

EVOLVE

Building 810, Winnersh Triangle Business Park

Surface Water Drainage Strategy

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1 Introduction

1.1 Scope

Evolve Consulting Engineers Limited has been appointed by Burnley Wilson Fish in respect to the proposed development centred at approximate National Grid Reference SU 77425 71641 (E 477425, N 171641) What3Words gain.mini.undulation, Building 810, Winnersh Triangle Business Park, Eskdale Rd, Winnersh Triangle, Reading RG41 5TS.

The planning application area is 1.202ha

The proposed development comprises the demolition of existing buildings and erection of a replacement building for flexible use within use classes E(g), B2 and/or B8, together with access, parking, landscaping and associated works.

This report has been produced in support of the planning application for the development and should be read in conjunction with the other relevant planning documents.

1.2 Sources of Information

This report has been prepared based on the following set of information.

- Proposed Site Layout produced by The Harris Partnership, drawing reference 17922-1-THPW-XX-XX-DR-A-1010, dated July 2025
- Topographical Survey by Midland Survey Ltd, drawing reference 33009/R8 2 dated November 2019
- Utilities records – Midland Survey Ltd, drawing reference 33009/R8 2 dated November 2019
- Geo-Environmental Assessment by Delta Simons, report reference 93445.565584, dated June 2023
- Thames Water Asset Location Search by Thames Water, report reference ALS Standard/2023_4882231, dated Sept 2023
- Environment Agency (EA) online flood maps at <https://flood-map-for-planning.service.gov.uk/>
- British Geological Survey (BGS) online mapping available at <https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/>
- Magic website mapping available at <https://magic.defra.gov.uk/magicmap.aspx>
- Lead Local Flood Authority (LLFA) information – Wokingham Borough Council - Strategic Flood Risk Assessment, dated May 2023, available at <https://www.wokingham.gov.uk/sites/wokingham/files/2024-05/WBC%20Level%20SFRA%202023%20-%20Main%20report.pdf>
- Lead Local Flood Authority (LLFA) information – Wokingham Borough Council – Level 2 Strategic Flood Risk Assessment, dated Aug 2023, available at <https://www.wokingham.gov.uk/sites/wokingham/files/2024-05/WBC%20Level%20SFRA%202023%20-%20Main%20report.pdf>
- National Planning Policy guidance on Flood Risk and Coastal Change, UK Government, published 6 March 2014, last updated 25 August 2022, available at <https://www.gov.uk/guidance/flood-risk-and-coastal-change>
- The National Planning Policy Framework (NPPF): Annex 3, Flood risk vulnerability classification – UK Government, published March 2012, available at <https://www.gov.uk/guidance/national-planning-policy-framework/annex-3-flood-risk-vulnerability-classification>

1.3 Limitations

This report has been prepared in accordance with the NPPF and Local Planning Policy. The proposed flood management (including ground floor level recommendations) and surface water management strategies are based on the relevant British Standards (BS8533), the standing advice provided by the EA or based on common practice. The findings of this report are based on the information available at the time of the production.

The Construction (Design and Management) Regulations 2015 (CDM Regulations) will apply to any future development of this site which involves “construction” work, as defined by the CDM Regulations. As such it is the responsibility of the proposed developer (ultimate Client) to fulfil its duties under the CDM Regulations.

2 Site Setting

2.1 Existing Site

The site is located within the Winnersh Triangle Business Park, approximately 0.28 kilometres (km) northeast of Winnersh Triangle train station in a mixed-use commercial and industrial area.

The area of the site is 12,020m². Most of this area is currently classed as impermeable, with this being split into 10,608m² of roof area and hardstanding and 1,412m² of perimeter landscaping.

The CCTV drainage survey shows that the surface water from the site is discharged to a below ground drainage system, which in turn outfalls approx. 50% of the sites flow to the sewer in Eskdale Rd to the North and the remaining 50% to a sewer in the access road to the south of the site. There are currently no flow restrictions or attenuation shown.

According to the Wokingham Borough Council SFRA, no Critical Drainage Areas (CDA) have been defined by the Environment Agency within Wokingham Borough therefore the site is not shown to be located in a CDA.



Figure 2.1 – Site location plan

2.2 Proposed Development

The proposed development comprises the demolition of existing buildings and erection of a replacement building for flexible use within use classes E(g), B2 and/or B8, together with access, parking, landscaping and associated works.

The proposed site layout Plan is shown in Figure 2.2.

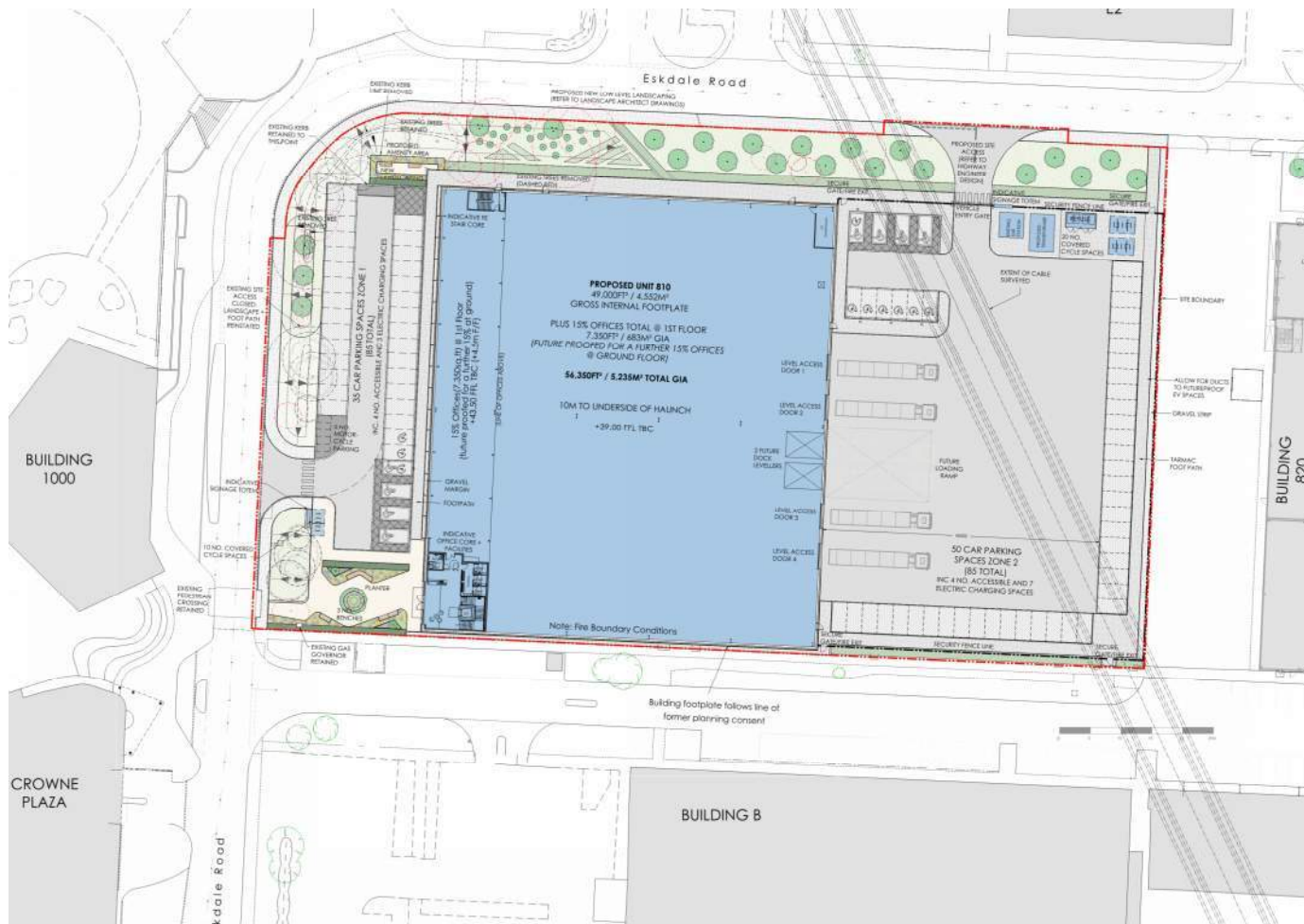


Figure 2.2 Proposed site layout plan

2.3 Topography

The topographical site survey shows the levels of the site to be formed in peaks and troughs to fall towards the existing drainage channels/gullies within the car park between 38.8 and 38.7m AOD to the west of the site and 38.98 and 38.72m AOD within the service yard to the east of the site.

There are landscaped mounds to the north that rise approximately 0.6m above the surrounding levels.

Levels adjacent to the building vary somewhat but seem to show the FFL for the existing building to be around 39.000m AOD.

The FFL of the recently completed, adjacent building (Building 820) is also 39.000m AOD.

2.4 Hydrology

Reference to OS Mapping shows that the River Loddon flows broadly northeast (clockwise around the site), some 220m at its closest to the north-northwest. This tributary of the River Thames discharges into the Thames at Shiplake Lock, many kilometres to the north. The nature reserve, Dinton Pastures, which includes White Swan Lake and Black Swan Lake is approximately 180m north of the site. These lakes appear to be linked to the Loddon. A small pond is

approximately 400m to the east. A number of ditches and drains to the east and southeast appear to be linked with the pond and Black Swan Lake in Dinton Pastures,

2.5 Geology

Based on the information available from BGS online mapping:

- Bedrock geology description – London Clay Formation - Clay and Silt
- Superficial deposits – River Terrace Deposits - Sand And Gravel

The nearest borehole records with similar geological profiles to the site available from this website are summarised in Table 2.1.

Table 2.1 – Summary of nearby BGS borehole records

BGS Borehole Reference	SU77SE298	SU77SE166	SU77SE164
Date Drilled	2008	1986	1986
Grid Reference	477240E, 171650N	477710E, 171660N	477650E, 171510N
Cover level m (AOD)	Not Given	33.66 m	33.97 m
Proximity to site	160m west of site	180m east of site	300 m south east of site
Borehole depth	130.0 m	3.5 m	5.50 m
Depth to Bedrock	15.9 m	1.4 m	3.3 m
Groundwater depth	4.65m from surface	Not recorded	Not recorded

Soilscape information available from Magic Maps service indicate this area as:

- Loamy soils with naturally high groundwater

As part of the Geo-Environmental Assessment undertaken by Delta Simons, a Ground Investigation comprising a range of geotechnical testing, sampling and groundwater monitoring was carried out to ascertain geotechnical information. The work included (but was not limited to) Drilling of three cable percussive boreholes (BH1 to BH3) to a maximum depth of 15.0 m bgl; and the excavation of 4 foundation inspection pits (TP1 to TP4) to a maximum depth of 1.2 m bgl. The locations of the dynamic boreholes and rotary borehole are shown on Figure 2.3.

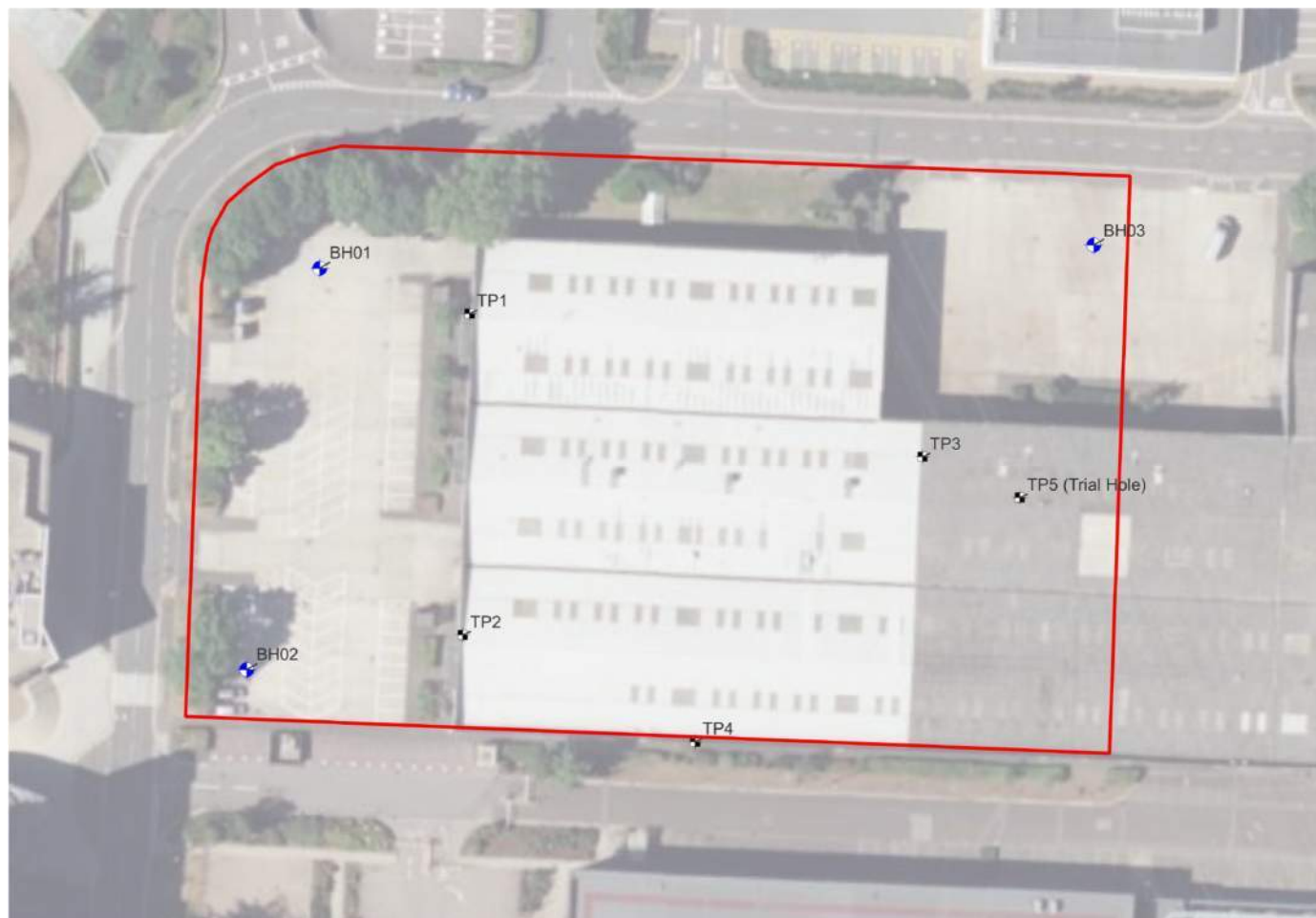


Figure 2.3 - Location of Delta Simons boreholes

The following summary of ground conditions encountered during the site investigation was extracted from the Delta Simons Geo-Environmental Assessment report.

Strata	Strata Description	Depth Range of Strata Top m bgl (m AOD)	Depth Range of Strata Base m bgl (m AOD)	Thickness Range (m)
Hard standing	Concrete or asphalt	Ground Level (40.59 – 36.01)	0.10 – 0.30 (40.34 – 35.81)	0.10 – 0.30
Made Ground	This was then underlain by gravelly SAND.	0.20 – 0.30 (38.83 – 35.81)	1.60 – 1.70 (37.83 – 35.01)	1.40 – 1.60
Kempton Park Gravel Member	Brown very sandy slightly silty angular to subrounded, fine to coarse flint GRAVEL with a low cobble content.	1.20 – 1.80 (37.83 – 36.91)	2.30 – 2.80 (36.51 – 36.01)	0.60 – 1.60
London Clay	Stiff grey CLAY.	2.30 – 2.80 (36.51 – 36.01)	Not Proven	Not Proven

The site is underlain by hardstanding, typically concrete with macadam over the top and was encountered to depths of up to 0.3m bgl with variable Made Ground deposits consisting of gravelly sands beneath. This was overlying the Kempton Park Gravel Member which was of limited thickness overlying the London Clay Formation to a proven depth of 15m bgl.

2.6 Hydrogeology

The following hydrogeological information was obtained from the online Magic Maps service.

- Aquifer destination (Bedrock) – Unproductive
- Aquifer Designation Map (Superficial Drift) – Secondary A
- Groundwater Vulnerability – Medium Low

BSG borehole log SU77SE298 (dated 2008) to the west of the site recorded a groundwater level of 4.65 m below a cover ground level.

The following summary of onsite groundwater monitoring carried out by Delta Simons was extracted from the Delta Simons Geo-Environmental Assessment report.

Groundwater levels during monitoring varied between 2.16m and 2.26m bgl (36.55 to 36.77m AOD) within the Kempton Park Gravel Member and generally groundwater falls towards the south west..

Groundwater provides a third of the drinking water in England and Wales, and maintains the flow in many of our rivers. In some areas of Southern England, groundwater supplies up to 80% of the drinking water, therefore it is crucial that these sources are looked after thus ensuring that the water is completely safe to drink.

The Environment Agency has identified Source Protection Zones (SPZs) for 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied to a groundwater source.

According to Environment Agency data, the site is not located in a groundwater Source Protection Zone (SPZ).

Thames Water asset record reference ALS Standard/2023_4882231 indicates separate foul and surface water trunk sewers running in Eskdale Rd generally parallel to the northern and western site boundary. The surface water sewer run connects to manhole 3650 before heading north away from the site. The foul sewer runs east to west adjacent to the northern boundary before continuing south adjacent to the western boundary.

The utilities records shown on the Midland Survey Ltd drawing (reference 33009/R8 2 dated November 2019) shows an extensive network of surface water gullies surrounding the site building.

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2.8 Summary of Flood Risk

The following table provides a summary of flood risk for the site:

Table 2.1 – Summary of sources of flood risk

Source of Flooding	Risk Level	Source of Data	Comments, Mitigation Requirements
Fluvial and Tidal	Low	EA mapping	The yearly chance of rivers and sea flooding Low staying at Low between 2036 to 2069. Low flood risk means Between 0.1% and 1% chance of a flood each year.
Surface water (Pluvial)	Low	EA mapping	The yearly chance of surface water flooding Very low increasing to Low between 2040 to 2060. Very Low flood risk means less than 0.1% chance of a flood each year. Low flood risk means between 0.1% and 1% chance of a flood each year.
Groundwater	Low	BGS mapping, Delta Simons Geo-Environmental Assessment and LLFA information	The closest reported groundwater flooding to the site is approximately 1.55km to the south east and is reported to be un-naturel groundwater flooding likely caused by a pipe. The EA reports that flooding from groundwater is unlikely in this area.
Sewers	Low	Thames Water and LLFA information	The RG41 5 postcode given covers a very large area. Given the number of incidents reported over the years, the chances that these affect the site are Low.
Reservoirs, Canals	Negligible	EA mapping	Site not affected.

Key	Description
	Low/Negligible Risk – No noticeable impact to site and not considered to be a constraint to development.
	Medium Risk – Issue requires consideration but not a significant constraint to development
	High Risk – Major constraint to development requiring active consideration in mitigation proposals

3 Surface Water Drainage Design

3.1 Policy Requirements

This drainage strategy has been written baring reference to:

3.1.1 DEFRA Sustainable Drainage Systems Non-Statutory Technical Standards for Sustainable Drainage Systems

This document states that the following options must be considered for disposal of surface water runoff in order of preference:

- Discharge to ground
- Discharge to a surface water body
- Discharge to a surface water sewer
- Discharge to a combined sewer

3.1.2 The Wokingham Borough Council SuDS Strategy April 2016.

This document offers guidance on the use of sustainable drainage systems within the Borough. The guide forms the basis for assessment of all planning applications in the borough of Wokingham in line with the following local plan policies:

3.1.2.1 Core Strategy 17 Policy CP1 – Sustainable Development:

There are several aspects that link directly to the use of SuDS. It states that “planning permission will be granted to developments that provide a range of things including limiting any adverse effects on water quality, provision of adequate drainage, incorporation of facilities for recycling of water and management of flood risk from all sources.”

3.1.2.2 Core Strategy Policy C3 –General Principles for Development:

This states that “planning permission will be granted to developments that have no detrimental impact upon the landscape, geological features or watercourses.”

3.1.2.3 Managing Development Delivery Local Plan16 policy CC10: Sustainable Drainage:

This gives specific requirements for provision of drainage in new development. The requirements of policy CC10 are set out below:

“All development proposals must ensure surface water arising from the proposed development including taking into account climate change is managed in a sustainable manner. This must be demonstrated through:

- a) A Flood Risk Assessment, or
- b) Through a Surface Water Drainage Strategy.
- 2. All development proposals must:
 - a) Reproduce greenfield runoff characteristics and return run-off rates and volumes back to the original greenfield levels, for greenfield sites and for brownfield sites both run-off rates and volumes be reduced to as near greenfield as practicably possible.
 - b) Incorporate Sustainable Drainage Systems (SuDS), where practicable, which must be of an appropriate design to meet the long-term needs of the development and which achieve wider social and environmental benefits
 - c) Provide clear details of proposed SuDS including the adoption arrangements and how they will be maintained to the satisfaction of the Council [as the Lead Local Flood Authority (LLFA)]
 - d) Not cause adverse impacts to the public sewerage network serving the development where discharging surface water to a public sewer.”

3.1.3 The Wokingham Borough Council – Borough Design Guide SPD (2012)

This is a material consideration in all planning applications. The Borough Design Guide SPD gives guidance on the incorporation of SuDS into different types of development.

For Non-Residential Development: NR10: For Car Parking designers should incorporate SuDS measures such as swales or permeable paving into the scheme to facilitate drainage and flood attenuation.

3.2 Contributing Areas.

This assessment includes an overview and comparison of the existing scenario and proposed development scenario which is summarised in Table 3.1.

Table 3.1 – Contributing areas

Parameter	Existing (m ²)	Existing (%)	Proposed (m ²)	Proposed (%)
Roof Area	4,690	39%	4,688	39%
Hardstanding Area	5,918	49%	5,491	46%
Soft Landscape Area	1,412	12%	1,841	15%
Total area	12,020	100%	12,020	100%

3.3 Pre-development Situation

3.3.1 Greenfield Rates

The Greenfield runoff tool available from www.uksuds.com was used to estimate the greenfield rates. Calculations are presented in Appendix B and the results are summarised in Table 3.2.

Table 3.2 – Greenfield runoff rates

Return period	Peak flow (l/s)
QBar	2.40
1 in 1 year	1.70
1 in 30 year	4.60
1 in 100 year	6.40

3.3.2 Greenfield Volumes

Using the Greenfield Volume Calculator within Microdrainage the following values have been calculated for the 1.2020ha development site catchments. The results of the calculation are shown below:

FSR Data Parameters	Site Specific Variables
Return Period (years)	100
Storm Duration (mins)	360
M5-60 (mm)	20.000
Ratio R	0.400
Areal Reduction Factor	1.00
Undeveloped Gross Area (ha)	1.2020
SAAR (mm) – Average Annual Rainfall	747
CWI – Catchment Wetness Index	105.000
Urban – Proportion of Area Urbanised	0.000
SPR – Standard Percentage Runoff for Soil	47

The total greenfield runoff volume for the greenfield site 345.458m³

3.3.3 Brownfield Rates

As this is a brownfield site, the existing runoff rates for a variety of return periods have been calculated using the Wallingford Method (also referred to as Modified Rational Method).

The Modified Rational method uses the following equation to calculate peak runoff rate from an area:

$$Q = 2.78 C_v C_r i A$$

Where:

2.78 = Coefficient which accounts for the differences in units used for the inputs and the outputs of the equation

C_v = Volumetric Runoff Coefficient - a coefficient that describes the proportion of rainfall appearing in the surface water drainage system, assumed to be 1.0 for impermeable areas

C_r = Routing Coefficient - a routing coefficient added to the Rational Method to represent runoff characteristics of a particular site or area in a more accurate manner, assumed to be 1.3 for urban areas

i = Rainfall Intensity (mm/hr)

A = Area (ha)

Based on the FSR rainfall data the maximum existing peak discharge rates have been calculated as follows.

Table 3.3 – Modified Rational Method pre-development surface water runoff

Return period	Rainfall Intensity (mm/hr)	Peak flow (l/s)
1 in 1 year	32.37	89.16
1 in 30 year	79.46	218.90
1 in 100 year	103.28	284.53

3.4 Discharge Options

When developing or redeveloping a site, the control and dispersion of surface water falling on the site's catchment always must be considered. Wherever possible runoff from developments should be managed on the surface. This enables their performance to be more easily inspected and managed with pollution incidents and potential flood risk being visible. But due to the nature of some developments this is not always possible.

If surface water is to be discharged from the site it should be discharged as high up the following hierarchy of drainage options as reasonably practicable. The proposed development has been developed in accordance with this hierarchy.

- 1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
- 2) rainwater infiltration to ground at or close to source
- 3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
- 4) rainwater discharge direct to a watercourse (unless not appropriate)
- 5) controlled rainwater discharge to a surface water sewer or drain
- 6) controlled rainwater discharge to a combined sewer.

It is recommended to manage surface water as close to the source i.e., where the rain falls. The effective use of control and management of surface water runoff will need to be addressed through the application of the above drainage hierarchy.

3.4.1 Rainwater Harvesting

There is an opportunity to include rainwater harvesting providing it can be combined with parapet gutter and a syphonic rainwater system. This will be explored further in the detailed design phase.

3.4.2 Discharge to Ground

The potential for surface water to discharge to ground has been assessed through a desk-based review of the likely ground conditions and possible infiltration structures.

Due to the underlying strata on the site and the potential for high groundwater, infiltration is not considered suitable as a method of surface water discharge due to the risk of contamination to the groundwater.

3.4.3 Blue/Green Roofs and Raingardens

Green and blue roofs have been discounted from the scheme due to the additional imposed load on the structure, increased beam and column dimensions and resultant embodied carbon, with the client focusing on drainage measures at ground level. Although not currently shown on the design it may be possible to use rain gardens within adjacent planted areas shown on the plans. These could be considered in detailed design subject to client approval.

3.4.4 Discharge to Surface Water Body

Reference to OS Mapping shows that the River Loddon flows broadly northeast (clockwise around the site), some 220m at its closest to the north-northwest. This tributary of the River Thames discharges into the Thames at Shiplake Lock, many kilometres to the north. The nature reserve, Dinton Pastures, which includes White Swan Lake and Black Swan Lake is approximately 180m north of the site. These lakes appear to be linked to the Loddon. A small pond is approximately 400m to the east. A number of ditches and drains to the east and southeast appear to be linked with the pond and Black Swan Lake in Dinton Pastures.

The distance from the site means that discharging to the to a surface water body will not be possible.

3.4.5 Discharge to Surface Water Sewer

The CCTV drainage survey shows that the existing surface water from the site is discharged to a below ground drainage system, which in turn outfalls approx. 50% of the sites flow to the private site wide surface water sewer in Eskdale Rd to the North and the remaining 50% to a sewer in the access road to the south of the site. This private surface water sewer is part of the wider private drainage network that serves the Winnersh Triangle Business Park as a whole.

There are currently no flow restrictions or attenuation shown on the site. It is our intention to discharge the surface water from the site into a below ground gravity drainage system and utilise the existing 525dia connections to the Winnersh Triangle site wide system to outfall to (albeit with a restricted and attenuated discharge rate).

3.4.6 Discharge to Combined Water Sewer

No combined sewers are in the vicinity of the site.

3.5 Post-development Situation

3.5.1 Discharge Rate

The discharge from the site must not impact the flood risk of the surrounding developments both upstream and downstream of the site.

As the site has been previously developed it can be classed as a Brownfield Development. The peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event but should never exceed the rate of discharge from the development prior to redevelopment for that event.

In addition to this, the runoff volume for the 1 in 100-year, 6-hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event but should never exceed the runoff volume from the development site prior to redevelopment for that event. The difference in runoff volume pre and post-development for the 100 year six hour event, (the additional runoff generated) should be disposed of by way of infiltration, or if this is not feasible due to soil type, discharged from the site at flow rates below 2 l/s/ha.

When the compliance to 100 year volumetric criterion cannot be achieved, the limiting discharge for any return period up to the 100 year event shall not be greater than the mean annual peak rate of runoff for the greenfield site (Referred to as QBAR in IH Report 124) or 2 l/s/ha, whichever is the greater.

It is our intention to discharge the flows from the site using 2 existing connections.

The total discharge from the site will be reduced to match the greenfield runoff rate but it will not be possible to reduce the volume of water discharged from the site due to the inability to retain the difference between the existing greenfield runoff volume and the proposed volume for the 100yr 6hr storm due to the lack of space and unsuitability of using open storage on site.

Therefore, each outfall will be restricted to 2.0 l/s to avoid the possibility of blockage for all storms up to and including the 1:100yr + Climate Change allowance

3.5.2 Climate Change Allowance

Based on the latest guidance from the Environment Agency, the climate change factor to apply has been taken as 40% for this development.

By controlling runoff rates and providing attenuation for all storm events up to and including the 1 in 100-year storm + 40 % climate change allowance, the risk of downstream flooding will be minimised. Details of the drainage system calculations are provided in Appendix B.

3.5.3 Urban Creep

As the site has limited scope for layout changes based on the intended use and proposed permeable areas, no allowances have been made for urban creep.

3.6 Sustainable Drainage Systems (SuDS)

To maximise the potential use of SuDS at the site, a review has been undertaken as shown in Table 3.4 in accordance with the SuDS Hierarchy. This review highlights the components referenced in the SuDS Hierarchy and provides recommendations on whether the components could be incorporated into the development.

Table 3.4 – SuDS selection based on the SuDS Hierarchy

Component	Recommendation
Rainwater reuse	There is an opportunity to include rainwater harvesting providing it can be combined with parapet gutter and a syphonic rainwater system. This will be explored further in the detailed design phase.
Green/Blue roofs	Due to the loading on the structure associated with either a blue or green roof, this is not proposed, with the client focusing on drainage measures at ground level.
Basins and Ponds	There are no open areas on the site which are suitable for basins or ponds due to the industrial setting of the scheme.
Filter Strips and Swales	There is an opportunity to include swales and/or filter strips within the planted areas shown on the proposed site plans. This will be explored further in the detailed design phase.
Infiltration Devices	Due to the underlying strata on the site and the potential for high groundwater, infiltration is not considered suitable as a method of surface water discharge due to the risk of contamination to the groundwater.
Permeable Paving	Tanked permeable paving is proposed for the parking bays along the western elevation of the building.
Tanked Systems	Due to the proposed use of the scheme and the likely vehicular loading, a tanked system is considered the most suitable for the site. Oil separators will be provided to offer water quality improvements.

3.8 Attenuation Requirements

The below ground drainage will be designed to ensure:

- No surcharging for the 1:1yr storm
- No flooding for all storms up to and including the critical 1:30yr storm.
- Any flooding experienced for all storms in excess of 1:30yr and up to and including the 1:100yr storm will need to be contained on site posing no risk to the building or affecting safe egress from site.
- The design will be checked for the impact of climate change on the 1:100yr storm.

The catchment areas for the development are broken down as follows:

Table 3.5 – Site Catchments

	Area (m ²)	Runoff Coefficient	Factored Area (m ²)	Total (m ²)	Total Factored (m ²)
Roof	4,688	0.95	4,453	12,020	9,488
Hardstanding	5,491	0.85	4,667		
Soft Landscaping	1,841	0.20	368		

3.8.1 Southern Outfall

The southern 525Ø outfall will take the flow from the tanked permeable paved car park to the west of the building along with water from the roof over the western elevation which will discharge to the subbase of the permeable paved car park.

Table 3.6 – Southern Outfall Catchments

	Area (m ²)	Runoff Coefficient	Factored Area (m ²)	Total (m ²)	Total Factored (m ²)
Roof	1,945	0.95	1,847	3,855	3,096
Hardstanding	1,336	0.85	1,135		
Soft Landscaping	574	0.20	114		

Table 3.7 – Southern Outfall Attenuation Requirements

Return period	Flow restriction (l/s)	Attenuation requirement (m ³)
1 in 100 year + 40%	2.0	249

This will be stored below ground within the voids of subbase of the permeable paving. Allowing for a tanked area of 850m², this equates to approximately a 835mm depth of sub-base beneath the entire car park area assuming a void ration of 35%.

3.8.2 Northern Outfall

The Northern 525Ø outfall will take the flow from the service yard and surrounding hardstanding areas along with the remaining roof water.

Table 3.8 – Northern Outfall Catchments

	Area (m ²)	Runoff Coefficient	Factored Area (m ²)	Total (m ²)	Total Factored (m ²)
Roof	2,743	0.95	2,605	8,165	6,389
Hardstanding	4,155	0.85	3,531		
Soft Landscaping	1,267	0.20	253		

Table 3.7 – Northern Outfall Attenuation Requirements

Return period	Flow restriction (l/s)	Attenuation requirement (m ³)
1 in 100 year + 40%	2.0	608

This will be stored below ground within attenuation crates. This equates to a tank 40m x 20m x 0.8m deep assuming a void ratio of 95%.

Refer to Appendix B for MicroDrainage Calculations.

3.9 Flood Risk Reduction

Compared to the existing drainage network which appears not to contain any flow controls or attenuation, the proposed scheme will provide significant improvement to the flow rates, hence offer flood risk reduction.

3.10 Exceedance Flooding and Overland Flow

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, or when the outfall becomes restricted due to flood levels in the receiving water.

Underground conveyance cannot economically or sustainably be built large enough for all types of extreme rainfall, as a result, there will be occasions when surface water runoff will exceed the capacity of drains. This is especially problematic with combined sewers and sewage flooding can result. When drainage system capacity is exceeded the excess water (exceedance flow) surcharges above ground, causing surface water flooding and indiscriminate flooding of property can occur when this flow of water is not controlled.

The area is not subject to overland flow routes and surface water flooding as summarised in Section 2.8 of this report. The drainage system for the proposed development has been designed to cater for the 1 in 100 year + 40 % climate change storm i.e. in such a storm event, all surface water would be collected on site and slowly released. Thus, the overland flow route would only be required in the event of a drainage network failure, or if a storm in excess of the 1 in 100 year + 40 % climate change storm caused flows from offsite to flow through the site.

The site levels will be designed to direct all surface water away from the buildings and towards the two vehicular site entrances and then follow the existing topography.

3.11 Consents, Offsite Works and Diversions

The proposed surface water drainage strategy is accommodated entirely on site. The existing drainage outfalls will be reused and parts of the existing drainage network may also be reused where possible. Based on the existing information, there are no existing Thames Water assets that will be affected by the proposed works. Any private drainage serving the existing buildings will be removed/abandoned if affected by the proposed building footprints.

3.12 Adoption and Maintenance

The long-term maintenance of the SuDS features within the site boundary will most likely be undertaken by a management company.

Maintenance of SuDS features should be undertaken in line with maintenance schedules outlined in the SuDS Manual. Full maintenance schedules should be confirmed at the detailed design stage in consultation with appropriate product suppliers. An example maintenance schedule is provided below:

The following is an example of a SuDS Maintenance Plan for the scheme based on CIRIA Guidance.

As the maintenance of the communal SuDS features will be carried out via a Management Company, the form of agreement should include the required maintenance listed below. Should the maintenance be transferred at a later date to a public body, then the model agreement SuDS MA1 should be used, details of which can be found in the CIRIA guidance C625.

The following section describes the required maintenance for each feature in turn. The SuDS maintenance requirements listed below should be reviewed after the first 5 years, with a view to agreeing a new regime for the ongoing maintenance.

Notwithstanding the routine inspections and maintenance requirements, after severe storm events all features shall be inspected to clear debris and repair damaged structures or features. Records of the maintenance carried out shall be prepared by the Management Company.

3.12.1 Cellular Attenuation Storage

Maintenance Schedule	Required Action	Typical Frequency
Monitoring / Inspections	Inspect all inlets, outlets, vents, overflows and control structures to ensure they are working as they should	Annually or after severe storms
Regular Maintenance	Inspect and identify any elements that are not operating correctly.	Monthly for three months, then Half yearly or as required.
	Remove sediments / debris from catch pits / gullies and control structures	Annually, after severe storms or as required
Remedial Actions	Repair inlets, outlets, vents, overflows and control structures.	As required

3.12.2 Permeable Paving

Maintenance Schedule	Required Action	Typical Frequency
Monitoring / Inspections	Visual Inspection of the surface and sweeping	2-4 times per year or after severe storms
Regular Maintenance	Inspect and identify any areas of the surface that is contaminated/ silted.	2-4 times per year or after severe storms
	Sweeping of the surface is to be carried out manually or mechanically. Mechanical sweeping should be carried out with the suction feature of the machine turned off	Annually, after severe storms or as required
Remedial Actions	Surface dressing grit that is misplaced by sweeping needs to be replaced to ensure the structural and hydraulic performance of the surface. The joints between the	As required

	blocks should be topped up with 2-4mm surface dressing.	
--	---	--

3.12.3 Swales

An adoptable swale will usually include the side and base of the channel, any vegetation that is part of the function of the swale and any under-drainage including any liner, check dam, flow control or erosion control measure.

Typically, the swales should be monitored and inspected after the vegetation establishment period & after significant storm events to:

- Identify areas of erosion, scour or gullies
- Identify locations of silt deposits
- Determine the health of the vegetation & soil
- Identify areas of excessive waterlogging or other damage
- Filter strips and swales accumulate silt naturally due to their primary position in the SuDS 'management train' sequence.
- Regular maintenance should be carried out by keeping the grass cut and any litter removed. The outlets from the perforated drain below should be inspected and cleaned out if necessary.
- Every 6 months removal of excess silt should be undertaken.

3.12.4 Proprietary Treatment - Quadraceptor

Maintenance schedule	Required Action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

To ensure the ACO Quadraceptor surface water runoff treatment system provides continuous and reliable environmental protection it needs appropriate maintenance and servicing. Where a system is correctly maintained in accordance with supplier recommendations the environmental performance will be maintained, otherwise environmental damage and increased liability are likely to be experienced.

ACO service partners work closely with the relevant UK Environment Agencies and are able to offer ongoing maintenance and servicing programmes, waste disposal, inspection, testing and full installation and commissioning of water treatment systems and alarms. For further details contact the ACO Water Management Design Services Team on 01462 816666.

3.12.5 Aco QMAx Channels and Access Chambers

Maintenance schedule	Required Action	Typical frequency
Monitoring / Inspections	Inspect channels for signs of blockage and oil spillages	Monthly
Regular Maintenance	Inspect chambers for silt detritus and oil buildup.	Yearly
	Sweep external surfaces	Yearly
Monitoring	Remove silts as required but at least every year from the channels and access chambers.	As required/yearly.

Access to ACO Qmax channels is gained through the access and silt chambers. There are three types of access lid depending on the channel system installed. The covers may/may not be bolted in the corners, and these require removing prior to lifting.

Access chambers installed with ACO Qmax Q-Slot grates will have a recessed steel cover and frame.

- Remove the M8 screws with an allen key and lift out the tray using appropriate lifting method. When replacing ensure the screws are fully tightened through the tray and into the frame.
- The top of the screw should not project above the top of the tray, maximum tightening torque 18Nm.
- Removal and lifting of access covers will require on-site assessment of H&S manual handling procedures.
- Position the jetting unit near to the access chamber to allow a 3-6 inch (75-150mm) suction hose to be introduced. This suction hose will remove the silt/detritus that the jetting hose flushes out.
- Attach a suitable jetting head and introduce the jet into the channel, facing the direction of travel. Activate the suction hose and jetting hose. A suitable initial jetting pressure is 80 bar or 1160 psi.
- As the jetting head travels up the length of the channel, place boards over the channel inlets to prevent the escape of water (spray back) and protect any vehicles or nearby property. The jetting head will be propelled to the end of the channel. When it reaches the end, increase the pressure to 150 bar (2176 psi).
- Use a hydraulic winch to pull the jetting head backwards toward the access chamber. The suction hose previously inserted in the access unit will remove the water and detritus. If a reduction of 'spray back' is required reduce the pressure to 80 bar (1160 psi). This pressure will still be sufficient to clean the channel.
- After cleaning is complete, replace cover and secure in place.

3.12.6 Traditional Drainage Features

Frequency	Task	Details
Monthly	Inspection of Gullies and Hoppers	Check for debris and remove any visible blockages.
	Visual Inspection of Pipes	Look for signs of leakage or damage in accessible areas.
	Inspection of Silt Traps	Check silt traps for accumulation and remove visible debris to prevent blockages.
Quarterly	Cleaning of Gullies	Thoroughly clean gullies to remove silt, leaves, and other debris.
	Check and Clear RWP Hoppers	Ensure they are free of debris and functioning properly.

	Cleaning of Silt Traps	Remove accumulated silt and debris to ensure optimal flow and prevent overflow.
Semi-Annual	CCTV Inspection of Pipes	Conduct a detailed inspection to identify cracks, blockages, or misalignments.
	Jet Cleaning of Drainage Pipes	Use high-pressure water jets to clear build-ups within the pipes.
	Comprehensive Cleaning of Silt Traps	Perform a thorough cleaning and check for any damage or wear that could affect performance.
Annual	Full System Inspection and Cleaning	Perform a comprehensive inspection and cleaning of all components.
	Assessment of System Performance	Review the performance to identify recurrent problems or areas needing frequent attention.
	Update Maintenance Logs	Keep detailed records of all maintenance activities, findings, and repairs.
	Assessment and Repair of Silt Traps	Evaluate the condition of silt traps and perform any necessary repairs or replacements.
As Needed	Post-Storm Checks	Inspect and clean the drainage system and silt traps after significant rainfall or storms.
	Repair and Replacement	Address any issues found during inspections or indicated by poor drainage performance.

3.13 Drainage During Construction

Drainage is typically an early activity in the construction stage of a development, taking form during the earthworks phase. However, final construction i.e. piped drainage system connections to the SuDS devices should not take place until the end of site development work, unless a robust strategy for silt-removal is implemented prior to occupation of the site. A plan for the management of construction (including phasing of works, details of any offsite works etc.) cannot be provided at this early stage, as construction work plans are not yet known.

Runoff control measures will need to be implemented in order not to overwhelm the temporary system and cause flooding issues. Runoff rates from the site should be managed so they are no greater than pre-development or in keeping with the best practice guidance to minimise risk of blockages. Any additional conveyance measures should be installed as needed during grading. All drainage infrastructure should be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers, and storing construction materials away from the drainage infrastructure.

4 Water Quality

In line with the 2015 SuDS Manual (CIRIA C753), particular criteria should be applied to manage the quality of runoff to support and protect the natural environment effectively. Treatment design, wherever practicable, should be based on good practice, comprising the following principles:

- Manage surface water runoff close to source
- Treat surface water runoff on the surface
- Treat surface water runoff to remove a range of contaminants
- Minimise risk of sediment remobilisation
- Minimise impacts from accidental spills

Managing pollution close to the source can help keep pollutant levels and accumulation rates low, essentially allowing natural treatment processes to be effective. This in turn can help maximise the amenity and biodiversity value of downstream surface SuDS components and keep maintenance activities straightforward and cost-effective.

SuDS Manual Table 26.2 provides the details for assessing the pollution levels associated with the developments. This table is reproduced below in Table 4.1 with the applicable land use highlighted.

Table 4.1 – Extract of SuDS Manual Table 26.2: Pollution hazard indices for different land use classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
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

*(up to 0.8 where there is potential for metals to leach from the roof)

The proposed drainage strategy utilises the following SuDS features:

- Permeable paving
- Proprietary treatment/ Quadraceptor
- Swales

The indicative SuDS mitigation indices, provided in Table 26.3 of the 2015 SuDS Manual (C753) have been reviewed in relation to the proposed measures. This table is reproduced in Table 4.2.

Table 4.2 – Extract of Table 26.3: Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS	Mitigation Indices		
	TSS	Metals	Hydro-carbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention 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
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

The SuDS Manual States:

Total SuDS mitigation index (for each contaminant type) ≥

pollution hazard index (for each contaminant type)

- Car park areas and permeable paving together with proprietary system such as Permachannel and ACO Quadrceptor or similar approved can provide the mitigation required for roof and car parking areas.
- Yard and delivery areas – Quadrceptors to be provided as required to address the pollution associated with the heavy good vehicle movements

Therefore, it can be concluded that the provision of proposed SuDS measures exceeds the required pollution mitigation indices and provides sufficient treatment as part of the surface water management train, in accordance with the 2015 SuDS Manual (CIRIA C753).

5 Foul Water Drainage Design

5.1 Existing Arrangements

The foul water is shown to connect to the private foul water sewer that serves Winnersh Triangle Business Park adjacent to the northern boundary of the site.

5.2 Proposed Drainage

It is proposed that the flow from the new building is connected utilising the connection to the existing private foul water sewer that serves Winnersh Triangle Business Park to the north of the site.

6 Conclusion

This surface water drainage strategy has been prepared for the proposed development at Building 810, Winnersh Triangle Business Park, Eskdale Rd, Winnersh Triangle, Reading RG41 5TS. The site covers approximately 1.202ha. The proposed development comprises the demolition of existing buildings and erection of a replacement building for flexible use within use classes E(g), B2 and/or B8, together with access, parking, landscaping and associated works.

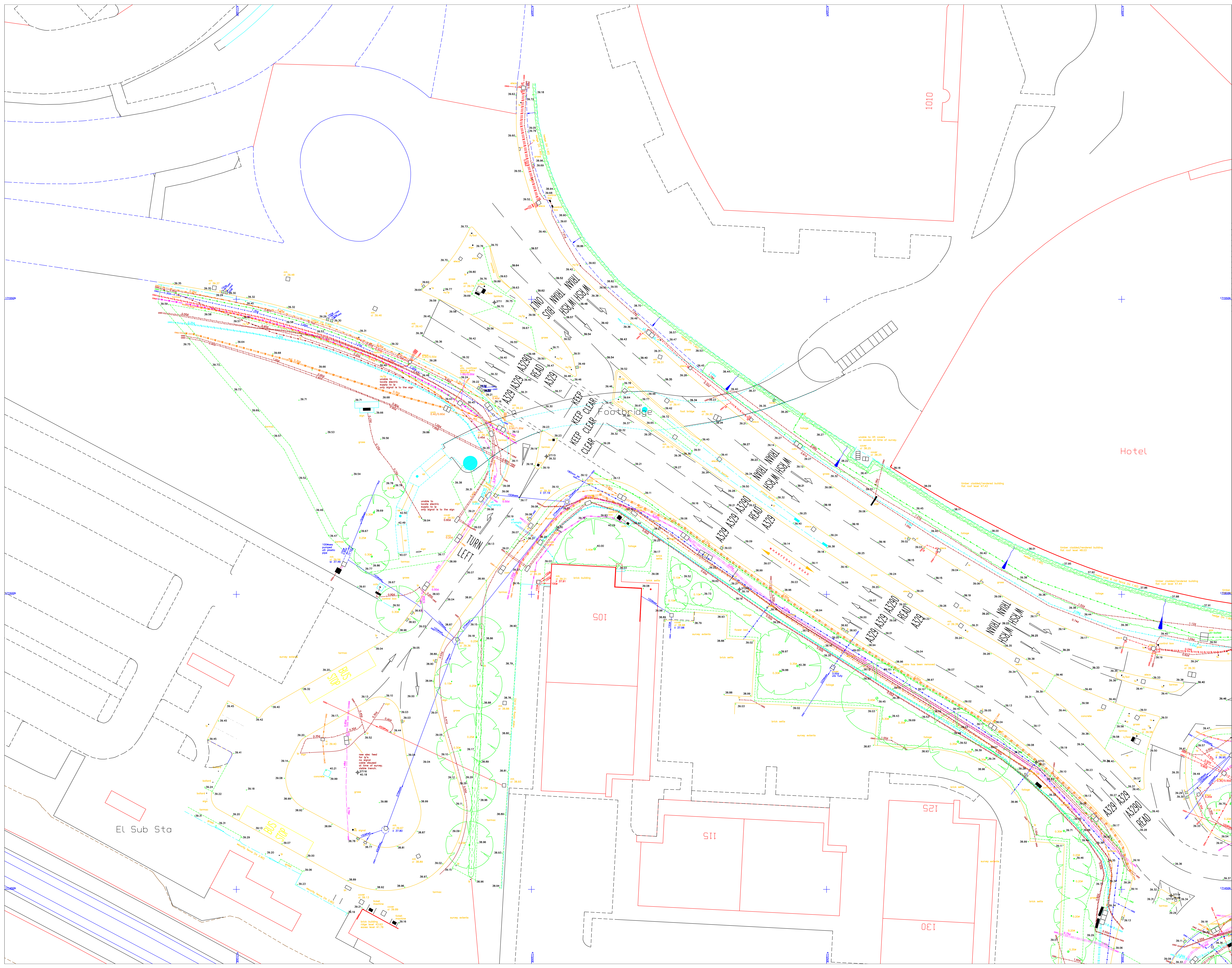
It is proposed that, in line with the local policy requirements, the surface water from the development is discharged at a restricted rate to match the greenfield rates for 1 in 1, 1 in 30 and 1 in 100 year storms. Attenuation storage is provided within an attenuation tank and the subbase of the tanked permeable paved areas on the site to cater for all rainfall event up to and including 1 in 100-year event plus 40 % climate change allowance.

As this is a commercial development with heavy goods vehicles, the level of contamination associated varies from low for the roof areas to high for the loading areas. Due to the industrial setting of the site, a number of proprietary treatment systems together with SuDS measures such as green roof and permeable paving are proposed to provide the water quality improvements required.

It is proposed that the existing foul water network is utilised to discharge foul water from the development.

This report demonstrates that the site can be developed in a sustainable manner to manage the surface water discharge from the development.

Appendix A – Site Survey & Utility Records



NOTES

GENERAL NOTES:

ALL LEVELS ARE IN METERS DERIVED FROM GPS TRANSFORMATION.

GPS COORDINATES ARE DERIVED USING SURFACE POINTS. ALL SERVICES FROM GPS TRANSFORMATION ARE APPROXIMATE. THERE MAY BE DIFFERENCES BETWEEN GPS AND SURFACE POINTS.

THIS DRAWING HAS BEEN PRODUCED WITH A PLOT SCALE ACCURACY OF 1:2000

SERVICE COVERS INDICATED WERE VISITED, BUT, DUE TO LIMITED DETAILS SURROUNDING FROM SURFACE POINTS, THERE MAY BE SOME UNEXPECTED CHANGES TO THE SERVICE AREAS. ALL BUT THE 1ST SERVICE ARE APPROXIMATE.

THESE SERVICES SHOULD BE CONFIRMED BY THE DISSEMINATOR IF CRITICAL.

OUTLINED AREAS ARE INDICATING THE SPREADSHEET SURVEY METHODS AND ARE SUBJECT TO SEASONAL VARIATIONS. THESE ARE NOT TO BE USED FOR ANYTHING OTHER THAN DISSEMINATION.

SERVICE COVERS LOCATED UNDER PARKED VEHICLES, MOBILE STRUCTURES MAYBE CANNOT BE VISUALLY OBSERVED. COVERED AND UNCOVERED AREAS MAY BE DIFFERENT.

UNLESS OTHERWISE NOTED, ALL COORDINATES ARE IN METERS.

SYMBOLS:

TOPOGRAPHICAL SURVEY/UTILITY KEY -

o - height	o - offset
o - den trip	o - 250m
o - den trip	o - 500m
o - den trip	o - 1000m
o - den trip	o - 2000m
o - den trip	o - 4000m
o - den trip	o - 8000m
o - den trip	o - 16000m
o - den trip	o - 32000m
o - den trip	o - 64000m
o - den trip	o - 128000m
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ST04	477458.829	171671.268	38.857
ST11	477193.732	171549.482	39.723
ST19	477646.767	171572.268	38.866
ST10	477697.745	171649.997	39.711
ST104	477845.915	171558.709	39.156
ST107	477859.827	171499.671	39.004
ST108	477853.412	171479.440	39.017
ST13	477592.572	171418.151	39.829
ST116	477757.814	171469.816	39.511
ST16	477617.317	171617.516	38.823
ST17	477616.617	171556.247	39.207
ST18	477593.914	171570.409	38.866
ST19	477597.447	171572.268	38.866
ST19	477597.447	171572.268	38.811

UTILITY SURVEY KEY :		 N N  W W  C C  S S  E E  U U  D D  T T  O O  F F  G G  P P  A A  R R  T T	ELECTRIC CABLE WATER PIPE FUEL PIPE STORM SEWER COMBINED SEWER DUCT CABLE TELEVISION DATA CABLE TELEPHONE CABLE GAS PIPE UNIDENTIFIED SERVICE OTHER CTV TRAFFIC LIGHT OFFSET LINK VOID FUEL PIPE GUY ASSIGNED ROUTE TAKEN FROM RECORDS
	HATCHED AREA		
	BOREHOLE		
	CPT		
	TRAIL PIT		
	HAND PIT		
	GROUND SAMPLE		

DISCLAIMER :

Electromagnetic techniques have been used in the location of underground structures. The results of these surveys are not always reliable and are often carried out to confirm service identification, positions and particularly depths, where these are critical. The completeness of the underground services information cannot be guaranteed.

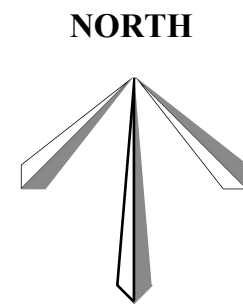
This method of survey does not differentiate between live and dead services, and as a result it cannot be used to identify live services. It is also possible to find a false positive as the method can pick up any metallic object, such as a metal pipe, that may exist in the area of public services that may cross the site, therefore the nearest service drawings should be obtained from the appropriate utility company and used in conjunction with this drawing.

Private service pipes and cables in highways are not shown, but their presence should be anticipated.

Additional below ground structures or obstructions not shown on this drawing may be present. Reference should be made to historical plans and on-call drawings. Investigation in the social planning and design stages of a project is a high priority. Reference: HS047 detailed avoiding drawings from underground services

Please note that factors such as ground conditions, proximity of other utilities, material and method of construction have an influence on the quality of the data collected on site.

UTILITY NOTES

[illegible]

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Client FRASERS PROPERTY UK

Project WINNERSH TRIANGLE LANDSCAPE MASTERPLAN

Title TOPOGRAPHICAL/ UTILITY SURVEY

Date	NOVEMBER 2019	Revisions
		R1 Gas pipe taken from records adjusted February 20

Scale	1:200@A0	R2 Extra detail added as requested July 2019 R3 Extra detail added as requested August 2019
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Dwg No	33009/P8 -1	R4 Mh covers, rap's & gullys added indicatively as requested from services dwg on supplied September 2019
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Surveyor	A.B./T.J./J.Y./D.H./ J.W./M.G./S.A.F./J.C./	R5 Extra detail added as requested November 2019
		R6 Extra detail added as requested December 2019

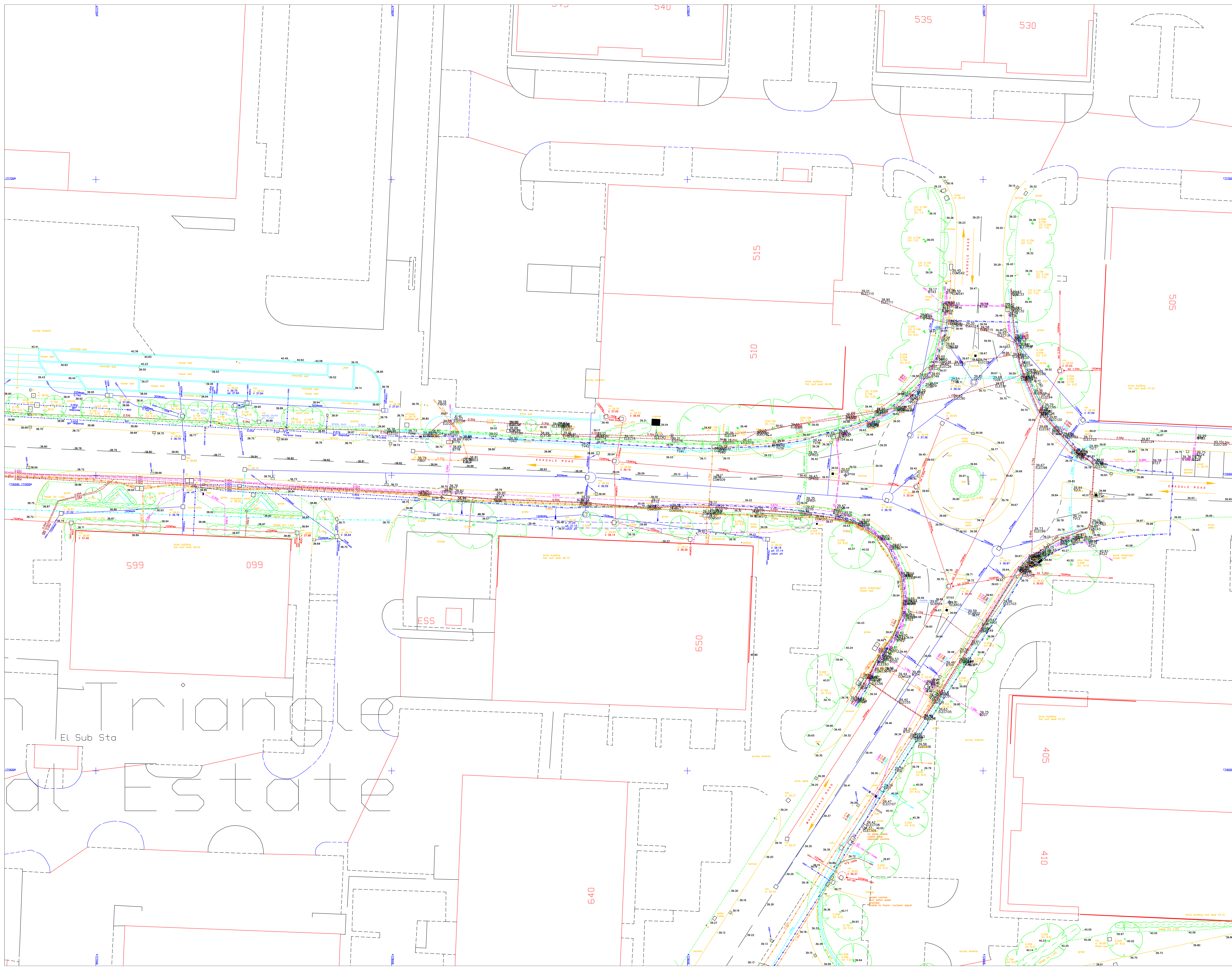
LIB/LLG/LKB

Checked: MJP/JMP/RN/SJM | R10 Extra detail added as requested November 2022

**TOPOGRAPHICAL (LAND) SURVEYORS / UTILITY SURVEYORS
BUILDING MEASUREMENT SURVEYORS / 3D LASER SCANNING**

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NOTES

GENERAL NOTES: 20

ALL LEVELS ARE IN METERS DERIVED FROM GPS TRANSFORMATION.

GRID COORDINATES ARE ORDNANCE SURVEY NATIONAL GRID DERIVED FROM GPS TRANSFORMATION.

GPS COORDINATES AND LEVELS SET AT ST102 (NO SCALE FACTOR APPLIED)

THIS DRAWING HAS BEEN PRODUCED WITH A PLOT SCALE ACCURACY OF 1:200

SERVICE COVERS INDICATED WHERE VISIBLE PIPE INVERTS / DETAILS SURVEYED FROM SURFACE INSPECTION ONLY. GENERALLY DAMAGED COVERS AND COVERS WITH HIGHWAYS WILL NOT BE LIFTED

THIS SPECIES SHOULD BE CONFIRMED BY THIS SPECIALIST IF CRITICAL.

OVERHEAD CABLES ARE INDICATED USING REMOTE SURVEY METHODS AND ARE SUBJECT TO SEASONAL VARIATION, AND SHOULD BE TREATED AS APPROXIMATE

SERVICE COVERS LOCATED UNDER PARKED VEHICLES/MOBILE STRUCTURES MAYBE OMITTED

BURIED SERVICE COVERS WILL NOT BE INDICATED.

TOPOGRAPHICAL SURVEY/UTILITY KEY :-

[illegible]

SURVEY CONTROL

STATION	EASTING	NORTH	LEVEL
S102	477598.290	171637.691	38.884
S103	477458.828	171627.268	38.857
S111	477183.732	171549.482	39.723
S110	477646.007	171680.261	39.156
S104	477678.175	171549.898	39.156
S105	477645.815	171508.709	38.926
S107	477658.862	171499.671	39.004
S108	477653.412	171479.440	39.017
S112	477592.812	171418.101	38.829
S116	477130.547	171469.816	40.181
S117	477617.317	171617.516	39.223
S118	477616.417	171596.247	38.807
S119	477693.674	171570.498	39.375
S120	477579.847	171570.209	38.861
S120	477507.475	171574.238	38.885

UTILITY SURVEY KEY :-

		W	WATER PIPE
		CS	COAL SEWER
		SS	STORM SEWER
		CS	COMBINED SEWER
		DT	DATA TELEVISION
		G	GAS LINE
		T	TELEPHONE CABLE
		S	SAN SEWER
		US	UNDERSIZED SERVICE
		CT	CITY
		TL	TRAFFIC LIGHT
		O	OPEN FILL
		V	VENT
		F	FUEL PIPE
		OL	ORANGE LINES
		P	PIT
		AR	ASSUMED ROUTE
		TR	TAKEN FROM RECORDS

DISCLAIMER :

Electromagnetic techniques 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. The completeness of the underground services information cannot be guaranteed.

This method of survey does not differentiate between live and dead services, and as such all services should be treated as live. This drawing may not include the location of all public services that may be in the area, therefore the relevant service drawings should be obtained from the appropriate utility company and used in conjunction with this drawing.

Additional below ground structures or obstructions not shown on this drawing may be present. Reference should be made to historical plans and as-built drawings. Excavations in the vicinity of services should be carried out with due diligence ref: HSD47 document avoiding dangers from underground services

TSA Standards = "Even an appropriate and professionally executed survey may not be

UTILITY NOTES

[illegible]**MIDLAND SURVEY LTD**

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Client FRASERS PROPERTY UK

Project WINNERSH TRIANGLE LANDSCAPE MASTERPLAN

Title	TOPOGRAPHICAL/ UTILITY SURVEY		
Date	NOVEMBER 2019	Revisions	

Scale 1:200@A0

Dwg No 33009/98-7

Surveyor	A.B./I.J./J.T.U.H/ J.W./N.G./S.A.F./J.C./ L.J.B./L.L.G./L.K.B	R6 Extra detail added as requested December 2019
		R7 Extra detail added as requested January 2020
		R8 Extra detail added as requested January 2020

Checked M.F./J.M.P./K.N./S.A.M. | R9 Extra detail added as requested march 2020
R10 Extra detail added as requested november 2022

**TOPOGRAPHICAL (LAND) SURVEYORS / UTILITY SURVEYORS
BUILDING MEASUREMENT SURVEYORS / 3D LASER SCANNING**







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[illegible][illegible]

SURVEY CONTROL				SHEET LAYOUT
STATION	EASTINGS	NORTHINGS	LEVEL	
ST02	47558.260	171657.691	38.884	
ST04	47549.828	171667.318	38.807	
ST11	47571.320	171548.452	39.723	
ST12	47594.037	171460.851	39.856	
ST02	47378.745	171446.997	39.695	
ST04	47843.915	171558.703	39.158	
ST07	47859.827	171499.671	39.004	
ST08	47563.412	171479.440	39.017	
ST12	47592.812	171418.101	38.829	
ST16	47770.547	171469.816	39.181	
ST16	47767.317	171617.516	38.823	
ST17	47813.417	171586.247	39.207	
ST18	47593.914	171570.458	39.975	
ST19	47578.947	171570.299	39.865	
ST20	47290.745	171573.326	39.811	

VELOCITY SURVEY KEY:	
	HATCHED AREA
	BOREHOLE
	CPT
	TRENCH PIT
	HAND PIT
	WINDOW SAMPLE
	ELECTRIC CABLE
	WATER PIPE
	FOUL SEWER
	STORM SEWER
	COMBINED SEWER DUCTS
	CABLE TELEVISION
	DATA CABLE
	TELEPHONE CABLE
	GAS PIPE
	UNDEFINED SERVICE OTHER
	TRAFFIC LIGHT
	OFFSET FROST LINE
	VENT
	FUEL PIPE
	GAS LINES
	PIPE
	ASSIGNED ROUTE
	RISE

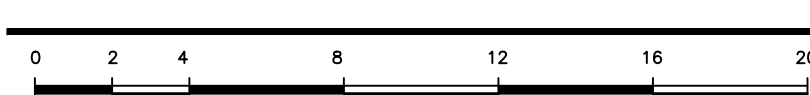
Endometriographic techniques have been used in the location of underground services. The results are not infallible and trial excavations should be considered to confirm the results. The following are some of the factors which may affect where these are critical. The completeness of the underground services information should be considered before any excavation is planned.

This method of survey does not differentiate between live and dead services, and as such is not suitable for the location of live services. The location of live services by other means is essential. The location of live services by other means is essential. The location of live services by other means is essential.

The location of live services by other means is essential. The location of live services by other means is essential. The location of live services by other means is essential.

Please note that factors such as ground conditions, proximity of other utilities, material to be excavated, construction have an influence on the quality of the data collected on site.

Site Standards - "Use an appropriate and professionally executed survey may not be possible in some circumstances."

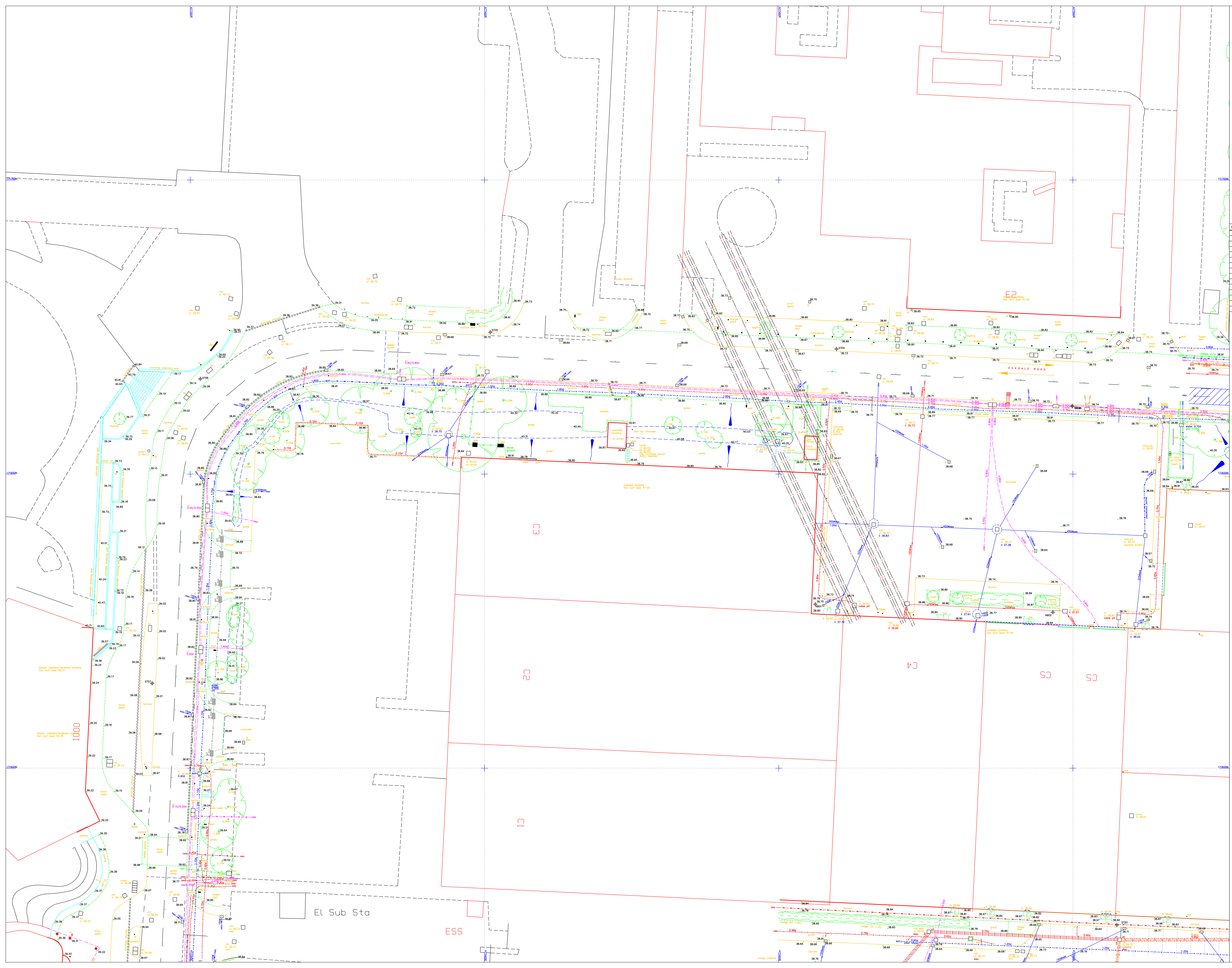
[illegible]

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Client	FRASERS PROPERTY UK
Project	WINDHRAVE TRIANGLE LANDSCAPE MASTERPLAN
Title	TOPOGRAPHICAL / UTILITY SURVEY
Date	NOVEMBER 2019
Scale	1:2000/40
Dwg No	10/009/78-2
Surveyor	A/B/J/C/V/S/D/H M/J/L/J/L/K/B
Checked	M/J/L/J/L/K/B
Revisions R1 GA plan taken from records adjusted February 20 R2 EX data edited as requested July 2019 R3 EX data edited as requested August 2019 R4 NH contours, mp's & puffed out indicatively as requested by client on 18 September 2019 R5 EX data edited as requested November 2019 R6 EX data edited as requested December 2019 R7 EX data edited as requested January 2020 R8 EX data edited as requested January 2020 R9 EX data edited as requested March 2020	

TOPOGRAPHICAL (LAND) SURVEYORS / UTILITY SURVEYORS
BUILDING MEASUREMENT SURVEYORS / 3D LASER SCANNING





Appendix B – Drainage Calculations

hrwallingford

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

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

Project details

Date

15/07/2025

Calculated by

Paul White

Reference

Winnersh

Model version

2.0.1

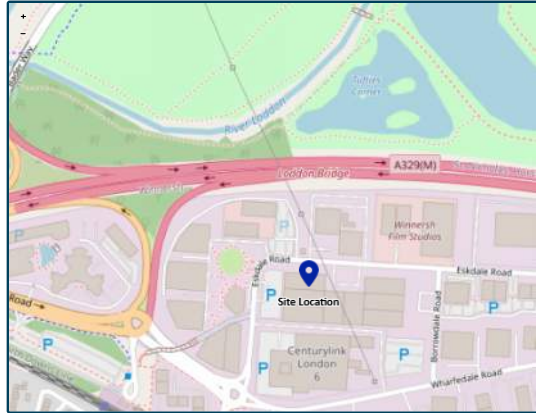
Location

Site name

Winersh 810

Site location

Reading



© OpenStreetMap (https://www.openstreetmap.org/copyright) contributors.

Site easting

477430

Site northing

171611

Site details

Total site area (ha)

1.2020

ha

Greenfield runoff

Method

IH124

IH124

My value

647

mm

Map value

647

SAAR (mm)

647

mm

How should SPR be derived?

WRAP soil type

WRAP soil type

2

SPR

0.3

QBar (IH124) (l/s)

2

l/s

Growth curve factors

Hydrological region

6

1 year growth factor

0.85

2 year growth factor

0.88

10 year growth factor

1.62

30 year growth factor

2.3

100 year growth factor

3.19

200 year growth factor

3.74

Results

Method

IH124

Flow rate 1 year (l/s)

1.7

l/s

Flow rate 2 year (l/s)

1.8

l/s

Flow rate 10 years (l/s)

3.2

l/s

Flow rate 30 years (l/s)

4.6

l/s

Flow rate 100 years (l/s)

6.4

l/s

Flow rate 200 years (l/s)

7.5

l/s

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.0.1) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.400
Areal Reduction Factor	1.00
Area (ha)	1.202
SAAR (mm)	700
CWI	105.000
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	45.98
Greenfield Runoff Volume (m³)	345.458

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.888	0.288	2.0	218.6	0 K
30 min Summer	8.977	0.377	2.0	286.5	0 K
60 min Summer	9.069	0.469	2.0	356.7	0 K
120 min Summer	9.162	0.562	2.0	427.1	0 K
180 min Summer	9.213	0.613	2.0	466.2	0 K
240 min Summer	9.247	0.647	2.0	491.9	0 K
360 min Summer	9.293	0.693	2.0	526.7	0 K
480 min Summer	9.324	0.724	2.0	550.2	0 K
600 min Summer	9.346	0.746	2.0	566.8	0 K
720 min Summer	9.362	0.762	2.0	578.9	0 K
960 min Summer	9.382	0.782	2.0	594.3	0 K
1440 min Summer	9.396	0.796	2.0	605.2	0 K
2160 min Summer	9.386	0.786	2.0	597.4	0 K
2880 min Summer	9.365	0.765	2.0	581.6	0 K
4320 min Summer	9.324	0.724	2.0	550.6	0 K
5760 min Summer	9.285	0.685	2.0	520.9	0 K
7200 min Summer	9.248	0.648	2.0	492.5	0 K
8640 min Summer	9.212	0.612	2.0	465.2	0 K
10080 min Summer	9.177	0.577	2.0	438.5	0 K
15 min Winter	8.888	0.288	2.0	218.6	0 K
30 min Winter	8.977	0.377	2.0	286.5	0 K
60 min Winter	9.069	0.469	2.0	356.7	0 K
120 min Winter	9.162	0.562	2.0	427.1	0 K
180 min Winter	9.214	0.614	2.0	466.3	0 K
240 min Winter	9.247	0.647	2.0	492.0	0 K
360 min Winter	9.293	0.693	2.0	527.0	0 K
480 min Winter	9.325	0.725	2.0	550.8	0 K
600 min Winter	9.347	0.747	2.0	567.6	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	163.0	27
30 min Summer	90.705	0.0	168.1	42
60 min Summer	56.713	0.0	318.5	72
120 min Summer	34.246	0.0	317.9	130
180 min Summer	25.149	0.0	311.1	190
240 min Summer	20.078	0.0	306.8	250
360 min Summer	14.585	0.0	301.6	370
480 min Summer	11.622	0.0	298.7	488
600 min Summer	9.738	0.0	297.2	608
720 min Summer	8.424	0.0	296.6	728
960 min Summer	6.697	0.0	297.6	966
1440 min Summer	4.839	0.0	297.5	1444
2160 min Summer	3.490	0.0	601.3	2152
2880 min Summer	2.766	0.0	582.8	2476
4320 min Summer	1.989	0.0	545.6	3208
5760 min Summer	1.573	0.0	955.9	4032
7200 min Summer	1.311	0.0	990.8	4840
8640 min Summer	1.129	0.0	1010.4	5704
10080 min Summer	0.994	0.0	990.8	6552
15 min Winter	138.153	0.0	163.0	27
30 min Winter	90.705	0.0	168.2	41
60 min Winter	56.713	0.0	318.5	70
120 min Winter	34.246	0.0	318.1	130
180 min Winter	25.149	0.0	311.3	188
240 min Winter	20.078	0.0	306.9	246
360 min Winter	14.585	0.0	301.7	364
480 min Winter	11.622	0.0	298.8	480
600 min Winter	9.738	0.0	297.2	598

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
720 min Winter	9.363	0.763	2.0	580.0	0 K
960 min Winter	9.384	0.784	2.0	595.9	0 K
1440 min Winter	9.400	0.800	2.0	608.1	0 K
2160 min Winter	9.393	0.793	2.0	602.9	0 K
2880 min Winter	9.370	0.770	2.0	585.3	0 K
4320 min Winter	9.320	0.720	2.0	546.9	0 K
5760 min Winter	9.269	0.669	2.0	508.3	0 K
7200 min Winter	9.217	0.617	2.0	468.7	0 K
8640 min Winter	9.164	0.564	2.0	428.6	0 K
10080 min Winter	9.107	0.507	2.0	385.2	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
720 min Winter	8.424	0.0	296.5	714
960 min Winter	6.697	0.0	297.5	946
1440 min Winter	4.839	0.0	297.2	1404
2160 min Winter	3.490	0.0	601.0	2072
2880 min Winter	2.766	0.0	583.0	2688
4320 min Winter	1.989	0.0	547.9	3336
5760 min Winter	1.573	0.0	956.2	4272
7200 min Winter	1.311	0.0	991.7	5192
8640 min Winter	1.129	0.0	1015.3	6136
10080 min Winter	0.994	0.0	1021.2	7064

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.639

Time (mins)			Time (mins)			Time (mins)		
From:	To:	Area (ha)	From:	To:	Area (ha)	From:	To:	Area (ha)
0	4	0.213	4	8	0.213	8	12	0.213

Time Area Diagram

Total Area (ha) 0.000

Time (mins)		
From:	To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	760.0	2.400	0.0	4.800	0.0	7.200	0.0	9.600	0.0
0.400	760.0	2.800	0.0	5.200	0.0	7.600	0.0	10.000	0.0
0.800	760.0	3.200	0.0	5.600	0.0	8.000	0.0		
0.801	0.0	3.600	0.0	6.000	0.0	8.400	0.0		
1.600	0.0	4.000	0.0	6.400	0.0	8.800	0.0		
2.000	0.0	4.400	0.0	6.800	0.0	9.200	0.0		

Hydro-Brake® Optimum Outflow Control

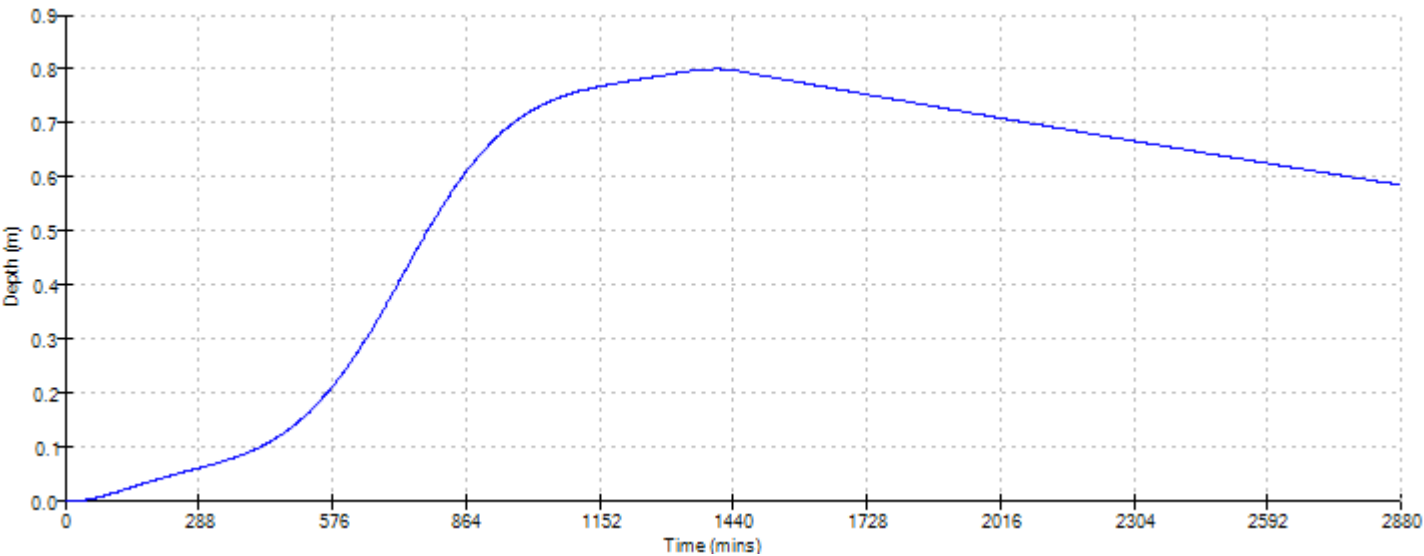
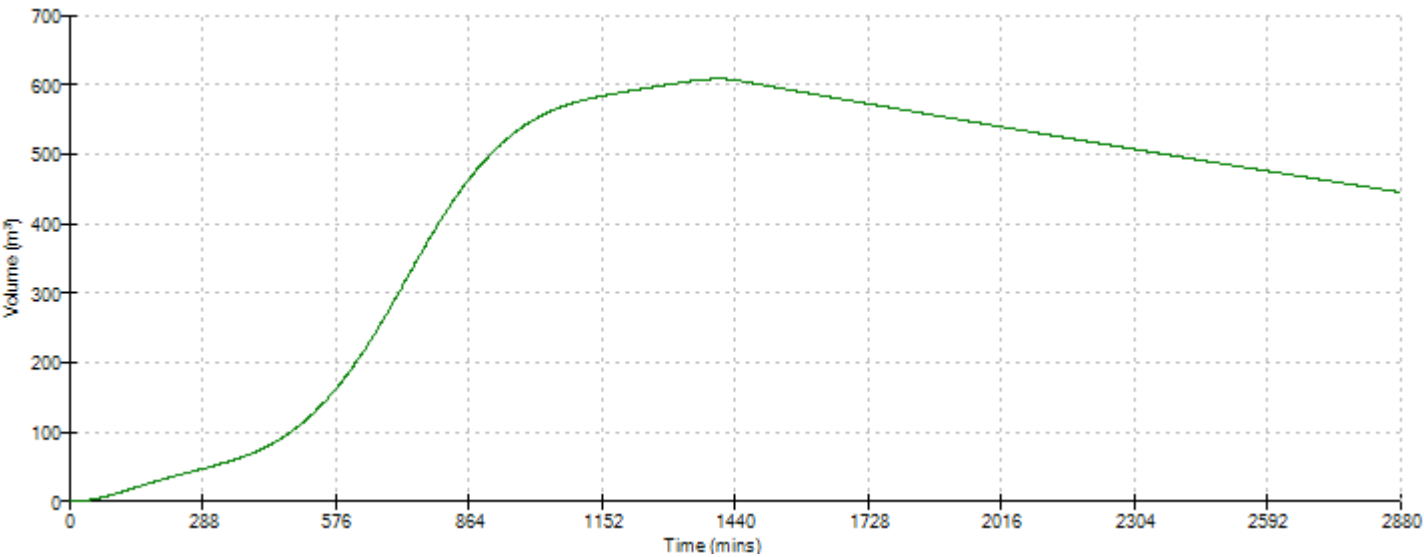
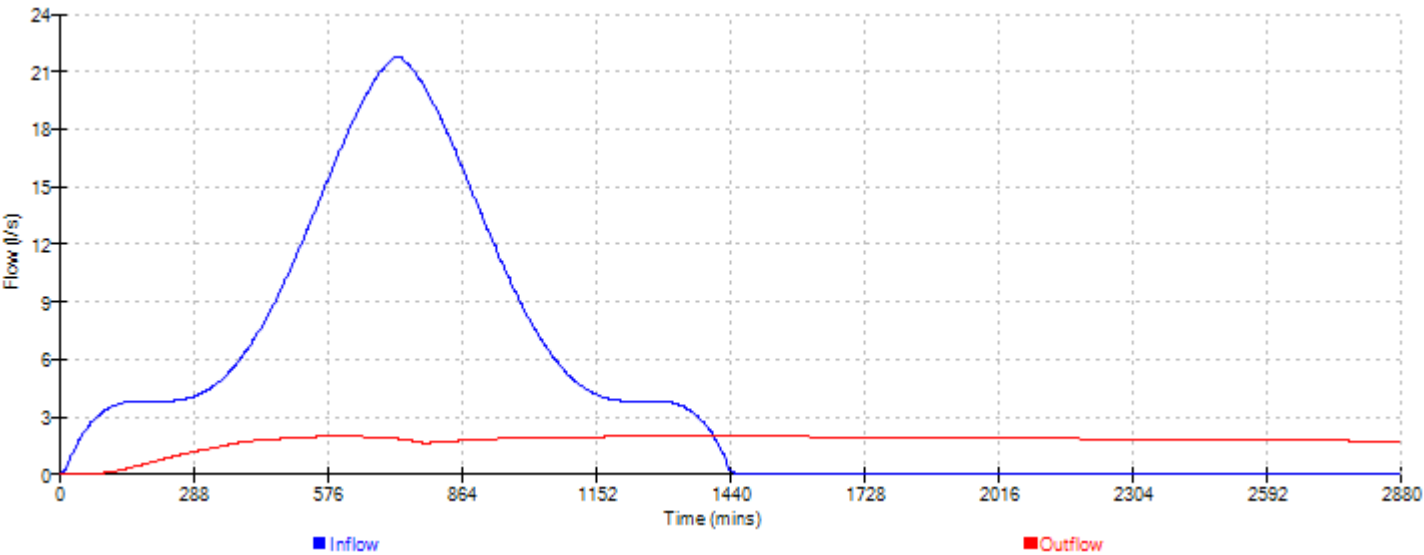
Unit Reference MD-SHE-0070-2000-0800-2000
Design Head (m) 0.800
Design Flow (l/s) 2.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 70
Invert Level (m) 8.600
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0	Kick-Flo®	0.504	1.6
Flush-Flo™	0.240	2.0	Mean Flow over Head Range	-	1.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	0.800	2.0	2.000	3.0	4.000	4.2	7.000	5.5
0.200	2.0	1.000	2.2	2.200	3.2	4.500	4.4	7.500	5.6
0.300	2.0	1.200	2.4	2.400	3.3	5.000	4.7	8.000	5.8
0.400	1.9	1.400	2.6	2.600	3.4	5.500	4.9	8.500	6.0
0.500	1.6	1.600	2.7	3.000	3.7	6.000	5.1	9.000	6.2
0.600	1.8	1.800	2.9	3.500	3.9	6.500	5.3	9.500	6.3

Event: 1440 min Winter



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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.509	0.209	2.0	104.7	0 K
30 min Summer	9.574	0.274	2.0	137.0	0 K
60 min Summer	9.640	0.340	2.0	169.9	0 K
120 min Summer	9.703	0.403	2.0	201.5	Flood Risk
180 min Summer	9.735	0.435	2.0	217.7	Flood Risk
240 min Summer	9.755	0.455	2.0	227.4	Flood Risk
360 min Summer	9.778	0.478	2.0	238.9	Flood Risk
480 min Summer	9.790	0.490	2.0	244.8	Flood Risk
600 min Summer	9.795	0.495	2.0	247.4	Flood Risk
720 min Summer	9.796	0.496	2.0	248.0	Flood Risk
960 min Summer	9.790	0.490	2.0	245.2	Flood Risk
1440 min Summer	9.775	0.475	2.0	237.5	Flood Risk
2160 min Summer	9.749	0.449	2.0	224.6	Flood Risk
2880 min Summer	9.723	0.423	2.0	211.4	Flood Risk
4320 min Summer	9.671	0.371	2.0	185.4	0 K
5760 min Summer	9.615	0.315	2.0	157.4	0 K
7200 min Summer	9.565	0.265	2.0	132.7	0 K
8640 min Summer	9.524	0.224	2.0	111.8	0 K
10080 min Summer	9.488	0.188	2.0	94.0	0 K
15 min Winter	9.510	0.210	2.0	104.8	0 K
30 min Winter	9.574	0.274	2.0	137.1	0 K
60 min Winter	9.640	0.340	2.0	169.9	0 K
120 min Winter	9.703	0.403	2.0	201.5	Flood Risk
180 min Winter	9.736	0.436	2.0	217.8	Flood Risk
240 min Winter	9.755	0.455	2.0	227.6	Flood Risk
360 min Winter	9.778	0.478	2.0	239.2	Flood Risk
480 min Winter	9.791	0.491	2.0	245.4	Flood Risk
600 min Winter	9.797	0.497	2.0	248.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	97.6	26
30 min Summer	90.705	0.0	127.2	41
60 min Summer	56.713	0.0	170.3	70
120 min Summer	34.246	0.0	205.4	130
180 min Summer	25.149	0.0	225.8	188
240 min Summer	20.078	0.0	239.9	248
360 min Summer	14.585	0.0	260.1	366
480 min Summer	11.622	0.0	274.6	484
600 min Summer	9.738	0.0	285.2	604
720 min Summer	8.424	0.0	292.8	722
960 min Summer	6.697	0.0	299.7	918
1440 min Summer	4.839	0.0	288.5	1144
2160 min Summer	3.490	0.0	384.4	1536
2880 min Summer	2.766	0.0	405.4	1944
4320 min Summer	1.989	0.0	434.4	2772
5760 min Summer	1.573	0.0	465.3	3568
7200 min Summer	1.311	0.0	484.2	4320
8640 min Summer	1.129	0.0	499.7	5016
10080 min Summer	0.994	0.0	512.0	5656
15 min Winter	138.153	0.0	97.6	26
30 min Winter	90.705	0.0	127.2	41
60 min Winter	56.713	0.0	170.3	70
120 min Winter	34.246	0.0	205.4	128
180 min Winter	25.149	0.0	225.8	186
240 min Winter	20.078	0.0	239.9	244
360 min Winter	14.585	0.0	260.1	360
480 min Winter	11.622	0.0	274.6	474
600 min Winter	9.738	0.0	285.3	588

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
720 min Winter	9.798	0.498	2.0	249.1	Flood Risk
960 min Winter	9.794	0.494	2.0	247.0	Flood Risk
1440 min Winter	9.773	0.473	2.0	236.4	Flood Risk
2160 min Winter	9.740	0.440	2.0	220.0	Flood Risk
2880 min Winter	9.703	0.403	2.0	201.6	Flood Risk
4320 min Winter	9.620	0.320	2.0	159.9	0 K
5760 min Winter	9.542	0.242	2.0	121.0	0 K
7200 min Winter	9.480	0.180	2.0	89.8	0 K
8640 min Winter	9.434	0.134	2.0	66.8	0 K
10080 min Winter	9.404	0.104	1.9	51.8	0 K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
720 min Winter	8.424	0.0	292.9	700
960 min Winter	6.697	0.0	300.0	918
1440 min Winter	4.839	0.0	289.7	1170
2160 min Winter	3.490	0.0	384.4	1624
2880 min Winter	2.766	0.0	405.5	2084
4320 min Winter	1.989	0.0	435.5	2948
5760 min Winter	1.573	0.0	465.3	3696
7200 min Winter	1.311	0.0	484.2	4392
8640 min Winter	1.129	0.0	499.8	5016
10080 min Winter	0.994	0.0	512.3	5552

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.309

Time (mins)			Time (mins)			Time (mins)		
From:	To:	Area (ha)	From:	To:	Area (ha)	From:	To:	Area (ha)
0	4	0.103	4	8	0.103	8	12	0.103

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	500.0	0.501	0.0	1.200	0.0	1.800	0.0	2.400	0.0
0.100	500.0	0.700	0.0	1.300	0.0	1.900	0.0	2.500	0.0
0.200	500.0	0.800	0.0	1.400	0.0	2.000	0.0		
0.300	500.0	0.900	0.0	1.500	0.0	2.100	0.0		
0.400	500.0	1.000	0.0	1.600	0.0	2.200	0.0		
0.500	500.0	1.100	0.0	1.700	0.0	2.300	0.0		

Hydro-Brake® Optimum Outflow Control

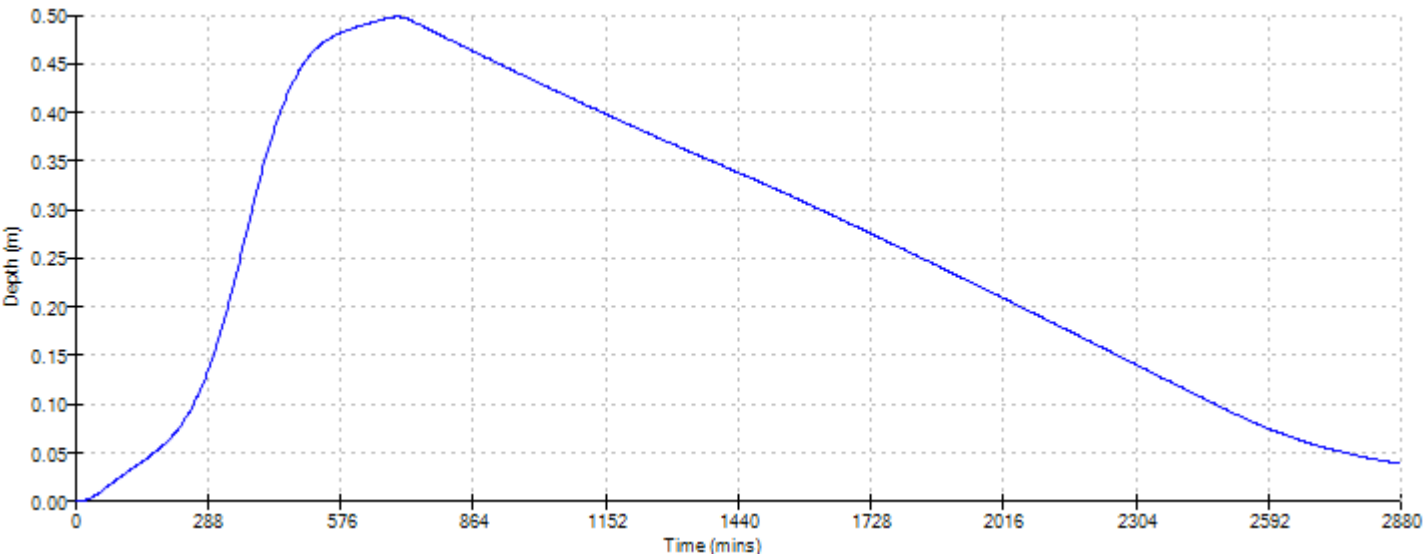
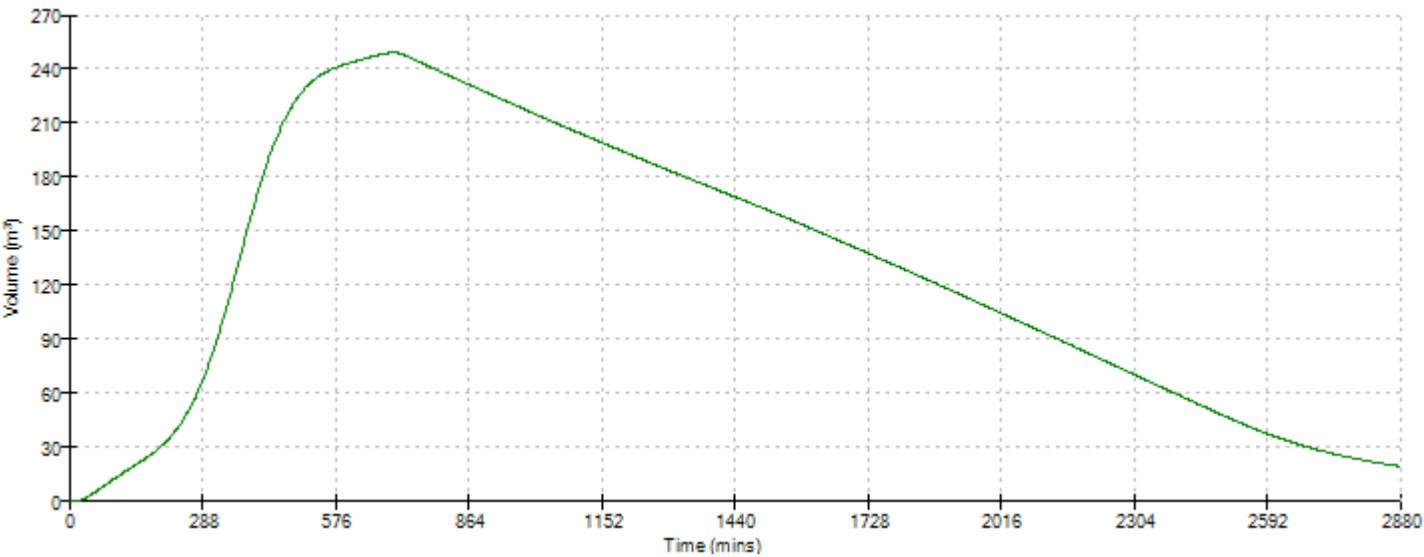
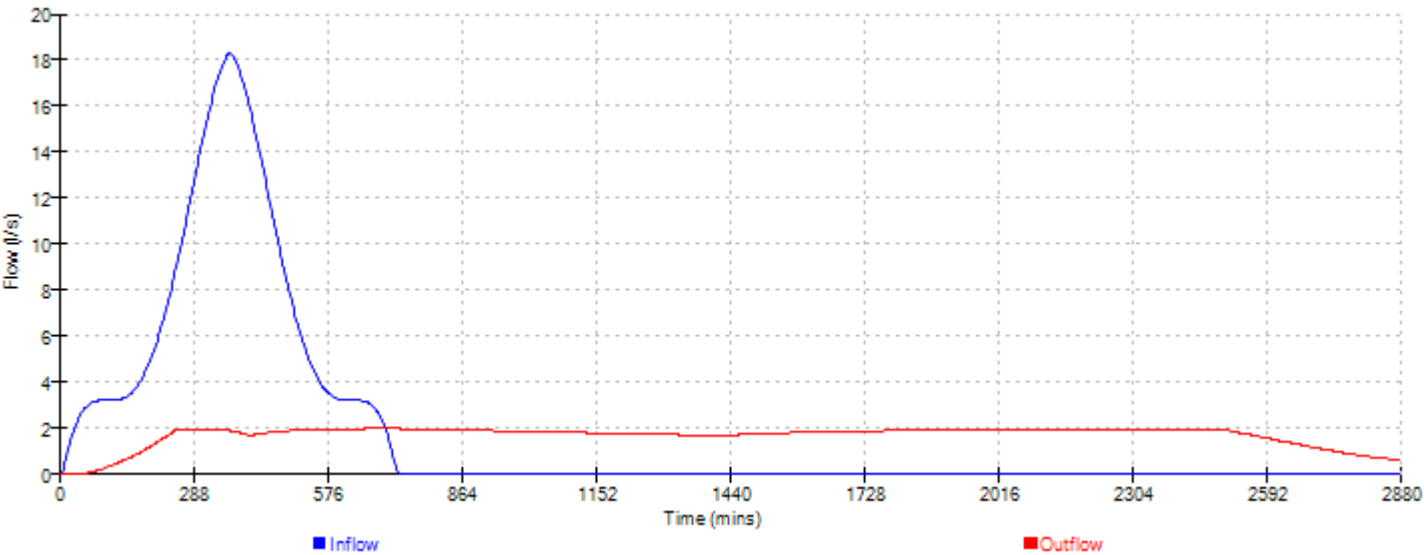
Unit Reference MD-SHE-0074-2000-0500-2000
Design Head (m) 0.500
Design Flow (l/s) 2.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 74
Invert Level (m) 9.300
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	2.0	Kick-Flo®	0.342	1.7
Flush-Flo™	0.149	2.0	Mean Flow over Head Range	-	1.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	0.800	2.5	2.000	3.8	4.000	5.2	7.000	6.8
0.200	2.0	1.000	2.7	2.200	3.9	4.500	5.5	7.500	7.1
0.300	1.8	1.200	3.0	2.400	4.1	5.000	5.8	8.000	7.3
0.400	1.8	1.400	3.2	2.600	4.3	5.500	6.1	8.500	7.5
0.500	2.0	1.600	3.4	3.000	4.6	6.000	6.3	9.000	7.8
0.600	2.2	1.800	3.6	3.500	4.9	6.500	6.6	9.500	8.0

Event: 720 min Winter



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