

**Drainage Strategy  
For  
Proposed Development  
at  
63-71 High Street, Hampton Hill  
TW12 1LZ**



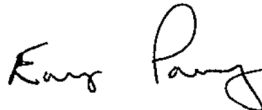
**REPORT PREPARED ON BEHALF OF  
GREATPLANET LIMITED**

**Issue record:**

Report Ref: SL05030-DS-01				
Issue	Description	Written By	Approved by	Date
1	Draft	EP	PW	06.10.16
2	2 <sup>nd</sup> Issue	EP	PW	11.10.16
3	3 <sup>rd</sup> Issue	EP	PW	21.10.16
4	4 <sup>th</sup> Issue	EP	PW	26.10.16

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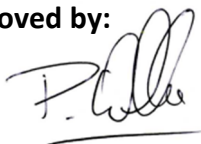
**Report prepared by:**



**E. Parry – Partner**

Date: 26.10.16

**Approved by:**



**P. Withers – Senior Partner**

Date: 26.10.16

## **CONTENT**

1. INTRODUCTION
2. SITE DESCRIPTION
3. PROPOSED PROJECT
4. DRAINAGE STRATEGY
5. CONCLUSION

## **APPENDICES**

- Appendix 1: Existing Buried Services Survey
- Appendix 2: Thames Water Asset Map
- Appendix 3: Pre-Application correspondence with Thames water
- Appendix 4: Drainage Design Drawings
- Appendix 5: Calculations for storage requirements

## 1. INTRODUCTION

HBPW LLP are appointed for the provision of Civil and Structural Engineering design services associated with the Pre-Planning stages on the Proposed Development at 63-71 High Street, Hampton Hill, London Borough of Richmond.

The following statement is a summary of the drainage strategy proposed for the site. The drainage strategy described within this statement has been developed in conjunction with the 'Flood Risk Assessment and Drainage Strategy' prepared for the proposed development by RAB Consultants.

## 2. SITE DESCRIPTION

The Site is on the western side of High Street centered at approximately national grid reference TQ 1424 7084.

The Site location is shown below:



**Site Location Plan**

(North is shown to the top of plan)

The current site forms an approximately rectangular parcel of land (68m by 38m) and is currently occupied by three buildings. Two office buildings located at the frontage to High Street are joined by an enclosed overhead link walkway at first floor level. The third building, St Clare Studio, is located in the south west quadrant backing onto the access road to the St Clare Business Park.

To the south of the site is a mixed office and residential terraces. To the north the land to the rear of the retail/residential frontage is, at time of writing, being developed with a number of 3 storey town houses.

The external areas are predominantly laid to hard standing.

A Buried services survey has been undertaken at the site which highlights the current surface water on the site as being discharged to a series of soakaways located beneath the car park. Foul water from the existing two offices adjacent to the High Street discharges to the public sewer on the High Street, foul water from St Clare Studio discharges to the public sewer located in the access road at the rear of the site leading to St Clare Business Park, this sewer subsequently connects to the foul sewer in Holly Road indicated on the Thames Water sewer records.

Thames Water sewer records local to the site indicate a 175mm diameter foul sewer located in the High Street and also a 175mm diameter foul sewer in Holly Road at the rear of the site leading to St Clare Business Park. A 225mm diameter Trunk Surface water sewer is located in the High Street which only captures water from the Highway.

An extract of the sewer record is included below:-  
 (N.B. this does not show the sewer serving St Clare Business Park)



Full copies of the below ground services and Thames Water asset map are included in Appendix 1 and 2 respectively.

### 3. PROPOSED PROJECT

The proposed project comprises the re-development of the site which will include the construction of eight townhouses, two commercial units, thirty one apartments and four penthouse apartments. In addition the scheme will feature underground parking together with paved and green landscaped areas.

The underground car park will occupy the majority of the site's footprint and provide parking for forty five cars.

A Pre-planning enquiry response from Thames Water has stated that a foul connection to the existing public sewer is agreeable. Foul water flow rates from the proposed development will exceed that of the current site. With regard to the proposed increase flows Thames Water have confirmed that there is sufficient capacity to accommodate the proposed flows and they have no concerns in regard to the sewer infrastructure capacity.

With regard to surface water Thames Water have agreed in principle to a connection into the public sewer in the High Street subject to the surface water discharge rate being restricted to 3.2 L/s for all storm events up to the 1% AEP + 40%CC.

The derivation of the restricted discharge rate which is based on the greenfield run off rate for the pre-developed site can be found in the Flood Risk Assessment prepared by RAB Consultants.

Correspondence from Thames water is included in Appendix 3.

#### **4. DRAINAGE STRATEGY**

Proposed Strategy

Foul Water

The layout of the site and local public sewer dictate that a foul connection to the public sewer in the High Street is proposed.

The foul water from the whole development will be served by a pumped system. A foul pumping system is proposed to be located in the basement which will discharge into the public foul sewer located in the High Street. A storage tank will be installed to provide 24 hour storage should the pumping station fail.

The foul water system for the development will be designed in accordance with the recommendations of Part H of the Building Regulations.

Surface Water

Thames Water has confirmed that surface water discharge to the public sewer network will be permitted subject to a detailed design and a S106 application. Surface Water discharge from the site shall be limited to 3.2 L/s for all storm events up to the 1% AEP + 40% CC. The flow rate from the site is to be controlled by means of a pump with any excess flows stored in a tank provided below the basement ground floor slab.

Thames Water sewer records indicate that there is no available public surface water sewer to connect into local to the development boundary. It is proposed therefore to combine the foul and surface water from the development at the final manhole before discharging by gravity into the public foul sewer located in the High Street. The final manhole will be provided with a non-return valve to protect the development from the potential of sewer relating flooding.

The surface water system for the development will be designed in accordance with the recommendations of Part H of the Building Regulations.

In addition and as outlined within the Flood Risk Assessment prepared by RAB Consultants a number of SuDS principles will be implemented as part of the scheme; and are summarised below:-

1. The roof space to the eight townhouses are to be provided as accessible amenity spaces, with limited areas of bio-diverse planting, the planting areas will be provided with a drainage layer in order that captured roof run off will be intercepted, stored and treated prior to discharge to the site surface water system.
2. Reference is made to the Landscape design prepared by Landscape Architects Bradley-Hole Schoenaich for the courtyard areas. The scheme comprises a number of planters located throughout the courtyard, the planters will take the form of a recess constructed within the ground floor podium slab, the depth of planters vary from 250mm deep to 700mm deep. It is proposed that the planters are used to intercept, store and treat surface water from rainfall falling directly onto the planters but also from adjacent paved areas that will be laid to falls directed towards the planters, in additional areas discreet slot drain will be incorporated into the hard landscaping to capture rainfall, slot drains will discharge into the planters. The base of the planters will be provided with a nominal 100m thick drainage layer and drainage outlets that will in turn connect to the site surface water system.
3. Captured surface water will be re-used to irrigate installed planting.
4. Surface water discharge from the site into the public sewer is to be controlled by means of a pump and as stated above flows in exceedance of 3.2 L/s will be attenuated and stored in a tank provided below the basement ground floor slab. Prior to entering the tank all flows will pass through an advanced hydrodynamic vortex separator to capture particulate matter, oils and other floatable debris to further treat the captured surface water. The pump will be supported by a back-up pump in case of a breakdown.

## **5. CONCLUSION**

- 5.1 There is adequate capacity in the existing public foul water sewer infrastructure to accommodate the expected requirements of the proposed development and accordingly there is no requirement for any enhancement of the existing infrastructure as a consequence of the development.
- 5.2 Surface water flows from the site are restricted to the calculated Greenfield run off rates for the pre-developed site, the derivation of the restricted discharge rate can be found in the Flood Risk Assessment prepared by RAB Consultants. Thames Water has confirmed their acceptance in principle to the discharge rate proposed with regard to a connection into the public sewer.
- 5.3 Surface water attenuation for the development in order to limit flows off site to the agreed restricted discharge rate has been provided. The location of the attenuation tank is to be below the basement ground floor slab and is shown on drawing SL05030.402 included in Appendix 4. Outflow from the tank is to be controlled by a pump which will automatically activate when required and pump at a constant rate

to match the agreed discharge rate, the tank storage volume has been determined to store all flows exceeding the restricted rate in all storm events up to the 1% AEP + 40% CC. The tank is also provided with 300mm freeboard in line with recommendations of the Flood Risk Assessment

- 5.4 The proposed surface water management strategy for the development will seek to maximize the use of SuDS to irrigate the installed planting, in addition soil to planted areas will provide further storage to surface water run off and will further mitigate the volume of surface water from the site.



# **Appendix 1**

## Existing site Buried Services Survey

NOTES:

**UTILITY KEY**

	ELECTRIC CABLE
	TELECOMS CABLE
	CABLE TELEVISION
	COMMUNICATION CABLE
	WATER PIPE
	GAS PIPE
	FOUL DRAINAGE
	CONTAMINATED SURFACE
	SURFACE DRAINAGE
	COMBINED DRAINAGE
	PUMPING MAIN
	FUEL PIPE
	VENT PIPE
	OFFSET FILL PIPE
	GAUGE LINE
	VAPOUR RECOVERY
	HEATING PIPES
	SERVICE DUCTS
	UNIDENTIFIED
	CABLE / PIPE RISER
	BACKDROP / TRAPPED EXIT

**ABBREVIATIONS**

AC	ASBESTOS CEMENT	LP	LAMP POST
AR	ASSUMED ROUTE	MH	MANHOLE
BB	BASE BEND	MW	MONITORING WELL
BD	BACKDROP	OH	OVERHEAD
BH	BORHOLE	OSA	OFF SURVEY AREA
BR	BRICK	PE	POLYETHYLENE
BT	BT INSPECTION CHAMBER	PL	PLASTIC
CATV	CATV INSPECTION CHAMBER	PR	PIPE RISER
CBX	CONTROL BOX	PVC	POLYVINYL CHLORIDE
CI	CAST IRON	RE	RODDING EYE
CL	COVER LEVEL	RWP	RAIN WATER PIPE
CO	CONCRETE	S/A	SOAKAWAY
CR	CABLE RISER	SI	SPUN IRON
CP	CATCHPIT	ST	STOP TAP
D	DEPTH	S.T	STEEL
DI	DUCTILE IRON	SV	SLUICE VALVE
DP	DOWN PIPE	SVP	SOIL VENT PIPE
EM	EMPTY DUCT	TE	TRAPPED EXIT
EOCS	END OF TRENCH SCAR	TFR	TAKEN FROM RECORD
EOT	END OF TRACE	TFL	TRAFFIC LIGHT
ER	EARTHING ROD	TP	TELEGRAPH POLE
EP	ELECTRICITY POLE	UTCCTV	UNABLE TO CCTV
FH	FIRE HYDRANT	UTL	UNABLE TO FIND
FL	FLOOD LIGHT	UTL	UNABLE TO LIFT
GPR	GROUND PENETRATING RADAR	VC	VITRIFIED GLASS
GRP	GLASS REINFORCED PLASTIC	VP	VENT PIPE
GV	GAS VALVE	WL	WATER LEVEL
HL	HIGH LEVEL	WR	WATER RECOVERY
HOR	HEAD OF RUN	WM	WATER METER
IC	INSPECTION CHAMBER	WO	WASH OUT VALVE
IL	INVERT LEVEL		
SWS	SURFACE WATER SEWER		
FWS	FOUL WATER SEWER		
CWS	COMBINED WATER SEWER		

**DISCLAIMER**

ELECTRO-MAGNETIC TECHNIQUES AND/OR GROUND PENETRATING RADAR HAVE BEEN USED IN THE LOCATION OF UNDERGROUND SERVICES. THE RESULTS ARE NOT INFALLIBLE AND TRIAL EXCAVATIONS SHOULD BE CARRIED OUT TO CONFIRM SERVICE IDENTIFICATION, POSITIONS AND PARTICULARLY DEPTHS, WHERE THESE ARE CRITICAL. ALTHOUGH ALL REASONABLE EFFORT HAS BEEN MADE IN SEARCHING AVAILABLE RECORD DRAWINGS, THE COMPLETENESS OF THE UNDERGROUND SERVICES INFORMATION CANNOT BE GUARANTEED. THE METHODS OF SURVEY DOES NOT DIFFERENTIATE BETWEEN LIVE AND DEAD SERVICES AND AS SUCH ALL SERVICES SHOULD BE TREATED AS LIVE.

WHERE SERVICES ARE NON-METALLIC POSITIONS MAY BE TAKEN FROM RECORDS, TRENCH SCARS & SURFACE DETAIL.

WHERE QUOTED, DEPTH ESTIMATIONS ARE GENERALLY TO THE CENTRE OF THE SERVICE. DEPTHS TO GRAVITY SEWERS AND DRAINS ARE GENERALLY TO INVERT LEVELS UNLESS OTHERWISE STATED.

PIPE SIZES WHICH CANNOT BE OBTAINED BY VISUAL SURVEY ARE TAKEN FROM RECORD DRAWINGS OR MARKER PLATES WHERE AVAILABLE.

WHERE GROUND PENETRATING RADAR HAS BEEN USED IT WILL PRIMARILY HAVE BEEN TO IDENTIFY UNDERGROUND UTILITIES IF POSSIBLE WE WILL ALSO IDENTIFY UNDERGROUND STRUCTURES/ TANKS ETC. BUT CANNOT GUARANTEE TO HAVE LOCATED ALL SUCH ITEMS. THE USE OF RADAR CAN BE LIMITED BOTH BY SURFACE CONDITIONS AND ALSO BY SOIL TYPE. DEPTH ESTIMATES WOULD NOT NORMALLY BE PROVIDED FOR SERVICES LOCATED WITH GPR.

REV	DATE	COMMENT	CAD

CLIENT: **CSL Surveys**

PROJECT: **63-71 High Street  
Hampton Hill  
TW12 1NL**

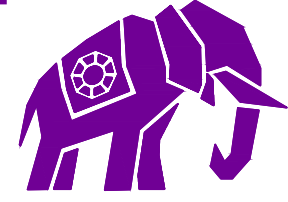
TITLE: **Underground  
Utility Survey**

**AMETHYST SURVEYS LIMITED**


Unit 6a Davy Court, Central Park  
Rugby, Warwickshire, CV23 0UZ

Tel: 01788 566740  
Fax: 01788 571158

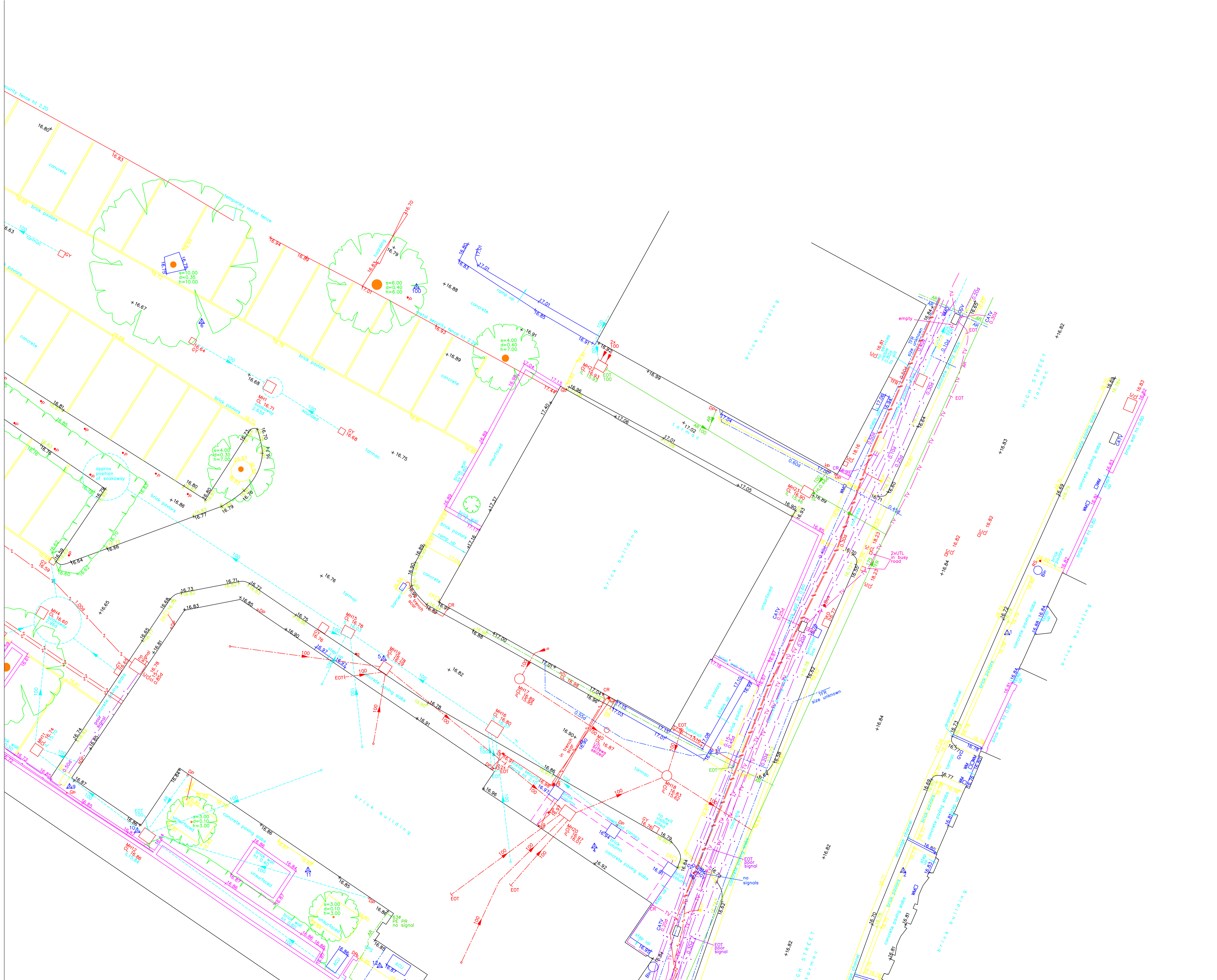
Email: enquiries@amethystsurveys.com  
www.amethystsurveys.com



DATE: 29.02-01.03.16	JOB No: 11671
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APPROVED: T.P.D	SCALE: 1:100 @ A1



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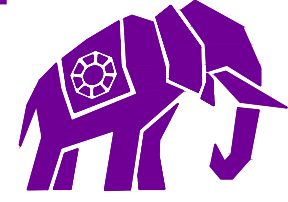
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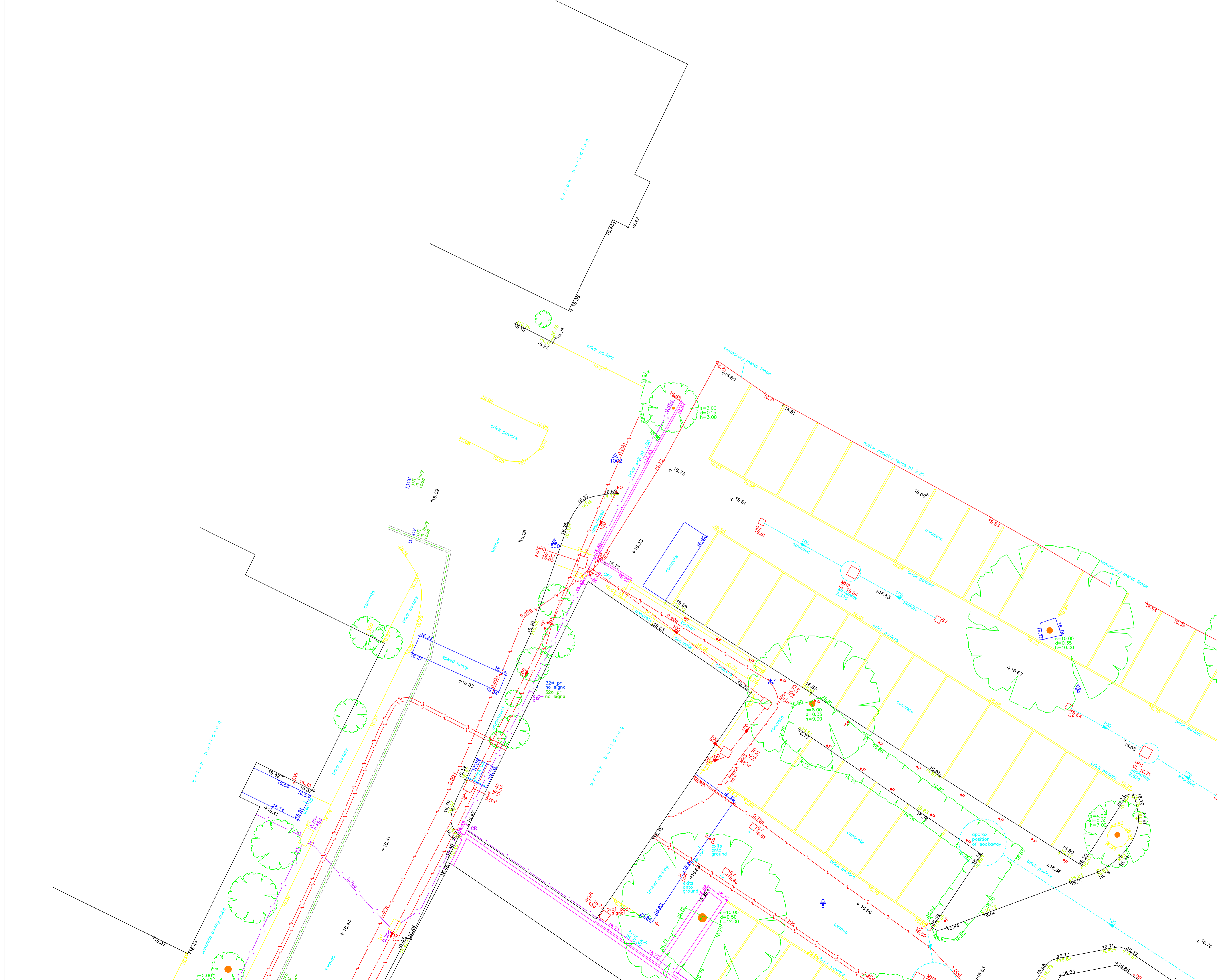
Unit 6a Davy Court, Central Park  
Rugby, Warwickshire, CV23 0UZ  
Tel: 01788 566740  
Fax: 01788 571158  
Email: enquiries@amethystsurveys.com  
www.amethystsurveys.com



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DRAWN: DS	SURVEYED: DS / NS
APPROVED: T.P.D	SCALE: 1:100 @A1

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# **Appendix 2**

## Thames Water Asset Map

# Asset Location Search



HBPW  
43 43

RETFORD  
DN22 7UX

**Search address supplied**      63  
High Street  
Hampton Hill  
Hampton  
TW12 1NH

**Your reference**                      Hampton

**Our reference**                        ALS/ALS/24/2016\_3311281

**Search date**                          25 April 2016

You are now able to order your Asset Location Search requests online by visiting  
[www.thameswater-propertysearches.co.uk](http://www.thameswater-propertysearches.co.uk)



# Asset Location Search



**Search address supplied:** 63, High Street, Hampton Hill, Hampton, TW12 1NH

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 search provides 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](mailto:searches@thameswater.co.uk)

Web: [www.thameswater-propertysearches.co.uk](http://www.thameswater-propertysearches.co.uk)

# Asset Location Search



## 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

# Asset Location Search



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.



# Asset Location Search



## 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

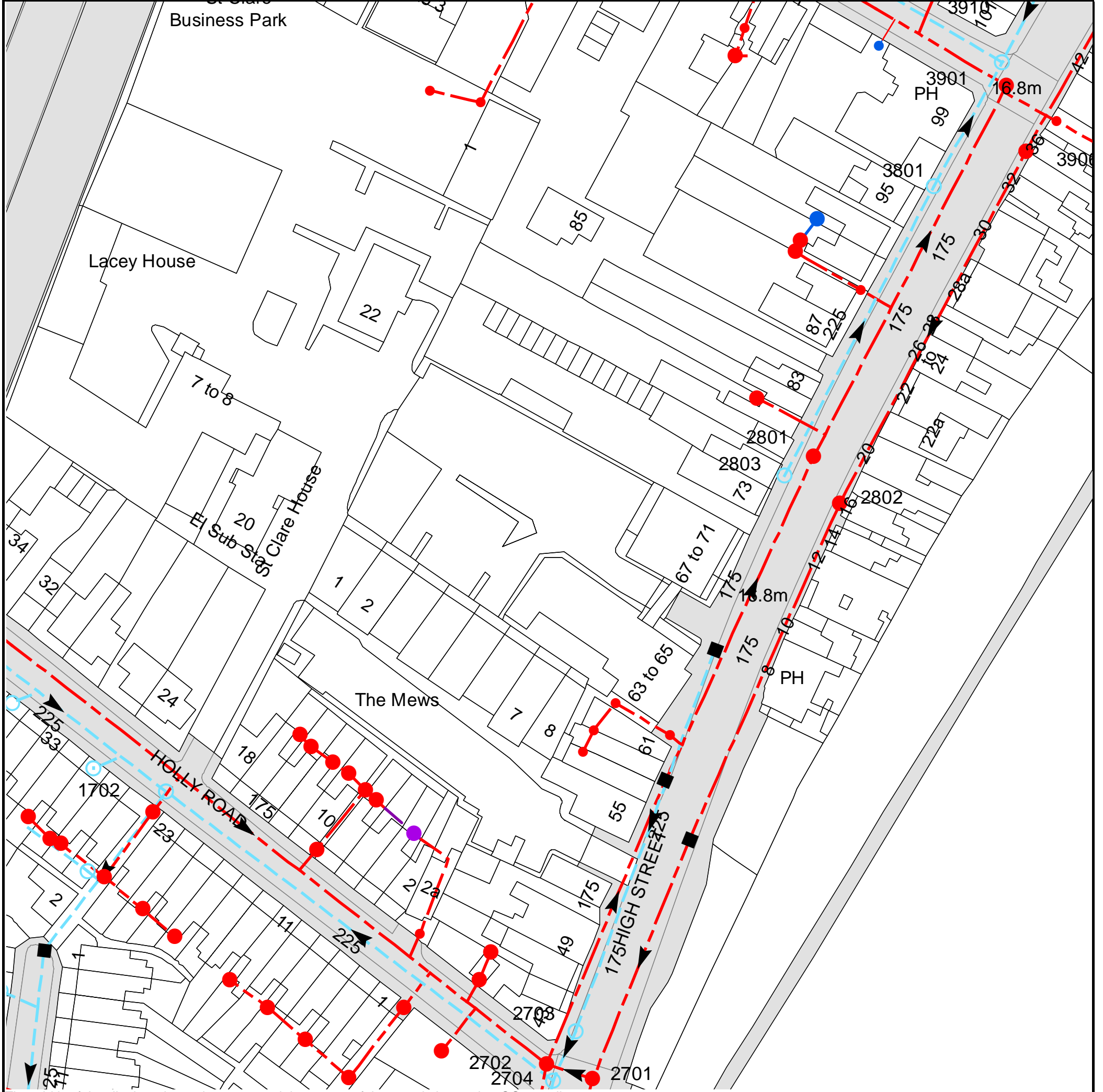
Tel: 0845 850 2777  
Email: [developer.services@thameswater.co.uk](mailto:developer.services@thameswater.co.uk)

### 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: 0845 850 2777  
Email: [developer.services@thameswater.co.uk](mailto:developer.services@thameswater.co.uk)



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 514241,170833  
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.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

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
2803	16.76	15.7
28ZW	n/a	n/a
28ZX	n/a	n/a
2801	16.67	13.01
28ZY	n/a	n/a
2802	16.76	14.58
28ZV	n/a	n/a
391A	n/a	n/a
3801	16.67	15.56
3910	16.59	15.4
3901	16.63	12.59
3906	16.68	15.08
39ZP	n/a	n/a
17XW	n/a	n/a
17XV	n/a	n/a
17XT	n/a	n/a
17WX	n/a	n/a
17XS	n/a	n/a
17WZ	n/a	n/a
17XR	n/a	n/a
1702	16.38	15.33
17XP	n/a	n/a
17WS	n/a	n/a
17VZ	n/a	n/a
17VY	n/a	n/a
17ZX	n/a	n/a
27YW	n/a	n/a
27ZS	n/a	n/a
27ZT	n/a	n/a
27YV	n/a	n/a
27ZV	n/a	n/a
27YY	n/a	n/a
27ZX	n/a	n/a
27ZY	n/a	n/a
2702	16.6	13.51
2704	16.61	15.7
2703	16.66	15.75
2701	16.53	13.54
18ZV	n/a	n/a
17WV	n/a	n/a
17VX	n/a	n/a
17VW	n/a	n/a
27YS	n/a	n/a
27YR	n/a	n/a
27ZR	n/a	n/a
27ZQ	n/a	n/a
28ZR	n/a	n/a
27ZP	n/a	n/a
29YX	n/a	n/a
291C	n/a	n/a
28ZT	n/a	n/a
271A	n/a	n/a
291J	n/a	n/a
291I	n/a	n/a

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.

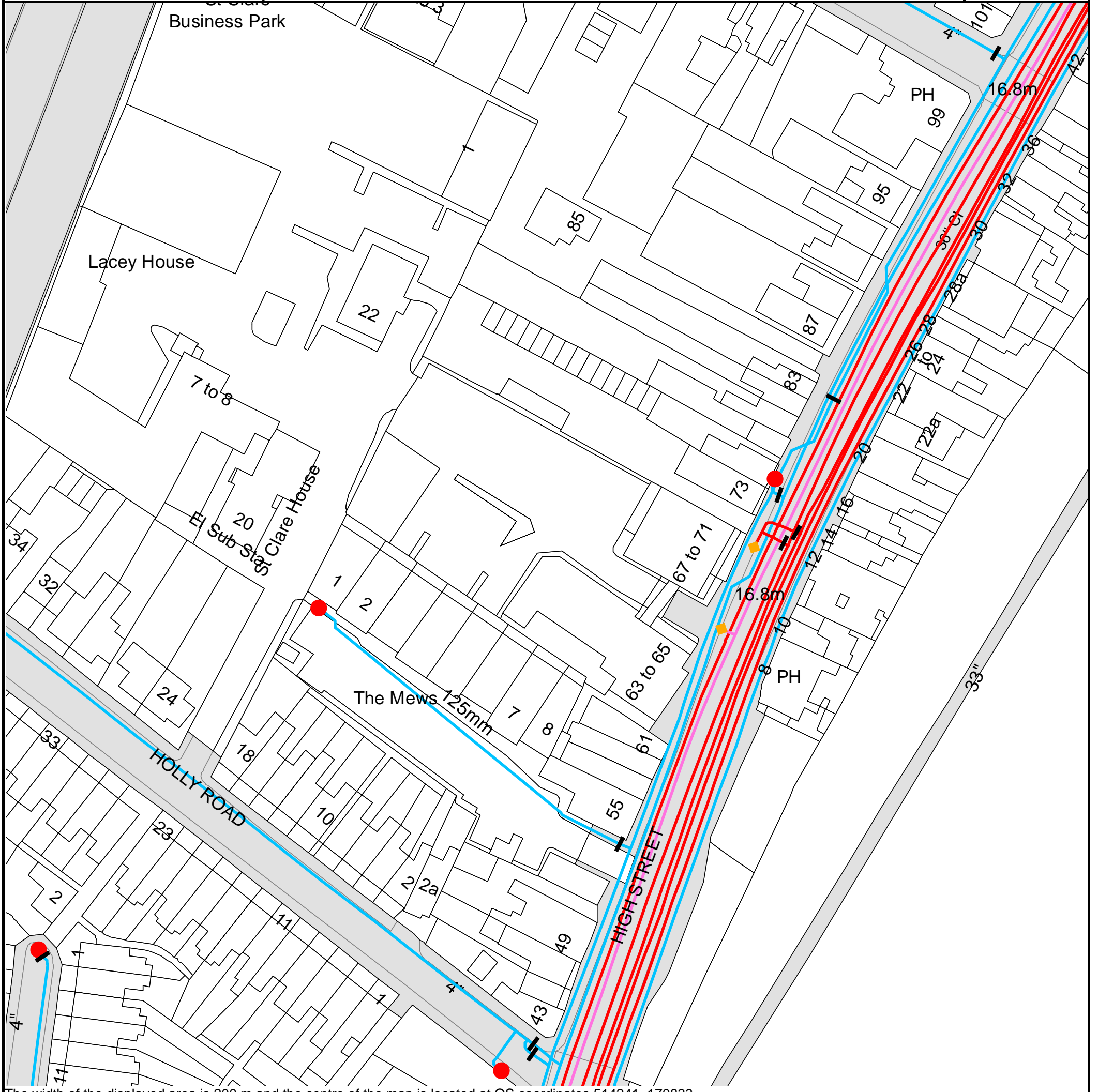
-  Agreement
-  Operational Site
-  Chamber
-  Tunnel
-  Conduit Bridge

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

-  Foul Sewer
-  Surface Water Sewer
-  Combined Sewer
-  Gully
-  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 millimetres. 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.



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 514241, 170833.  
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.  
Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.



# ALS Water Map Key

## Water Pipes (Operated & Maintained by Thames Water)

- 4"** **Distribution Main:** The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.
  
- 16"** **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.
  
- 3" SUPPLY** **Supply Main:** A supply main indicates that the water main is used as a supply for a single property or group of properties.
  
- 3" FIRE** **Fire Main:** Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.
  
- 3" METERED** **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.

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')

## 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

## 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:** Indicates 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 him 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 <b>0845 070 9148</b> quoting your invoice number starting CBA or ADS.	Account number <b>90478703</b> Sort code <b>60-00-01</b> A remittance advice must be sent to: <b>Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.</b> or email <a href="mailto:ps.billing@thameswater.co.uk">ps.billing@thameswater.co.uk</a>	By calling your bank and quoting: Account number <b>90478703</b> Sort code <b>60-00-01</b> and your invoice number	Made payable to ' <b>Thames Water Utilities Ltd</b> ' Write your Thames Water account number on the back. Send to: <b>Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW</b> or by DX to <b>151280 Slough 13</b>

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



## Search Code

### **IMPORTANT CONSUMER PROTECTION INFORMATION**

This search has been produced by Thames Water Property Searches, Clearwater Court, Vastern Road, Reading RG1 8DB, which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

#### **The Search Code:**

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

#### **The Code's core principles**

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

#### **Complaints**

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

**Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.**

#### **TPOs Contact Details**

The Property Ombudsman scheme  
Milford House  
43-55 Milford Street  
Salisbury  
Wiltshire SP1 2BP  
Tel: 01722 333306  
Fax: 01722 332296  
Email: [admin@tpos.co.uk](mailto:admin@tpos.co.uk)

You can get more information about the PCCB from [www.propertycodes.org.uk](http://www.propertycodes.org.uk)

**PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE**



# **Appendix 3**

## Pre-Planning Application correspondence with Thames Water



**Roy Bailie**  
**HBPW LLP**  
**43 Bridgegate**  
**Retford**  
**Nottinghamshire**  
**DN22 7UX**



Your account number  
DS6018027



[thameswater.co.uk](http://thameswater.co.uk)



0800 009 3921  
Mon – Fri 9am-5pm,  
16<sup>th</sup> May 2016

## Pre Development Enquiry

**Site Address: 63-71 High Street, Hampton Hill, Hampton, London, TW12 1NH**

**Development Details: Proposed mixed development of 27 flats, 8 townhouses and 1 retail unit**

Dear Mr Bailie

I refer to your application concerning the above site and requesting that a pre-development capacity check is undertaken.

Thank you for providing the correct fee and information regarding the site. I can now respond as follows;

### Foul Water

From the information you have provided, I can confirm that the existing foul water sewer has sufficient capacity to accommodate the proposed foul water discharge from the proposed residential property development.

We have no concerns in regards to the sewer infrastructure capacity.

### Surface Water

Where there are no Surface Water sewers connection of surface water to a Foul Sewer will only be considered when all other methods of disposing of the surface water have been proven impracticable.

In accordance with the Building Act 2000 clause H3.3. Positive connection to a public surface water will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. The disposal hierarchy being ; - 1st Soakaways; 2nd Watercourses; 3rd Sewer.

As this is a brownfield site, Thames Water expect a 50% reduction in surface water discharge post development.

Foul and surface water must not be combined. This will only be permitted when a combined public sewerage system exists. When it is proposed to connect to a combined public sewer, the site drainage should be separate and combined at the final manhole nearest the boundary.

A Trade Effluent Consent will be required for any Trade Effluent discharge. Applications should be made to Waste Water Quality, Crossness STW, Belvedere Road, Abbeywood, London. SE2 9AQ.

Where a developer proposes to discharge groundwater into a public sewer, a groundwater discharge permit will be required. Groundwater discharges typically result from construction site dewatering, deep excavations, basement infiltration, borehole installation, testing and site remediation. Groundwater permit enquiries should be directed to Thames Water's Risk Management Team by telephoning 020 8507 4890 or by emailing [wwriskmanagement@thameswater.co.uk](mailto:wwriskmanagement@thameswater.co.uk). Application forms should be completed on line via [www.thameswater.co.uk/wastewaterquality](http://www.thameswater.co.uk/wastewaterquality). Any discharge made without a permit is deemed illegal and may result in prosecution under the provisions of the Water Industry Act 1991.

Details approved in principle.

#### **Please Note**

All connection requests are subject to a full Section 106 (Water Industry Act 1991) application before the Company can confirm approval to the connection itself. Please also note that capacity in the public sewerage system cannot be reserved.

The views expressed by Thames Water in this letter are in response to this pre development enquiry at this time and do not represent our final views on any future planning applications made in relation to this site.

In regards to the sewer records and flooding history please contact Property Searches department, please find the link to their website here <https://www.thameswater-propertysearches.co.uk/>

Yours sincerely



Natalya Collins  
Development Engineer

## Emyr Parry

---

**From:** DEVELOPER.SERVICES@THAMESWATER.CO.UK  
**Sent:** 14 July 2016 12:14  
**To:** Emyr Parry  
**Subject:** RE: RE: IRef:1013964498 DS6018573 PDEV TW12 1NH 63-71 High St

Dear Emyr

I am pleased to let you know that your surface water proposed discharge rate of 3.2 l/s is acceptable by Thames Water. The proposal is approved in principal.

If you have any further enquiries, please don't hesitate to contact our Helpdesk on 0800 009 3921 . Alternatively you can email us at [developer.services@thameswater.co.uk](mailto:developer.services@thameswater.co.uk). For all our application forms and guidance documents please go to our website at <http://www.thameswater.co.uk/developers/592.htm>

Yours sincerely



**Natalya Collins**  
**Sewer Adoptions**  
**Strategic Partnering**

**Planning for and enabling growth**

Thames Water Utilities Ltd, Clear Water Court, Vastern Road, Reading, Berkshire, RG1 8DB  
Helpdesk: 0800 009 3921 Email: [developer.services@thameswater.co.uk](mailto:developer.services@thameswater.co.uk)

Original Text

**From:** e.parry@hbpwconsulting.co.uk  
**To:** developer.services@thameswater.co.uk  
**CC:** r.bailie@hbpwconsulting.co.uk  
**Sent:** 07.07.16 15:49:08  
**Subject:** RE: IRef:1013964498 DS6018573 PDEV TW12 1NH 63-71 High St

**For the attention of Natalya Collins.**

Dear Natalya,

Further to our telephone conversation yesterday with regards to the Pre-development Enquiry for the site at 63-71 High St, Hampton Hill, please can you clarify the following query in relation to your response in respect of Surface Water discharge for the proposed development.

Your response states that *"As this is a brownfield site, Thames Water expect a 50% reduction in surface water discharge post development"*, as discussed yesterday the surface water on the site is captured by galleys and carried to a number of soakaways located in the existing car park. the FRA document submitted with our enquiry suggested a restricted discharge rate of 3.2 L/s based on the pre development Greenfield runoff rate from the site. Derivation of the discharge rate is included within section 4.3 of FRA, a copy of the FRA is included for your convenience and relevant extract included below:-

### 4.3 Greenfield Runoff Rate

The pre-development runoff rate and volume were calculated on 1ha basis. Using the IH124 method for determining Greenfield runoff rate built into Microdrainage WinDes 2013.1 (including the modification given in the Interim Code of Practice for SUDS, Chapter 6):

- AREA = 1ha.
- SAAR = 600mm
- Soil = 0.3
- **Pre-development QBAR = 1.9 l/s/ha.**
- **Pre-development peak flow with 1 year return period = 1.3 l/s/ha.**
- **Pre-development Peak flow with 30 year return period = 3.4 l/s/ha.**
- **Pre-development Peak flow with 100 year return period = 4.9 l/s/ha.**
- **Pre-development Peak flow with 100 year return period plus 40% climate change = 6.86 l/s/ha.**
- The QBAR relevant to the development proposals is  $1.9 \times 0.2 = 0.8$  l/s. Given that the site is brownfield restricting the rate to 0.2ha (total proposed hardstanding)  $\times 6.86$  l/s = 1.37 l/s is unrealistic and impractical. Consequently, the rate should be limited to 0.2ha  $\times 16$  l/s (Planning Guidance Document: Delivering SuDS in Richmond, 2015) = 3.2 l/s for all events up to the 1% AEP+CC.

We would be grateful if you could review the above and advise if this in any way changes your original response.

Kind Regards

Emyr Parry



43 Bridgegate, Retford, Nottinghamshire, DN22 7UX

Tel: 01777 869 896 Mob: 07980286641

Email: [e.parry@hbpwconsulting.co.uk](mailto:e.parry@hbpwconsulting.co.uk)

[www.hbpw.co.uk](http://www.hbpw.co.uk)

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---

**From:** Roy Bailie  
**Sent:** 28 June 2016 14:30

**To:** Emyr Parry  
**Subject:** FW: IRef:1013964498 DS6018573 PDEV TW12 1NH 63-71 High St

FYI

Roy Bailie



43 Bridgegate, Retford, Nottinghamshire, DN22 7UX  
Tel: 01777 869896  
Fax: 01777 862491  
[www.hbpw.co.uk](http://www.hbpw.co.uk)

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**From:** [DEVELOPER.SERVICES@THAMESWATER.CO.UK](mailto:DEVELOPER.SERVICES@THAMESWATER.CO.UK) [mailto:[DEVELOPER.SERVICES@THAMESWATER.CO.UK](mailto:DEVELOPER.SERVICES@THAMESWATER.CO.UK)]  
**Sent:** 28 June 2016 14:22  
**To:** Roy Bailie <[r.bailie@hbpwconsulting.co.uk](mailto:r.bailie@hbpwconsulting.co.uk)>  
**Subject:** IRef:1013964498 DS6018573 PDEV TW12 1NH 63-71 High St

Dear Mr Bailie

Thank you for the submitted additional information. I do apologise it has taken a bit longer to send you a formal response due to my annual leave. Please find the letter attached and let me know if you have any questions.

Best Regards

Natalya Collins

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We provide the essential service that's at the heart of daily life.

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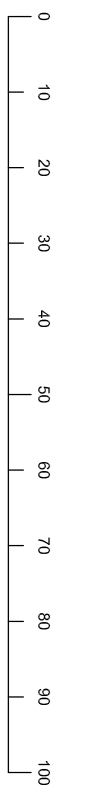
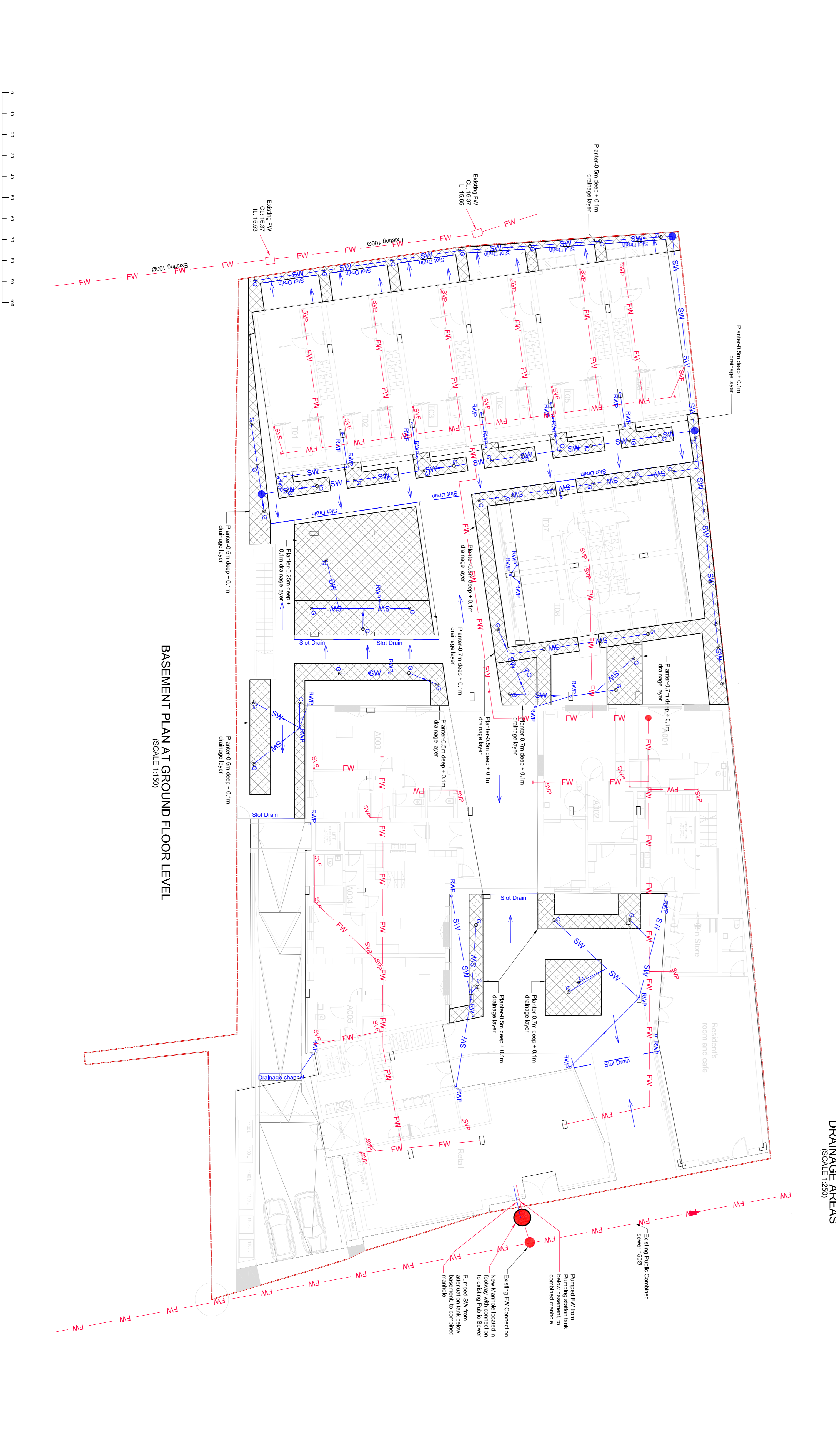
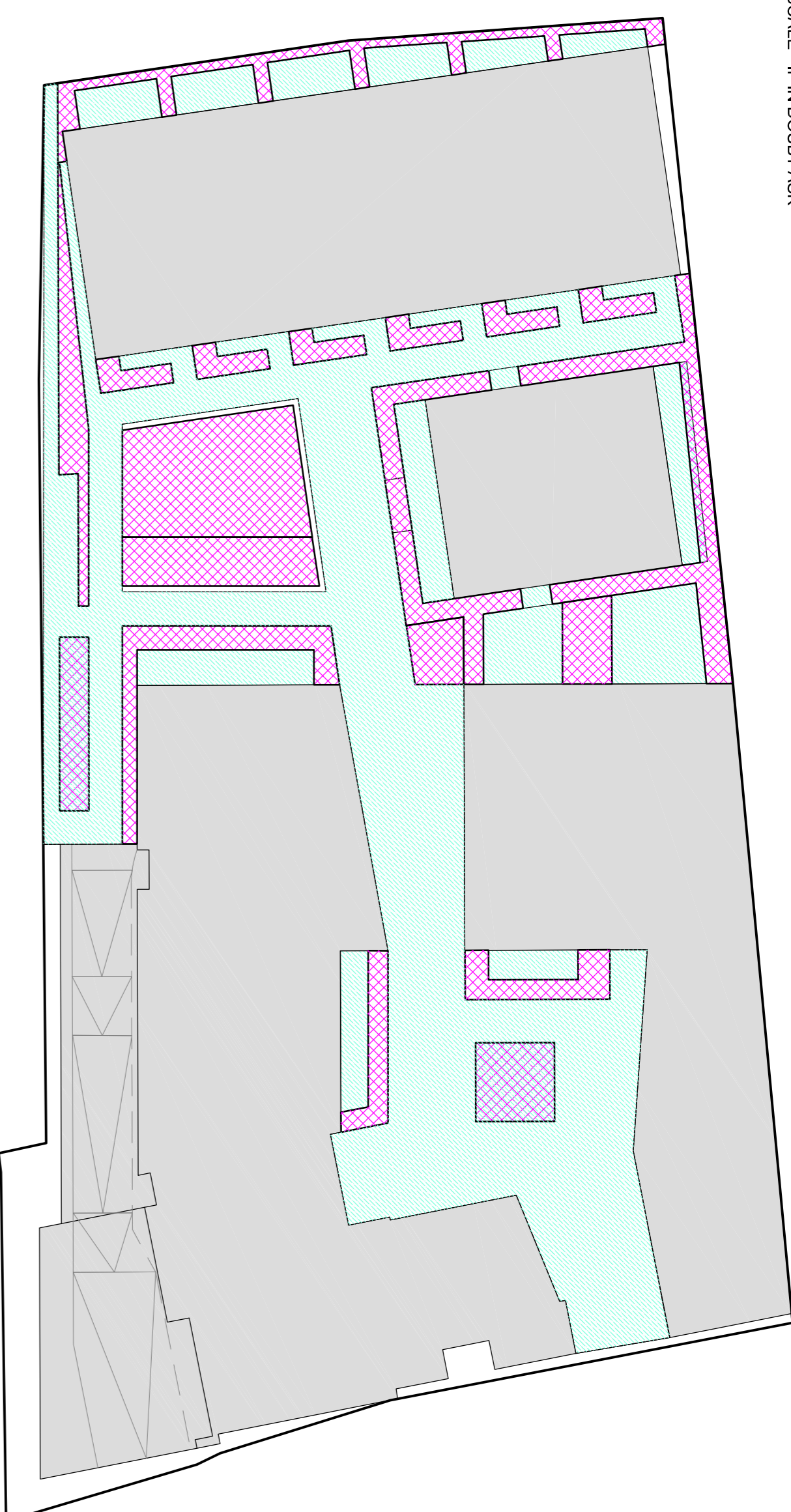
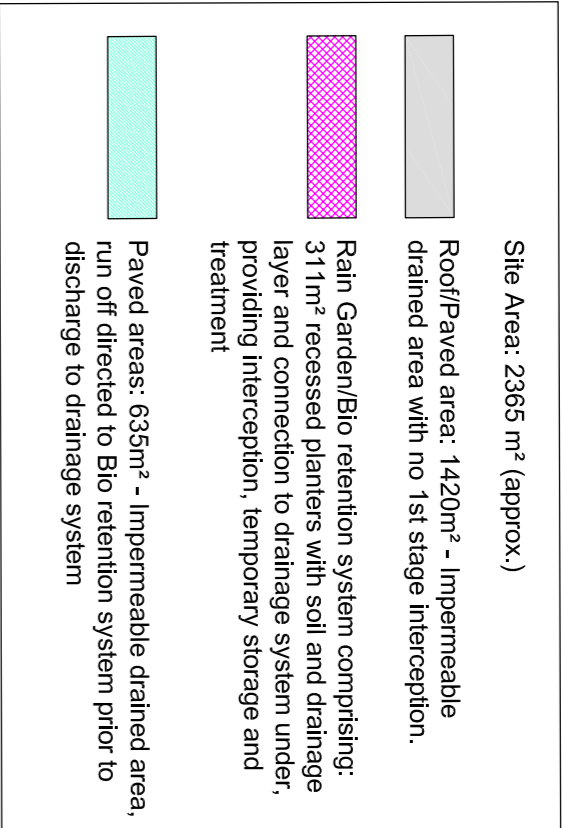
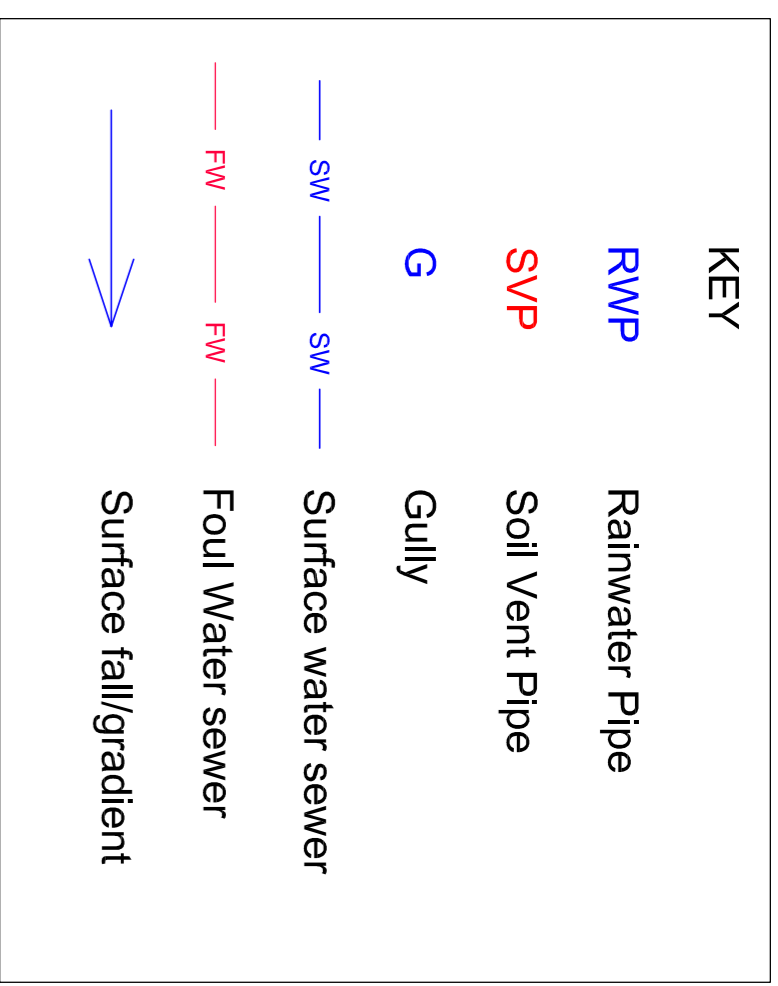
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# **Appendix 4**

## **Drainage Strategy Drawings**





**General Notes**

1. DO NOT SCALE.
2. This drawing is to be read in conjunction with all other relevant drawings and details.
3. Should there be any conflict between the details indicated on this drawing and those indicated on other drawings the Engineer should be informed PRIOR to construction on site.
4. Until technical approval has been obtained from the relevant Authority, it should be understood that all drawings issued are for information only and are not to be used for construction of any part of the site unless specifically approved in writing by the Authority.
5. All dimensions are in millimetres unless otherwise stated.
6. All access and gradients to be in accordance with Building Regulations Part M: Access to and use of buildings.
7. Drainage to be in accordance with Building Regulations Part H: Drainage and Waste Disposal & relevant British Standards.
8. Linear drainage keep clean sizing and gully capacity are to be confirmed by manufacturer.
9. Where parking steeper than 1:3 is proposed, appropriate slope stabilisation measures are to be provided.
10. Gravel margin around building perimeter to ensure the integrity of the SW at drain distribution.
11. Contractor to obtain any necessary approvals from the water authority prior to operation.
12. External threshold drains to be provided at level access to buildings where necessary due to approach gradients.
13. All planting within 5m of proposed drainage to be specified so as not to cause root damage to drainages, or be provided with suitable root protection measures.
14. Any positions of RWP's and foul connection points shown are for information only and to be confirmed by others - refer to architects drawings for setting out information.
15. Cover class to manholes/inspection chambers are to suit anticipated vehicle loadings in accordance with BS EN 124 (D400) where potential for HGV loading. C250/B125 in concrete/gully/railroad gully covers may be used only in cases not accessible by vehicles.
16. Durable concrete should be specified in accordance with the requirements of BS EN 12400 and BS EN 12401. Design Class and required Aggressive Ground Field: 8.1.3. Design Surface Class and required Aggressive Chemical Environment for Concrete Class to be confirmed by SI.
17. Before handover, all manholes shall be inspected, all rubble removed, and the whole system shall be thoroughly flushed and cleaned.

**HEALTH, SAFETY AND ENVIRONMENTAL INFORMATION**

In addition to the hazards/risks associated with the types of work detailed on this drawing please note the following:

Construction:

- 1) 2)
- 2) 3)
- 3) etc

Cleaning / Maintenance:

- 1)
- 2)
- 3)

etc

Demolition:

- 1)
- 2)
- 3)

etc

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement.

Layout updated	B	18.10.16	HP	EP	RWP
Drainage updated	A	14.10.16	HP	EP	RWP
1st Issue	L	27.05.16	HP	EP	RWP
DESCRIPTION	REV	DATE	BY	CHECKED	APP'D
			BR	CHWD	HPW

43 Bridgiate  
Ketteringham  
Retford  
S82 7JX

HPW  
LLP

Civil & Structural Engineering Services Fax: (01777) 862491

Tel: (01777) 869886

STATUS: PLANNING

CLIENT: GREAT PLANET LTD

PROJECT: 63-71 HIGH STREET  
HAMPTON HILL

DRAWING TITLE: DRAINAGE LAYOUT AT GROUND FLOOR LEVEL

DRAWN	EP	DATE	MAY 2016
PROJECT ENGINEER	EP	SCALE	AS SHOWN @ A1
CHECKED	SS	APPROVED	AS SHOWN @ A1
DRAWING NUMBER	SLS0500_401	REVISION	B

**General Notes**

1. DO NOT SCALE.
2. This drawing is to be read in conjunction with all other relevant drawings and details.
3. Should there be any conflict between the details indicated on this drawing and those indicated on other drawings the Engineer should be informed PRIOR to construction on site.
4. Until technical approval has been obtained from the relevant Authority, it should be understood that all drawings issued are for information only and are not to be used for construction on any site until such approval has been given. It is entirely at the owner's risk.
5. All dimensions are in millimetres unless otherwise stated.
6. All access and gradients to be in accordance with Building Regulations Part M1. Access to and use of buildings.
7. Drainage to be in accordance with Building Regulations Part H; Drainage and Waste Disposal & relevant British Standards.
8. Linear drainage keep drain sizing and gully capacity are to be confirmed by manufacturer.
9. Where banking steeper than 1:3 is proposed, appropriate slope stabilisation measures are to be provided.
10. Gravel margin around building perimeter to ensure the integrity of the D/W at drain obstruction.
11. Contractor to obtain any necessary approvals from the water authority prior to operation.
12. External threshold drains to be provided at level access to buildings where necessary due to approach gradients.
13. All planting within 5m of proposed drainage to be specified so as not to cause root damage to drainages, or be provided with suitable root protection measures.
14. Any positions of R/WPs and foul connection points shown are for information only and to be confirmed by others - refer to architects drawings for setting out information.
15. Cover class to manholes/inspection chambers are to suit anticipated vehicle loadings in accordance with BS EN 124 (D400) where potential for HGV loading. CS50(B) 125 in cover/gully/raile for cases 15 covers may be used only in cases as accessible by vehicles.
16. Staked concrete should be specified in accordance with the Aggressive Ground (Part 8.13) Design Subtype Class and required Aggressive Chemical Environment for Concrete Class to be confirmed by SI.
17. Before handover, all manholes shall be inspected, all rubble removed, and the whole system shall be thoroughly flushed and cleaned.

**HEALTH, SAFETY AND ENVIRONMENTAL INFORMATION**

In addition to the hazards/risks associated with the types of work detailed on this drawing please note the following:

- Construction:
- 1) 1)
  - 2) 2)
  - 3) 3)
- etc
- Cleaning / Maintenance:
- 1) 1)
  - 2) 2)
  - 3) 3)
- etc

Demolition:

- 1) 1)
- 2) 2)
- 3) 3)

etc

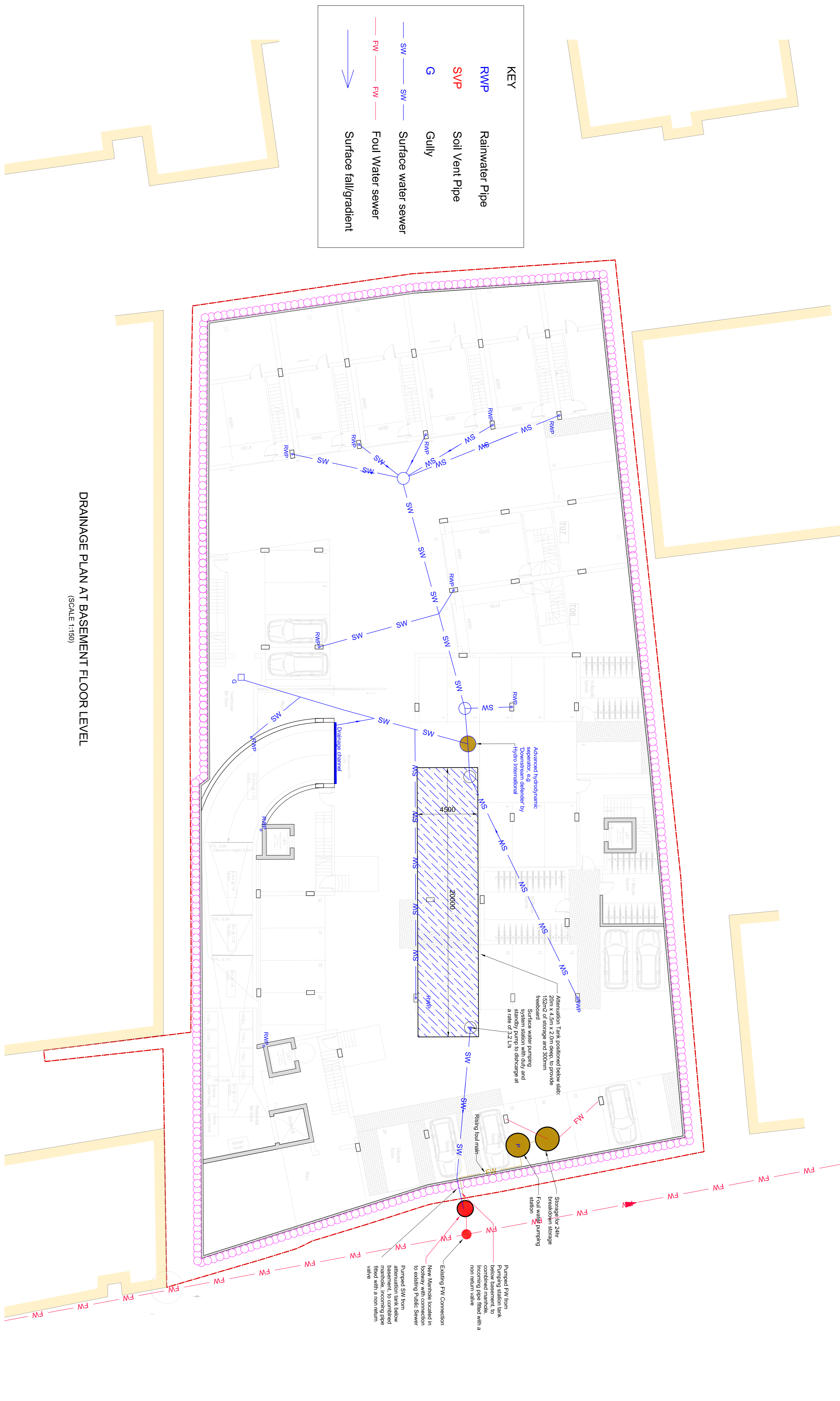
It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

Layout updated	A	B	18.10.16	RB	EP	R/W
Drawing updated	A	14.10.16	RB	EP	R/W	
1st Issue	L	27.05.16	RB	EP	R/W	
DESCRIPTION	REV	DATE	BY	CHKD	APPV	
4.3 Bridgegate Reflood						
HBPW LLP						
Civil & Structural Engineering Services Fax: (01777) 862491						

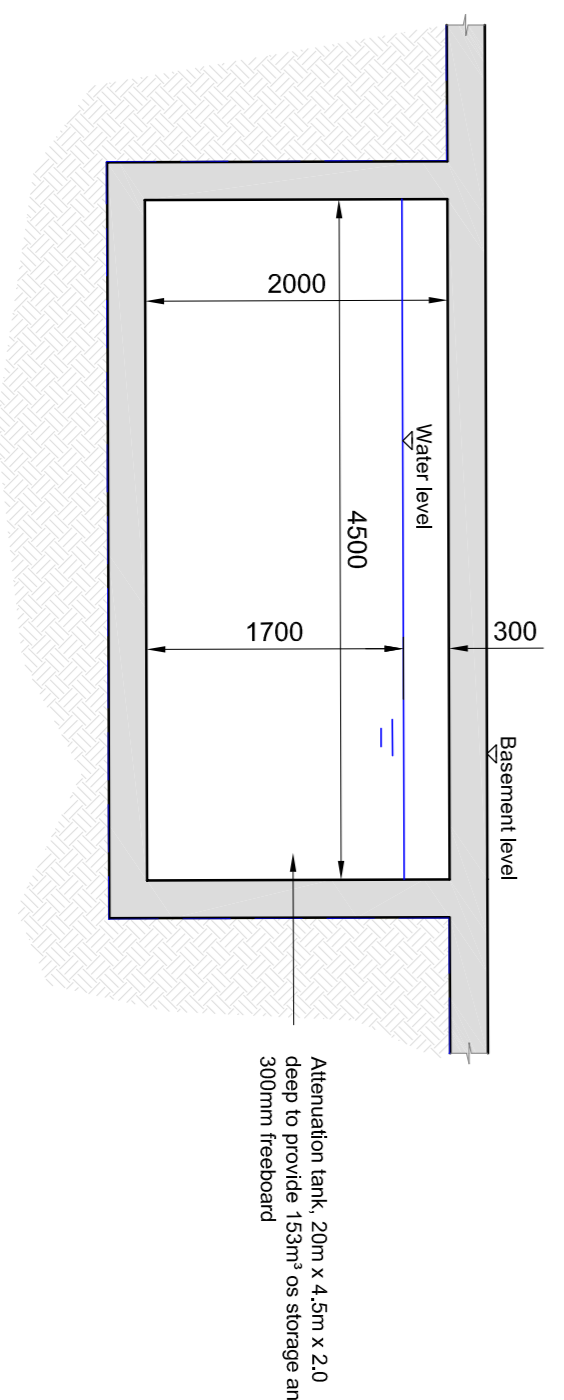
<b>STATUS</b>		PLANNING	
<b>CLIENT</b>		GREAT PLANET LTD	
<b>PROJECT</b>		69-71 HIGH STREET HAMPTON HILL	
<b>DRAWING TITLE</b>		DRAINAGE LAYOUT AT BASEMENT FLOOR LEVEL	
<b>DRAWN</b>	EP	<b>DATE</b>	MAY 2016
<b>PROJECT ENGINEER</b>	EP	<b>SCALE</b>	AS SHOWN @ A1
<b>CHECKED</b>	SS	<b>APPROVED</b>	EP
<b>DRAWING NUMBER</b>	SLS0500.002	<b>REVISION</b>	B

**KEY**

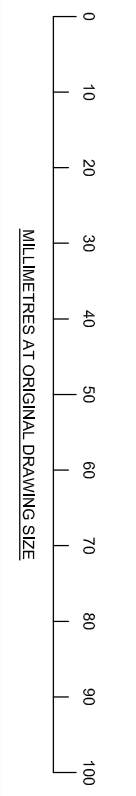
- RWP Rainwater Pipe
- SVP Soil Vent Pipe
- G Gully
- SW Surface water sewer
- FW Foul Water sewer
- Surface fall/gradient



**DRAINAGE PLAN AT BASEMENT FLOOR LEVEL**  
(SCALE 1:150)



**TYPICAL SECTION THROUGH ATTENUATION TANK**  
(SCALE 1:50)



# **Appendix 5**

## Calculations for storage requirements



43 Bridgegate  
Retford  
Nottinghamshire  
DN22 7UX

Tel: 01777 869896  
Fax: 01777 862491

Job No.  
SL05030

Sheet No.

Job Title  
Hampton Hill

Designed  
EP

Date  
01-Oct-16

Calculations Title  
Storage requirements

Checked

Date

M5-60= 20 mm  
40 % climate change  
r= 0.4 ratio of 60 minute to 2 day rainfall of 5year return period  
flow 3.2 lt/sec Allowable flow  
Aimp 2460 m2 Impermeable area

Duration (min)	Growth factor Z1	M5 rainfalls (mm)	30 year Growth factor Z2	100 year Growth factor Z2	30 year rainfall M30 (mm)	100 year rainfall, M100 (mm)	30 year Total surf water (m <sup>3</sup> )	100 year Total surf water (m <sup>3</sup> )	Permit dischrge (2 years) (m <sup>3</sup> )	30 year Storage vol. reqd (m <sup>3</sup> )	100 year Storage vol. reqd (m <sup>3</sup> )
5	0.39	11.01	1.45	1.92	16.01	21.12	39.4	52.0	0.96	38.4	51.0
10	0.52	14.65	1.45	1.95	21.25	28.53	52.3	70.2	1.92	50.3	68.3
15	0.63	17.73	1.45	1.98	25.65	35.06	63.1	86.3	2.88	60.2	83.4
30	0.80	22.49	1.47	2.01	33.14	45.32	81.5	111.5	5.76	75.8	105.7
60	1.00	28.00	1.52	2.02	42.65	56.50	104.9	139.0	11.52	93.4	127.5
120	1.21	33.79	1.55	1.99	52.37	67.40	128.8	165.8	23.04	105.8	142.8
240	1.45	40.51	1.52	1.97	61.57	79.74	151.5	196.2	46.08	105.4	150.1
360	1.60	44.89	1.52	1.96	68.24	87.78	167.9	215.9	69.12	98.7	146.8
600	1.79	50.21	1.50	1.94	75.12	97.40	184.8	239.6	115.2	69.6	124.4
1440	2.24	62.72	1.50	1.92	93.83	120.40	230.8	296.2	276.48	-45.7	19.7

worse case volume = 150