Notes To Building Regulations Part H unless noted
S1	14.750	14.250	Plastic IC	0.500	450mm Polypropylene Ring	450 diameter OSMA 4D927 Round	
S2	14.880	14.027	Plastic IC	0.853	450mm Polypropylene Ring	450 diameter OSMA 4D927 Round	
S3	14.700	13.907	Plastic IC	0.793	450mm Polypropylene Ring	450 diameter OSMA 4D927 Round	
S4	14.850	14.140	Plastic IC	0.710	450mm Polypropylene Ring	450 diameter OSMA 4D942 Round	
S5	14.880	13.800	Plastic IC	1.080	450mm Polypropylene Ring	450 diameter OSMA 4D942 Round	
FCMH1	14.850	13.758	PC Manhole	1.092	1200 Diameter Precast Concrete Rings	600x600 eccentric BS EN 124 CLASS B125	

Foul Water Manhole Schedule

Manhole / IC	Cover Level m	Invert Level m	Chamber Type	Chamber depth (m)	Internal Chamber Size	Cover Clear Opening and Cover Grade	Notes To Building Regulations Part H unless noted
F1	14.880	14.310	Plastic IC	0.570	450mm Polypropylene Ring	450 diameter OSMA 4D945 Square Recessed	Recessed cover finish to match adjacent
F2	14.880	14.260	Plastic IC	0.620	450mm Polypropylene Ring	450 diameter OSMA 4D945 Square Recessed	Recessed cover finish to match adjacent
F3	14.880	14.170	Plastic IC	0.710	450mm Polypropylene Ring	450 diameter OSMA 4D945 Square Recessed	Recessed cover finish to match adjacent
F4	14.880	14.120	Plastic IC	0.760	450mm Polypropylene Ring	450 diameter OSMA 4D945 Square Recessed	Recessed cover finish to match adjacent
F5	14.880	13.870	Plastic IC	1.010	450mm Polypropylene Ring	450 diameter OSMA 4D945 Square Recessed	Recessed cover finish to match adjacent

Combined Water Manhole Schedule

Manhole / IC	Cover Level m	Invert Level m	Chamber Type	Chamber depth (m)	Internal Chamber Size	Cover Clear Opening and Cover Grade	Notes To Building Regulations Part H unless noted
C1	14.880	13.690 TBC	Plastic IC	1.190	450mm Polypropylene Ring	450 diameter OSMA 4D945 Square Recessed	Recessed cover finish to match adjacent

Rev	Date	Drawn	Eng	Amendment
P03	01.02.21	SK	OF	Issued for Planning
P02	17.12.20	SK	DHF	Draft Issue
P01	04.12.20	SK	DHF	Draft Issue

1 RUSHMEAD,
LONDON, E2 6NE

BELOW GROUND DRAINAGE LAYOUT

Status
FOR INFORMATION
NOT FOR CONSTRUCTION

Drawn SK	Eng DHF
Scales 1:100 at A1	1:200 at A3
Drawing No 29189/6000	Rev P03
Doc Ref. --	

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Appendix F
MicroDrainage Calculations

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	14.107	0.307	2.3	15.6	O K
30 min Summer	14.183	0.383	2.3	19.5	O K
60 min Summer	14.235	0.435	2.3	22.2	O K
120 min Summer	14.238	0.438	2.3	22.4	O K
180 min Summer	14.215	0.415	2.3	21.2	O K
240 min Summer	14.188	0.388	2.3	19.8	O K
360 min Summer	14.137	0.337	2.3	17.2	O K
480 min Summer	14.091	0.291	2.3	14.9	O K
600 min Summer	14.050	0.250	2.3	12.7	O K
720 min Summer	14.013	0.213	2.3	10.8	O K
960 min Summer	13.953	0.153	2.3	7.8	O K
1440 min Summer	13.882	0.082	2.2	4.2	O K
2160 min Summer	13.844	0.044	1.8	2.2	O K
2880 min Summer	13.829	0.029	1.5	1.5	O K
4320 min Summer	13.815	0.015	1.1	0.8	O K
5760 min Summer	13.807	0.007	0.9	0.4	O K
7200 min Summer	13.802	0.002	0.7	0.1	O K
8640 min Summer	13.800	0.000	0.6	0.0	O K
10080 min Summer	13.800	0.000	0.6	0.0	O K
15 min Winter	14.148	0.348	2.3	17.7	O K
30 min Winter	14.240	0.440	2.3	22.4	O K
60 min Winter	14.478	0.678	2.3	25.7	O K
120 min Winter	14.591	0.791	2.4	25.8	O K
180 min Winter	14.286	0.486	2.3	24.8	O K
240 min Winter	14.252	0.452	2.3	23.1	O K
360 min Winter	14.171	0.371	2.3	18.9	O K
480 min Winter	14.098	0.298	2.3	15.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	17.6	18
30 min Summer	90.705	0.0	23.1	32
60 min Summer	56.713	0.0	28.8	62
120 min Summer	34.246	0.0	34.9	106
180 min Summer	25.149	0.0	38.5	134
240 min Summer	20.078	0.0	40.9	166
360 min Summer	14.585	0.0	44.6	232
480 min Summer	11.622	0.0	47.4	298
600 min Summer	9.738	0.0	49.7	362
720 min Summer	8.424	0.0	51.5	420
960 min Summer	6.697	0.0	54.6	540
1440 min Summer	4.839	0.0	59.2	764
2160 min Summer	3.490	0.0	64.1	1104
2880 min Summer	2.766	0.0	67.7	1468
4320 min Summer	1.989	0.0	73.0	2200
5760 min Summer	1.573	0.0	77.0	2936
7200 min Summer	1.311	0.0	80.2	3672
8640 min Summer	1.129	0.0	82.9	0
10080 min Summer	0.994	0.0	85.2	0
15 min Winter	138.153	0.0	19.7	18
30 min Winter	90.705	0.0	25.9	32
60 min Winter	56.713	0.0	32.4	60
120 min Winter	34.246	0.0	39.1	104
180 min Winter	25.149	0.0	43.1	144
240 min Winter	20.078	0.0	45.8	184
360 min Winter	14.585	0.0	50.0	254
480 min Winter	11.622	0.0	53.1	320

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
600 min Winter	14.035	0.235	2.3	12.0	O K
720 min Winter	13.982	0.182	2.3	9.3	O K
960 min Winter	13.906	0.106	2.2	5.4	O K
1440 min Winter	13.847	0.047	1.9	2.4	O K
2160 min Winter	13.825	0.025	1.4	1.3	O K
2880 min Winter	13.815	0.015	1.1	0.8	O K
4320 min Winter	13.805	0.005	0.8	0.2	O K
5760 min Winter	13.800	0.000	0.6	0.0	O K
7200 min Winter	13.800	0.000	0.5	0.0	O K
8640 min Winter	13.800	0.000	0.5	0.0	O K
10080 min Winter	13.800	0.000	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
600 min Winter	9.738	0.0	55.6	384
720 min Winter	8.424	0.0	57.7	442
960 min Winter	6.697	0.0	61.2	550
1440 min Winter	4.839	0.0	66.3	752
2160 min Winter	3.490	0.0	71.8	1108
2880 min Winter	2.766	0.0	75.8	1460
4320 min Winter	1.989	0.0	81.8	2204
5760 min Winter	1.573	0.0	86.3	0
7200 min Winter	1.311	0.0	89.8	0
8640 min Winter	1.129	0.0	92.8	0
10080 min Winter	0.994	0.0	95.4	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.068

Time (mins) From:	To:	Area (ha)
0	4	0.068

Model Details

Storage is Online Cover Level (m) 14.700

Tank or Pond Structure

Invert Level (m) 13.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	51.0	0.500	51.0	0.501	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0076-2300-0740-2300
Design Head (m)	0.740
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	13.760
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.740	2.3	Kick-Flo®	0.479	1.9
Flush-Flo™	0.222	2.3	Mean Flow over Head Range	-	2.0

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)	Depth (m)	Flow (l/s)
0.100	2.1	0.800	2.4	2.000	3.6	4.000	5.0	7.000	6.5
0.200	2.3	1.000	2.6	2.200	3.8	4.500	5.3	7.500	6.7
0.300	2.3	1.200	2.9	2.400	4.0	5.000	5.6	8.000	7.0
0.400	2.2	1.400	3.1	2.600	4.1	5.500	5.8	8.500	7.2
0.500	1.9	1.600	3.3	3.000	4.4	6.000	6.1	9.000	7.4
0.600	2.1	1.800	3.5	3.500	4.7	6.500	6.3	9.500	7.6

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	14.121	0.321	3.1	15.1	O K
30 min Summer	14.193	0.393	3.1	18.5	O K
60 min Summer	14.231	0.431	3.1	20.2	O K
120 min Summer	14.216	0.416	3.1	19.5	O K
180 min Summer	14.183	0.383	3.1	18.0	O K
240 min Summer	14.147	0.347	3.1	16.3	O K
360 min Summer	14.082	0.282	3.1	13.2	O K
480 min Summer	14.025	0.225	3.1	10.6	O K
600 min Summer	13.978	0.178	3.1	8.4	O K
720 min Summer	13.942	0.142	3.1	6.7	O K
960 min Summer	13.892	0.092	3.0	4.3	O K
1440 min Summer	13.853	0.053	2.5	2.5	O K
2160 min Summer	13.832	0.032	1.9	1.5	O K
2880 min Summer	13.822	0.022	1.5	1.0	O K
4320 min Summer	13.811	0.011	1.1	0.5	O K
5760 min Summer	13.804	0.004	0.9	0.2	O K
7200 min Summer	13.800	0.000	0.7	0.0	O K
8640 min Summer	13.800	0.000	0.6	0.0	O K
10080 min Summer	13.800	0.000	0.6	0.0	O K
15 min Winter	14.165	0.365	3.1	17.2	O K
30 min Winter	14.255	0.455	3.1	21.4	O K
60 min Winter	14.451	0.651	3.1	23.7	O K
120 min Winter	14.287	0.487	3.1	22.9	O K
180 min Winter	14.242	0.442	3.1	20.8	O K
240 min Winter	14.184	0.384	3.1	18.0	O K
360 min Winter	14.080	0.280	3.1	13.2	O K
480 min Winter	13.996	0.196	3.1	9.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	17.6	17
30 min Summer	90.705	0.0	23.1	31
60 min Summer	56.713	0.0	28.8	60
120 min Summer	34.246	0.0	34.9	90
180 min Summer	25.149	0.0	38.4	124
240 min Summer	20.078	0.0	41.0	156
360 min Summer	14.585	0.0	44.6	220
480 min Summer	11.622	0.0	47.4	284
600 min Summer	9.738	0.0	49.6	342
720 min Summer	8.424	0.0	51.5	398
960 min Summer	6.697	0.0	54.6	510
1440 min Summer	4.839	0.0	59.2	738
2160 min Summer	3.490	0.0	64.1	1100
2880 min Summer	2.766	0.0	67.7	1468
4320 min Summer	1.989	0.0	73.0	2184
5760 min Summer	1.573	0.0	77.0	2896
7200 min Summer	1.311	0.0	80.2	0
8640 min Summer	1.129	0.0	82.9	0
10080 min Summer	0.994	0.0	85.2	0
15 min Winter	138.153	0.0	19.7	17
30 min Winter	90.705	0.0	25.9	31
60 min Winter	56.713	0.0	32.4	58
120 min Winter	34.246	0.0	39.1	98
180 min Winter	25.149	0.0	43.1	136
240 min Winter	20.078	0.0	45.9	170
360 min Winter	14.585	0.0	50.0	238
480 min Winter	11.622	0.0	53.1	298

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
600 min Winter	13.934	0.134	3.1	6.3	O K
720 min Winter	13.892	0.092	3.0	4.3	O K
960 min Winter	13.857	0.057	2.6	2.7	O K
1440 min Winter	13.833	0.033	1.9	1.5	O K
2160 min Winter	13.818	0.018	1.4	0.9	O K
2880 min Winter	13.811	0.011	1.1	0.5	O K
4320 min Winter	13.802	0.002	0.8	0.1	O K
5760 min Winter	13.800	0.000	0.6	0.0	O K
7200 min Winter	13.800	0.000	0.5	0.0	O K
8640 min Winter	13.800	0.000	0.5	0.0	O K
10080 min Winter	13.800	0.000	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
600 min Winter	9.738	0.0	55.6	352
720 min Winter	8.424	0.0	57.7	404
960 min Winter	6.697	0.0	61.2	504
1440 min Winter	4.839	0.0	66.3	738
2160 min Winter	3.490	0.0	71.8	1104
2880 min Winter	2.766	0.0	75.8	1496
4320 min Winter	1.989	0.0	81.8	2192
5760 min Winter	1.573	0.0	86.3	0
7200 min Winter	1.311	0.0	89.8	0
8640 min Winter	1.129	0.0	92.8	0
10080 min Winter	0.994	0.0	95.4	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.068

Time (mins) From:	To:	Area (ha)
0	4	0.068

Model Details

Storage is Online Cover Level (m) 14.700

Tank or Pond Structure

Invert Level (m) 13.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	47.0	0.500	47.0	0.501	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0088-3100-0740-3100
Design Head (m)	0.740
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	88
Invert Level (m)	13.760
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.740	3.1	Kick-Flo®	0.484	2.6
Flush-Flo™	0.218	3.1	Mean Flow over Head Range	-	2.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	0.800	3.2	2.000	4.9	4.000	6.8	7.000	8.9
0.200	3.1	1.000	3.6	2.200	5.1	4.500	7.2	7.500	9.1
0.300	3.0	1.200	3.9	2.400	5.3	5.000	7.6	8.000	9.4
0.400	2.9	1.400	4.2	2.600	5.5	5.500	7.9	8.500	9.7
0.500	2.6	1.600	4.4	3.000	5.9	6.000	8.2	9.000	10.0
0.600	2.8	1.800	4.7	3.500	6.4	6.500	8.6	9.500	10.3