

BELLWAY HOMES

LAND AT THE FORMER DEE ROAD FIRE STATION, READING

DRAINAGE TECHNICAL NOTE

REPORT REF.
2107330-02

July 2022

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AW

B. Brooks

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Appendices

Appendix A – Preliminary Drainage Strategy

Appendix B – Topographic Survey

Appendix C – Extracts from Wardell Armstrong's Ground Investigation

Appendix D – Thames Water Asset Plans

Appendix E – Source Control Calculations

Appendix F – SuDS Maintenance Schedule

1.0 INTRODUCTION

Scope

- 1.1 Ardent Consulting Engineers (ACE) has been commissioned by **Bellway Homes** to advise on flood risk and drainage matters concerning the proposed residential development on Land at the former Dee Road Fire Station, Tilehurst, Reading, RG30 4FS.
- 1.2 The following sections outline the existing site characteristics, flood risk environment, surface water drainage, foul water drainage, and sewer removals.
- 1.3 This briefing note should be read in conjunction with Ardent Consulting Engineers' drawing 2107330-005 entitled *Preliminary Drainage Strategy* included in **Appendix A**.

2.0 SITE CHARACTERISTICS

Existing Site Description

- 2.1 The site is approximately 0.97ha in area and is in Tilehurst, Reading. It is situated within the administrative boundary of Reading Borough Council, approximately centered on Ordnance Survey grid co-ordinates 468526mE, 173359mN.
- 2.2 The site is brownfield and currently encompasses the former Dee Road Fire Station. Under Reading Borough Council's *WR3m "103 Dee Road" Policy* in its *2019 Local Plan*, the site is allocated for residential development (subject to the fire station being surplus to requirements). The former fire station comprises of various sized buildings surrounding a hard-standing car park. The most significant buildings are located on the site's southern perimeter adjacent to Dee Road.
- 2.3 The site is bound by Spey Road along its eastern boundary with Dee Road laying adjacent to the site's southern perimeter. To the west, residential properties within Gairn Close border the proposed development while Leven Street is situated along the site's northern boundary.
- 2.4 In terms of topography, the site exhibits steep falls in an easterly direction. The shape of the proposed development area means the site falls at a greater magnitude across the south (1:21) rather than in the north (1:26). Levels peak in the south west at 61.73mAOD and culminate with a low point of 56.74mAOD in the site's south-east. The topography is included for reference in **Appendix B**.
- 2.5 The British Geological Survey (BGS) *Geology of Britain* viewer suggests that the site is underlain by the Lambeth Group bedrock – a combination of clay silt and sand. There are no recorded superficial deposits across the site.
- 2.6 Ground investigations at the site were undertaken by Wardell Armstrong in October 2020. The ground investigation confirmed the findings from the BGS – finding solid deposits of the Lambeth Group at the site. Extracts from the ground investigation are included in **Appendix C**.

Current Surface Water Drainage Strategy

- 2.7 The site is predominantly buildings and hardstanding with a series of gravity-based sewers used to drain runoff from the site. Information on the existing foul water

strategy has been collated from both Thames Water asset plans and a drainage survey in the topographical data. The topographic survey is included in **Appendix B** and asset plans obtained from Thames Water are in **Appendix D**.

- 2.8 The drainage strategy shows the existing site discharges surface water to catchpits along Spey Road to the site's east. The northern section of the site discharges runoff to Thames Water manhole 5350 located adjacent to the north-eastern section of the site, with the rest of the site discharging to an existing on-site manhole south of this. A series of gullies are used across the car parking areas to drain the surface runoff generated from the large impermeable areas. After receiving flow from the proposed area of development, Thames Water's manholes on Spey Road convey surface water northwards using a 225mm diameter gravity pipe. Plans showing the extent of existing Thames Water assets can be seen in **Figure 2-1** below and found in **Appendix D**.

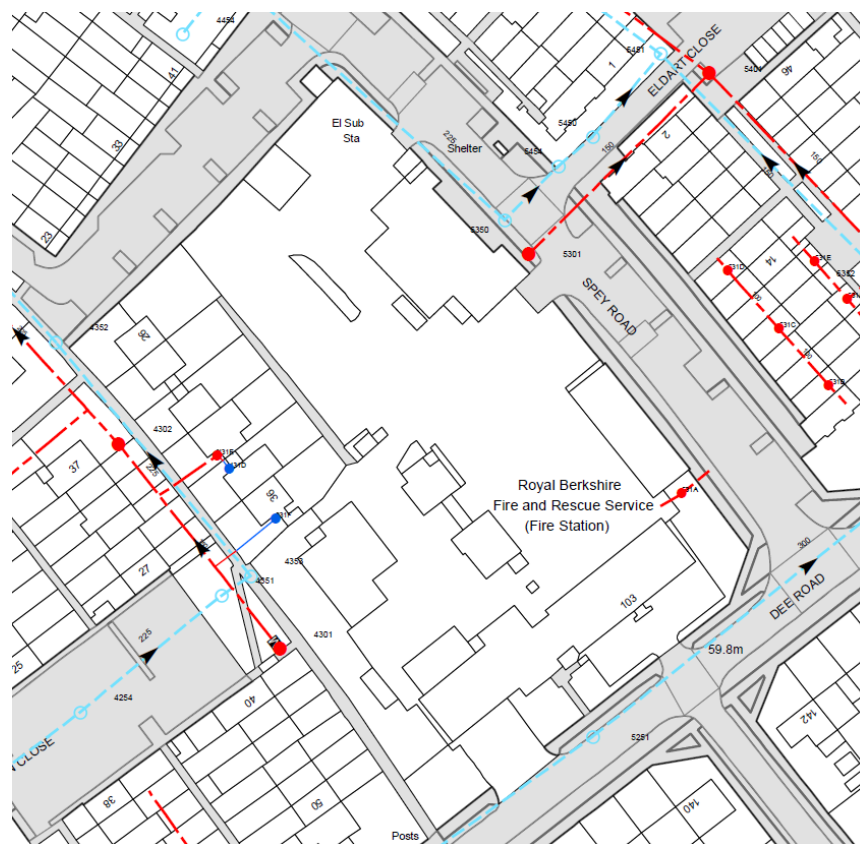


Figure 2-1: Thames Water Asset Plans

3.0 FLOOD RISK ENVIRONMENT

Technical Standards

- 3.1 The EA Flood Map for the site and surrounding area designates the site to be entirely within Flood Zone 1; a very low risk of fluvial and tidal flooding which corresponds to an annual flood probability of less than 0.1% (less than 1 in 1000-year-return period).
- 3.2 The EA's Flood Maps also determine the site to not be at risk of flooding from the failure of reservoirs within the wider area.
- 3.3 Mapping from the EA also suggest the site is deemed completed at 'very low' risk from surface water flooding.
- 3.4 The DEFRA Magic Map suggests that the site is located in an area of 'high' risk of groundwater flooding. However, there were no water strikes in any of the intrusive works undertaken by Wardell Armstrong in their ground investigation at the site, with soakaway drainage considered 'viable' if more testing was carried out. Subsequently, considering all buried storage and permeable paving at the site will also be lined, the risk of groundwater flooding is considered 'low'.

4.0 SURFACE WATER DRAINAGE

Technical Standards

- 4.1 The surface water drainage strategy for the proposed development is in accordance with the following technical standards and best practice guidance, which are referred to throughout this section:
- The CIRIA SuDS Manual (C753);
 - Non-statutory technical standards for sustainable drainage systems. A Best Practice Guidance was published by the Local Authority SuDS Officer Organisation (LASOO) in July 2015 to accompany this document;
 - BS8582 Code of practice for surface water management for development sites; and
 - The National Planning Policy Framework.

Surface Water Drainage Options Consideration

- 4.2 In line with CIRIA guidance C753 (The SuDS manual), the drainage hierarchy needs to be considered and is listed below in order of preference:
- Store rainwater for later use;
 - Use infiltration techniques, such as porous surfaces in non-clay areas;
 - Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse;
 - Discharge rainwater direct to a watercourse;
 - Discharge rainwater to a surface water drain; and
 - Discharge rainwater to the combined sewer.

Store rainwater for later use

- 4.3 There is potential to reuse a percentage of the rainwater within the site by installing water butts on each unit. However, this only accounts for a limited proportion of the runoff during a storm event, therefore options further down the hierarchy need to be considered to serve the site.

Use infiltration techniques, such as porous surfaces in non-clay areas

- 4.4 Information and data on groundwater vulnerability at the site vary. While ground investigations incurred no water strikes at the site, DEFRA magic mapping at the site classes the area at being of 'high' risk of groundwater flooding. The contrast in information on ground conditions means infiltration at the site has been discounted.

Attenuate rainwater by storing for gradual release to a watercourse

- 4.5 There are no existing watercourses within the vicinity of the site, so this option has been discounted.

Discharge rainwater direct to a watercourse

- 4.6 There are no existing watercourses within the vicinity of the site, so this option has been discounted.

Discharge rainwater to a surface water drain

- 4.7 There are both existing Thames Water surface water sewers and existing on-site sewers within the vicinity of the site.
- 4.8 Existing 225mm diameter surface water sewers are located within Spey Road with two manholes located adjacent to the site's eastern perimeter.
- 4.9 The depth of the manholes along Spey Road enables gravity connections from the proposed on-site surface water network to be possible; therefore, this is the preferred drainage option.
- 4.10 Sustainable Drainage Systems (SuDS) Hierarchy **Table 4-1** below appraises the constraints and opportunities for the use of SuDS techniques within the site and it adopts the management train approach outlined in CIRIA C753 'The SuDS Manual'.

Table 4-1: C753 SuDS Hierarchy, Site Assessment

Type:	Infiltration Devices (Source Control)
Constraints:	Infiltration has been discounted due to contrasting information on the suitability of infiltration at the site. DEFRA magic mapping suggest that the area is at 'high' risk of groundwater, however there was an absence of groundwater strikes during a ground investigation at the site.
Opportunities:	None.
Type:	Lined Permeable Paving (Source Control)
Constraints:	The use of permeable paving with infiltration is not suitable, see infiltration devices above. The effectiveness of Permeable Paving is dependent upon regular maintenance, in private areas this cannot be assured.
Opportunities:	It is the intention to construct lined permeable paving underneath the parking courts across the site. The permeable paving will use Type sub-base of 500mm.
Type:	Swales, Bio-retention etc. (Permeable Conveyance)
Constraints:	Swales are restricted to a maximum 1 in 3 side slope which have a significant land take, particularly when accommodating headwalls from adoptable sewer networks as proposed within this development.
Opportunities:	None.
Type:	Attenuation Basin / Ponds (end of pipe treatment)
Constraints:	Basins require significant land take and need to be designed with a flat base to maximise storage potential.
Opportunities:	None.
Type:	Attenuation Tanks (end of pipe treatment)
Constraints:	None.
Opportunities:	The attenuation tanks are being used to store water and help the system maintain control of surface water flows at the site. They are being located along the main adoptable road in the southern catchment while two small storage tanks are being used in the northern catchment.

Proposed Surface Water Drainage Strategy

- 4.11 The proposed strategy has been designed using a 40% allowance for climate change during the 1-in-100 year return period. Using *Innovyze's* MicroDrainage module

Source Control, the amount of storage required to serve each catchment was calculated and then distributed across SuDS storage options on site. A breakdown of the volumes required for storage can be seen on drawing 2107330-005 in **Appendix A**. The full calculations from *Source Control* are included in **Appendix D**.

- 4.12 After consideration of the CIRIA C753 approach, the most viable SuDS options for this development parcel are the use geocellular storage tanks and lined permeable paving. The permeable paving is to have a voids ratio of 30% along with Type 3 sub-base at 500mm storage depth. Due to the steepness of site, an efficiency of 60% is assumed at all the permeable paving. The geocellular tanks are used to provide the majority of storage in each catchment with a porosity of 95% making the tanks highly efficient.
- 4.13 The surface water runoff from the site will discharge into the Thames Water Surface water sewers to the east of the site. Surface water design calculations have been carried out for the following storm events; 1 in 1 and 1 in 100 year plus 40% climate change allowance. The existing runoff, greenfield rates and post development rates have been summarised within **Table 4-2** below and can be found in full within **Appendix D**. The results show significant betterment on the existing rates at the site.

Table 4-2: Development Runoff Rates

Storm Event	Existing Brownfield Runoff Rates (l/s)	Greenfield Runoff Rates (l/s)	Proposed Post Development Discharge Rates (l/s)	Reduction in pre and post development rates (%)
1 in 1 year	150.5	0.3	5	96.7%
1 in 100 year	388	1.3	5	99.7%
1 in 100 year + 40% CC	n/a	n/a	5	n/a

- 4.14 The impermeable area of the proposed development has been estimated from the site plan and includes an allowance of 10% for urban creep on house and garage

roofs. Note, this does not include the proposed flats to the north of the site. At each catchment's proposed discharge points into the Thames Water network, Hydro-Brake flow controls have been used to limit the discharge rates to 2.5l/s for up to and including the 1 in 100-year storm events plus 40% climate change allowance.

- 4.15 The Surface Water Drainage Strategy is shown in **Appendix A** and indicates how the site will be drained, including details of the SuDS features, the indicative piped network and discharge location.

Long Term Storage

- 4.16 The site will discharge at a greatly reduced rate from the existing site and reduce the overall impermeable area and as a result, the provision of long term storage will not be required.

Surface Water Runoff Quality

- 4.17 An assessment of the water quality of surface water runoff has been carried out in line with CIRIA C753 requirements.
- 4.18 In determining the necessary SuDS treatment methods, reference is made to Table 26.2 and Table 26.3 of the SuDS Manual (CIRIA C753), which have been duplicated in **Tables 4-3** and **4-4** on the following pages. The tables outline the 'Simple Index Approach' which sets out the water treatment criteria in relation to land use and SuDS performance evidence. To ensure sufficient treatment is proposed for surface waters, the total pollution mitigation index of the selected SuDS methods must equal or exceed the pollution hazard index for the site.

Table 4-3: Pollution Hazard Indices for Different Land Use Classifications
(land use in bold applicable for the development)

Land use	Pollution hazard level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2	0.05

Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

Table 4-4: Indicative SuDS Mitigation Indices for Discharges to Surface Waters

Type of SuDS component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio retention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8

4.19 **Table 4-5** below analyses the mitigation indices for the use of permeable paving as SUDS at the proposed development, demonstrating the proposals will be able to achieve suitable levels of surface water treatment prior to runoff leaving the site. With the absence of SUDS features at the existing brownfield site, the high quantity of proposed permeable paving means a substantial betterment is provided on the existing drainage network. It has therefore been demonstrated that adequate treatment is provided within the proposed SuDS network prior to discharge of run-off

into Thames Water's sewer network.

Table 4-5: Mitigation Indices Analysis of Runoff at the Site

For surface water discharge from Residential Parking Areas and Low Traffic Roads <300 traffic movements/day			
	Required Mitigation Indices		
Source	TSS	Metals	Hydrocarbons
Low	0.5	0.4	0.4
Minimum SuDS Component Provided			
Permeable Paving	0.7	0.6	0.7
Benefit	+0.2	+0.2	+0.3

Exceedance Routes

- 4.20 As a result of heavy or extreme storm events it is sometimes unavoidable for the capacity of sewers and other drainage systems to be exceeded. Drainage exceedance will occur when the rate of surface water runoff exceeds the inlet capacity of the drainage system, when the receiving water or pipe system becomes overloaded, blocked or when the downstream Thames Water sewer network becomes overloaded or blocked.
- 4.21 The overland exceedance routes follow the contours of the on-site roads and drives across the site, mimicking the current flow routes associated with the existing site's topography. The overland flow exceedance routes are demonstrated in drawing 2107330-005 in **Appendix A**.

Future Maintenance and Adoption

- 4.22 It is the intention that the sewers underlying the main access road will be adopted by Thames Water under a Section 104 agreement.
- 4.23 The management and maintenance of the permeable paving and geocellular storage tanks will be the responsibility of a private management company.
- 4.24 All the plot drainage at the site will remain private whilst all gullies and connections

within adoptable roads will be offered to West Berkshire County Council for adoption.

- 4.25 Regular maintenance will be required to ensure that the drainage system is working effectively, reducing the risk of flooding. The tables below outline the maintenance requirement of the drainage components which will be serving the proposed development. These have been informed by the guidance outlined within CIRIA C753 and best practice guidance.

Maintenance Regime for Flow Controls, Manholes, Chambers and Pipes

Location (refer to drawing 2107330-005): Pipework and manholes located beneath the private drives at the site (non-adoptable drainage systems). Flow control location specified on drawing 2107330-005.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove sediment, debris and litter from the drainage catchment	Monthly or as required
	Remove any root ingress from chambers/pipework	As required
	Remove sediment and debris from chambers/manholes	Annually
Occasional Maintenance	CCTV survey of drains to check alignment, cracking and joint displacement	10-year intervals
Remedial Actions	Repair/rehabilitation of pipes and chamber/manhole covers.	As required
Monitoring	Initial inspection	Monthly for 3 months after installation
	Inspect for evidence of poor operation, weed growth and/or excessive sediment build-up. If required take remedial action	3-monthly, 48 hours after large storm
	Inspect silt accumulation rates and establish appropriate clearance rates	Annually
	Monitor chambers and manholes	Annually

Maintenance Regime for Permeable Paving

Location (refer to drawing 2107330-005): Numerous locations across north and southern catchments at the site.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after Autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations- particular attention is to be paid to areas where water runs on to pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements.
Remedial Actions	Repair/rehabilitation of inlets and outlets	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of the pavement or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper sub-structure by remedial sweeping.	Every 10-15 years or as required
Monitoring	Initial inspection	Monthly for 3 months after installation
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action.	3-monthly, 48 hours after large storm
	Inspect silt accumulation rates and establish appropriate clearance rates	Annually
	Monitor chambers and manholes	Annually

4.26 A maintenance plan is also included in **Appendix E**. These have been informed by the guidance outlined within CIRIA C753 and would be supplemented by manufacturer's specifications.

5.0 FOUL WATER DRAINAGE

- 5.1 The existing site contains a series of gravity-based pipes and manholes to discharge foul water. Information on the existing foul water strategy has been collated from both Thames Water asset plans and a drainage survey in the topographical data.
- 5.2 All existing foul drainage on-site discharges to Thames Water Manhole 5301 located at the junction of Spey Road with Eldart Close. The foul water is currently conveyed with the site's topography via a gravity-based system outside the eastern perimeter of the proposed development to Thames Water Manhole 5301. At this point, a 150mm diameter pipe conveys the foul discharge eastwards along Eldart Close.
- 5.3 The proposed foul drainage network at the site will be partially adopted. Foul drainage assets underlying the main access road through the site's centre will be adopted, with all other foul drainage to remain private (foul pipes/manholes underneath private drives, plot drainage and laterals).
- 5.4 It is proposed that foul water from the development will utilise a similar arrangement to the existing network by discharging to Thames Water Manhole 5301. There will be three main foul runs across the site, each serving either the north, south or centre of the development via a gravity-based system. The point of connection is subject to confirmation of sufficient capacity from Thames Water.

6.0 CONCLUSION

- 6.1 The development proposals are to construct a total of 63 dwellings and associated car parking and infrastructure.
- 6.2 The site is shown to be wholly within Flood Zone 1 and at 'low' risks from all possible types of flooding. The proposed development would not be at risk of flooding or increase the flood risk to others as a result.
- 6.3 The quality of surface water runoff has been assessed based on guidance within CIRIA C753 SuDS Manual. The results demonstrate that both catchments receive adequate treatment, and provides a greatly improved treatment on the existing site prior to discharging to the Thames Water network.
- 6.4 The surface water drainage is discharging to the existing Thames Water network within Spey Road using a gravity-based system. Surface water storage design calculations have been carried out for the 1 in 1 and 1 in 100 year plus climate change allowance storm events. The use of lined permeable paving and buried storage at the site has allowed for adequate storage of surface runoff in each catchment.
- 6.5 A 40% allowance for climate change was applied to the rainfall intensities and a 10% allowance for future urban creep has been applied to the impermeable areas.
- 6.6 The foul water drainage is discharged to existing Thames Water foul network, located within Spey Road via a gravity connection.
- 6.7 This Technical Note demonstrates that the proposals are consistent with the aims of the technical standards and the site can successfully drain the surface and foul water from the site to the Thames Water sewer network.

Appendix A

Foul and Surface Water Drainage Strategy



NOTE: PROPOSED LINED PERMEABLE PAVING TO RECEIVE RUNOFF FROM PARKING BAYS & ROAD AND DISCHARGE TO PIPED SURFACE WATER NETWORK VIA 50mm ORIFICE PLATES (PROPRIETARY ORIFICE FLOW CONTROL CHAMBER WITH INBUILT TRASH SCREEN AS 'RIDGISTORMcheck' BY POLYPIPE OR SIMILAR).

NOTE: CCTV SURVEY REQUIRED TO DETERMINE WHETHER OFF-SITE CONNECTIONS ARE PRESENT AT THE SITE.

- NOTES:**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION, INC. RISK ASSESSMENTS (SEE CDM NOTES) AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
 - DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
 - ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES UNLESS OTHERWISE STATED.
 - ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
 - NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
 - ANY WORKS OUTSIDE RED SITE BOUNDARY ARE FOR INFORMATION PURPOSES ONLY. UNLESS SPECIFICALLY NOTED, ALL WORKS OUTSIDE THE SITE BOUNDARY WILL BE UNDERTAKEN BY OTHERS UNDER A SEPARATE CONTRACT.
 - REFER TO ARCHITECTS AND STRUCTURAL ENGINEERS DETAILS FOR BOTH RAISED DPC / FLUSH THRESHOLD DETAIL AND TANKING DETAIL.
 - ALL MATERIALS AND WORKMANSHIP SHALL COMPLY FULLY WITH THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS, VOLUME ONE, SPECIFICATION FOR HIGHWAY WORKS AND THE LOCAL AUTHORITY SPECIFICATION FOR ROAD CONSTRUCTION AND STANDARD DETAILS.
 - THE PUBLIC HIGHWAY AND WORKS WILL BE KEPT CLEAN AND FREE OF DEBRIS BY USE OF WHEEL WASHING FACILITIES AND ROAD SWEEPERS TO THE COUNCIL'S SATISFACTION.
 - ALL SETTING OUT SHALL BE AGREED ON-SITE WITH THE ENGINEER, PRIOR TO THE COMMENCEMENT OF THE WORKS.
 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY APPROVALS FROM THE LOCAL AUTHORITY PRIOR TO COMMENCING WORKS ON THE HIGHWAY.

- CONSTRUCTION NOTES:**
- ALL SOFT SPOTS AND VOIDS SHALL BE REMOVED BEFORE CONSTRUCTION AND REPLACED WITH SUITABLE FILL MATERIAL.
 - ROAD FORMATION TO BE IN ACCORDANCE WITH CLAUSE 6.16 AND COMPACTED IN ACCORDANCE WITH TABLE THE REQUIREMENTS OF 6/4 OF THE SPECIFICATION FOR HIGHWAY WORKS - SERIES 600 EARTHWORKS.
 - APPROVED RESIDUAL WEEDKILLER, WHICH DOES NOT CONTAIN ATRAZINE OR SIMAZINE, MUST BE APPLIED TO ALL FORMATIONS.
 - ALL CONCRETE AND CEMENT MORTAR MUST BE SULPHATE RESISTING TO BS 4021.
 - ALL CARRIAGEWAY MATERIALS SHALL BE SUPPLIED AND LAID IN ACCORDANCE WITH BS EN 13108-1.
 - ALL MATERIALS IN CARRIAGEWAYS TO BE LAID BY MACHINE.
 - MINIMUM DEPTH OF 450mm CONSTRUCTION IS REQUIRED FOR NON-FROST SUSCEPTIBLE MATERIAL.
 - THE CONTRACTOR MUST VERIFY CBR VALUES ALONG EACH ACCESS ROAD AT 30m INTERVALS, THE RESULTS OF WHICH MUST BE SENT TO THE ENGINEER FOR CONFIRMATION OF THE CARRIAGEWAY CONSTRUCTION SHOWN ON THIS DRAWING, PRIOR TO COMMENCING THE WORKS.

- CDM NOTES:**
- THE ATTENTION OF THE CLIENT AND THE PRINCIPAL CONTRACTOR IS DRAWN TO THE FOLLOWING POTENTIAL RISKS IN CONJUNCTION WITH THE PROPOSED ON-SITE AND OFF-SITE WORKS AS DESIGNED FOR THIS PROJECT:
 - WORKS IN THE VICINITY OF LIVE SERVICES WILL BE NECESSARY AND THE ADVICE OF ALL STATUTORY SERVICE COMPANIES MUST BE SOUGHT BEFORE ANY WORKS COMMENCE.
 - WORKS WITHIN AND ABUTTING THE EXISTING HIGHWAY WILL ENTAIL TRAFFIC HAZARDS AND ALL APPROPRIATE SAFETY MEASURES INCLUDING BARRIERS, SIGNS AND LIGHTING MUST BE UNDERTAKEN TO THE APPROVAL OF THE LOCAL AUTHORITY, THE HIGHWAY AUTHORITY AND THE POLICE.
 - HAZARDOUS MATERIALS INCLUDING CEMENT AND BITUMINOUS MATERIALS ARE SPECIFIED AND THE MANUFACTURER'S ADVICE ON SAFE HANDLING PROCEDURES MUST BE OBTAINED AND MADE CLEAR TO ALL OPERATIVES.
 - THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL EXISTING SERVICES WITHIN THE VICINITY OF THE WORKS AND ENSURE THESE ARE PROTECTED THROUGHOUT THE DURATION OF THE WORKS. ALL UTILITY PLANT SHOULD BE CLEARLY MARKED ON THE GROUND PRIOR TO COMMENCEMENT OF THE WORKS.
 - THE CONTRACTOR MUST ENSURE ALL WORKING AREAS ARE FULLY SECURE.

SOUTHERN CATCHMENT
DEVELOPMENT AREA: 0.84ha
PERCENTAGE IMPERMEABLE: 42%
MEASURED IMPERMEABLE AREA: 0.35ha
DISCHARGE RATE: 2.5l/s
TOTAL STORAGE VOLUME: 211m³

TOTAL PERMEABLE PAVING PROVIDED ACROSS NORTHERN CATCHMENT:
PERMEABLE PAVING AREA: 279m²
DEPTH: 500mm
VOID RATIO: 30%
EFFICIENCY: 60%
TOTAL PERMEABLE PAVING STORAGE: 25m³

GEOCELLULAR STORAGE TANK 3.0
COVER LEVEL: 57.55m AOD
SOFFIT LEVEL: 56.65m AOD
INVERT LEVEL: 55.85m AOD
PLAN AREA: 87m²
AVE. DEPTH OF STORAGE: 0.8m
POROSITY: 95 %
VOLUME OF STORAGE: 66m³

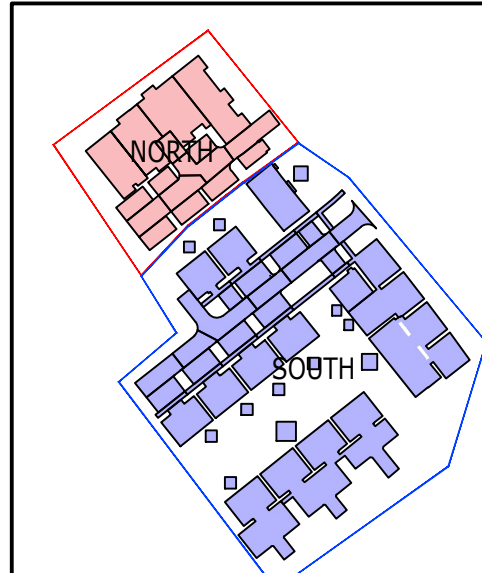
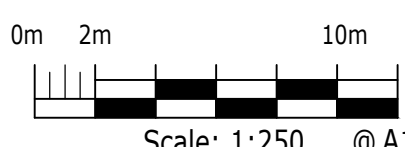
GEOCELLULAR STORAGE TANK 5.0
COVER LEVEL: 58.50m AOD
SOFFIT LEVEL: 57.60m AOD
INVERT LEVEL: 56.80m AOD
PLAN AREA: 67m²
AVE. DEPTH OF STORAGE: 0.8m
POROSITY: 95 %
VOLUME OF STORAGE: 51m³

GEOCELLULAR STORAGE TANK 4.0
COVER LEVEL: 57.80m AOD
SOFFIT LEVEL: 56.90m AOD
INVERT LEVEL: 56.10m AOD
PLAN AREA: 28m²
AVE. DEPTH OF STORAGE: 0.8m
POROSITY: 95 %
VOLUME OF STORAGE: 21m³

TOTAL PERMEABLE PAVING PROVIDED ACROSS SOUTHERN CATCHMENT:
PERMEABLE PAVING AREA: 817m²
DEPTH: 500mm
VOID RATIO: 30%
EFFICIENCY: 60%
TOTAL PERMEABLE PAVING STORAGE: 73m³

FOUL AND SURFACE WATER DRAINAGE KEY

- DEVELOPMENT BOUNDARY
- PROPOSED ADOPTABLE FOUL WATER SEWER & MANHOLE (WITH MANHOLE REF. No.)
- PROPOSED ADOPTABLE SURFACE WATER SEWER & MANHOLE (WITH MANHOLE REF. No.)
- EXISTING THAMES WATER FOUL WATER SEWER & MANHOLE
- EXISTING THAMES WATER SURFACE WATER SEWER & MANHOLE
- MANHOLE REFERENCE COVER LEVEL (TEXT COLOUR INDICATES PROPOSED NETWORK TYPE)
- PROPOSED BURIED STORAGE
- PROPOSED PERMEABLE PAVING (30% VOIDS)
- FW TYPE 4 NON-ENTRY ACCESS CHAMBER (4500) MAX DEPTH TO INVERT 3m OR 'TEGRA' NON-ENTRY ACCESS CHAMBER (6000)
- SW TYPE 4 NON-ENTRY ACCESS CHAMBER (4500) FOR PIPE DIAMETERS OF 150mm OR LESS. MAX DEPTH TO INVERT 3m
- OVERLAND EXCEEDANCE ROUTE
- PROPOSED FINISHED FLOOR LEVEL



Catchment	North	South
Catchment Storage Required (m³)	85	204
Permeable Paving Storage (m³)	25	73
Tank Storage (m³)	62	138
Total Storage Provided (m³)	87	211

FOR PLANNING

NOT FOR CONSTRUCTION

A	UPDATED TO SUIT SITE LAYOUT.	AW	AW	BB	28.07.22
Rev	Description	Drn	Chk	App	Date

ARDENT CONSULTING ENGINEERS

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The Hallmark Building
52-56 Leadenhall Street
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Client

BELLWAY HOMES

Project Title:

**DEE ROAD FIRE STATION
DEE ROAD, READING**

Drawing Title:

PROPOSED DRAINAGE STRATEGY

A1 Scale	Date	Designed by
1:250	JULY 2022	JL
Drawn by	Checked by	Approved by
JL	AW	BB

Drawing Number

2106740-005

Rev

A

**Appendix B
Topographic Survey**

173450 N

468400 E

468450 E

468500 E

468550 E

468600 E

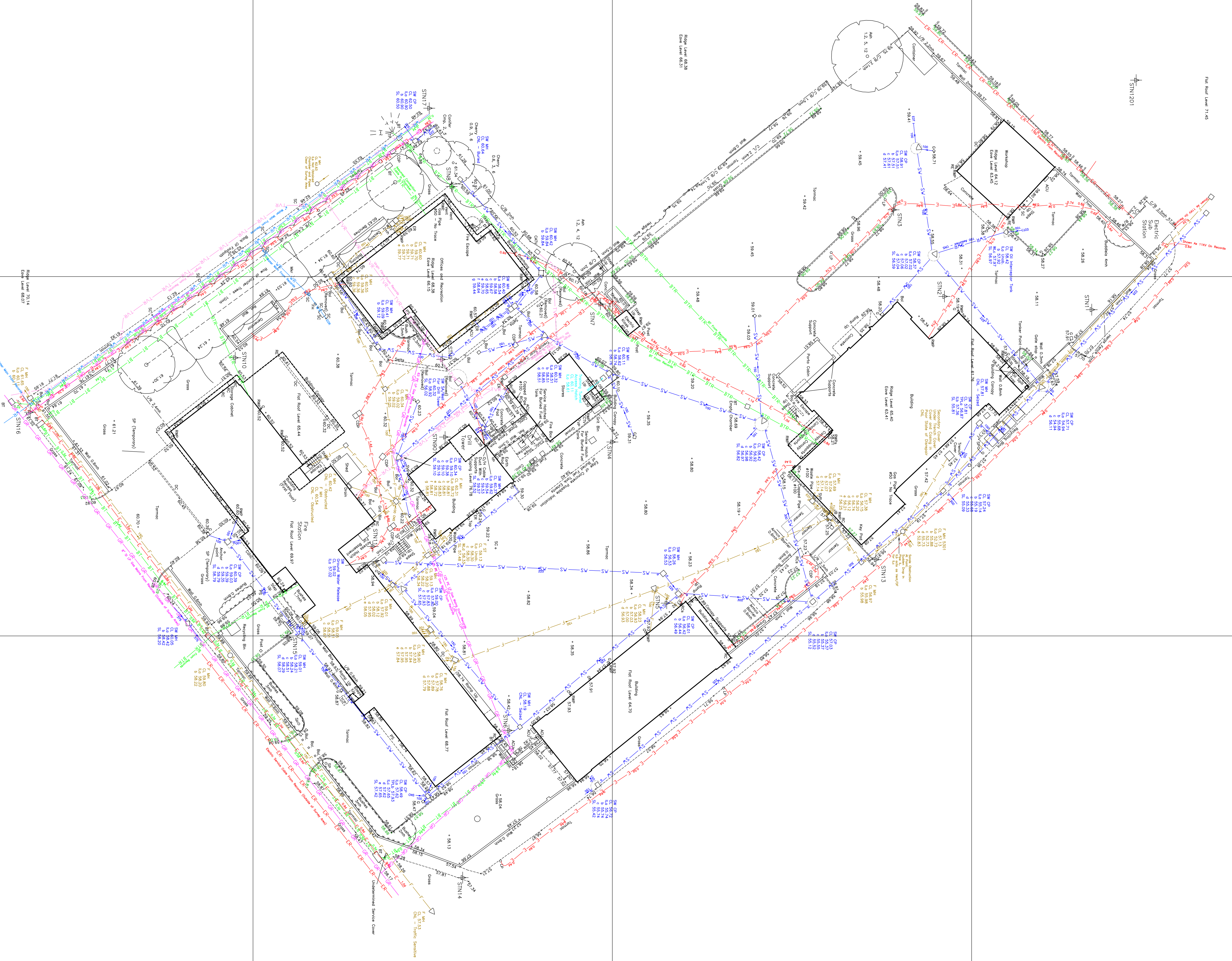
173450 N



Station Service	No. Vis Points
Records Provided	✓
Built-in Telecom	✓
CATV	✓
Electric	✓
Foul Sewer	✓
Gas	✓
Surface Water Sewer	✓
Water	✓

Stn No.	Eastings	Northings	Level
1	468500.000	72410.000	58.000
2	468500.000	72410.000	58.000
3	468500.000	72410.000	58.000
4	468500.000	72410.000	58.000
5	468500.000	72410.000	58.000
6	468500.000	72410.000	58.000
7	468500.000	72410.000	58.000
8	468500.000	72410.000	58.000
9	468500.000	72410.000	58.000
10	468500.000	72410.000	58.000
11	468500.000	72410.000	58.000
12	468500.000	72410.000	58.000
13	468500.000	72410.000	58.000
14	468500.000	72410.000	58.000
15	468500.000	72410.000	58.000
16	468500.000	72410.000	58.000
17	468500.000	72410.000	58.000
18	468500.000	72410.000	58.000
19	468500.000	72410.000	58.000
20	468500.000	72410.000	58.000
21	468500.000	72410.000	58.000
22	468500.000	72410.000	58.000
23	468500.000	72410.000	58.000
24	468500.000	72410.000	58.000
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31	468500.000	72410.000	58.000
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33	468500.000	72410.000	58.000
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39	468500.000	72410.000	58.000
40	468500.000	72410.000	58.000
41	468500.000	72410.000	58.000
42	468500.000	72410.000	58.000
43	468500.000	72410.000	58.000
44	468500.000	72410.000	58.000
45	468500.000	72410.000	58.000
46	468500.000	72410.000	58.000
47	468500.000	72410.000	58.000
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95	468500.000	72410.000	58.000
96	468500.000	72410.000	58.000
97	468500.000	72410.000	58.000
98	468500.000	72410.000	58.000
99	468500.000	72410.000	58.000
100	468500.000	72410.000	58.000

Station 4 has O.S. National Grid coordinates. Based on the National Grid network using state GPS network. Station 4 has an origin at Station 4 and preserving the O.S. National Grid rotation but with O.S. scale factor removed.



CONTROL DATA	FEATURES
Survey Station	Feature Name
Level Data	Feature Name
Spot Levels	Feature Name
Contours	Feature Name
Tree Symbols	Feature Name
Overhead Cables	Feature Name
Fence Types	Feature Name
Other	Feature Name

At 100m	At 100m
At 200m	At 200m
At 300m	At 300m
At 400m	At 400m
At 500m	At 500m
At 600m	At 600m
At 700m	At 700m
At 800m	At 800m
At 900m	At 900m
At 1000m	At 1000m
At 1100m	At 1100m
At 1200m	At 1200m
At 1300m	At 1300m
At 1400m	At 1400m
At 1500m	At 1500m
At 1600m	At 1600m
At 1700m	At 1700m
At 1800m	At 1800m
At 1900m	At 1900m
At 2000m	At 2000m
At 2100m	At 2100m
At 2200m	At 2200m
At 2300m	At 2300m
At 2400m	At 2400m
At 2500m	At 2500m
At 2600m	At 2600m
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At 4000m	At 4000m
At 4100m	At 4100m
At 4200m	At 4200m
At 4300m	At 4300m
At 4400m	At 4400m
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At 5100m	At 5100m
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At 8100m	At 8100m
At 8200m	At 8200m
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At 40700m	At 40700m
At 40800m	At 40800m
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At 41000m	At 41000m
At 41100m	At 41100m
At 41200m	At 41200m
At 41300m	At 41300m
At 41400m	At 41400m
At 41500m	At 41500m
At 41600m	At 41600m
At 41700m	At 41700m
At 41800m	At 41800m
At 41900m	At 41900m
At 42000m	At 42000m

Appendix C

Extracts from Wardell Armstrong's Ground Investigation

investigation in this regard is likely to take the form of cable percussion boreholes and a range of specific geotechnical laboratory testing.

- 7.11 The underlying Chalk strata at the site is at risk of forming dissolution features particularly due to the presence of overlying Lambeth Group deposits. Should high rise structures be intended for the development site, further site investigation will be required to establish the presence of solutions pipes/ cavities. Investigation techniques could include deep ground probing.
- 7.12 Due to the presence clay soils which may have potential for volume change, it is considered at this stage that suspended floor slabs should be utilised with heave precautions for both a residential or commercial development however further testing and assessment of clay soils is required. As appropriate, foundations should be designed in accordance with chapter 4.2 of NHBC Standards 2020 – ‘Building Near Trees’. The potential for trees to be included as part of the future developments at the site cannot be discounted and should be assessed in accordance with the NHBC Standards once known.
- 7.13 It is considered that buried concrete can be designed on the basis of a Design Sulphate Class DS-2 and an Aggressive Chemical Environment Concrete class AC-1s, assuming static groundwater conditions. It would be prudent to reassess concrete design when detailed development proposals are known.
- 7.14 The Lambeth Group deposits encountered at the site have potential for soakaway drainage, although this will require investigation and assessment.
- 7.15 Shallow groundwater was not encountered during the site investigation however may exist in other parts of the site therefore dewatering of excavations may be required. Additionally, excavations are unlikely to be stable in the short term.
- 7.16 The Envirocheck Report did not record potential for groundwater flooding to occur at the surface of the site within the site boundary however there is limited potential for groundwater flooding to occur immediately along the eastern boundary of the site. There is also a low risk of flooding from surface water immediately to the east of the site along Spey Road. The Environment Agency’s national flood mapping for

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468504.00 N173414.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
-------------------------------	-----------------------	------------------------	-------------------------	---------------------

Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.20	ES		0.20			Macadam	
		0.40	ES		0.35			MADEGROUND: Dark brownish black slightly ashy medium to coarse sand and gravel. Gravels comprise medium to coarse brick, stone, chalk and bitumen. Organic odour present.	
					0.60			Loose creamish grey becoming orangey grey medium to coarse SAND.	
					0.90			Soft orange brown silty CLAY.	
		1.00	SPT	N=15 (3,3/3,4,4,4)	1.30			Medium dense orange brown mottled grey silty SAND.	1
					1.80			Firm to stiff orange brown mottled grey very sandy SILT with occasional black partings of lignite	
		2.00	SPT	N=23 (3,4/5,5,6,7)	2.10			Stiff orange brown mottled grey very sandy gravelly SILT with occasional black partings of lignite. Gravels are coarse subangular flints.	2
					2.80			Stiff brown slightly sandy SILT.	
		3.00	SPT	N=24 (4,7/7,7,6,4)	3.10			Weak creamish white structureless weathered CHALK (Dm).	3
								Stiff white silt (melange) CHALK (Dm)	
		4.00	SPT	N=16 (4,4/4,4,4,4)					4
		4.50	B						

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.00m	66mm														
5.45m	51mm														

Remarks
Location CAT scanned. Organic odour present in made ground between 0.2m and 0.35m Borehole remained dry and stable on completion.

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS01
Sheet 2 of 2

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468504.00 N173414.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
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Instali. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT	N=17 (3,3/3,5,5,4)	5.45			Stiff white silt (melange) CHALK (Dm)	5
								End of Borehole at 5.45m	6
									7
									8
									9

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.00m	66mm														
5.45m	51mm														

Remarks
Location CAT scanned. Organic odour present in made ground between 0.2m and 0.35m Borehole remained dry and stable on completion.



Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS02
Sheet 1 of 2

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468499.00 N173376.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By Suvom Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
					0.25			Macadam	
		0.30	ES					MADEGROUND: Soft gravelly clay with occasional cobbles. Gravels and cobbles comprise brick, flint chalk and stone.	
		0.60	B		0.60				
		0.80	D					Stiff brown mottled greyish orange CLAY. Roots to 2mm diameter present to 1.3m.	
		1.00	SPT	N=16 (1,2/3,5,4,4)					1
					1.30			Stiff brown mottled greyish orange CLAY with occasionally inter-bedded with orange fine to medium slightly clayey sand. Fibrous and decomposing roots to 1.6m depth.	
					1.85			Medium dense fine to medium orange SAND.	2
		2.00	SPT	N=12 (3,3/3,3,3,3)					
					2.35			Stiff orange brown silty sandy CLAY inter-bedded with fine orange sand.	
		2.80	D						3
		3.00	SPT	N=13 (3,3/3,3,3,4)					
					3.50			Medium dense orange very silty SAND.	
		4.00	SPT	N=17 (3,3/4,4,4,5)					4
					4.10			Stiff dark orange brown silty sandy slightly gravelly CLAY. Gravels are of medium to coarse subangular flints.	
		4.80	D						

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.00m	66mm														
5.45m	51mm														

Remarks
Location CAT scanned. Roots encountered between 0.6m and 1.6m. Borehole remained dry and stable on completion.

Log printed on 14/10/2020 at 08:10

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS02
Sheet 2 of 2

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468499.00 N173376.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By Suvom Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT	N=15 (3,3/3,4,4,4)				Stiff dark orange brown silty sandy slightly gravelly CLAY. Gravels are of medium to coarse subangular flints.	5
					5.45			End of Borehole at 5.45m	6
									7
									8
									9

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.00m	66mm														
5.45m	51mm														

Remarks
Location CAT scanned. Roots encountered between 0.6m and 1.6m. Borehole remained dry and stable on completion.

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468536.00 N173355.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.04	ES		0.04			Macadam	
		0.10			0.10			MADEGROUND: Fine to medium black ashy gravel of stone.	
		0.23	ES		0.23			MADEGROUND: Medium to coarse gravel of brick, stone and concrete.	
		0.35			0.35			Thin layer (c.2mm) of carbonaceous material (vegetation) underlain by firm dark brown mottled black silty CLAY.	
		0.50			0.50			Soft dark orange grey mottled grey CLAY	
								Medium dense grey orange slightly silty clayey SAND.	
		1.00	SPT	N=14 (2,2/3,4,3,4)					1
		1.50	B		1.60				
		2.00	SPT	N=19 (3,3/4,5,5,5)				Very stiff light brown orange slightly sandy CLAY/SILT occasionally inter-bedded with medium subangular gravels of flint.	2
		2.70	D						
		3.00	SPT	N=19 (3,5/4,5,4,6)					3
					3.50				
		4.00	SPT	N=22 (11,7/6,5,4,7)				Very stiff dark brown clayey SILT with occasional coarse sub-angular flints.	4
					4.20				
		4.70	D					Weak white structureless CHALK with fine to medium sub-angular flints. (Dm).	

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.45m	51mm														

Remarks
Location CAT scanned. Borehole remained dry and stable on completion.

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS03
Sheet 2 of 2

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468536.00 N173355.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT	N=22 (7,5/6,5,5,6)	5.45			Weak white structureless CHALK with fine to medium sub-angular flints. (Dm).	5
								End of Borehole at 5.45m	6
									7
									8
									9

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.45m	51mm														

Remarks
Location CAT scanned. Borehole remained dry and stable on completion.

Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS04
Sheet 1 of 1

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468511.70 N173310.14
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 2.40
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
					0.03			Macadam Concrete (non-reinforced)	
		0.30	ES		0.30 0.40			MADEGROUND: Light brown slightly clayey gravel (stone sub-base). Dense creamish orange fine SAND occasionally thinly bedded with firm brown clay.	
		1.00	SPT	N=32 (4,6/6,8,9,9)	1.20			Dense fine grey SAND.	1
		1.70	ES		1.70			Very dense reddish brown gravelly SAND. Gravels comprise fractured tabular iron-rich mudstones (rusty appearance).	
		2.00	SPT	50 (10,12/15,15,13,7 for 20mm)	2.40			End of Borehole at 2.40m	2
									3
									4

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m 2.00m 2.40m 5.00m	116mm 102mm 51mm 66mm							0.00m	2.40m	90°					

Remarks
Location CAT scanned. Borehole terminated due to SPT refusal. Borehole remained dry and stable on completion.



Windowless Sample Borehole Log

BOREHOLE REFERENCE

WS05

Sheet 1 of 2

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468577.00 N173335.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.10	ES		0.10			Grass over spongy brown silty TOPSOIL with roots.	
					0.20			MADEGROUND: Brown silty sandy gravel with occasional brisk cobbles. Numerous roots present.	
		0.40	ES					MADEGROUND: Orange brown slightly sandy clay with occasional cobbles of brick. Numerous roots present.	
					0.60			Firm to stiff orange brown slightly sandy CLAY with occasional thin flint beds. Numerous fibrous roots present to 1.3m.	
		1.00	SPT	N=10 (3,3/2,3,2,3)					1
					1.30			Firm to stiff reddish orange brown silty gravelly CLAY. Gravels are of medium subrounded flints.	
		2.00	SPT	N=12 (2,2/2,3,3,4)					2
		2.10	D		2.10			Stiff light brown orange CLAY.	
					2.50			Medium dense orange brown coarse SAND with alternating medium beds of stiff brown CLAY.	
		3.00	SPT	N=13 (2,3/3,3,3,4)					3
		4.00	SPT	N=18 (4,4/6,4,4,4)					4
		4.80	D						

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.00m	66mm														
5.45m	51mm														

Remarks

Location CAT scanned. Fibrous roots encountered to 1.3m. Borehole remained dry and stable on completion.

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468577.00 N173335.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 5.45
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		5.00	SPT	N=9 (3,2/3,2,2,2)	5.45			Medium dense orange brown coarse SAND with alternating medium beds of stiff brown CLAY.	5
								End of Borehole at 5.45m	6
									7
									8
									9

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	5.45m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
5.00m	66mm														
5.45m	51mm														

Remarks
Location CAT scanned. Fibrous roots encountered to 1.3m. Borehole remained dry and stable on completion.



Windowless Sample Borehole Log

BOREHOLE REFERENCE
WS06
Sheet 1 of 1

Project Name: Dee Road Fire Station	Client: BNP Paribas Real Estate	Date: 02/09/2020
Location: Dee Road Fire Station, Tilehurst, Reading, RG30 4BX	Contractor: Exploration Ltd	Co-ords: E468519.00 N173289.00
Project No. : ST17828	Drilling Equipment: Competitor Dart	Level :

Logged By S Quinlan-Rahman	Checked By R.Bates	Approved By R.Bates	SPT Energy Ratio 67%	Final Depth 4.43
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Instal. / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	Scale
		Depth (m)	Type	Results					
		0.10			0.10			Grass over spongy brown silty TOPSOIL with roots.	
		0.20	ES		0.30			Firm dark brown slightly gravelly SILT. Gravels are of fine to medium sub-angular flints. Numerous fibrous roots present.	
		0.60	D		0.80			Stiff light brown slightly gravelly SILT. Numerous fibrous roots present to 0.8m.	
		1.00	SPT	N=12 (4,3/3,3,3,3)	1.25			Medium dense orange brown black dense slightly silty fine to medium SAND.	1
		1.50	D		2.70			Medium dense orange slightly silty fine to medium SAND.	2
		2.00	SPT	N=13 (2,3/3,3,3,4)	3.90			Medium dense creamish orange slightly silty fine SAND.	3
		3.00	SPT	N=24 (4,4/5,6,6,7)	4.10			Very stiff orange brown slightly sandy CLAY	4
		4.00	SPT	50 (5,6/9,11,15,15 for 60mm)	4.44			Very dense orange brown slightly clayey gravelly SAND. Gravels are of medium subangular flints.	
								End of Borehole at 4.43m	

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Installation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Top	Base	Inclination	Orientation	Top	Base	Pipe Type	Diameter
1.00m	116mm							0.00m	4.43m	90°					
2.00m	102mm														
3.00m	86mm														
4.00m	76mm														
4.44m	51mm														

Remarks
Location CAT scanned. Fibrous roots encountered to 0.8m. Borehole terminated due to SPT refusal. Borehole remained dry and stable on completion.

**Appendix D
Thames Water Asset Plans**

Ardent Consulting Engineers
LONDON
SE26 5HZ

Search address supplied Dee Road Fire Station
23
Spey Road
Tilehurst
Reading
RG30 4DJ

Your reference Dee Road Fire Station

Our reference ALS/ALS Standard/2022_4689179

Search date 26 July 2022

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



0800 009 4540

Search address supplied: Dee Road Fire Station, 23, Spey Road, Tilehurst, Reading, RG30 4DJ

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 0800 009 4540, 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

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

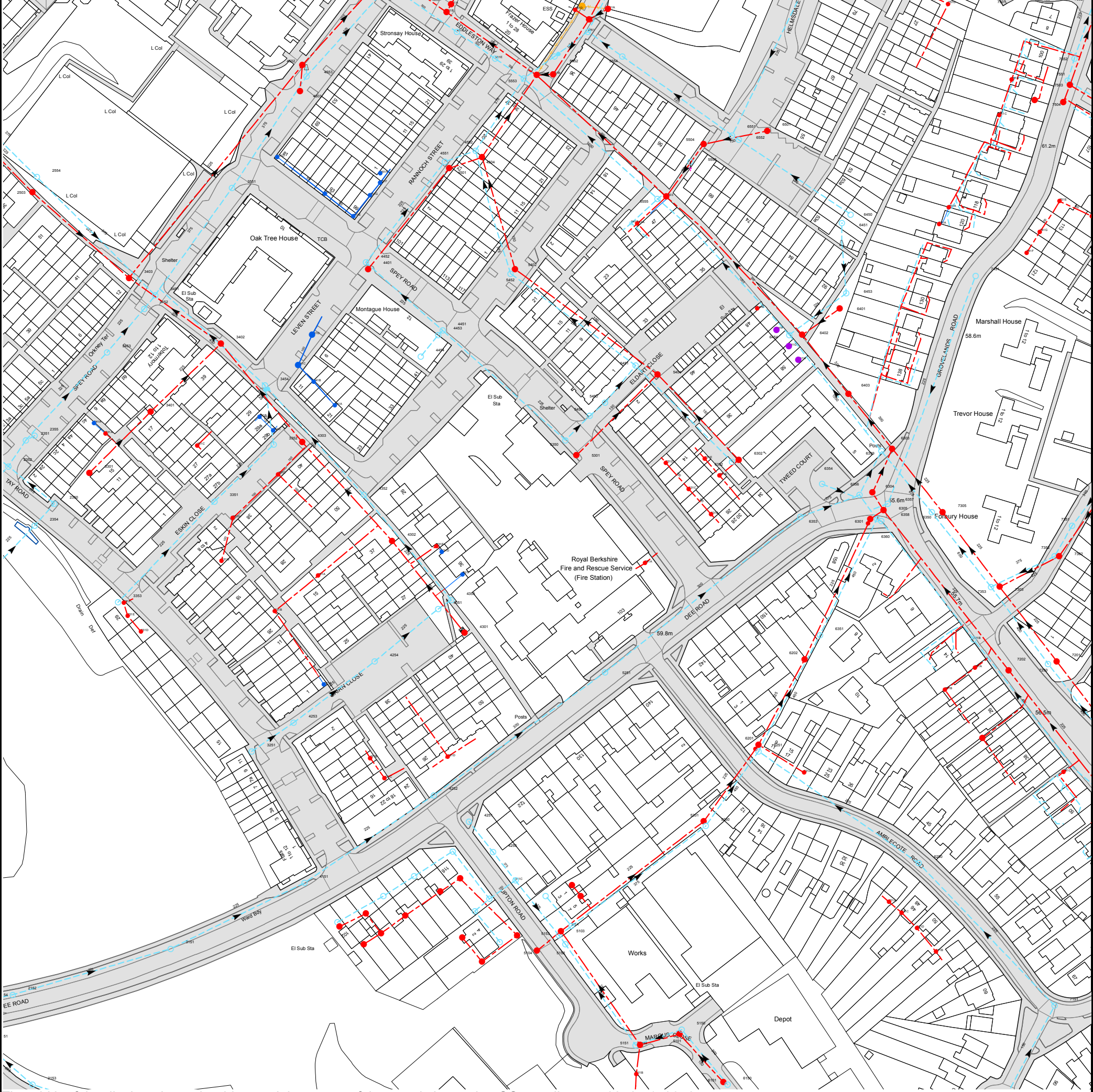
Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

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



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 468525,173349
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 (2020) 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
7250	57.2	54.46
7201	57.35	54.14
721C	n/a	n/a
7203	56.93	54.79
7151	62.77	61.54
6150	62.6	61.77
6101	62.57	61.54
5101	62.4	61.33
5150	62.37	61.52
611B	n/a	n/a
611D	n/a	n/a
611C	n/a	n/a
611A	n/a	n/a
7504	60.53	57.79
7503	60.27	57.51
7551	60.21	58.4
7552	59.96	58.12
7502	58.78	56.74
7352	57.44	55.63
7302	57.48	55.36
7351	57.94	56.15
741F	n/a	n/a
741G	n/a	n/a
741H	n/a	n/a
751E	n/a	n/a
751C	n/a	n/a
7553	n/a	n/a
751B	n/a	n/a
751D	n/a	n/a
7501	59.48	57.5
6250	62.23	60.66
5250	n/a	n/a
5201	n/a	n/a
621A	n/a	n/a
6251	59.6	57.36
6201	59.46	56.87
7256	n/a	n/a
721B	n/a	n/a
7202	56.22	54.02
721A	n/a	n/a
6202	n/a	n/a
731B	n/a	n/a
6351	n/a	n/a
7353	56.84	53.63
7303	56.81	53.52
531A	n/a	n/a
6360	55.56	53.53
6358	55.42	53.47
6301	55.29	53.15
6353	55.66	53.78
531B	n/a	n/a
7305	56.88	52.59
6350	56.43	53.27
6305	55.45	52.87
6357	55.48	54.5
6356	55.46	53.19
6304	55.5	52.73
531C	n/a	n/a
6354	55.05	53.69
631A	n/a	n/a
531D	n/a	n/a
6352	55.24	52.86
6302	55.19	52.79
531E	n/a	n/a
6359	55.85	52.08
6303	55.82	52.36
6403	55.6	51.79
5401	55.69	51.77
641H	n/a	n/a
641G	n/a	n/a
6454	55.8	50.08
6402	56.37	51.56
641F	n/a	n/a
6401	57.13	55.56
641E	n/a	n/a
6453	57.85	55.29
7451	59.78	57.76
741A	n/a	n/a
541A	n/a	n/a
6451	58.64	56.2
6450	58.96	57.54
751A	n/a	n/a
5555	55.46	49.21
5503	55.68	50.63
4504	53.46	49.79
551E	n/a	n/a
5553	53.72	47.48
5502	54.12	51.36
551B	54.62	52.97
5552	55.17	51.24
551D	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
5551	57.13	55.25
551C	57.14	55.41
551A	n/a	n/a
5554	57.27	56.13
5556	n/a	n/a
5504	57.37	55.35
6551	57.95	56.37
6552	58.01	56.36
6501	58.46	56.36
451D	n/a	n/a
4503	55.37	50.99
4502	54.88	50.83
4553	54.97	49.75
451E	n/a	n/a
451G	n/a	n/a
451F	n/a	n/a
451H	n/a	n/a
4551	53.39	50.96
451B	52.37	48.609
4501	53.23	50.22
451A	52.3	50.533
451C	n/a	n/a
4552	53.35	48.98
341B	n/a	n/a
3454	60.41	54.73
341C	n/a	n/a
3352	62.09	59.61
431C	n/a	n/a
441C	n/a	n/a
4303	61.69	n/a
441D	n/a	n/a
441B	n/a	n/a
441A	n/a	n/a
441E	n/a	n/a
4352	62.14	57.98
4452	55.67	53.9
4401	56.38	53.54
4454	58.02	55.87
4453	57.83	54.62
4451	57.32	54.41
5452	56.96	49.7
5402	55.81	50.47
5350	57.24	55.16
5301	57.12	52.77
5454	57.05	54.94
5450	56.68	54.81
541B	n/a	n/a
5451	n/a	n/a
51MN	n/a	n/a
51ND	n/a	n/a
41MM	n/a	n/a
41NF	n/a	n/a
51NE	n/a	n/a
4151	68.28	66.79
511C	n/a	n/a
41NE	n/a	n/a
41ML	n/a	n/a
4255	n/a	n/a
42NM	n/a	n/a
4251	n/a	n/a
4252	64.04	62.25
421C	n/a	n/a
421B	n/a	n/a
421D	n/a	n/a
3251	66.83	62.36
4253	65.88	62.31
421A	n/a	n/a
5251	60.08	58.47
4254	64.6	61.49
4301	62.62	60.95
331B	n/a	n/a
4351	63.07	60.9
4353	62.49	60.87
431A	n/a	n/a
431F	n/a	n/a
431D	n/a	n/a
431E	n/a	n/a
4302	62.67	60.18
331D	n/a	n/a
331E	n/a	n/a
331F	n/a	n/a
3353	65.57	61.81
331G	n/a	n/a
2354	61.92	60.87
331H	n/a	n/a
2350	61.98	60.69
3351	62.74	60.73
3301	63.58	60.78
2352	64.92	60.31
331C	n/a	n/a
2351	64.21	58.19
2355	64.02	62.31
331A	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
341A	n/a	n/a
3401	61.7	58.43
3453	61.41	55.7
3402	59.7	57.25
3452	n/a	n/a
3451	56.62	54.08
3403	56.75	54.93
2503	60.03	55.46
3551	56.69	51.78
2554	n/a	n/a
41MN	n/a	n/a
41NK	n/a	n/a
41NM	n/a	n/a
41NJ	n/a	n/a
41NL	n/a	n/a
41NH	n/a	n/a
41ND	n/a	n/a
41MJ	n/a	n/a
41NC	n/a	n/a
41MK	n/a	n/a
51NF	n/a	n/a
51NH	n/a	n/a
5104	n/a	n/a
5153	63.17	60.58
5103	63.17	60.08
5152	62.94	60.71
511A	n/a	n/a
5151	62.36	61.37
511B	n/a	n/a
5102	62.31	61.2
2153	85.8	84.01
2152	79.74	77.91
3151	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.		



Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

	Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Storm Sewer
	Sludge Sewer
	Foul Trunk Sewer
	Surface Trunk Sewer
	Combined Trunk Sewer
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Vacuum
	Thames Water Proposed
	Vent Pipe
	Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

	Sewer		Culverted Watercourse
	Proposed		Decommissioned Sewer
	Content of this drainage network is currently unknown		Ownership of this drainage network is currently unknown

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plan are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

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		Meter
	Dam Chase		Vent
	Fitting		

Operational Controls

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

	Ancillary		Drop Pipe
	Control Valve		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.

	Inlet		Outfall
	Undefined End		

Other Symbols

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

	Change of Characteristic Indicator		Public / Private Pumping Station
	Invert Level		Summit

Areas

Lines denoting areas of underground surveys, etc.

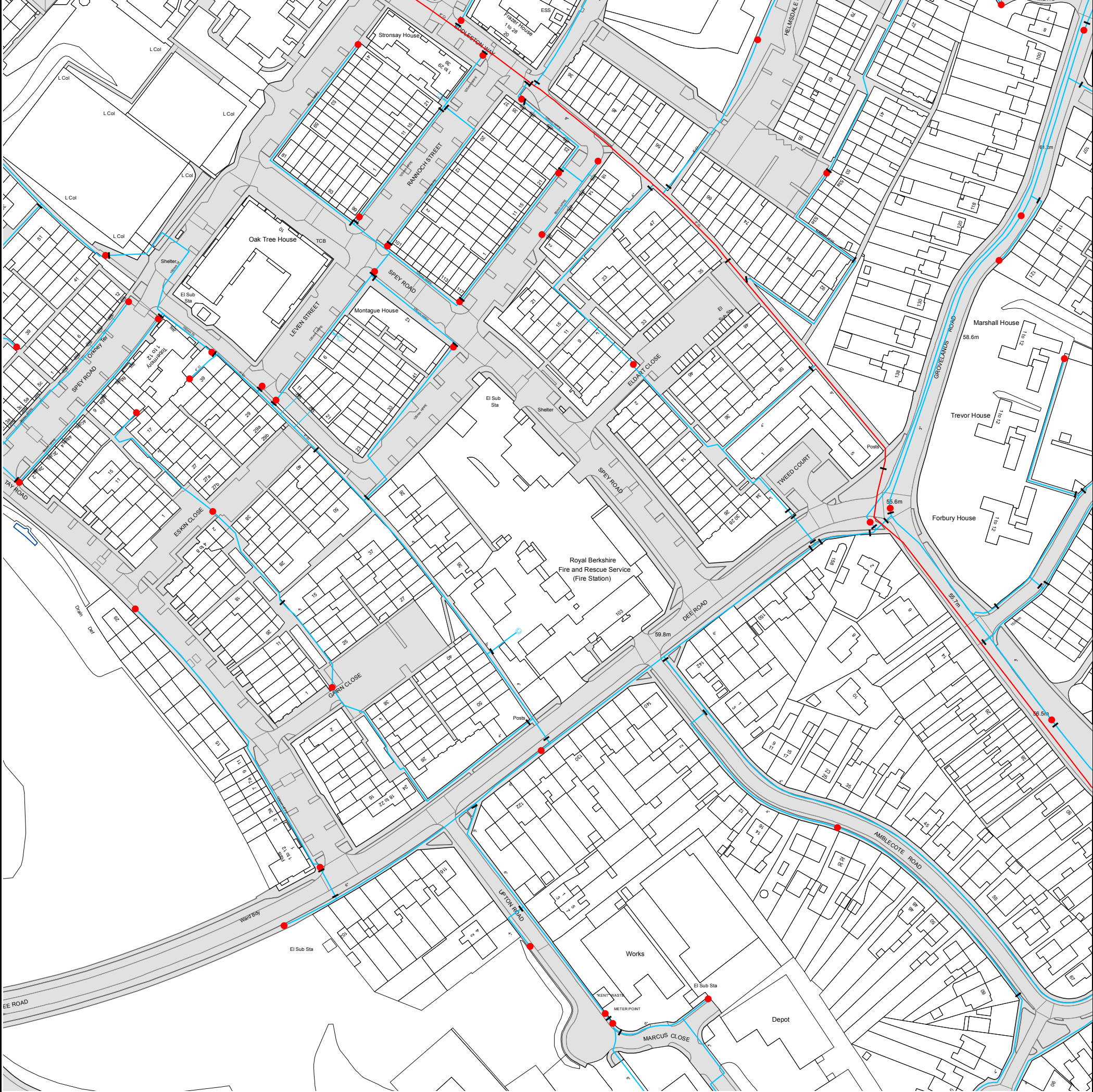
	Agreement
	Chamber
	Operational Site

Ducts or Crossings

	Casement	Ducts may contain high voltage cables. Please check with Thames Water.
	Conduit Bridge	
	Subway	
	Tunnel	

5) 'na' or '0' on a manhole indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. 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, please contact Property Searches on 0800 009 4540.



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 468525, 173349.
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 (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.



Asset Location Search - Water 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.

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

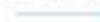
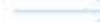
-  Single Hydrant

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
-  **Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

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 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 0800 009 4540 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 E
Source Control Calculations**

Ardent Consulting Engineers		Page 1
4th Floor, Diamond House 36-38 Hatton Garden London EC1N 8EB		
Date 25/07/2022 14:05 File	Designed by jlawrence Checked by	
Micro Drainage Source Control 2017.1.2		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.150
Area (ha)	0.970	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results 1/s

QBAR Rural	0.4
QBAR Urban	0.4
Q1 year	0.3
Q1 year	0.3
Q30 years	0.9
Q100 years	1.3

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Ardent				Page 1	
3rd Floor, The Hallmark Buil...					
52-56 LeadenHall Street					
London, EC3M 5JE					
Date 22/07/2022 16:15		Designed by jlawrence			
File		Checked by			
Innovyze		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	56.298	0.388	2.2	33.8	O K
30 min Summer	56.413	0.503	2.2	43.8	O K
60 min Summer	56.520	0.610	2.2	53.1	O K
120 min Summer	56.598	0.688	2.2	59.9	O K
180 min Summer	56.617	0.707	2.2	61.5	O K
240 min Summer	56.612	0.702	2.2	61.1	O K
360 min Summer	56.582	0.672	2.2	58.5	O K
480 min Summer	56.553	0.643	2.2	55.9	O K
600 min Summer	56.521	0.611	2.2	53.2	O K
720 min Summer	56.488	0.578	2.2	50.3	O K
960 min Summer	56.427	0.517	2.2	44.9	O K
1440 min Summer	56.320	0.410	2.2	35.7	O K
2160 min Summer	56.196	0.286	2.2	24.8	O K
2880 min Summer	56.110	0.200	2.2	17.4	O K
4320 min Summer	56.018	0.108	2.0	9.4	O K
5760 min Summer	55.982	0.072	1.8	6.2	O K
7200 min Summer	55.966	0.056	1.5	4.9	O K
8640 min Summer	55.957	0.047	1.3	4.1	O K
10080 min Summer	55.950	0.040	1.2	3.5	O K
15 min Winter	56.348	0.438	2.2	38.1	O K
30 min Winter	56.479	0.569	2.2	49.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	129.843	0.0	36.2	25	
30 min Summer	85.337	0.0	47.6	39	
60 min Summer	53.483	0.0	59.7	68	
120 min Summer	32.428	0.0	72.4	126	
180 min Summer	23.896	0.0	80.1	182	
240 min Summer	19.136	0.0	85.5	240	
360 min Summer	13.890	0.0	93.1	300	
480 min Summer	11.074	0.0	99.0	364	
600 min Summer	9.283	0.0	103.7	430	
720 min Summer	8.033	0.0	107.7	492	
960 min Summer	6.389	0.0	114.2	620	
1440 min Summer	4.620	0.0	123.9	876	
2160 min Summer	3.335	0.0	134.2	1240	
2880 min Summer	2.644	0.0	141.8	1588	
4320 min Summer	1.904	0.0	153.1	2256	
5760 min Summer	1.506	0.0	161.6	2944	
7200 min Summer	1.256	0.0	168.3	3672	
8640 min Summer	1.082	0.0	174.0	4408	
10080 min Summer	0.953	0.0	178.9	5136	
15 min Winter	129.843	0.0	40.6	25	
30 min Winter	85.337	0.0	53.4	39	
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Ardent				Page 2	
3rd Floor, The Hallmark Buil... 52-56 LeadenHall Street London, EC3M 5JE					
Date 22/07/2022 16:15		Designed by jlawrence			
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Innovyze			Source Control 2017.1.2		
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	56.603	0.693	2.2	60.3	O K
120 min Winter	56.696	0.786	2.2	68.4	O K
180 min Winter	57.438	1.528	2.7	70.4	Flood Risk
240 min Winter	57.309	1.399	2.6	70.2	O K
360 min Winter	56.690	0.780	2.2	67.9	O K
480 min Winter	56.653	0.743	2.2	64.6	O K
600 min Winter	56.615	0.705	2.2	61.3	O K
720 min Winter	56.574	0.664	2.2	57.8	O K
960 min Winter	56.479	0.569	2.2	49.5	O K
1440 min Winter	56.311	0.401	2.2	34.9	O K
2160 min Winter	56.137	0.227	2.2	19.7	O K
2880 min Winter	56.042	0.132	2.1	11.5	O K
4320 min Winter	55.975	0.065	1.6	5.6	O K
5760 min Winter	55.957	0.047	1.3	4.1	O K
7200 min Winter	55.948	0.038	1.1	3.3	O K
8640 min Winter	55.942	0.032	1.0	2.8	O K
10080 min Winter	55.938	0.028	0.8	2.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	53.483	0.0	66.9	68	
120 min Winter	32.428	0.0	81.1	124	
180 min Winter	23.896	0.0	89.7	176	
240 min Winter	19.136	0.0	95.8	230	
360 min Winter	13.890	0.0	104.3	338	
480 min Winter	11.074	0.0	110.8	382	
600 min Winter	9.283	0.0	116.1	460	
720 min Winter	8.033	0.0	120.6	540	
960 min Winter	6.389	0.0	127.9	682	
1440 min Winter	4.620	0.0	138.7	938	
2160 min Winter	3.335	0.0	150.3	1284	
2880 min Winter	2.644	0.0	158.8	1612	
4320 min Winter	1.904	0.0	171.5	2248	
5760 min Winter	1.506	0.0	181.0	2944	
7200 min Winter	1.256	0.0	188.5	3672	
8640 min Winter	1.082	0.0	194.9	4376	
10080 min Winter	0.953	0.0	200.4	5136	
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3rd Floor, The Hallmark Buil...					
52-56 LeadenHall Street London, EC3M 5JE					
Date 22/07/2022 16:07		Designed by jlawrence			
File		Checked by			
Innovyze		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	55.910	0.000	0.0	0.0	O K
30 min Summer	55.910	0.000	0.0	0.0	O K
60 min Summer	55.910	0.000	0.0	0.0	O K
120 min Summer	55.910	0.000	0.0	0.0	O K
180 min Summer	55.910	0.000	0.0	0.0	O K
240 min Summer	55.910	0.000	0.0	0.0	O K
360 min Summer	55.910	0.000	0.0	0.0	O K
480 min Summer	55.910	0.000	0.0	0.0	O K
600 min Summer	55.910	0.000	0.0	0.0	O K
720 min Summer	55.910	0.000	0.0	0.0	O K
960 min Summer	55.910	0.000	0.0	0.0	O K
1440 min Summer	55.910	0.000	0.0	0.0	O K
2160 min Summer	55.910	0.000	0.0	0.0	O K
2880 min Summer	55.910	0.000	0.0	0.0	O K
4320 min Summer	55.910	0.000	0.0	0.0	O K
5760 min Summer	55.910	0.000	0.0	0.0	O K
7200 min Summer	55.910	0.000	0.0	0.0	O K
8640 min Summer	55.910	0.000	0.0	0.0	O K
10080 min Summer	55.910	0.000	0.0	0.0	O K
15 min Winter	55.910	0.000	0.0	0.0	O K
30 min Winter	55.910	0.000	0.0	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	129.843	0.0	0.0	0	
30 min Summer	85.337	0.0	0.0	0	
60 min Summer	53.483	0.0	0.0	0	
120 min Summer	32.428	0.0	0.0	0	
180 min Summer	23.896	0.0	0.0	0	
240 min Summer	19.136	0.0	0.0	0	
360 min Summer	13.890	0.0	0.0	0	
480 min Summer	11.074	0.0	0.0	0	
600 min Summer	9.283	0.0	0.0	0	
720 min Summer	8.033	0.0	0.0	0	
960 min Summer	6.389	0.0	0.0	0	
1440 min Summer	4.620	0.0	0.0	0	
2160 min Summer	3.335	0.0	0.0	0	
2880 min Summer	2.644	0.0	0.0	0	
4320 min Summer	1.904	0.0	0.0	0	
5760 min Summer	1.506	0.0	0.0	0	
7200 min Summer	1.256	0.0	0.0	0	
8640 min Summer	1.082	0.0	0.0	0	
10080 min Summer	0.953	0.0	0.0	0	
15 min Winter	129.843	0.0	0.0	0	
30 min Winter	85.337	0.0	0.0	0	
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Innovyze		Source Control 2017.1.2			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	55.910	0.000	0.0	0.0	O K
120 min Winter	55.910	0.000	0.0	0.0	O K
180 min Winter	55.910	0.000	0.0	0.0	O K
240 min Winter	55.910	0.000	0.0	0.0	O K
360 min Winter	55.910	0.000	0.0	0.0	O K
480 min Winter	55.910	0.000	0.0	0.0	O K
600 min Winter	55.910	0.000	0.0	0.0	O K
720 min Winter	55.910	0.000	0.0	0.0	O K
960 min Winter	55.910	0.000	0.0	0.0	O K
1440 min Winter	55.910	0.000	0.0	0.0	O K
2160 min Winter	55.910	0.000	0.0	0.0	O K
2880 min Winter	55.910	0.000	0.0	0.0	O K
4320 min Winter	55.910	0.000	0.0	0.0	O K
5760 min Winter	55.910	0.000	0.0	0.0	O K
7200 min Winter	55.910	0.000	0.0	0.0	O K
8640 min Winter	55.910	0.000	0.0	0.0	O K
10080 min Winter	55.910	0.000	0.0	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	53.483	0.0	0.0	0	
120 min Winter	32.428	0.0	0.0	0	
180 min Winter	23.896	0.0	0.0	0	
240 min Winter	19.136	0.0	0.0	0	
360 min Winter	13.890	0.0	0.0	0	
480 min Winter	11.074	0.0	0.0	0	
600 min Winter	9.283	0.0	0.0	0	
720 min Winter	8.033	0.0	0.0	0	
960 min Winter	6.389	0.0	0.0	0	
1440 min Winter	4.620	0.0	0.0	0	
2160 min Winter	3.335	0.0	0.0	0	
2880 min Winter	2.644	0.0	0.0	0	
4320 min Winter	1.904	0.0	0.0	0	
5760 min Winter	1.506	0.0	0.0	0	
7200 min Winter	1.256	0.0	0.0	0	
8640 min Winter	1.082	0.0	0.0	0	
10080 min Winter	0.953	0.0	0.0	0	
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**Appendix F
SuDS Maintenance Plan**

REPORT REF: JL/2107330/02A**DOCUMENT CONTROL**

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	DRAFT	JL	AW	-	22.07.22

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1.0 INTRODUCTION

This report is intended to outline the proposed maintenance regime of the surface water drainage network and Sustainable Drainage System (SuDS) pertinent to the proposed development at Dee Road Fire Station, Tilehurst, Reading, RG30 4FS.

This report has been written in addendum to Ardent Consulting Engineers' *Preliminary Drainage Strategy* (2107330-005) and *Drainage Strategy Note* (2107330-02).

2.0 SCOPE

This report considers whole life design & maintenance criteria for the SuDS features proposed as part of the development at Dee Road Fire Station, Reading. These features include permeable paving and geocellular storage tanks. The design and management of these features needs to consider all the following issues to ensure that risks to performance are minimised:

- Hydraulic design objectives of the scheme;
- Amenity objectives;
- Ecological benefits;
- Health and safety issues, e.g. effective inlet and outlet structures that are easy to maintain.

Regular inspection, monitoring and maintenance will be required to ensure the effective long-term operation of the SuDS on-site. This will be included as part of the overall site management company contract and would form part of the non-adopted estate road maintenance regime.

A management company will be in place, which will employ suitable landscape contractors to maintain the SuDS. They should have a comprehensive knowledge of the development and visit the site on a regular basis to undertake routine care such as cleaning of inlet and outlet pipework, grass cutting, tree and shrub maintenance, sweeping and litter picking.

Such attendance will ensure regular monitoring of the drainage system, a rapid response to maintenance needs, and a feeling of ownership of the SuDS features.

As part of the management company contract, the following landscape maintenance procedures will be applied:

- **Management Plan** - describing the management objectives for a site over time, and the management strategies that will be employed to both realise these objectives and reconcile any potential conflicts that may arise.
- **Specification** - detailing the conditions under which the work will be done, the materials to be used and the standard of work required.
- **Schedule of Work** – itemising the tasks to be undertaken and the frequency at which they will be performed.

As landscape maintenance contract periods are usually 1 or 3 years duration, this is a convenient starting point for SuDS maintenance contracts. The frequency of regular maintenance tasks in a contract period will vary from fortnightly to monthly periods, unless in situations where grass or weed growth requires a higher frequency of work.

Maintenance tasks which suit a performance approach commonly include plant growth, grass cutting, pruning and tree maintenance. However, work tasks such as sweeping paths, regular litter collection and cleaning road surfaces will require work at an agreed frequency with a more specific timing such as weekly, monthly or annually. Where the frequency and timing of tasks is critical then a mixture of performance and frequency specification is necessary to ensure effective maintenance. This type of specification is useful where SuDS features require regular attention.

SuDS maintenance tends towards a frequency requirement to ensure a predictable standard of care which can be recorded on site and which provides a reasonable basis for pricing work. A convenient frequency for many tasks is at a monthly inspection as this is the usual minimum site attendance required in a landscape specification. The monthly frequency provides for an inspection of all SuDS features and checking of all inlets and outlets.

It is recommended that SuDS are not handed over to those responsible for maintenance until upstream construction has ceased, the contributing catchment has stabilised, and any necessary rehabilitation of downstream components has been undertaken by the construction contractor. However, if maintenance agreements have to be put in place in advance of this time, and the level of construction activity in the contributing catchment is still high, bespoke temporary maintenance specifications should be prepared that take account of high sediment accumulation rates and the increased risks of potential spillages.

SuDS MAINTENANCE SCHEDULE
3.0 SURFACE WATER DRAINAGE OWNERSHIP PROPOSALS

It is the intention that ownership and responsibility of all various surface water drainage elements including the receiving surface water ditch bounding the site will be managed and maintained by the private management company. This will receive annual contributions from all residents.

4.0 SUDS MAINTENANCE PROPOSALS

The proposed drainage strategy utilises sustainable drainage techniques to ensure that the site can accommodate all storm events up to and including the 1 in 100-year storm event with allowances for future climate change.

It is the intention that all SuDS features are to be maintained by a private management company. The tables below outline the maintenance requirements of the SuDS components throughout the drainage strategy. These have been informed by the guidance outlined within CIRIA C753 and best practice guidance. The following information would be supplemented by manufacturer's specifications where applicable and be obviously dependent on the type of system involved.

Maintenance Regime for Manholes, Flow Controls and Pipes
Locations:

Manholes/Pipes – Non-adoptable manholes underlying private drives at the site.

Flow Control – Hydrobrake structures – see drawing 2107330-005.

MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
Regular Maintenance	Remove sediment and debris from chambers	Annually
	Remove sediment and debris from headwall aprons	Annually
	Remove any root ingress from chambers/pipework	As required
	Remove vegetation blocking sight of and access to headwalls	As required
Occasional Maintenance	CCTV survey of drains to check alignment, cracking and joint displacement	10-year intervals
Remedial Actions	Repair/rehabilitation of inlets, outlet, overflows and railings.	As required
Monitoring	Inspect for evidence of poor operation, weed growth and/or excessive sediment build-up. If required take remedial action	3-monthly, 48 hours after large storm
	Inspect silt accumulation rates and establish appropriate clearance rates	Annually

SuDS MAINTENANCE SCHEDULE

	Monitor chambers and headwalls	Annually
	Inspect pipes, flow controls and catchpit chambers for blockages, and clear if required	Monthly
	Records to be kept throughout the year to produce annual reports of inspections, remedial actions and maintenance undertaken.	Annually

Maintenance Regime for Permeable Paving

Locations: Numerous locations across north and southern catchments at the site.

MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after Autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations- particular attention is to be paid to areas where water runs on to pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements.
Remedial Actions	Repair/rehabilitation of inlets and outlets	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of the pavement or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper sub-structure by remedial sweeping.	Every 10-15 years or as required
Monitoring	Initial inspection	Monthly for 3 months after installation
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action.	3-monthly, 48 hours after large storm
	Inspect silt accumulation rates and establish appropriate clearance rates	Annually
	Monitor chambers and manholes	Annually

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SuDS MAINTENANCE SCHEDULE

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