MOTT MACDONALD

Oxford United Stadium Development

Flood Risk Assessment and Drainage Strategy

December 2023

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Flood Risk Assessment and Drainage Strategy

December 2023

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
P01	September 2023	MT CE	RG	SC	Planning Issue
P02	October 2023	CE	RS	SC	Amendments following discussions with statutory bodies – Planning Issue
P03	November 2023	CE	RS	SC	Amendments following Ridge review
P04	December 2023	MT	RS	SC	Amendments following Ridge review

Document reference:

Information class: Standard

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Executive summary

Mott MacDonald (MM) was commissioned by Oxford United Football Club to carry out a Flood Risk and Runoff Assessment for land to the east of Stratfield Brake and west of Oxford Parkway Station, known as the Triangle..

This report is to support a detailed Planning Application for this site and to incorporate a SuDS based storm water management scheme.

The site is to be assessed with regard to the requirements of the Planning Practice Guidance (PPG) and the associated Technical Guidance to determine the suitability of the proposed development on the site.

This report identifies the risk of flooding to, from and within the site pre- and post-development and consider the following potential sources of flooding:

- Fluvial Flooding (from rivers and seas);
- Pluvial Flooding (from surface water);
- Groundwater flooding; and
- Artificial sources, including sewers, reservoirs and canals.
- This report identifies the risk of flooding to, from and within the site pre- and post-development and consider the following potential sources of flooding: Fluvial Flooding (from rivers and seas);
- Pluvial Flooding (from surface water);
- Groundwater flooding; and
- Artificial sources, including sewers, reservoirs and canals.

This element will include a general overview of the suitability of Sustainable Drainage Systems (SuDS) type systems.

If required, mitigation measures and recommendations will be made that will enable the site to be suitably developed while actively seeking to reduce flood risk locally.

The following guidelines and references have been used in the preparation of this report:

- National Planning Policy Framework (NPPF) and Planning Policy Guidance – Technical Guidance (PPG-TG)[1]
- Environment Agency Flood Risk Standing Advice for England[2]
- Oxfordshire County Council Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire[3]
- Cherwell Level 2 Strategic Flood Risk Assessment[4]
- Mott MacDonald archives
- Oxford City Council Planning Application Guidance Flooding

1 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

2 https://www.gov.uk/flood-risk-assessment-local-planning-authorities

3 https://www.oxfordshirefloodtoolkit.com/wp-content/uploads/2022/01/LOCAL-STANDARDS-AND-GUIDANCE-FOR-SURFACE-WATER-DRAINAGE-ON-MAJOR-DEVELOPMENT-IN-OXFORDSHIRE-Jan-22-2

4 https://www.cherwell.gov.uk/downloads/download/367/cherwell-level-2-strategic-flood-risk-assessment-may-2017

- Oxford City Council Level 1 Strategic Flood Risk Assessment
- Oxford City Council Level 2 Strategic Flood Risk Assessment
- Oxford City Sustainable Drainage Design and Evaluation Guide
- Oxfordshire County Council (Lead Local Flood Authority) guidance

The report is also based on additional information received from the Environment Agency (EA), Cherwell District Council (CDC), Oxfordshire Country Council (OCC) and Thames Water Ltd.

The report concludes that the development is suitable for this location and can be safely developed to manage and control all identified long term residual flood risks in this area. The provision of a positive drainage system on the site may also contribute to a reduction in flood risk locally.

Notwithstanding this, it is demonstrated that the layout may be developed to incorporate a SuDS based system that will not only provide adequate runoff protection but will also provide an improvement in the runoff quality and biodiversity.

1 Introduction

Oxford United has played at the Kassam Stadium since 2001, however in 2021 the license agreement was terminated which resulted in the agreement for Oxford United to play the stadium terminating in May 2026. The Proposed Development looks to deliver a 16,000 capacity Stadium for OUFC, as well as a Club Shop, public restaurant, bar, health and wellbeing/clinic facility and gym, and 180-bed hotel within a single building.

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process, to reduce future damage to property and loss of life. The PPG- Technical Guidance (PPG-TG) identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications.

The purpose of this report is to assist our client and the Local Planning Authority to make an informed decision on the flood risks associated with the site development.

Local Planning Authorities have the powers to control development in accordance with the guidelines contained in PPG-TG and are expected to apply a risk-based approach to development with the Sequential Test in Table 1. This sets out a sequential; characterisation of flood risk in terms of annual probability of river, tidal and coastal flooding.

In accordance with the sequential test in the technical guidance, sites are to be classed as follows:[5]

Table 1.1 Flood Zones - PPG-TG Table 3

Flood Zone	Appropriate Users
Flood Zone 1 - Low Probability This zone comprises land having less than 1 in 1000 annual probability of river or sea flooding (<0.1%)	All uses of land are appropriate in this zone
Flood Zone 2 - Medium Probability This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%- 0.1%) in any year	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this Zone Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test is passed
Flood Zone 3a - High Probability This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	The water-compatible and less vulnerable uses of land in Table D.2 area appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this should be designed and constructed to remain operational and safe for users in time of flood.
Flood Zone 3b - Functional Floodplain This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA	Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to: Remain operational and safe for users in times of flood; Result in no net loss of floodplain storage;

[5] http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

Flood Zone	Appropriate Users
and the Environment Agency, including water conveyance routes)	Not impede water flows; and Not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception Test.

Mott MacDonald has followed accepted procedure in providing the services but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, we take no liability for and give no warranty against actual flooding of any property (client's or third party) or the consequences of flooding in relation to the performance of the service. This report has been prepared for the purposes of planning approval only and is to assist our client and the local Planning Authority to make an informed decision on the flood risks associated with the site redevelopment.

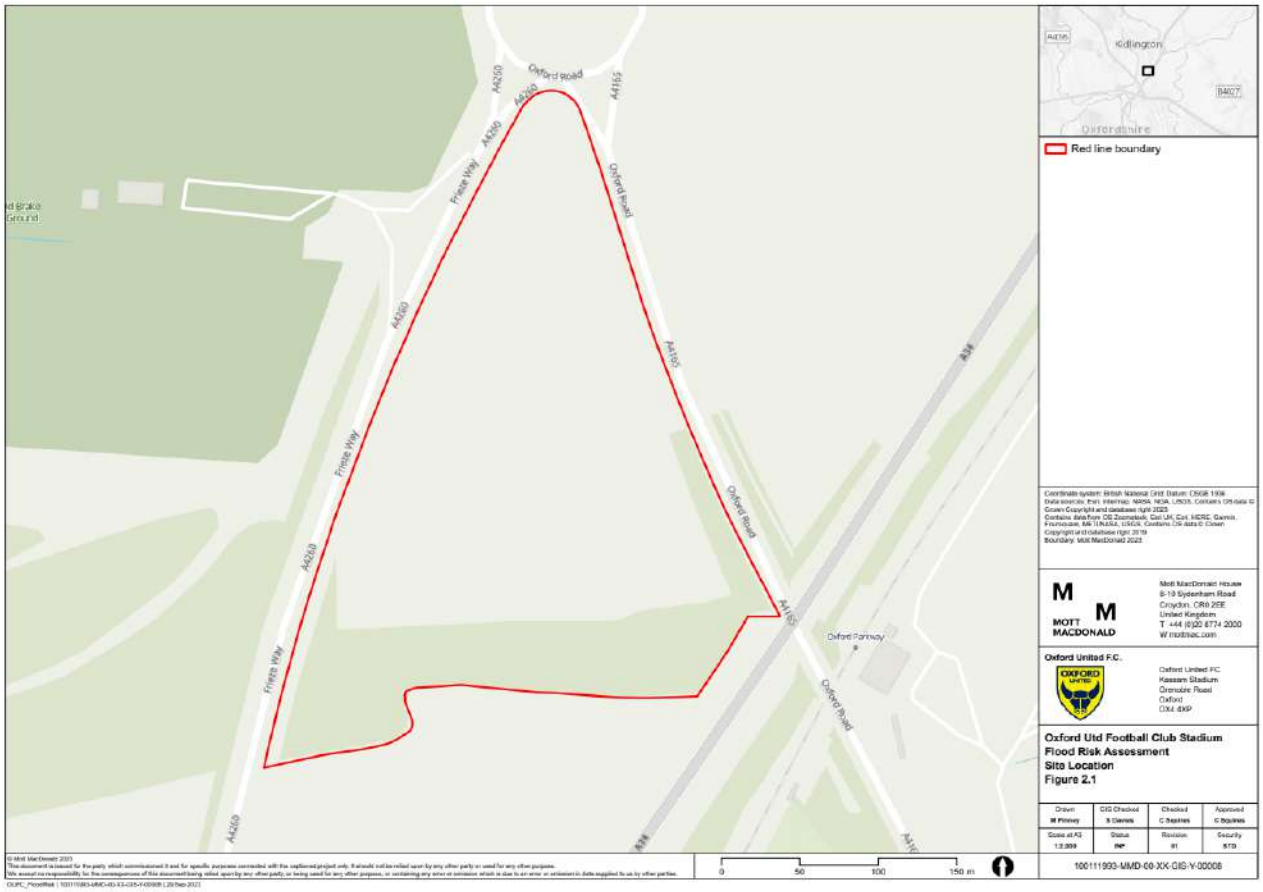
Allowance for the effects of climate change will be made in accordance with government recommendations in place and statistical data available at the time of writing this report. These recommendations may become more onerous, and the statistical data may be revised in the future; we will not make any estimate of what changes may result from this. Please be aware that this, and other issues over which the Mott MacDonald has no control, may affect future flood risk at the development and require further work to be undertaken for which we accept no liability.

2 Existing Site

2.1 Site Location

The proposed site is approximately 5.5km North of Oxford Centre and immediately south of Kidlington in the district of Cherwell, Oxfordshire with a national grid reference of SP498120. The site is roughly triangular and is bordered to the East byA4260, the west by Frieze Way (A34) with Oxford Road across the Northern face.

Figure 2.1 Location of Main Site



2.2 Site Description

The main site is greenfield with no hardstanding, existing buildings, or any visual evidence of previously demolished buildings. The area shown in Figure 2.1 is a willow coppice, harvested in rotation and the area to the south is currently a memorial planting area. There is existing access from Oxford Road north of the site via an access gate. The north and south site are separated by a band of woodland referred to as Stratfield Brake, made up of mature and young species of trees and wet grass land. The planning application red line boundary includes stretches of Frieze Way and Oxford Road, and includes the ramped access and embankment down to Oxford Parkway Station.

The topography of the site is relatively flat with a gentle fall from east to west to a low spot in the west of the site at a minimum level of 63.400mAOD and a high spot of 76.195mAOD in the northeast. The levels along the boundary, excluding the northeast, ranges between 65.650mAOD and 63.400mAOD, and the northeast corner has a steep incline towards the boundary that gradually decreases as the levels of Oxford Road tie into the existing site levels.

The site area for the planning application is 7.17ha; however this includes roads and areas such as Stratfield Brake which drain as existing and include no proposed works. Therefore, the approximate effective drainage area is 4.7ha. The site area shown in Figure 2.1 is used for the purposes of this assessment.

2.3 Existing and Natural Drainage Features

The site has existing field ditches running along the eastern and southern boundary leading to an existing culvert west of the site.

Excluding the existing field ditches, there are no main rivers, watercourses, or water bodies within 300m of the site. However it is assumed that the existing site discharges into the culverts below the A4260, into the Kingsbridge Brook which ultimately discharges into the River Thames. There are no surface water records from Thames Water Ltd. at present, however C2 information has been requested from Highways England. There are records however, from Thames Water, for an existing public sewer connection, located on the adjacent roundabout and Kennington circa 300m from the centre of the site and approximately 150m from north of the site.

Desktop study, site observations and a Ground Penetrating Radar (GPR) survey carried out in July 2023 revealed that there is surface water drainage within Oxford Rd and Frieze Way.

From a desktop study, visual inspection and a GPR carried out in July 2023 it is known that there is existing Highways surface water drainage on both Frieze Way and Oxford Rd.

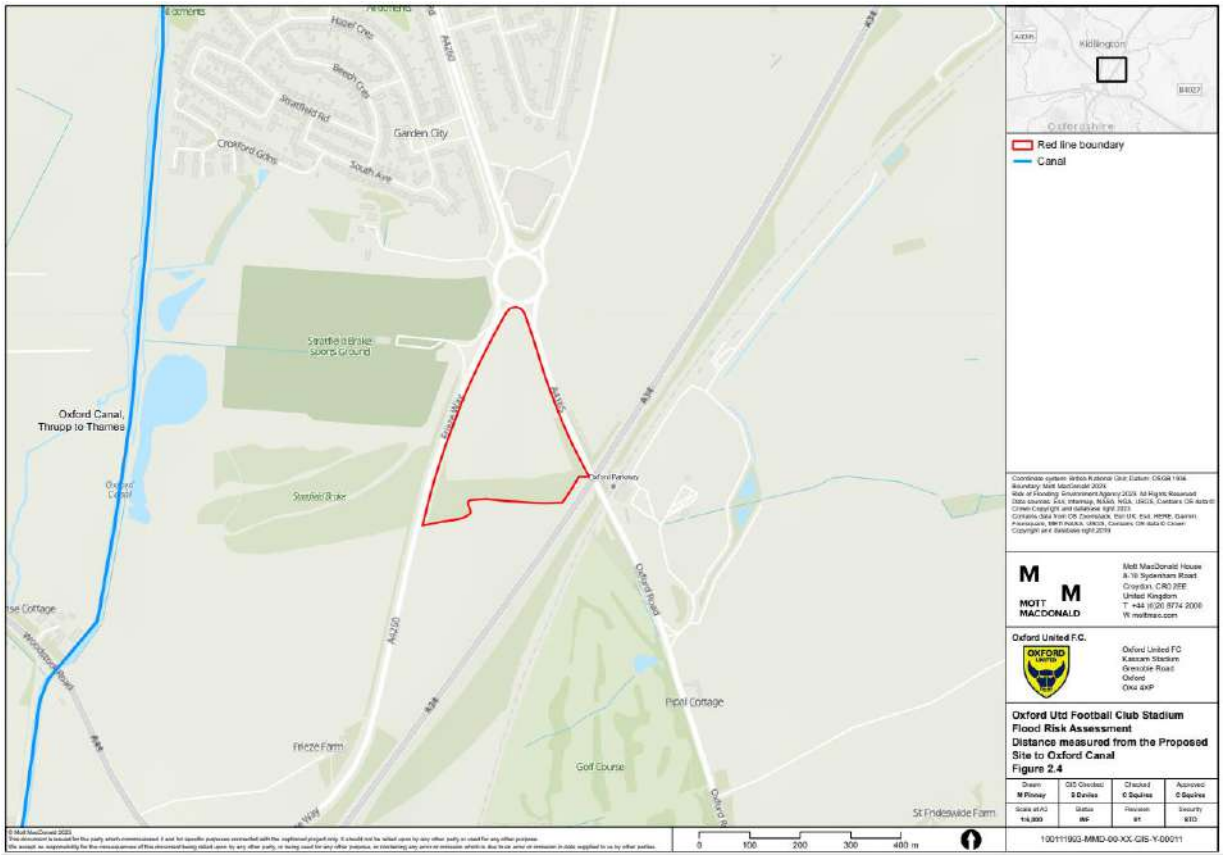
There are two existing ditches on the site, one on the southern fence and the second on the western side, The southern ditch falls from east to west and the western ditch falls from north to south, both falling towards the existing culverts located southern west of the site as seen below in Figure 2.2.

Following a walk over survey in July 2023 by Mott MacDonald, the existing culvert west of the site was found to be obstructed by debris, with surface water surrounding the area at a maximum depth of approximately 200mm the surrounding surface water is presumed to be present due to the debris obstructing the outfall. The remainder of the site was also found to have standing water in several locations.

Figure 2.2 Existing Culvert

A desktop study using available topographical information, Ordnance Survey (OS) mapping and World Wildlife (WWF) revealed that the closest watercourse is the Oxford Canal – Thrupp, to Thames west of the site. Figure 2.4 shows the proposed site in relation to Oxford Canal, measuring at a distance of approximately 750m to the west of the site.

Figure 2.3 Distance measured from the main site to Oxford Canal



3 Planning Policy Context

3.1 The National Planning Policy

The National Planning Practice Guidance (paragraph 80) sets out the Sustainable Drainage Hierarchy. Generally, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water from the site. Where possible, surface water run-off from the developed site will be drained in such a way as to mimic the natural drainage system and thereby implement a SuDS approach. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak-flow rates, or positively impact on the existing flood profile.

The Environment Agency requires, in accordance with the Government's PPG-TG document, that there should be no increase in the rate of surface water emanating from a newly developed site above that of any previous development. Furthermore, it is the joint aim of the Environment Agency and Local Planning Authorities to actively encourage a reduction in the discharge of storm water as a condition of Approval for new developments.

3.2 Oxfordshire County Council Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire

Section 5, Flood risk outside the development, Local Standards states:

- L1 The greenfield runoff rate will need to be agreed with the LLFA, Environment Agency (EA), relevant sewerage undertaker and Canal and River Trust (CRT), where appropriate, and should take into account the 1 in 1 year, 1 in 30 year and 1 in 100-year rainfall events, including climate change allowances.
- L2 Evidence would need to be provided to support a higher rate of discharge than greenfield rates and would have to be agreed by the relevant authorities as in L1.
- L3 For brownfield or previously developed sites, where it is proposed to discharge runoff at rates greater than greenfield rates, evidence will be required to demonstrate why it is not feasible to achieve greenfield rates. The capacity of any existing drainage system within the site should also be assessed in order to determine the current discharge rates.
- L4 All flow control devices restricting the rate of flow should have a bypass feature to manage flows when a blockage occurs. The bypass can be an internal weir overflow within the chamber discharging to the outfall pipe or channel. An overflow shall be provided from any basin/pond etc. safely routing flows to the discharge location.
- L5 For all residential developments, the proposed impermeable area for the site used in all calculations should include an additional allowance of 10% to account for the potential of Urban Creep.

And continues within flood risk within the development, Local Standards states:

- L6 Flow across the site must be diverted away from buildings and main access-egress routes. This flooding should be assessed to ascertain if is safe for the site's users. All drainage schemes must demonstrate that flooding will not occur to any habitable building for

the worst case 1:100yr +40% climate change event. The depth and rate of flow of the flood water should be compared to Table 4 of "Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purposes" May 2008.

- L7 The drainage system must be designed to accommodate overland flow from adjacent land if this is likely to be intercepted or affected by the development. All development must clearly identify that surface water from adjacent land has been considered appropriately and mitigation measures employed to prevent flood risk.
- L8 Any infiltration storage features should be capable of half emptying within 24 hours of the rainfall event. This is to ensure capacity for further rainfall events.
- L9 It should be demonstrated that high water access for maintenance of all elements is possible. The design of the scheme should ensure that the levels at the outfall for the design storm event would not affect the performance of the system. If the outfall of an attenuation facility is likely to be submerged in the design 1 in 100-year rainfall event, then this should be assessed within any hydraulic modelling.
- L10 All surface storage features should provide a minimum 300mm residual uncertainty allowance (freeboard) above the design maximum water level to top of bank and to finished floor levels around the site.
- L11 The risk of high groundwater levels must be accounted for in the design of infiltration drainage. The invert of any infiltration device should be at least 1.0m above the maximum groundwater level recorded.

3.3 DEFRA Non-Statutory Standards for Drainage Systems

In line with National Standards, the requirements for the design of a new surface water drainage system are as follows:

- NS7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 3.33% AEP (equivalent to 1 in 30 year) rainfall event.
- NS8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1% AEP (equivalent to 1 in 100 year) rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.
- NS9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1% AEP (equivalent to 1 in 100 year) rainfall event are managed in exceedance routes that minimise the risks to people and property.
- NS3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 100% AEP (equivalent to 1 in 1 year) rainfall event and the 1% AEP (equivalent to 1 in 100 year) rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

4 Consultation

4.1 Oxfordshire County Council

A response was received from OCC, as the LLFA, to the Mott MacDonald Scoping Request document for the Proposed Development on 27 September 2023. The response identifies the key legislation and policies to be addressed in the design of the Proposed Development. OCCs response also includes comments from the Local Council Member for the Kidlington East Ward as summarised in the following list.

- Highlighting the risk of flooding in the general area of the site (site and surrounding areas) due to the interrelated aspects of historic flood management in the area.
- A concern regarding the 'knock-on effect' of removal of vegetation in the Proposed Development causing flood risk to other areas including the railway station and the Stratfield Brake sports ground nearby.
- The change in land cover (permeable to impermeable) and land use for the Proposed Development site having a potential impact of flood risk to other areas.
- A query relating to the capacity of the field ditches/channels and the culvert under the A4260 to serve as the discharge location for the site and the sub-catchment areas connected by the drainage ditches.
- The groundwater flooding risk due to the Proposed Development, with groundwater flooding issues noted/observed in the nearby Garden City area.
- A suggestion for a discussion with Thames Water regarding their capacity of sewers for dealing with surface water and waste from the site.

4.2 Cherwell District Council

The scoping response from CDC was received on 29 September 2023. The response confirms the site is located in the Environment Agency's Flood Zone 1, with an area of surface water flood risk on part of the site due to the low topography.

- The collated responses related to flood risk from consultees in CDC correspondence comprise the following points. Thames Water: A consideration that surface water drainage requirements are met in the Proposed Design.
- CDC Land Drainage: The response highlights the need for the planning application to consider surface water management as the surface water discharge leaves the site. The comments recommend consideration of (i) the impact of the surface water discharge from the site on downstream flood risk; and (ii) the potential impact of blockage and maintenance issues at the downstream siphon under the Oxford Canal on the floodplain and the site. The comment requests consideration to both the hydraulic and ecological effects of the site drainage.
- Review of appraisal process for flood risk: The response shows agreement from CDC on the sources of flooding that should be scoped into the ES being surface water, groundwater and artificial sources; the response excludes fluvial flood risk from the scope of the assessment.
- The response cross-references the comments from the CDC Land Drainage team, as discussed above and the comments from the LLFA from Oxford City Council.

The points are considered in detail within this document in Section 7.

A meeting was held with the CDC Flood Risk Manager on 11 October 2023 to discuss CDC comments to the Mott MacDonald Scoping Request document, and a follow up meeting was

undertaken on site on the 17 October 2023 to carry out a site walkover and to locate the existing drainage ditch to the west of the A4260.

During the site visit, it was identified by both Mott MacDonald and CDC attendees that the size and gradient of the downstream ditch/channel from the site was larger than expected with approximate dimensions 1-1.5m deep, 1m channel base width and 2-3m bank top width. It is expected that the ditch/channel is owned and therefore assumed to be maintained by the Woodland Trust as part of the Stratfield Brake woodland area.

During the site visit, a significant blockage of silt in the existing culvert under the A4260 that drains the site was observed. Estimates from the site walkover indicated that the ditch/channel gradient as approximately 1:300, with an estimated elevation difference between the A4260 culvert and the siphon under the Oxford Canal of 2-3m. The channel was relatively clear of dense vegetation in the upstream reach near the A4260, but was progressively more overgrown, largely with brambles towards the canal.

The Flood Manager from CDC noted that if the culvert and ditch were unblocked and cleared out there would be no significant concern for flood impacts from the Proposed Development downstream of the site, which reduced the level of the flood risk concerns raised by CDC in their response to the ES scoping report. The Flood Manager explained that historic flooding from the ditch/channel network had not been known to extend beyond the existing small pond adjacent to the canal (grid reference 449130, 211865). The floodplain, considering the gradient along the ditch to the canal was agreed by both parties to be of a considerable size.

5 Sources and Extents of Flooding

5.1 Summary

Table 5.1 : Summary of sources and extent of flooding

Potential Source of Flooding	Is there a flood risk to the development?	Does the development increase the flood risk upstream?	Does the development increase the flood risk downstream?
Fluvial Flooding	No	No	No
Pluvial Flooding and Overland Flow	Yes	No	No
Groundwater Flooding	No	No	No
Adopted Drainage	No	No	No
Private Drainage	No	No	No
Highway Drainage	No	No	No
Reservoir Flooding	No	No	No
Development Drainage	No	No	No

Source: Flood Risk Assessment

5.2 Pre-Development Flood Risk

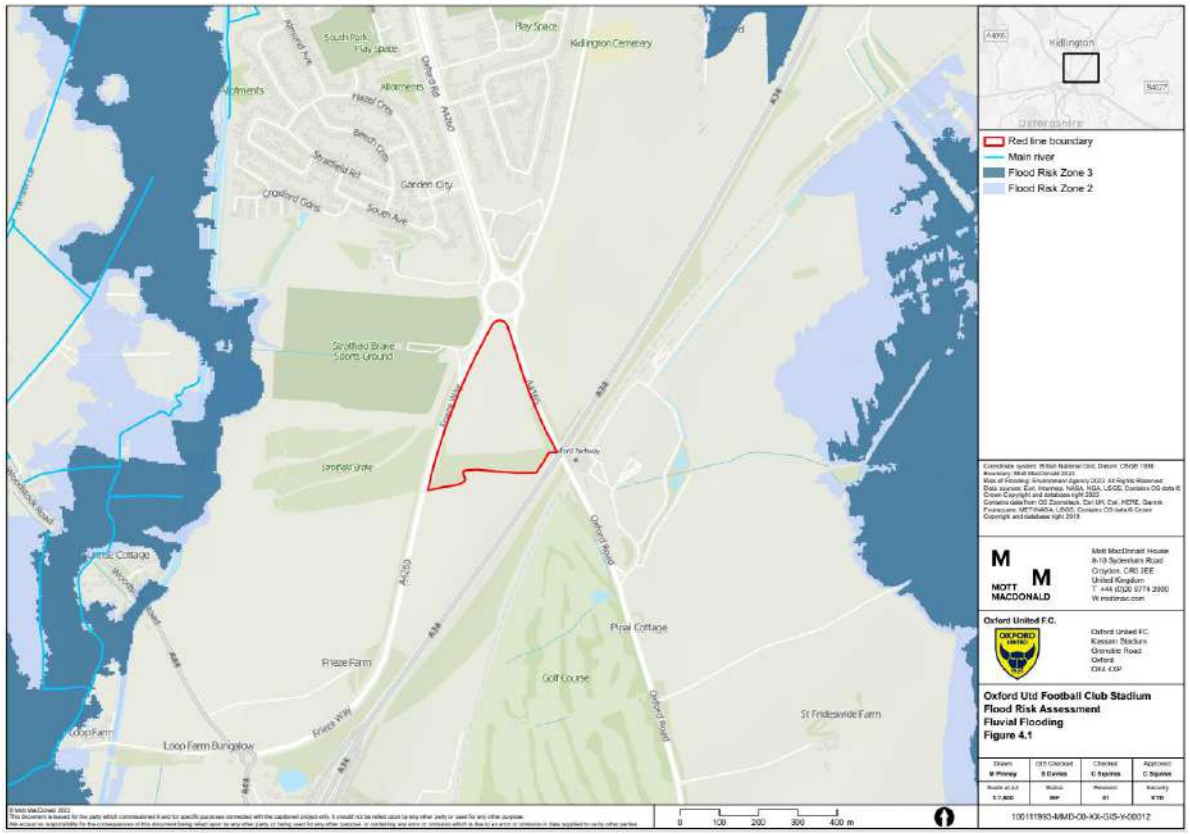
5.2.1 Fluvial (Rivers and Sea) Flooding

With reference to the EAs indicative flood maps,

Figure 5.1 shows that the site lies in an area of no fluvial flood risk. The site is therefore located in Flood Zone 1 (low probability, comprising of land having less than 1 in 1000 annual probability of river or sea flooding) as defined by the EAs Flood Map for planning. It should be

noted that the EA flood maps (Figure 5.1) are based on JFLOW modelling data which present the current flood risk based on present day flows i.e., do not consider impact of climate change.

Figure 5.1 Fluvial Flooding



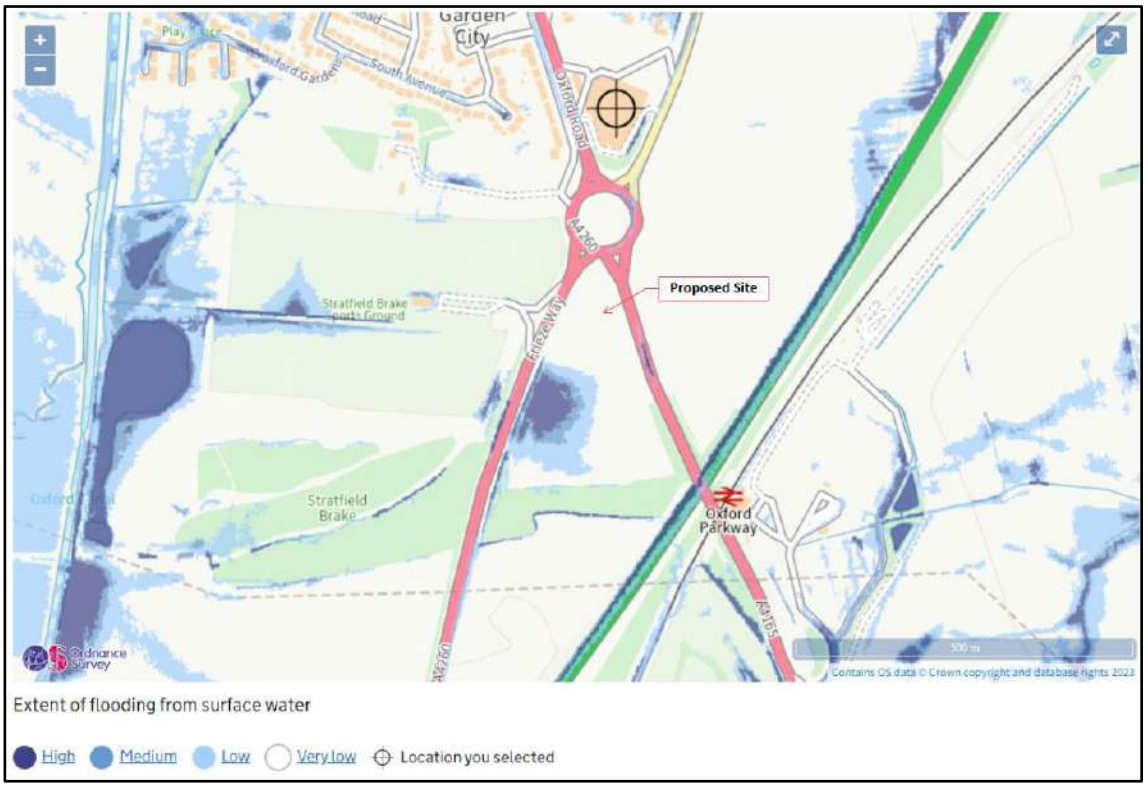
Source: EA Flood Maps 2023

5.2.2 Pluvial (Surface Water) Flooding and Overland Flow

With reference to the EA's online flood mapping, data related to the risk of potential surface water inundation or flooding is also provided in Figure 5.2. This indicates an area of localised high risk surface water flooding (annual chance of flooding of 1 in 30 year or less) as defined by the EA. This area of high-risk surface water flooding is shown located at the west of the site and correlates with an area of low topography. Further small areas are indicated at risk of flooding that follow the known locations of the drainage ditches to the southwest and south (beyond Stratfield Brake), ranging from high to low risk.

Drainage ditches invert levels indicate that they convey surface water runoff toward the existing culvert located southwest that discharges under and beyond Frieze Way. Site walkover completed in July 2023 confirmed that the existing culvert is approximately 825mm in diameter and mostly blocked (approx. 85%) with silt, likely restricting flows during large storm events and causing localised flooding particularly in areas of low topography. All remaining areas of the site are considered very low risk of flooding from surface water.

Figure 5.2 Pluvial Flooding and Overland Flow



Source: EA Flood Maps 2023

5.2.3 Groundwater Flooding

As per the British Geological Survey (BGS), the underlying geology in the area is weathered Oxford Clay overlying un-weathered Oxford Clay. Superficial deposits are unspecified. The aquifer designation of the bedrock and superficial deposits are specified by the BGS. The bedrock and superficial deposits are designated as unproductive aquifers. This area of the Cherwell District is therefore likely to present a low risk to groundwater flooding. This is reflected in the Areas Susceptible to Groundwater (AStGWF) map where the Site spans low (0-25%) and medium susceptibility (25-50%) to groundwater emergence.

5.2.4 Flooding from Sewers

There are no known instances of flooding from sewers in the immediate vicinity of the site. The Strategic Flood Risk Assessment (SFRA) does report some incidents of surface water sewer flooding in the area. These are not however, anticipated to contribute to on-site flood risk.

5.2.5 Reservoir Breach

There are no reservoirs close to site therefore flood risk to the site from reservoir breach is therefore assumed very low (source GOV.UK).

5.2.6 Climate Change

The Environment Agency requires, in accordance with the Government's PPG-TG document, that there should be no increase in the rate of surface water emanating from a newly developed site above that of any previous development. Furthermore, it is the joint aim of the Environment Agency and Local Planning Authorities, to actively encourage a reduction in the discharge of storm water as a condition of Approval for new developments. In addition, all drainage systems

should be sized to accommodate the runoff arising from a 1 in 100-year rainfall event and should include a further allowance to account for the further effects of climate change. Table 3.2 below, shows the anticipated increases in rainfall intensities and has been reproduced in part from the Department for Environment Food and Rural Affairs Climate Change Allowances map.

Table 5.2 Climate Change Allowances – 1% (100yr) Annual Exceedance Rainfall Event

Type	Applies within Cherwell and Ray Management Catchment	2050s	2070s
Rainfall	Upper End	20%	40%
	Central	25%	40%

Source: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3012

The development has a proposed design life of 50 years, which if constructed this year will be until 2073 or later. Due to the type of development and end-users proposed on the site, it is proposed to conservatively use the upper end allowance (40%) to determine rainfall for 1 in 100-year events and size attenuation accordingly.

5.3 Artificial Drainage

5.3.1 Adopted Drainage

Sewer records obtained from Thames Water are included in Appendix E for reference.

These records show that there is no surface water owned and managed by Thames Water within 300 metres of the centre of the proposed site.

5.3.2 Highway Drainage

The proposed site is bordered by two carriageways, Frieze Way and Oxford Road.

Based on the results of a desktop study, it has become evident that a filter drain exists within the verge area separating the proposed site and Frieze Way. It can be reasonably deduced that this filter drain captures surface water runoff from at least one lane of the carriageway, given that topographical data indicates the carriageway has a raised centre or crown. It should be noted that the filter drain is situated approximately 2-3 meters away from the existing drainage ditches.

The way the filter drains discharges surface water, whether through the drainage ditches and culvert, remains uncertain. This potential discharge through the drainage ditches and culvert may not have received the necessary approvals from the EA. Therefore, it is assumed that the highway drainage system on Frieze Way operates independently from the drainage ditches, until this separation is officially confirmed through Highways England. C2 information has been requested from Highways England regarding the highway drainage, and as of time of writing the response is awaited.

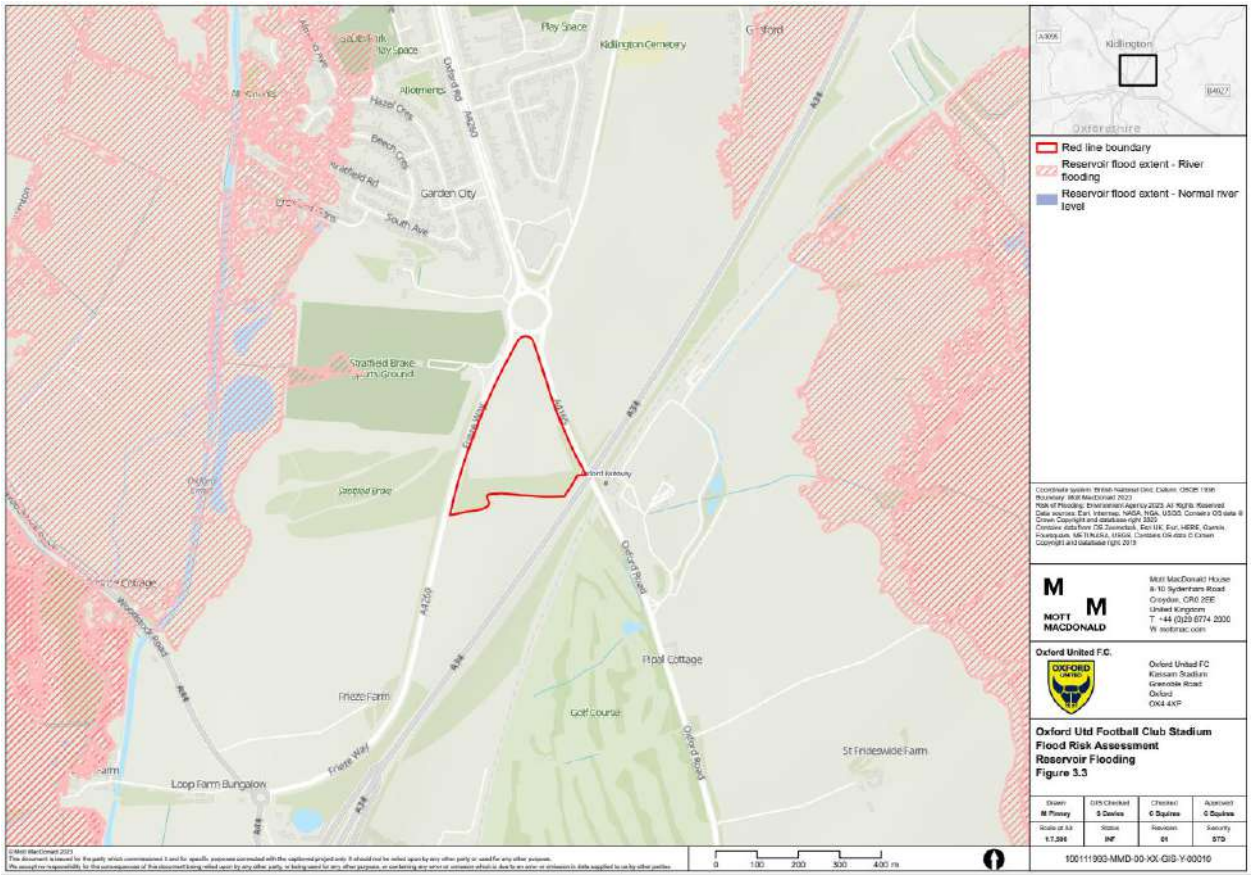
Oxford Road has a series of road gullies adjacent the length of the site with no indication of discharging within the site. Therefore, it is assumed that Oxford Road drainage operates independently from the site drainage system and poses no flood risk.

Further discussions with OCC Highways shall be undertaken to determine surface water exceedance during infrequent storm events I.e., 1 in 100 yr plus CC for both Frieze Way and Oxford Rd to ensure that any exceedance routing does not flow onto the proposed development.

5.3.3 Reservoir Flooding

With reference to the EA's online mapping, data related to the risk of potential reservoir flooding is also provided. As seen below, the boundary lies within an area of no risk of reservoir flooding (when there is also flooding from rivers).

Figure 5.3 Reservoir Flooding



Source: EA 2023

5.3.4 Canal Flooding

As stated with Section 2.3 the Oxford Canal is located approximately 750m to the west of the site. The canal is approximately 63.000mAOD, roughly 3m lower than the lowest elevation of the site, therefore deemed of low flood risk and importance.

Directly adjacent (east) of the Oxford Canal are a number of lakes, however it is unknown how these lakes are filled or what catchment they serve. Given that they are located approximately 700m from the site and appear to be situated at the same level as the canal they are deemed of low flood risk and importance.

Response from CDC – Land Drainage on the Mott MacDonald Flood Risk EIA Scoping Inputs document dated 23 September 2023 stated the following:

The crossing of the outfall system under the Oxford Canal is by means of an inverted siphon about 1 kilometre west of the site. The siphon receives very poor and infrequent maintenance due to its inaccessibility. It is known to pose a hydraulic obstruction in the outfall network. The siphon discharges into the Kingsbridge Brook which is a Main River. The Brook flows into the

River Thames a further 3 kilometres downstream. Most of this section of watercourse is in the flood plain of the River Thames.

The drainage from the site may also impact on the sensitive wildlife reserve which is upstream of the canal siphon and a little to the north.

The potential impact of flooding on the proposed site as a result of the downstream structure receiving poor and infrequent maintenance is assumed to be of no risk due to the level difference from the canal and the proposed site of approximately 3m. Further consultation with statutory bodies has been highlighted and discussed in Section 4.

Discharging the proposed site surface water runoff at greenfield runoff rates ensures that there is no increase in in surface water discharge from existing.

5.3.5 Development Drainage

The current proposed layout for the site is shown in Appendix A.

The total area within the effective drainage boundary is 4.7ha, this excludes the Stratfield Brake which is proposed to drain as existing. The proposed site includes the following impermeable areas:

- Football Stadium Footprint (~2.3ha)
- Fan Zone Multi-functional space (multiple areas - Buffer zone and fan zone total ~0.4ha)
- Car Parking area (~ 0.5ha)
- Carriageway (providing access/egress to site ~0.4ha)

For the purpose of this study the remaining drainage area of 1.1ha will be classed as permeable and is predominantly made up of proposed soft landscaping areas, swales, filter strips, rain gardens, and ponds.

In regard to the total site area, the additional area is also permeable area, however, will drain as existing and is not affected by the proposed development. This calculates as a 66% decrease in total permeable area from the existing greenfield site to the proposed development.

Estimation of the runoff for the proposed development site using the Lloyd-Davies method;

Q = 2.78 . C . I . A

Where;

C	is the coefficient of run off	1.0
I	is the rainfall intensity	50mm/hr
A	is the contributing area in hectares	3.6ha

Q = 2.78 . (1) . (50mm/hr) . (3.6ha) = 500 l/s

A development of this scale is likely to generate relatively large amounts of storm water runoff. However, the runoff itself will not pose a risk to both the development site and the areas downstream of this point. The new impermeable area of the development will alter the existing runoff profile of the site with a commensurate increase in runoff potential. As such, the management of surface water will be important as not to pose a significant flood risk and is dealt with more in Section 6.

6 Sequential Test

As the development site is shown to be wholly within Flood Zone 1 and outside the influence of any other local flood risk elements, in accordance with Table 3 of the PPG it is concluded that the development is suitable for this location and the Sequential Test is deemed to have been passed.

7 Flood Risk Assessment

7.1 Natural Drainage

7.1.1 Fluvial Flooding

With reference to the EA's published flood maps (see Figure 5.1 within Section 5.2.1) the site can be shown to be outside the influence of the flood envelope of any rivers.

The site can therefore be classified as within the Flood Zone 1. EA guidance does not recommend any special additional consideration for assets in Flood Zone 1 and the impact of climate change is considered unlikely to pose an increased fluvial flood risk to the site.

7.1.2 Pluvial Flooding and Overland Flow

With reference to the EA's published flood maps (see Figure 5.2 within Section 5.2.2) the site can be shown to indicate areas of high pluvial flood risk.

As stated in Section 5.2.2 an area of higher risk surface water flooding as defined by the EA. Existing site level suggest that the site, generally, fall toward the drainage ditches to the south and west boundaries. Drainage ditches invert levels indicate that they convey surface water runoff toward the existing culvert located southwest that discharges under and beyond Frieze Way. Site walkover completed in July 2023 confirmed that the existing culvert is approximately 825mm in diameter and mostly blocked (approx. 85%) with silt, likely restricting flows during large storm events. The ownership, maintenance, condition (as a whole), and functionality of the culvert remain unknown, especially beyond the downstream section located southwest of our site and it is therefore recommended that this information is confirmed as soon as possible to determine the responsibility for unblocking and maintaining.

Available topographical information for the site indicates a low area in the west of the site which correlates with the high-risk area shown in Figure 5.2. Hence, it can be inferred that the pluvial flooding depicted on the EA Flood Maps is directly associated with the low-lying topography, causing water to become trapped due to being unable to drain via the ditches. Runoff unable to drain via the culvert due it being blocked may also be a contributing factor.

Environment Agency defines low risk of surface water flooding as land with a chance of flooding between 0.1% and 1% annually. Medium surface water flooding risk is defined as land with a chance of flooding between 1% and 3.3% annually. The definitions note that flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast, and that local features can greatly affect the chance and severity of flooding.

Furthermore, there is an expected level of inaccuracy with the drainage features within the drainage network that have not been accounted for or represented in the EA's indicative flood maps which may be the cause of the isolated areas of flooding/ponding being showed. Therefore, it is considered that in this case the surface water flooding risk is low to very low. Although this flood risk has been identified, measures have been identified in terms of drainage provision, building flood resilience and site levels to ensure that the risk to the site is manageable.

7.1.2.1 Site south of the application site

Much like the proposed site, the land to the south of the application site indicates that it conveys surface water to drainage ditches on the northern and eastern boundary with the whole site appearing to fall from south to north.

The presence of dense vegetation during the topographical survey prevented the surveying of certain areas within the site. However, during a site walkover conducted July 2023, two significant observations were made:

1. An additional ditch, denoted by a green arrow in Figure 7.1, was identified. This ditch had a north-to-south slope.
2. Another drainage ditch originating from the southern site, indicated by a red arrow in Figure 7.1, exhibited a south-to-north slope.

These two drainage ditches converged at the point depicted inFigure 7.1. It was noteworthy that the ground level at this junction was noticeably lower than the drainage ditch located to the south of the proposed site, as shown in Figure 7.1, adjacent to Stratfield Brake and represented in blue. Further information gleaned from HA Drainage Data Management System (HADDMS) revealed that these converging drainage ditches are owned by Highways England and appear to discharge to the A34 highway via filter drains, see Figure 7.2.

Data obtained from the topographical survey reveals that the drainage ditch within the proposed site, adjacent to Stratfield Brake and indicated as blue arrows, slopes from east to west, leading toward the culvert. Additionally, the drainage ditches on the west side of the site also directs water toward the culvert.

However, it's important to note that the existing ground levels next to the south-western drainage ditch and within Stratfield Brake are relatively high. This means that there isn't a clear catchment area for this ditch from the data available.

The surveyed ground levels along the drainage ditch to the north of the southern site generally indicate an eastward slope, although do show some variation in levels such as high spots and low spots throughout its length. The variation in existing ground levels observed along the ditches' length could potentially be attributed to debris accumulation resulting from inadequate maintenance, as observed with the ditches during the site walkover.

Therefore, based on the assessment of available data and pending further surveys to confirm the surface water conveyance method, it appears that the southern site drains in the direction toward southwest and not towards the existing culvert to the southwest of the proposed site.

Figure 7.1: Estimation of Conveyance of Water within Existing Drainage Ditches

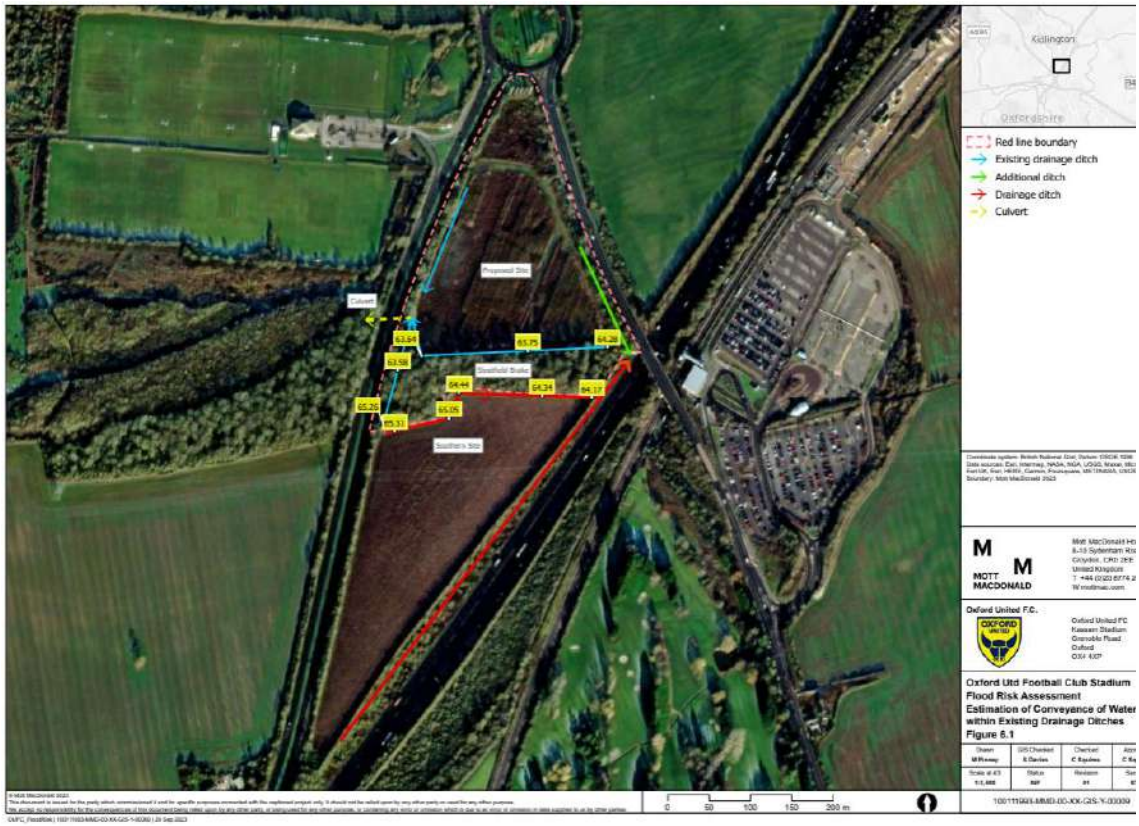
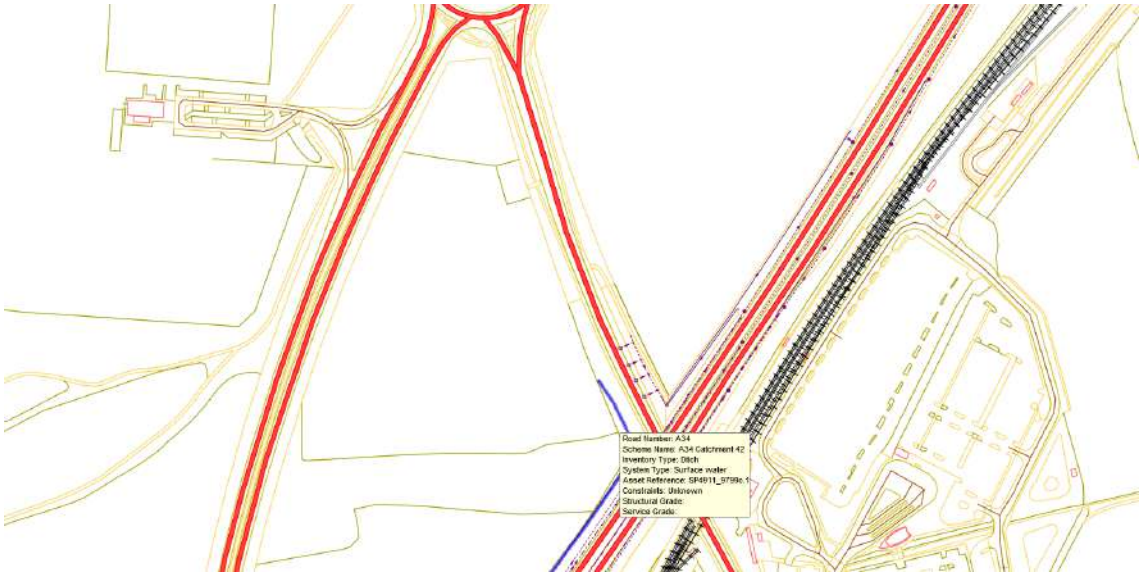


Figure 7.2: Southeast Drainage Ditches HADDMS



Source: Highways England HADDMS

7.1.3 Groundwater Flooding

Groundwater flooding is not considered to be an issue as stated within Section 5.2.3.

It is recommended that groundwater is measured and monitored as part of any future intrusive ground investigation.

7.1.4 Climate Change

As discussed in Section 5.2.6 all designs will be based on an allowance of 40% increase in climate change. For fluvial, climate change values have been ignored as there is no risk of fluvial flooding at this site.

7.2 Artificial Systems

7.2.1 Adopted Drainage

Adopted drainage flood risk is not considered to be an issue as stated within Section 5.3.1.

7.2.2 Highway Drainage

Highway drainage is not considered to be an issue as stated within Section 5.3.2.

The site is bordered by Frieze Way and Oxford Rd. Desktop study and a partial GPR survey of the carriageway indicates that Oxford Rd has a series of existing road gullies, with the road naturally sloping from south to north. In the event of any sewer is flooded upstream, inundated or becomes blocked, surface water would naturally flow towards these gullies for drainage. Assuming these gullies are blocked, the highway kerb height is approximately 125mm. Consequently, any significant accumulation of surface water exceeding 125mm depth across a substantial area is impractical.

Frieze Way presents a level of uncertainty. As discussed in Section 5.3.2, the assumption is that the highway drainage is distinct from the site's drainage. However, in a scenario where the filter drain is inundated or gets obstructed, the excess water will initially utilise the entire capacity of the filter drain structure. Subsequently, it would generally follow the road's slope from south to north. Depending on the water volume and resulting depth, any overflow may direct itself toward the site's drainage ditches. The area between the ditches and Frieze Way is a 2-3m grass verge populated by a dense shrub/hedgerow, which would act as an interception. It's worth noting that any surface water making its way to the drainage ditch is likely to be minimal, rendering it inconsequential within the broader network.

7.2.3 Reservoir Flooding

Reservoir flooding is not considered to be an issue as stated within Section 5.3.3.

7.2.4 Canal Flooding

With reference to Section 5.3.3 canal flooding is not considered to be an issue.

7.2.5 Development Drainage

It will be necessary to provide a suitably designed storm water drainage system to collect, convey and attenuate the additional runoff generated by the development of this site. The net result should be that there is no increase in flood risk to either downstream properties or assets as a result of the development.

This will be demonstrated by the developing drainage strategy of the site. This strategy should also include measures to improve run-off quality whilst maximising biodiversity and amenity to provide a sustainable drainage system as noted in PPG.

Foul flows from the development should be drained through an entirely separate system designed to adoptable standards to minimise the risk of foul flooding occurring as a result of the development.

8 Storm Water Management

The following design standards and the best practice guidelines have been used in developing this drainage strategy;

- Oxford City Sustainable Drainage Design and Evaluation Guide;
- Oxford City Council Level 1 Strategic Flood Risk Assessment;
- Building Regulations Approved Document Part H 2015;
- CIRIA C753: SuDS Design Manual;
- CIRIA 680: structural design of modular geocellular drainage tanks;
- Design and Construction Code (DCG).

8.1 Control of Surface Water Run-off

It should be acknowledged that the satisfactory collection, control and discharge of storm water is now a principal planning and design consideration. This is reflected in recently implemented guidance and the National SuDS Standards.

Part H of the Building Regulations 2015 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

- An adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable;
- A watercourse, or, where that is not reasonably practicable;
- A surface water sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

8.1.1 Infiltration Based Systems

As per the Cherwell Strategic Flood Risk Assessment, the underlying geology of the site is predominantly clay, meaning infiltration is considered an unlikely method of discharge. However, in-situ, site specific testing would need to be undertaken and has been specified within the Ground Investigation (GI) scope. Therefore, in-lieu of this data, for the purpose of this study alternative methods of surface water discharge shall be considered as the primary means of disposal of storm water.

8.1.2 Watercourses

The Oxford Canal – Thrupp west of the site, approximately 750m away is the closest watercourse to the site. The proposed discharge method is to utilise the existing culvert west of the site which travels under the A4260 as per existing site and towards the canal where it discharges to the Kingsbridge Brook.

8.1.3 Adopted Sewers

As discussed in Section 8.1.1 and 8.1.2, infiltration-based system is not considered a viable option and an existing culvert that ultimately discharges to a watercourse is the proposed

method of discharge. Therefore, discharging to an existing sewer has been discounted for this assessment.

8.2 Allowable Site Discharge

The preferred method of discharge for the site is the existing culvert west of the site which discharges to the Kingsbridge Brook via an inverted siphon. The proposed discharge rate will be the estimated greenfield runoff rates for the site. In order to calculate the greenfield runoff rates, the proposed site area is required along with the exact location.

Based on the current proposed drainage area of 4.7ha and the location of the site, the IH124 method is used to calculate the greenfield runoff rates and therefore the proposed discharge rates of the site. The HR Wallingford tool indicates a QBar rate of 11.6 l/s, whereas the MicroDrainage results quote a QBar rate of 11.6/s. The difference in rates is due to the accuracy in location, the HR Wallingford tool allows the user to more accurately pinpoint the location, and therefore, is considered a more accurate source in addition to providing a more robust design.

In order to adhere to a discharge rate of 11.6 l/s a flow control device in the form of a Hydrobrake has been specified, which in turn requires the inclusion of onsite surface water storage that is discussed in subsequent sections. In the event that the Hydrobrake flow control device becomes blocked a bypass in the form of an overflow has been designed such that any water unable to pass through will be diverted via an overflow pipe to the outfall. Likewise for the pond structures, in the event that the main outlets become blocked overflow pipes shall divert storm water safely to the outfall.

8.2.1 Highway Drainage

The two highways either side of the proposed triangle site, Frieze Way and Oxford Road, require some accommodation works as part of a Section 278 (S278) Agreement. Any works regarding the drainage within the highways, will also be considered part of the S278 rather than part of the development's drainage proposal. The proposal is to keep highway drainage to remain within highway area and the proposed site surface water is to continue discharging into the network as per existing. Therefore, the highway and proposed site drainage are to remain separate and the greenfield run off rate of the development will not be affected by the highways catchment areas, and vice versa. The proposed development will not impact any of the existing drainage networks within both Frieze Way and Oxford Road.

8.3 Existing Culvert

The existing culvert located to the southwest of the site is the proposed method of discharge. However, upon inspection on a walkover survey, the culvert was identified as mostly blocked with debris and silt. The design assumes that the landowner will unblock the culvert and provide maintenance to ensure no future blockages and to maintain a fully operational and functional culvert. Confirmation of this has been sought in September 2023 and remains open as of time of writing.

8.3.1 Existing Culvert Remaining Blocked

In the unlikely event that the culvert is not unblocked by the landowner and remains blocked then there would be an uncertainty attached to its functionality. If remained blocked, it's capacity to effectively handle greenfield runoff rates during significant storm events would raise doubts.

In order to provide solutions for all potential outcomes concerning the blocked culvert the following design alternatives have been considered.

In the event of flooding on the proposed site due to system inundation as a result of the culvert remaining blocked, the current design suggests the car park would flood due to it likely being the lowest point of the site, placing the egress from site to Frieze Way at risk. However, it's proposed that levels within the proposed site be designed such that the access/egress onto Frieze Way remains operational during such storm events.

Other alternative discharge locations could also be investigated, such as the drainage ditch to the southeast owned by Highways England or the surrounding highways drainage, albeit likely requiring pumping due to the topographical difference. To summarise, the proposed strategy has assumed that the existing culvert is the proposed discharge location, and design has been assumed such that the landowner will unblock and maintain the culvert to ensure its functionality and effective operation. However, there are alternative solutions should this not be achievable. Detail can be secured via a commencement planning condition

Correspondence with the landowner (OCC) regarding the culvert has been included within Appendix D.

8.4 Site Attenuation

The provision of suitable attenuation on-site to mitigate flood risk resulting from the proposed development will be a key factor in the evolution of the site development layout.

The provision of large volumes of attenuation, as is likely in this case, can be achieved by a number of methods; however, not all systems can be assessed in direct comparison.

One of the aims of PPG is to provide not only flood risk mitigation but also maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity. Systems incorporating these features are often termed Sustainable Drainage Systems (SuDS) and it is a requirement of PPG that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

Calculation of the storm water attenuation requirements has been estimated in Microdrainage software, taking into account guidance on increased rainfall intensities to account for climate change. In accordance with the NPPF, 20% and 40% increase have been applied to assess the impact of climate change. The attenuation volume required to accommodate this is 3,715m^3. The proposed impermeable areas taken from the current layout may be used to evaluate the runoff response of the site during varying rainfall events as seen in Table 5.1. The software uses the FSR characteristics of M5- 60= 20 mm and ratio R=0.4.

Table 8.1 Summary of Anticipated Attenuation Volume

	Impermeable Area	**Anticipated Unrestricted Run-off**	**Flow Restriction**	**Attenuation Volume (1 in 100 + 40%)**
	ha	ls^{-1}	ls^{-1}	m^3
Whole Site	3.6	500	11.6	3,715

Source: Microdrainage Calculation

As per the current site plan, the surface water network includes two storage ponds and cellular attenuation as the proposed attenuation. The total proposed attenuation volume for the ponds and geo cellular storage is 3,715$m^{3.}$

The proposed network also includes a number of rain gardens amongst the car parking area and towards the southwest of the site as well as filter drains along the western boundary and to the north of the stadium. The rain gardens and filter drains will provide a volume of attenuation

depending on the proposed area and depth which will be further developed at the next design stage.

If infiltration does prove to be a viable drainage solution for the proposed site, then it should be possible to reduce the overall size of the attenuation required.

8.5 Sustainable Drainage Systems (SuDS) and Water Quality

The most appropriate attenuation system should satisfy three main characteristics:

- Provide the required volume of storage;
- Minimise the loss of developable land and;
- Where possible provide local amenity.

A summary of the various types of attenuation is included overleaf.

The application of the 'SuDS Manual' CIRIA report C753 for new developments requires that the runoff from sites is not only restricted to meet the pre-development runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses.

The manual and EA guidance applies a sustainability hierarchy to the various types of SuDS systems, this is summarised in Table 8.2;

Table 8.2 SuDS Hierarchy

	SuDS Technique	Flood Reductions	Pollution Reductions	Landscape & Wildlife Benefit
Most Sustainable	Biodiverse Roofs	√	√	√
	Basins and Ponds Constructed Wetlands Balancing Ponds Detention Basins Retention Ponds	√	√	√
	Filter strips and swales Infiltration devices Soakaways Infiltration trenches and basins	√	√	√
	Permeable surfaces and filter drains Gravelled areas Solid paving blocks Porous paviours	√	√	
Least Sustainable	Tanked Systems Oversized pipes/ tanks Cellular Storage	√		

Source: CIRIA SuDS Manual C753

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where some systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy. However, included below are summaries of some of the main types of SuDS systems that may be applied to the development outlining the main benefits and constraints to their application.

In addition to the above hierarchy, the CIRIA SuDS Manual C753 identifies a number of treatment trains or SuDS devices through which flow should pass from various point sources of runoff. This is designed to ensure that the receiving watercourses are not put at risk of pollution by new development.

Notwithstanding this, reference to the SuDS manual and the simplified index approach (Chapter 26) classifies the hardstanding runoff thus:

Table 8.3: Summary of Pollution Index Table from SuDS Manual

Land use	Pollution Hazard level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
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

Source: SuDS Manual C753 Table 26.2

Figure 8.1: Proposed Catchment Areas

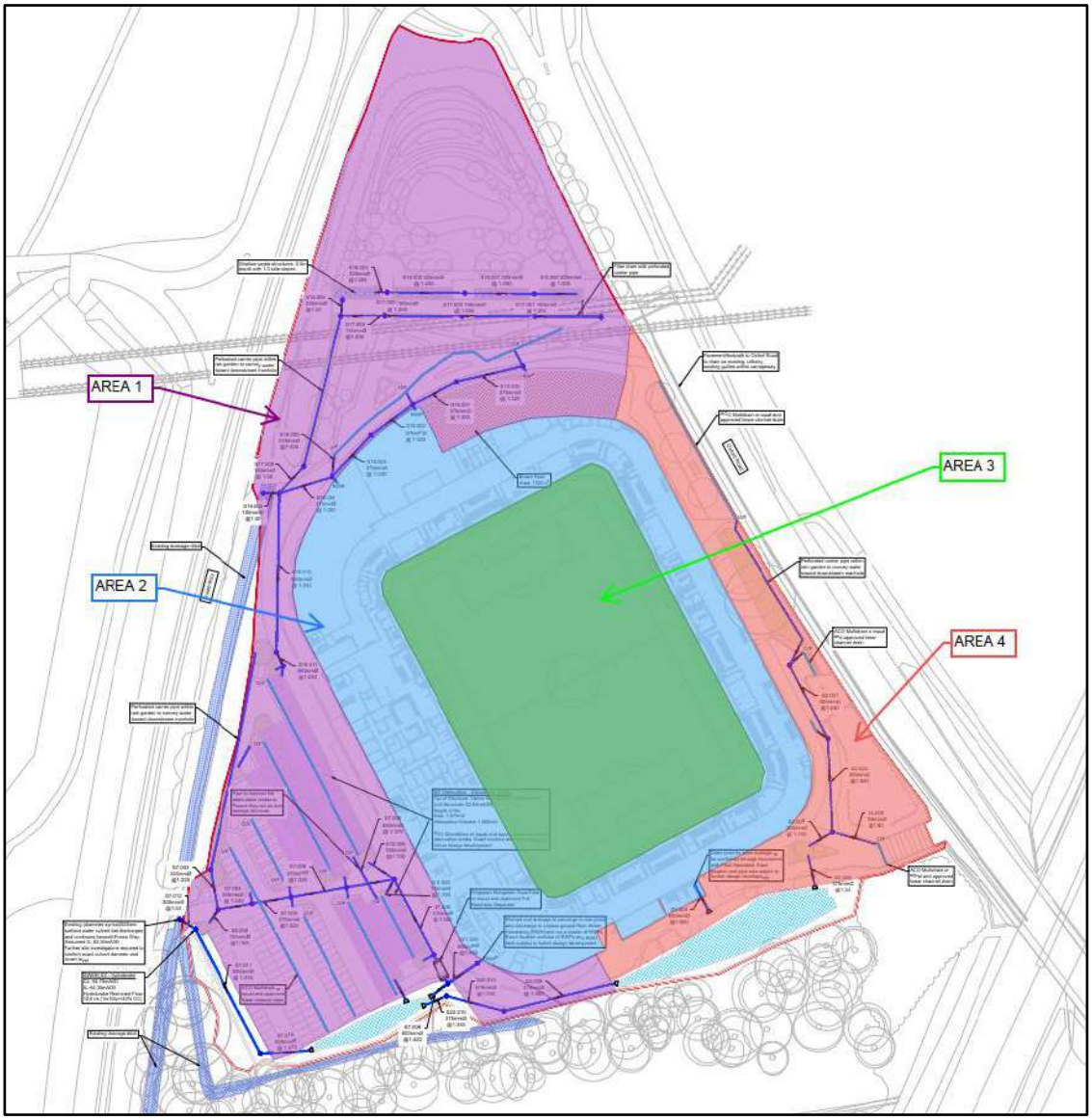


Table 8.4: Summary of Treatment Index for SuDS used

Type of SuDS Component	Mitigation Indices		
	Total Suspended Solids (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
Bioretention System (Rain Garden)	0.8	0.8	0.8
Full Retention Separator (Kingspan Klargester Aqua Treat Full Retention GRP or equal and approved)	0.85	0.64	0.99
Pond	0.7	0.7	0.5

Source: SuDS Manual C753 Table 26.3

Area 1 within Figure 7.1 will contain land use with the most pollution due to the access/egress and car parking being situated within the catchment. However, using Table 7.3 we can determine that the land use will have a pollution hazard level 'medium'. The SuDS components treating this catchment will be a mixture of filter drains, filter strips, swales, rain gardens and pond. However, the SuDS treating the immediate runoff from the car parking area and access/egress carriageway will predominantly be the rain gardens. Table 7.4 indicates that rain gardens provide sufficient mitigation for the 'medium' pollution hazard land use, whilst also removing sediments prior to discharging to the geo cellular crates or pond. Further treatment is also provided downstream via the pond, prior to discharge to the culvert.

Al other areas can be classified as 'low' pollution hazard level with sufficient treatment provided through the pond(s) alone.

This type of system will not only provide the required attenuation for the site but would also enable the features to be integrated with the existing natural habitat and provide water quality improvements to the flow prior to discharge.

8.5.1 Green Roof/Biodiverse Roof

Larger areas of roof may be designated as green or biodiverse roofs to provide both point water treatment and significant enhancement of local biodiversity. The assessed gains are such that these systems are the preferred EA option for the provision of SuDS.

If considered at the outset of the design of a unit, a green roof can be integrated within the provision of a roof terrace area to multiply the benefits, alternatively, a maintained roof can be installed that may require specialised access.

There are numerous propriety systems available on the market to suit various specific applications and it is recommended that if these systems are being considered discussion with several suppliers is instigated as soon as possible.

A biodiverse roof has been proposed to take advantage of the sizeable roof area of the proposed stadium. Due to the nature of the roof plan, the flat section of the north roof area will be the extent of the brown roof, totalling an area of approximately 2,270m^2. A brown roof is left to self-seed with plants, via wind or bird and self-populate with wildlife that was displaced by the build. The aim of a brown roof is to replicate the wild urban spaces that are found on ground level.

8.5.2 Ponds and Basins

The nature of these systems is such that the run-off from the development can be treated by biological action and stilling to significantly improve the quality of water discharged from the system.

Basins also provide large areas of open space that can be developed for recreational uses or as new habitat for wildlife.

Both systems do, however, take up developable land and have residual maintenance and liability issues attached to their implementation.

Two ponds have been incorporated within the proposed drainage network to provide attenuation and to aid reaching the site's greenfield runoff rates requirements. One pond is positioned directly south of the stadium, receiving runoff from the western part of the site and drainage from the pitch. The second pond, located west of the first pond, and southwest of the stadium, receives the runoff from the remainder of the site as well as the Stadium roof.

The proposed levels and the FFL will impact the invert levels of the pond, however, based on the current proposal of an FFL at 64.8mAOD the pond south of the stadium has an invert level of 62.883mAOD and a total attenuation volume of 1,224m^3. The second pond has an invert level of 62.477mAOD which provides an attenuation volume of 545m^3. Therefore, the total attenuation volume provided by the ponds is 1,769m^3. The ponds will improve biodiversity, provide habitat creation benefits for the site, provide water treatment through settling and biological uptake, settling being the primary form of pollutant removal.

The emergent and submerged aquatic vegetation along the shoreline can consume dissolved constituents in the inflow. However, it is suggested that an upstream pre-treatment system is proposed to prevent open water features from becoming unsightly and odorous and reduces the risk of rapid silt accumulation. Pre-treatment methods such as a separator provides treatment i.e., capturing and retaining sediments, oils and floatables from stormwater runoff.

8.5.3 Filter Strips and Swales

Often used adjacent to roads and footpaths, swales and filter strips can be used to collect water directly from linear features, percolate some of the flow, attenuate and then discharge the flow to either a traditional system or a secondary SuDS device.

The use of these systems is more suited to linear applications such as roads as the typical cross section is relatively small and longer runs are required to provide attenuation volume.

Filter strips will be smaller in plan area than a swale although the swale can be landscaped to be incorporated into the verge of the carriageway, combining two functions.

Land take can be relatively small in comparison to other systems and both types perform well in improving water quality. They are also ideally suited for disposal of water via a secondary infiltration.

Filter strips are proposed where possible along the access road from Frieze Way to provide initial treatment to the surface water runoff before entering the wider surface water network. Swales have been proposed to the north of the stadium receiving runoff from areas to the north and the fan zone.

8.5.4 Rain Gardens

Rain gardens are designed to mimic the natural water retention of undeveloped land and reduce the volume of rainwater running off into drains from impervious areas. They also have the added benefit that they are able to treat low levels of pollution. In construction, they are shallow depressions with absorbent, yet free draining soil which are populated with plants that are able to withstand temporary flooding conditions.

The current design includes a number of rain gardens predominantly amongst the car parking area that receives surface water runoff via intermittent linear channel drains. Raingardens utilise infiltration through the growing medium and drainage fill before discharging to carrier pipes, therefore providing a slow release of surface water runoff. In order to provide a robust design, overflow pipes will be specified to ensure that large storm events do not inundate the raingardens and cause flooding of the surrounding areas.

This type of system not only has the advantage of meeting the requirements of SuDS but could also provide additional educational benefits for certain sites.

8.5.5 Rainwater Harvesting

Rainwater harvesting involves the collection of rainwater runoff with the intent of using it elsewhere as a water supply. The runoff is collected from roofs and impermeable areas, it is

then stored below ground and pumped through a treatment plant to a day tank where it is stored and ready for use as a supply of water. The benefits of rainwater harvesting include; delivering sustainability and climate resilience benefits, reducing the volume of runoff from impermeable areas and therefore aid in the reduction of attenuation volume required on site.

In regard to the implementation of rainwater harvesting within this strategy, the design requires an agreed end-use point and therefore shall be assessed in subsequent design stages. Factors such as the size of the below ground storage and treatment plant will impact the intended use of water supply, however examples include;

- External and washdown use,
- WC flushing.

8.5.6 Permeable Paving

Larger areas of block paved hardstanding can easily be converted to provide significant volumes of storage. These systems also encourage biological treatment of flow and extraction of oils and heavy metals from the run-off.

Land take is reduced as storage is located under car parks and access roads. However, maintenance is potentially a long-term issue and the possibility of the paving being damaged, dug up and not properly reinstated or not regularly swept could lead to compromising the future capacity of the system.

This system will negate the need for a separate collection system such as kerbs and gullies. It will also assist in reducing the flood profile of the site by significantly attenuating the run-off from the development within the sub-base material.

There is no specific amenity provided by the system other than enabling other areas to be utilised for development rather than potentially sterilizing area with an easement for a sewer or stand-off for a basin.

These systems may be incorporated into normal car-parking areas and driveways but may not be suitable for areas accessed by larger vehicles. These systems can also be used in conjunction with geo-cellular attenuation where attenuation volumes are large.

The proposed car park is set to be approximately 0.5ha and D400 loading. This area has potential to be permeable paving, allowing for additional attenuation for the site. Geo cellular storage and ponds have been the primary source of proposed on site attenuation however there is scope to include a hybrid or stepped system whereby surface water within the car parking area is initially intercepted by the permeable paving before discharging into the geo cellular storage.

This would serve multiple purposes, including the removal of sediment prior to discharge into the geo cellular storage, allowing for a shallower surface fall due to the risk of standing water being lowered which in turn allows for proposed ground levels to be higher and less of a flood risk during large storm events.

8.5.7 Cellular Storage

Large volumes of storage can be provided under grassed and lightly trafficked areas by using proprietary geo-cellular systems. This will maximise the developable area of the site.

There are no specific mechanisms within the system designed to treat flow, but extended detention times will allow sedimentation reducing the suspended solids within the discharge.

There is no creation of amenity by the installation of these types of systems, indeed by maintaining access to the system small areas may need to be reserved.

If the developable footprint is constrained then these systems may be advantageous, however, to ensure suitability it is recommended that the use of these systems is discussed with the maintaining body as they are not always preferred.

The installation of cellular storage requires significant excavation and therefore where space is not a critical issue other forms of attenuation should be considered. These systems will also require occasional maintenance to remove sediments which can be difficult depending on the design and access arrangements and forms of upstream treatment to prevent ingress of sediments.

The proposed surface water network includes a large volume of cellular attenuation located in the car parking area. The proposed dimensions of the cellular storage are as follows:

Area = 2,275m^2

Depth = 0.9m

Volume = 1,945m^3

Considering the proposed levels, it's not possible to increase the depth while adhering to the minimum cover depth requirement of 0.8m (manufactures specific min. cover) to geo cellular storage crates in the car parking areas, as specified in the proposed product specifications (Polytstorm) and ensuring the conveyance of water remains via gravity.

However, if the detailed cut and fill analysis during subsequent design stages determines that raising the FFL is feasible and practical, it could potentially offer the opportunity to reduce the geo cellular storage crates footprint and increase its depth.

8.5.8 Tank or Culvert Storage

Hard engineered tank storage systems have traditionally been used for attenuation structures for the past decade and are often specified where large volumes of storage are required (>200m^3) and available space is an issue.

These systems have no inherent water treatment properties except potential sedimentation of the attenuated flow and offer no additional amenity benefits. In some cases, the easement to the tank or culvert is such that a significant portion of land area is sterilized from development as are certain types of landscape planting.

There are also significant costs associated with these systems in production, transportation, and installation. However, once installed the long-term maintenance requirement of the system is relatively low.

With a proven record of successful installation, tanks and culverts are regularly adopted by water authorities across the country, albeit with a large associated easement that will sterilise that portion of the site. It should be noted however, that these systems will require occasional maintenance to remove sediments which can be difficult depending on the design and access arrangements.

Due to the constraints of the site and limited available space, tank or culvert storage has been discounted.

8.5.9 Surface Storage

The use of roads, public areas and even landscaped areas as additional storage for an extreme rainfall event is becoming a widely accepted form of attenuation.

Water spilling from the drainage systems can be collected via roads and kerbs and channelled to lower lying areas where it would be stored until the capacity in the existing system returns.

These systems have the advantage of requiring little additional infrastructure merely detailing of the proposed roads and grassed areas.

As these systems will only by used in extreme events when the adopted drainage system is exceeded (>1 in 30 years), they provide a very efficient way of catering for these events rather than providing permanent capacity.

There is no inherent water treatment capability in this system nor any particular increase in amenity, however, the costs associated with this provision are relatively small.

Surface storage may be utilised in subsequent design progression however may cause a hazard due to the limited available space on site, the nature of the site attracting large masses of people and the natural topography resulting in the low-level areas being located at the egress of the site.

8.5.10 Oversized Pipework

It is often possible to provide the required volume of storage within the existing collection pipework of the proposed system. This may be incorporated by using oversized pipework designed to act as inline storage.

As the diameter of larger pipes readily available is limited the applicability of these types of systems is more suited to <200m^3 of attenuation. Above this volume, the length of pipe required is excessive and difficult to suitably fit into a normal site layout.

There is no intrinsic amenity provided by the use of this system neither is there any specific level of run-off treatment over and above that of a standard pipe and gully system.

However, due to their traditional nature, the adoption of these types of systems by water companies is straightforward and does not require any specialist input. The pipes are generally available direct from suppliers with little or no lead time and the satisfactory long-term performance of these systems is well documented.

The use of oversized pipework is not deemed a suitable choice for the proposed site at its current FFL. This is primarily because it presents challenges in maintaining the required minimum cover depth uniformly across the site while still enabling a gravity-based system.

8.6 Summary

The application of a SuDS based system needs to be considered as the primary measures for dealing with surface water for any proposals, these systems are the only ones that provide the required level of treatment. This type of system will not only provide the required attenuation for the site but would also enable the features to be integrated with the existing natural habitat and also provide water quality improvements to the flow prior to discharge.

To summarise, the following SuDS systems were not incorporated within the design for reasons previously discussed.

- Oversized pipework
- Permeable paving

However, the remaining SuDS systems discussed within section 7 have been incorporated within the proposed design, which includes:

- Biodiverse/green roof
- Two ponds

- Filter drains and swales
- Rain gardens
- Cellular storage
- Rainwater harvesting

8.7 Design Example

In order to give some idea of the size of attenuation features that may be required and thus begin the process of integration, it is possible to provisionally size a typical feature at this stage based upon the assumptions discussed previously.

The proposed drainage network has been designed for a 1 in 100 year + 40% climate change event, with a flow restriction of 11.6 l/s and an impermeable area of 3.6ha. As per Microdrainage source control function and the parameters, a storage volume between 3,164m^3 and 4,220m^3 is required.

A provisional design has been carried out for the site as a whole which shows that an attenuation volume of 3,715m^3 provides adequate storage for a 1 in 100-year storm + climate change. The total storage volume has been proposed as a combination of geo cellular storage and two ponds. The proposed rain gardens and filter drains also provide an additional level of storage to the network. The dimensions for the proposed ponds can be found in section 7.5.2 and the geo cellular storage in section 7.5.7.

8.8 Flood Routing

The performance of the system during extreme events (>1 in 100 years) should also be considered at this stage.

The routing of potential storm water run-off, should the capacity of the proposed site drainage system be exceeded, needs to be built into the layout of the site such that the residual risk of flooding from this element can be easily mitigated.

In an event of exceedance, the nature of the proposed levels will allow for the exceedance flows to drain towards a low spot within the car parking area. The existing highway tie-in level is stated at 64.700mAOD, therefore a low spot is proposed between the stadium and the access due to minimum gradient standards and to ensure that all levels fall from the proposed building. The proposed level of the low spot is 64.200mAOD. Which has been assumed at this stage of design to be the lowest level on the site, therefore, in the event of exceedance, the storm water run-off will accumulate at this point and enter the drainage network via the proposed drainage channel.

The drainage strategy has taken consideration of the phasing of works to ensure that existing flows are not hindered and that no additional flood risk is caused elsewhere on-site during construction.

8.9 Foul Drainage

8.9.1 Foul Water Flow Rates

The following foul water drainage strategy has been developed in accordance with UK Government Planning Practice Guidance, local planning policy requirements, SSG Design and Construction Guidance, Building Regulations, BS EN 752 and other relevant design standards and best practice guidance.

The foul water flow rates are calculated as per the current proposed design, therefore are subject to change with design updates. Foul flows calculated using the following formula;

$Qww = k \Sigma DU\ DU$

Where:

Qww is the domestic wastewater design flow rate, in litres per second.

kDU is a frequency factor, dimensionless.

ΣDU is the sum of discharge units associated with the pipe under consideration

K factors, Table 3 taken from BS EN 12056 pt 2.

The stadium wastewater flow rate is calculated at 24l/s and the hotel flow rate is 13l/s, giving a total foul water flow rate of 37l/s for the site.

At the time of writing, a pre application form has been sent to Thames Water regarding the proposed development and the flow rates, however, confirmation of sufficient capacity in the existing system to accommodate the above rates is awaited.

Due to the location of the existing outfall, it is anticipated that the proposed foul network will require pumping in order to reach the existing invert level.

8.9.2 Proposed Outfall

As mentioned in section 2.3, an existing Thames Water sewer is located north of Kidlington Roundabout, and therefore the proposed outfall for the foul network. This area is highlighted within the received C2 utility search information in Appendix E that indicates the distance from the proposed site to the existing manhole is approximately 150m and 300m from the centre of the site.

Discussions with Thames Water in September 2023 suggested that a requisition design would be required to connect into the existing Thames Water sewer. Capacity of the existing sewer was noted to have capacity for the proposed development however during discussions with Thames Water it was stated that a separate development was also utilising the same connection, therefore further Thames Water modelling would be required to determine sufficient capacity.

8.9.3 Strategy

The proposed foul network can be found in Appendix B. At current, it is proposed that the site outfalls to an existing sewer north of the site. Due to the size of the stadium footprint, two drainage runs are proposed, located either side of the stadium to pick up the proposed internal foul network.

8.9.4 Adoption and Maintenance

Further discussion with Thames Water is required to determine the extent of the connection from the site to the proposed Thames Water asset is adopted by Thames Water.

9 Flood Risk Mitigation

9.1 Pluvial Flooding

EA Flood maps indicate an area of medium-high risk due to existing levels being lower in a concentrated location. However, the development will mitigate this risk as the exiting ground levels will be raised to suit finished floor levels therefore the area of lower existing ground levels will match levels of an area associated with no flood risk.

9.2 Access and Egress

The surface water drainage network has been designed for no flooding up to and including the 1 in 100 year + 40% CC storm event. However, in the event that a storm surpasses this, the following mitigation has been included and identified.

Safe access and egress will be maintained at all times. Additionally, there is a secondary point of access and egress to the site for vehicles during peak events to the northeast, connecting to Oxford Road carriageway.

The northwest of the site has been identified, at this early design stage, as the lowest topographical area of the site. Pedestrians however have several other means of access and egress located on the east and west of the site.

Due to the nature of the site and the potential for large masses of people during match days etc, it is recommended that a Flood Emergency Access plan be developed and provided to the stadium and local emergency services.

9.3 Overland Flow

The site generally slopes from north to south; the proposed slope of the site will remain the same. Levels will generally be raised in the south to suit finished floor levels and therefore no new conveyance routes will be introduced.

9.4 Storm Water Management

A SuDS based drainage system will be required on this site in order to meet the requirements of CIRIA C735, PPG and water quality guidance.

An indicative scheme is shown on the drainage masterplan included in Appendix A.

The development will utilise SuDS such as swales, filter drains, filter strips, rain gardens and ponds. This approach will ensure that the develop drainage system will remain operational during an extreme event and therefore not contribute to the flood event.

9.5 Safe Failure Planning

The developing layout and associated drainage strategy should include provision for the safe failure of the drainage systems during extreme events. In the event this happens surface water will be retained within the proposed site car park.

9.6 Flood Resilience and Resistance

The development of the layout should always consider that the site is potentially at risk from an extreme event and as such the implementation of flood resilience and resistance is incorporated at this stage.

Relatively simple measures such as raising utility entry points, using first floor or ceiling down electrical circuits and sloping landscaping away from buildings can be easily and economically incorporated into the development of the site.

The development should also consider the use of flood resistant construction in the building of the new units, in particular on the ground floor and below ground structures and the building facades. This would include the use of solid floors, sealed door and window cavities, locating IT infrastructure at high level, building facades to be constructed with water resilient materials and utility shut-off points.

Any electrical plant, cables and sockets should be located above the flood level and any potential pollutants, including plant fuels, oils and petrol's should also be stored securely above flood levels.

Attenuation has been appropriately sized to manage surface water flows generated from the development and will be fitted with flow controls to limit the discharge off-site. Groundwater management such as lining features with impermeable membranes will help to ensure that available storage is not reduced by groundwater ingress.

Finished external levels are designed to direct surface water away from the proposed building to low risk areas of the site such as the car park and public open spaces. Boundary features such as walls/bunds will help to retain flows within these areas until the pressure on the network has subsided and the area can be drained. Vulnerable properties will have raised thresholds so as to provide further protection in the event of extreme storm events, groundwater emergence or network failure.

More information can be found in the Communities and Local Government publication ' Improving the Flood Performance of New Buildings[6].

9.6.1 Management of Residual Risk

The site is not considered to be at risk of fluvial flooding in the future (considering a 1 in 100-year return period plus climate change) however, the site will be designed to mitigate the potential pluvial flood risk posed to and from the site as rainfall intensities increase.

[6] http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

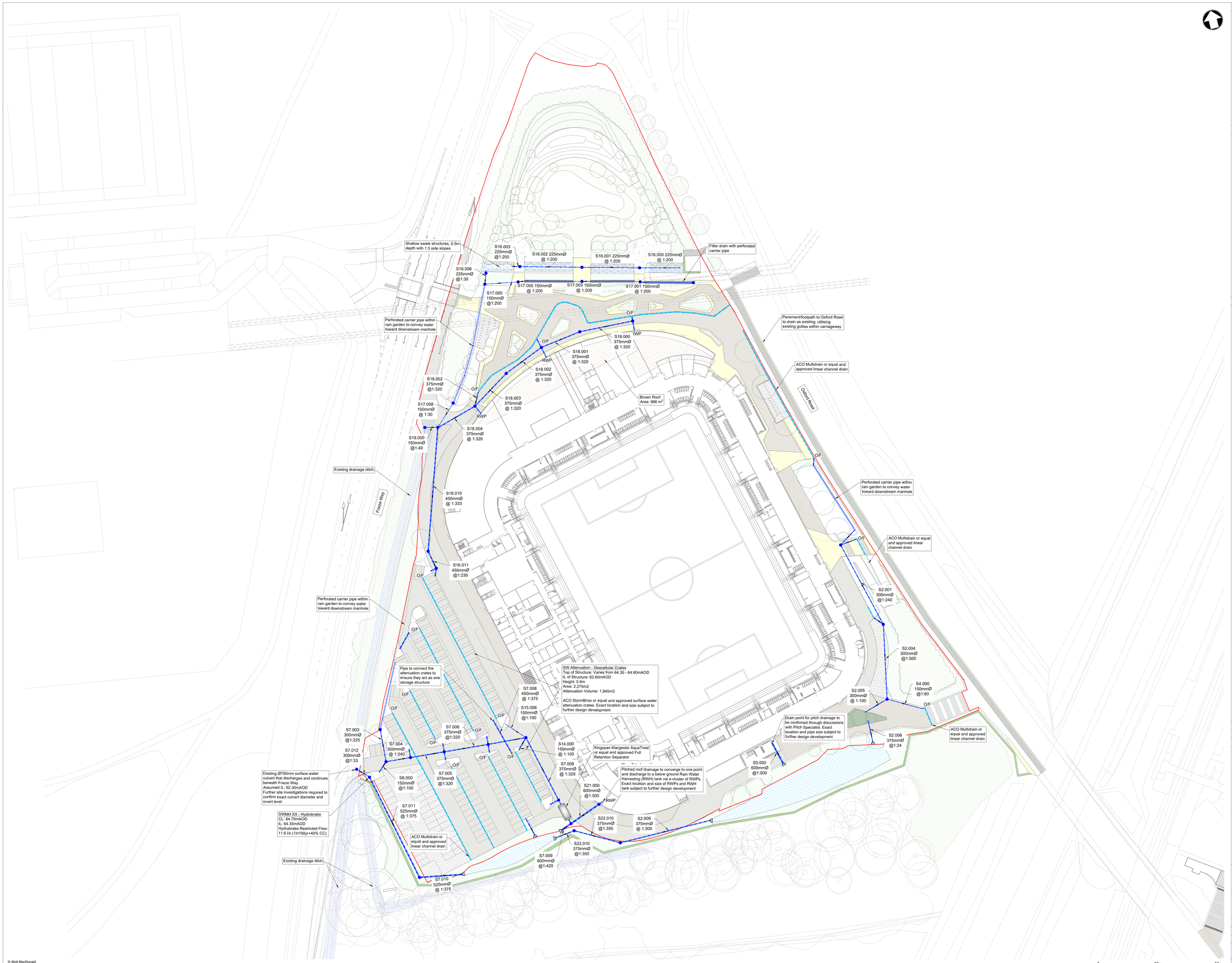
10 Conclusions and Recommendations

- The site is shown to be within Flood Zone 1, a site with an annual probability of flooding of less than 0.1%. The development is therefore considered suitable for this location.
- The pluvial flooding depicted on the EA Flood Maps is directly associated with the low-lying topography, causing water to become trapped due to being unable to drain via the ditches. However, the preliminary cut and fill exercise demonstrates that proposed levels will be raised to circa 64.800mAOD (FFL). Additionally, proposed surfaces will be positively drained and therefore alleviating the issue of standing water.
- Infiltration is not considered viable for this site due to the underlying geology being predominantly clay, however, will be reassessed once on-site testing has confirmed suitability of infiltration.
- The proposed method of discharging is to utilise the existing culvert whilst restricting proposed surface water flows to greenfield runoff rates with the use of a Hydrobrake. Not only will this minimise the offsite flows in accordance with policy requirement it also mitigates the risk of flooding to both the development and its surroundings. In order to achieve this, provisions of sustainable drainage features (SuDS) to attenuate flows are required, which are provided as ponds and geo cellular crates that total an approximate volume of 3,715m^3. Hydraulic modelling has confirmed that there is no flooding in the 1 in 30-year storm event and flooding of less than 8m^3 during the 1 in 100 year + 40% CC storm event.
- The unblocking and maintenance of the existing culvert is the responsibility of the land owner (OCC) to ensure it's a functional and operational waterway. Discussions with OCC ongoing and shall be progressed in subsequent design stages to confirm.
- It is important that the proposed design ensure that the risk of surface water flooding is mitigated. Elements within the proposed design will mitigate the risk of flooding such as providing onsite attenuation in the form of ponds and geo cellular crates. Other SuDS features like rain gardens, swales and filter drains will also provide some attenuation. During an exceedance or any flooding caused by blockages, any surface water arising will be contained onsite and due to surfacing designed to fall away from building, will be held within the car park area until the network is able to drain down.
- Surface water hydraulic modelling has been developed and used to demonstrate the principles of the proposed surface water drainage strategy. Further design development of the hydraulic model is recommended at subsequent design stages to ensure model depicts a holistic view whilst being robust.
- Further surveys and design development are required to ensure the accuracy and completeness of the design to validate the current design assumptions and strategy set out in this report.
- In general, the flood risk within the site boundary is considered to be low, and measures have been identified in terms of drainage provision, building resilience and site levels to ensure that the risk to the site is manageable. No further significant risks have been identified from other sources, and therefore is considered that the proposed development meets the requirements of the NPPF with regard to flood risk.
- The proposed foul strategy is to convey all foul drainage to the north of the site. The foul is then proposed to outfall to an existing sewer north of the site. Due to the size of the stadium footprint, two drainage runs are proposed, located either side of the stadium to pick up the proposed internal foul network. Discussions with Thames Water are ongoing however initial discussions during a meeting held September 2023 suggest there is capacity within the existing sewer. However, it was stated that a separate development was also utilising the same connection, therefore further Thames Water modelling would

be required to determine sufficient capacity. In addition to this, the method of connecting to the proposed outfall is ongoing with respect to a requisition design or a self-lay option and shall be developed in subsequent design stages.

Appendices

A. Surface Water General Arrangement



Notes

1. Do not scale from this drawing.
2. All dimensions are in metres (m) unless noted otherwise.
3. All levels are in metres (mAOD) unless shown otherwise.
4. This drawing is to be read in conjunction with all relevant drawings, documents, including from all other disciplines.
5. All drainage works to be in accordance with the National Building Specification (NBS) and the Civil Engineering Specification for the Water Industry (CESWI) as included in Sewer Sector Guidance - Design and Construction Guidance and the requirements of Building Regulations Approved Document Part H (2015 edition).
6. Design based on topographical survey information and C2 information received from statutory undertakers.
7. Cover levels as shown are subject to change during subsequent design stages.
8. All below ground surface water drainage pipes to be HDPE pipes unless noted otherwise.
9. All manholes and inspection chambers to be precast concrete.
10. All rain water pipes, denoted RWP, are based on the current Architectural layout D3263-FAB-00-XX-DR-L-1000-1002 P14 and MM MEP preliminary layouts. Therefore, the proposed surface water connection points are subject to change.
11. For health, safety and environment hazards and residual risk please refer to Designers' Hazard Elimination and Management Record - OUFC-MMD-ZZ-ZZ-HS-X-000001.
12. Drawing must be read in colour.

Key to symbols

- Proposed SW Drainage pipes
- Proposed SW Manhole
- RWP — Proposed Rain Water Pipe
- Proposed Perforated Pipe
- O/F — Proposed Linear Channel Drain and Outfall
- Proposed Full Retention Separator
- Proposed Geocellular Crates
- Rain Garden
- Existing Drainage Ditches
- Proposed Attenuation Basin
- Brown Roof
- Proposed Filter Drain
- Proposed Swale
- Proposed Works Headwall
- Drainage Boundary

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P02	3/11/2023	MT	RIBA 2	CE	SC
P01	29/9/2023	MT	Planning Issue	CE	SC

MOTT MACDONALD

Mott MacDonald House
8-10 Sydenham Road
Croydon, CR0 2EE
United Kingdom

T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W mottmac.com

Client

Oxford UTD Football Stadium

Title

Oxford United Stadium Development
Surface Water Drainage
General Arrangement

Designed	M. Thomas	MT	Eng check	C. Evans	CE
Drawn	C. Subia	CS	Coordination	M. Thomas	MT
Dwg check	C. Evans	CE	Approved	S.Campbell	SC

Scale at A0	Status	Rev	Security
1:500	S1	P02	STD

Drawing Number

OUFC-MMD-XX-XX-DR-C-930001

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SUB93846

B. Foul Water General Arrangement

Notes

1. Do not scale from this drawing.
2. All dimensions are in metres (m) unless noted otherwise.
3. All levels are in metres (mAOD) unless shown otherwise.
4. This drawing is to be read in conjunction with all relevant drawings, specifications and documents, including from all other disciplines.
5. All drainage works to be in accordance with the National Building Specification (NBS) and the Civil Engineering Specification for the Water Industry (CESWI) as included in Sewer Sector Guidance - Design and Construction Guidance and the requirements of Building Regulations Approved Document Part H (2015 edition).
6. Design based on topographical survey information (BES Geomatics April 2023).
7. Cover levels as shown are subject to change during subsequent design stages.
8. All manholes and inspection chambers to be precast concrete.
9. For health, safety and environment hazards and residual risk please refer to Designers' Hazard Elimination and Management Record - OUFC-MMD-ZZ-ZZ-HS-X-000001.
10. Drawing must be read in colour.
11. All pipes to be 225mmØ laid at 1:80 unless stated otherwise.

Key to symbols

- Proposed Foul Water Drainage
- Proposed Foul Water Manhole
- Drainage Boundary

Reference drawings

XXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXX

1:500 0 25m 50m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P02	3/11/2023	MT	RIBA 2	CE	SC
P01	29/9/2023	MT	Planning Issue	CE	SC

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W mottmac.com

Client
Oxford UTD Football Stadium

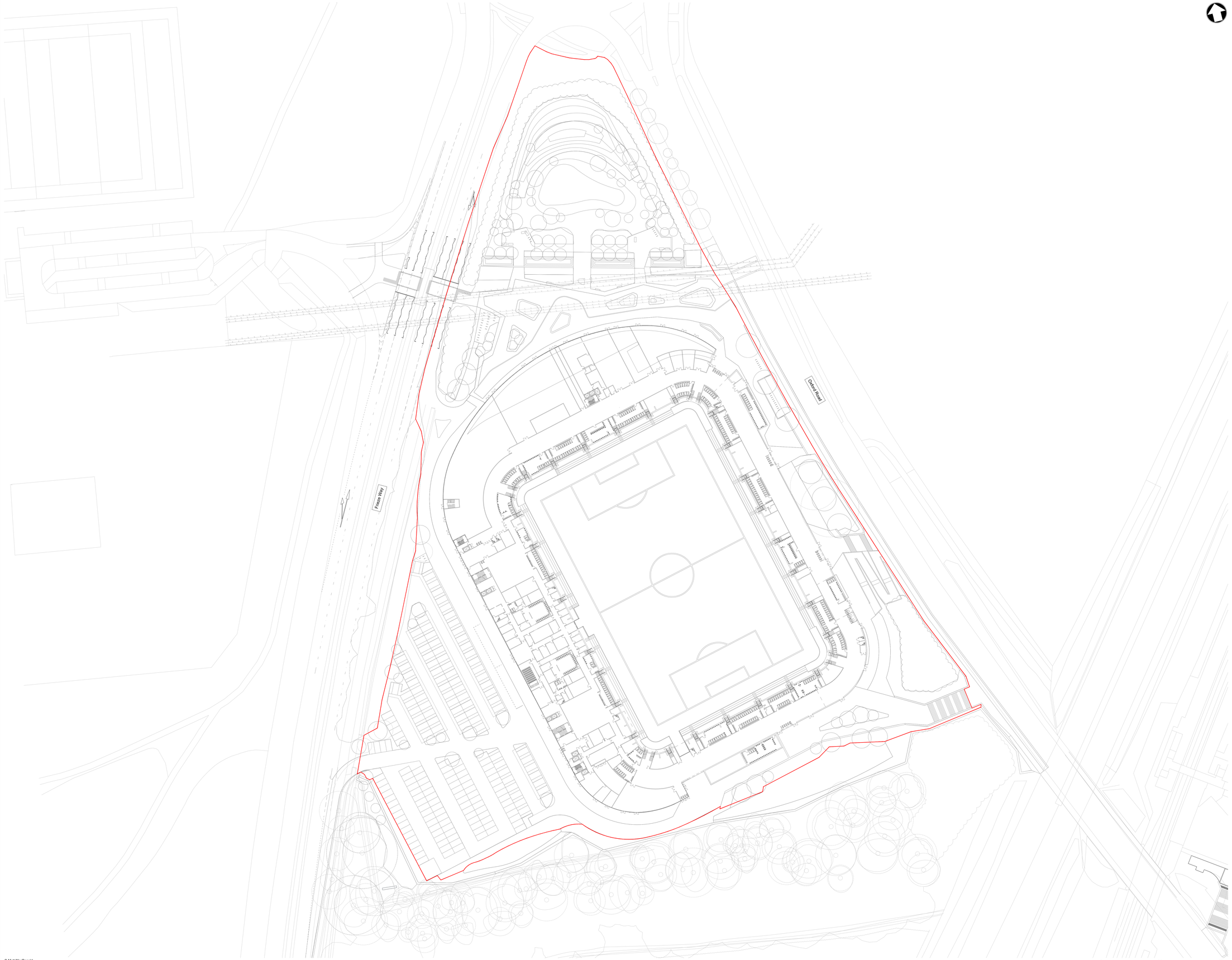
Title
Oxford United Stadium Development
Foul Water Drainage
General Arrangement

Designed	M. Thomas	MT	Eng check	C. Evans	CE
Drawn	C. Subia	CS	Coordination	M. Thomas	MT
Dwg check	C. Evans	CE	Approved	S.Campbell	SC

Scale at A0	Status	Rev	Security
1:500	S1	P02	STD

Drawing Number
OUFC-MMD-XX-XX-DR-C-930002

C. Proposed Permeable and Impermeable Area Plan



Notes

1. Do not scale from this drawing.
2. All dimensions are in metres (m) unless noted otherwise.
3. All levels are in metres (mAOD) unless shown otherwise.
4. This drawing is to be read in conjunction with all relevant drawings, specifications and documents, including from all other disciplines.
5. Design based on topographical survey information (BES Geomatics April 2023).
6. Drawing must be read in colour

Key to symbols

Drainage Boundary

Soft Landscaping Permeable Area = 1.1ha

Impermeable Area - Area = 3.6ha

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P01	29/9/2023	MT	Planning Issue	CE	SC

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8-10 Sydenham Road
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W mottmac.com

Client

Oxford UTD Football Stadium

Title

Oxford United Stadium Development
Proposed Impermeable/Permeable Plan
General Arrangement

Designed	M. Thomas	MT	Eng check	C. Evans	CE
Drawn	C. Subia	CS	Coordination	M. Thomas	MT
Dwg check	C. Evans	CE	Approved	S.Campbell	SC

Scale at A0	Status	Rev	Security
1:500	S1	P01	STD

Drawing Number

XXXXXXXXXXXXXXXXX

1:500 0 25m 50m

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Sep 29, 2023 - 3:32PM SUB93846

D. Existing Culvert Correspondence with Landowner (OCC)

From:
Sent:
To:
Cc:
Subject: RE: PRIVATE AND CONFIDENTIAL: OUFC_Culvert_Beneath_A4260-Frieze_Way
Attachments:

Follow Up Flag: Follow up
Flag Status: Flagged

Morning all,

The 750mm dia pipe is located “Stratfield Sports Ground sign” West side.
There is a wooden railed boundary railed fence East side and on the West side there is a wooden boundary railed fence about 10 meters in under vegetation.

Whilst looking for the 750mm pipe I came across a 150mm pipe on the West side adjacent to the “Service” sign on the East side. I believe this to be a drainage out let.

Kind regards

Oxfordshire County Council
County Hall
New Road
Oxford
OX1 1ND

From:
Sent:
To:
Cc:
Subject: RE: PRIVATE AND CONFIDENTIAL: OUFC_Culvert_Beneath_A4260-Frieze_Way

Hi XX,

XX has visited the site and found that the culvert being referred to is a 750mm internal diameter drain, which is more than half filled with silt and the ditches either side are in need of cleaning out. On the western side the ditch passes under a timber close boarded fence, such that the condition of the ditch further downstream was not observed. There is a concrete headwall to the western end of the drain and the remnants of concrete bagwork to the eastern end of the drain. The pipe appears to have between 800mm to 1000m of cover to the carriageway surface, roughly eying this through the vegetation either side of the carriageway. There are also 150mm internal diameter surface water drains with brickwork headwalls outfalling either side of the road.

The 750mm internal diameter drain is position roughly where the services sign is located to the carriageway.

It appears that the ditch on the eastern side of the road which outfalls through the 750mm dia drain, is primarily for highway drainage purposes with a 150mm diameter carriageway surface water drain outfalling into it from its northern end into the ditch. On the western side the 150mm dia, highway surface water drain outfalls into a separate ditch to the outfall ditch of the 750mm internal diameter drain.

It appears that the ditches need cleaning out together with the 750mm dia drain for highway surface water drainage purposes. It appears that the surface water drainage requirement of any new development would need to be separately considered, possibly with the introduction of a new culvert under the highway into a suitable downstream watercourse.

Regards

Oxfordshire County Council
County Hall

Oxford
OX1 1ND

Tel:
Email:
Web-Site:
For Countryside Access issue reporting:

From:
Sent:
To:
Cc:
Subject: FW: PRIVATE AND CONFIDENTIAL: OUFC_Culvert_Beneath_A4260-Frieze_Way

Hi both, can you help XX here?

Thanks

From:
Sent:
To:
Cc:
Subject: PRIVATE AND CONFIDENTIAL: OUFC_Culvert_Beneath_A4260-Frieze_Way

- PRIVATE AND CONFIDENTIAL -

Afternoon XX

In XX absence are you able to distribute the below email to the relevant OCC highways and drainage officers please? The below primarily addresses the maintenance of the culvert but there are a few more confirmations requested.

Should you require any further information please let me know.

Kind Regards,

From:
Sent:
To:
Cc:
Subject: PRIVATE AND CONFIDENTIAL: OUFC_Culvert_Beneath_A4260-Frieze_Way

- PRIVATE AND CONFIDENTIAL -

Good afternoon

As part of the proposed Oxford United Stadium development the surface water strategy utilises the existing culvert that runs beneath Frieze Way (A4260) as indicated below. The culvert is currently blocked with silt and debris (approx. 85%), and therefore poses an issue to the proposed surface water strategy as it's the single point of discharge.

From review of the attached land registry plan (received January 2023 from OCC Highways Records) it suggests that the culvert sits within OCC Highways land. See below where I have overlain the attached land ownership with Google Maps, where the 'pink' OCC Highways land extends beyond Frieze Way. Approximate Easting and Northing of upstream culvert opening: E 449746, N 211997.

Please confirm the following:

- Culvert structure is within OCC Highways land (as indicated below).
- Any previous or ongoing maintenance regime of the culvert structure and west ditches.
- Downstream section of culvert structure is within OCC Highways land (west of Frieze Way).
    - If so, any information on the condition, location or the conveyance path of water beyond the downstream culvert.
- OCC Highways proposal to unblock the culvert to ensure it's operational and a functional waterway.
- OCC Highways proposal to maintain the culvert to ensure it doesn't build up with silt and debris and block in the future.


Kidlington Roundabo
A4260
A4165
66.7m
65.7m
Oxford Rd
Stratfield Brake
Sports Ground
WEST
DITCH
CULVERT
WEST
DITCH
Friezew
Track
A34
A34
Stratfield Brake
Oxford Parkwa

Kind Regards,

Mott MacDonald
10 Fleet Place
London EC4M 7RB
United Kingdom

Website | **Twitter** | **LinkedIn** | **Facebook** | **Instagram** | **YouTube**

E. Existing Thames Water Asset Search Results

Asset location search

CHECKED

Property Searches

Atkins Ltd
Stats Enquiries Team The Hub
500Park Avenue
BRISTOL
BS32 4RZ

Search address supplied Site at A34, Frieze Way, Kidlington, Oxford
OX2 8HA

Your reference 115574

Our reference ALS/ALS Standard/2022_4761515

Search date 14 December 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: Site at A34, Frieze Way, Kidlington, Oxford, OX2 8HA

Dear Sir / Madam

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

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

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

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

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

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

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 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.

The following quartiles have been printed as they fall within Thames' sewerage area:

SP4912SE

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.

The following quartiles have not been printed as they contain no assets:

SP4911SE
SP4911NE
SP5011NW
SP5012SW

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.

The following quartiles have been printed as they fall within Thames' water area:

SP4912SE
SP5011NW
SP5012SW

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.

The following quartiles have not been printed as they contain no assets:

SP4911SE
SP4911NE

For your guidance:

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

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

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

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

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

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

Clean Water queries

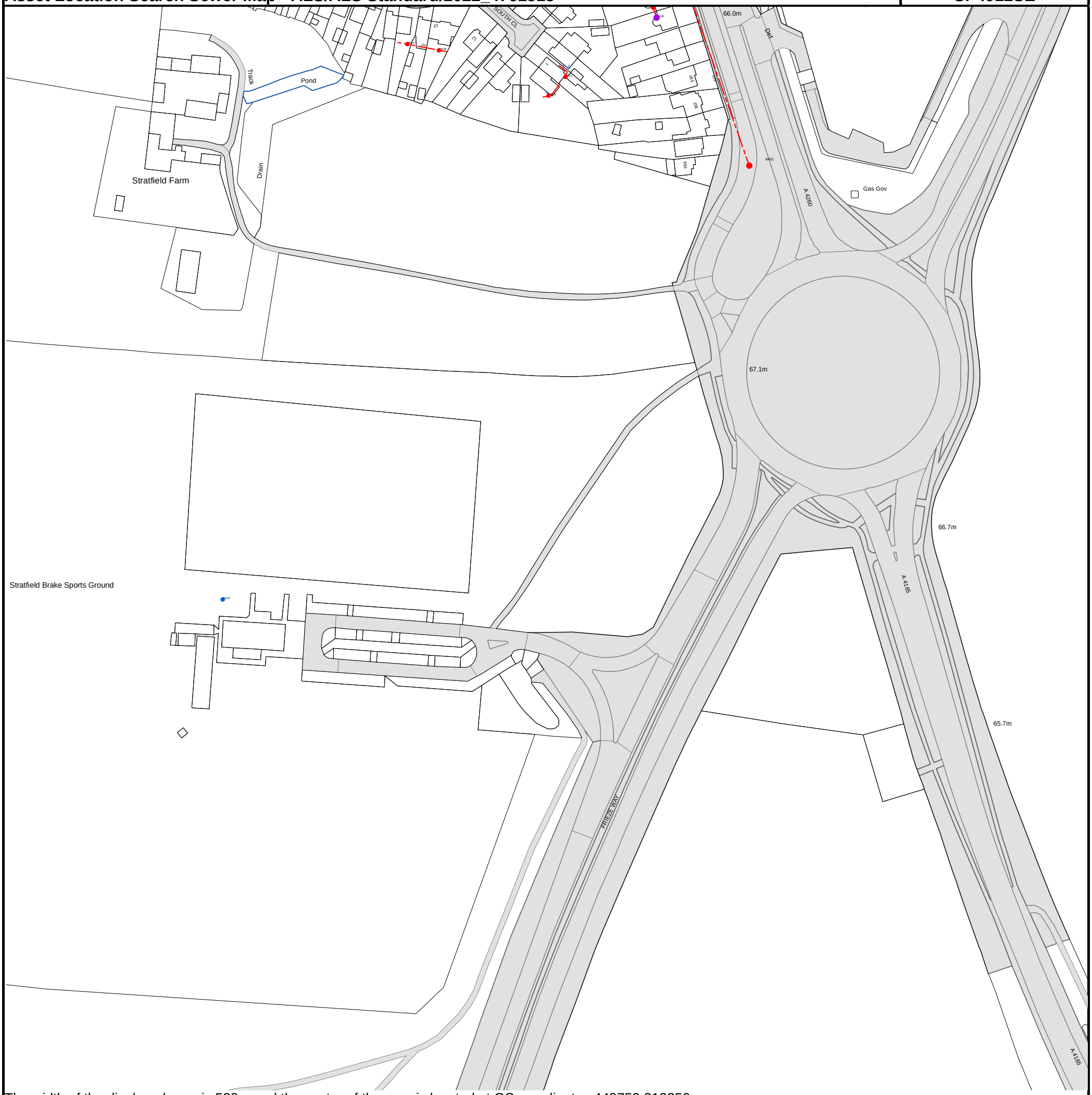
Should you require any advice concerning clean water operational issues or clean water connections, please contact:

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

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

Asset Location Search Sewer Map - ALS/ALS Standard/2022_4761515

SP4912SE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 449750,212250

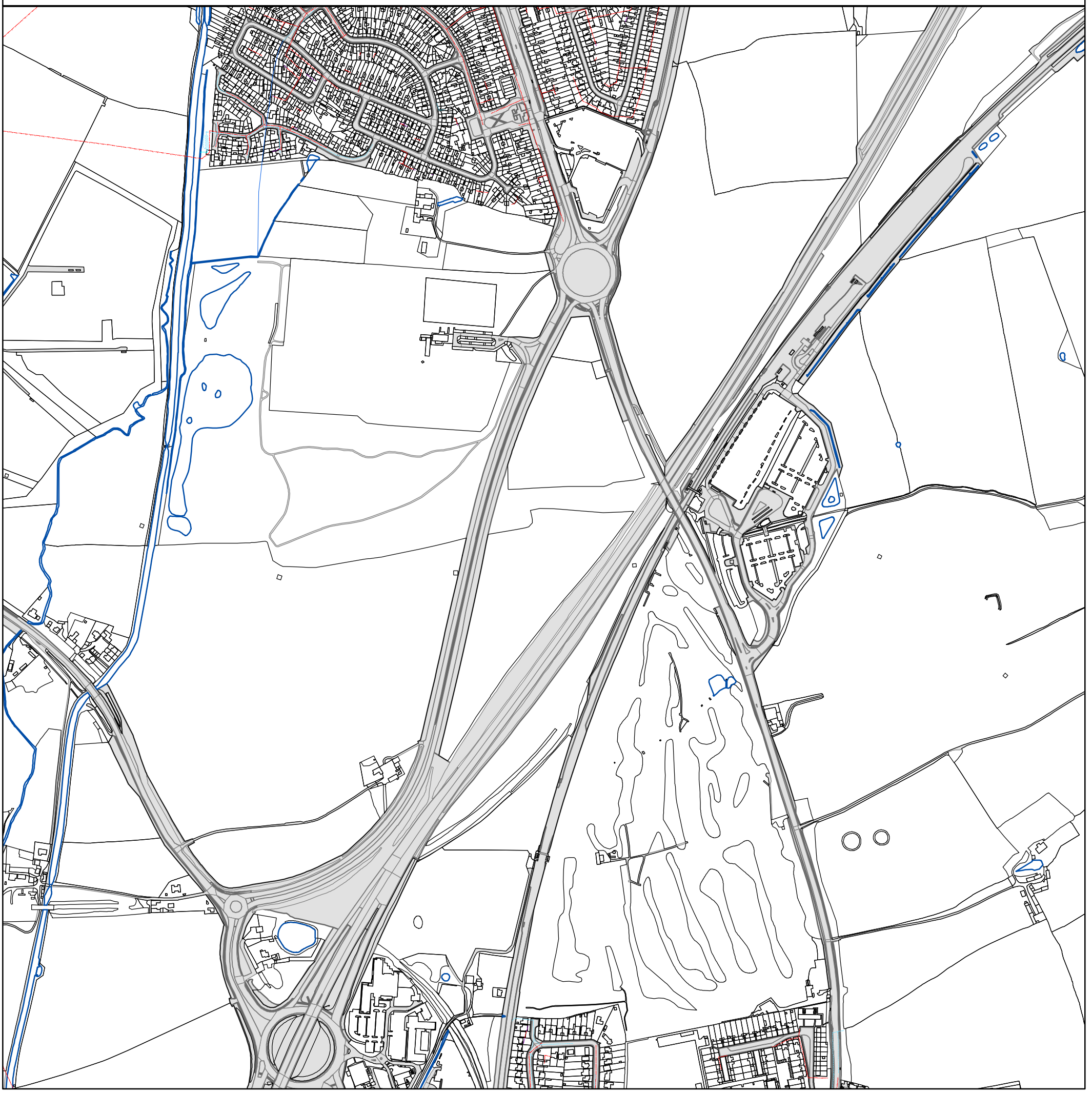
NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
641A	n/a	n/a
641B	n/a	n/a
741D	n/a	n/a
741C	n/a	n/a
741A	n/a	n/a
741B	n/a	n/a
8401	66.53	64.46
521A	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.

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2022_4761515



0 45 90 180 270 360
Meters

Scale:	1:7161
Width:	2000m
Printed By:	Skrishna1
Print Date:	14/12/2022
Map Centre:	449805,211822
Grid Reference:	SP4911NE

Comments:

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

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

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.
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.

Asset Location Search Water Map - ALS/ALS Standard/2022_4761515

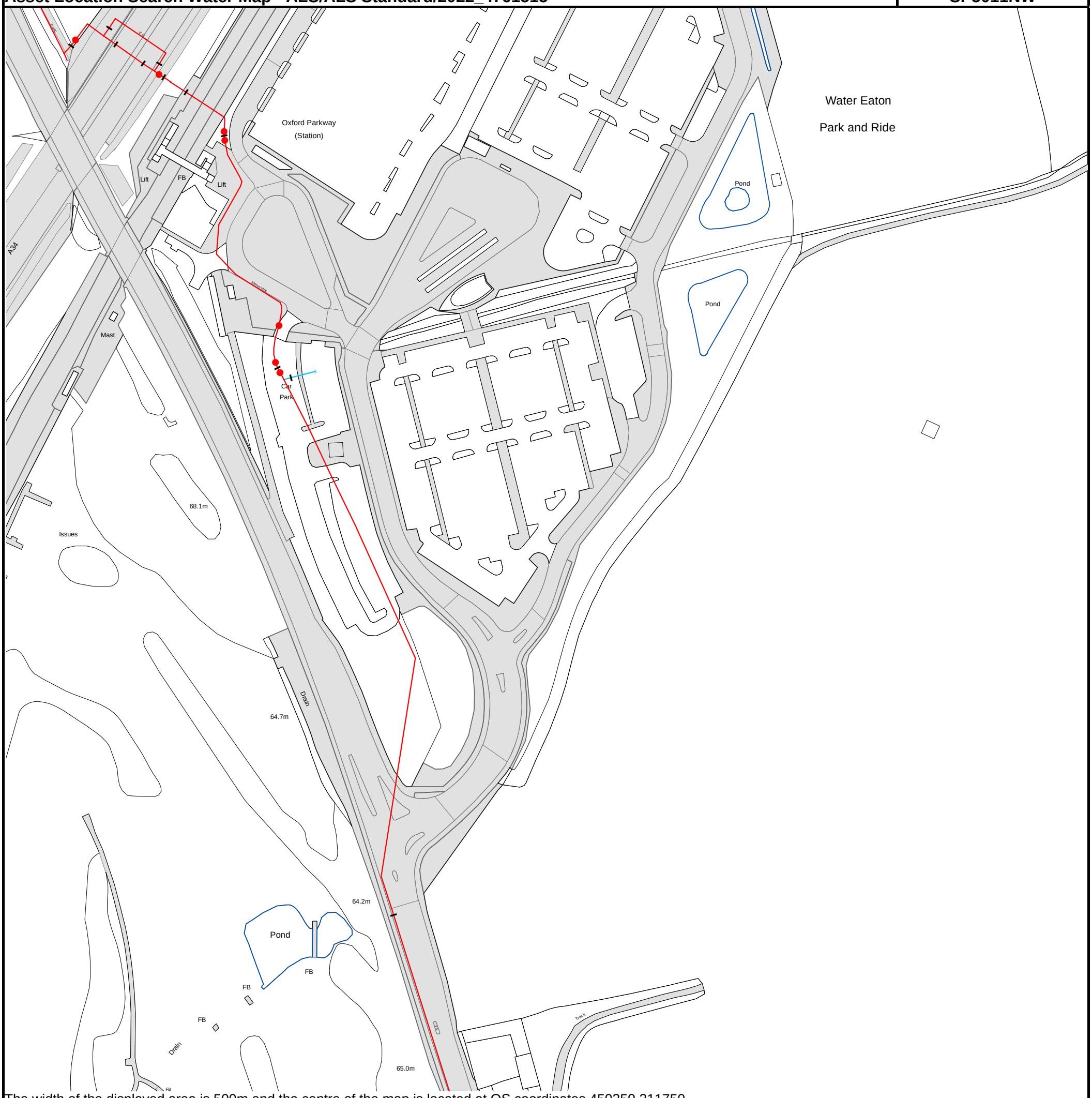
SP4912SE

The width of the displayed area is 500m and the centre of the map is located at OS coordinates 449750,212250

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 Water Map - ALS/ALS Standard/2022_4761515

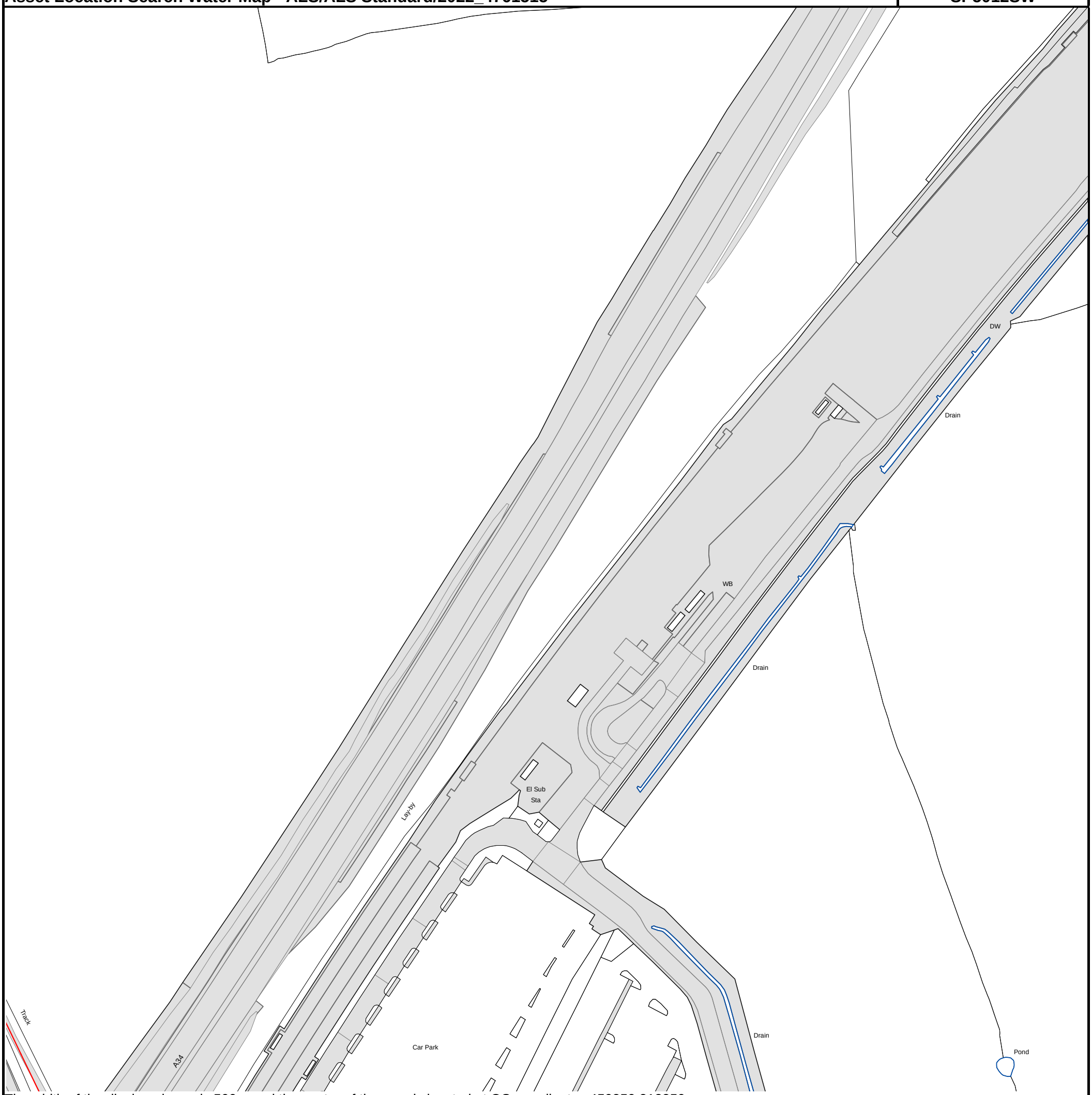
SP5011NW



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 450250,211750

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 Water Map - ALS/ALS Standard/2022_4761515	SP5012SW

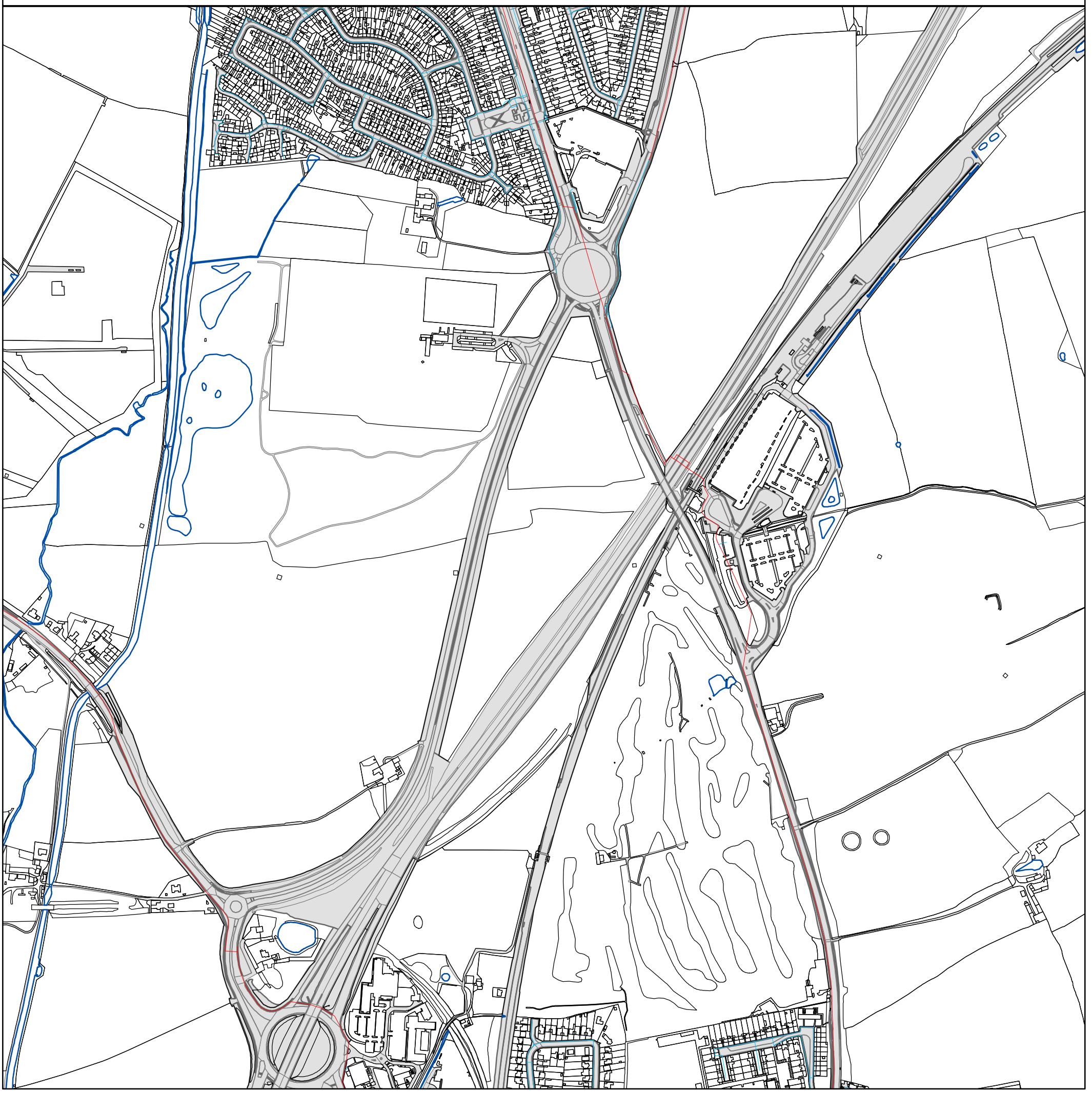


The width of the displayed area is 500m and the centre of the map is located at OS coordinates 450250,212250

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

Based on the Ordnance Survey Map with the sanction of the Controller of H.M Stationary Office License Number 10019345

ALS/ALS Standard/2022_4761515



0 45 90 180 270 360
Meters

Scale:	1:7161
Width:	2000m
Printed By:	Skrishna1
Print Date:	14/12/2022
Map Centre:	449805,211822
Grid Reference:	SP4911NE

Comments:

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.

F. HR Wallingford Greenfield Runoff Rate Estimation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Connor Evans
Site name:	OUFC
Site location:	Kidlington Triangle

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

Site Details

Latitude:	51.80490° N
Longitude:	1.27798° W
Reference:	3553461418
Date:	Sep 29 2023 08:14

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 4.7

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	616	616
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	11.63	11.63
1 in 1 year (l/s):	9.88	9.88
1 in 30 years (l/s):	26.74	26.74
1 in 100 year (l/s):	37.09	37.09
1 in 200 years (l/s):	43.48	43.48