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Football Club

Kop Development

Drainage Strategy Report

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WREXHAM ASSOCIATION FOOTBALL CLUB – KOP DEVELOPMENT DRAINAGE STRATEGY REPORT

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1. INTRODUCTION

1.1 Objective

The objective of this report is to provide a description of the foul and surface water drainage strategy to support the Full planning application for the redevelopment of the Kop Stand for 5,500 seats inclusive of 500 capacity hospitality area, new public realm, and associated works at Wrexham Association Football Club.

1.2 Constraints and Limitations

This report has been prepared by Ramboll UK Limited (Ramboll) exclusively for the intended use by Wrexham Association Football Club (WAFC).

The information contained within this report is based on a review of existing information and consultation with interested parties.

Ramboll UK has endeavoured to assess all information provided to them during this appraisal. The report summarises information from several external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon. Ramboll UK has not verified information from third parties, unless otherwise stated in this report.

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1.3 Records Review

The key reports and drawings reviewed as part of this strategy are listed in the table below:

Title	Author	Date
Welsh Water Asset Plan	Welsh Water	15 th September 2021
Drainage and Utility survey – “0921-RAM-001”	Subsite surveys	23 rd September 2021
WRX-AFL-Z4-00-DR-A-20110	AFL	13 th June 2022
WRX-AFL-Z4-01-DR-A-20111	AFL	13 th June 2022
WRX-AFL-Z4-02-DR-A-20112	AFL	13 th June 2022

Table 1 Key Reports and Drawings

The existing football ground lies to the northwest of the town centre and adjoins, but is outside, the Masterplan Area of the adopted Wrexham Town Centre Masterplan (2016). It is situated between the railway station and university campus as shown in the figure below.

2.2 Site Topography

2.3 Flood Risk Statement

The site is located in an area indicated to be at low risk of fluvial flooding, and given the site is less than 1 ha in area, a full Flood Consequences Assessment is not required. However, provided below is a summary assessment of the flood risk to the site from all sources.



2.3.1 Fluvial and Tidal Flood Risk

The primary resource for reviewing fluvial and tidal flood risk is via the NRW Flood Map for Planning. These classify risks as follows:

- Flood Zone 2 - Areas with 0.1% to 1% (1 in 1000 to 1 in 100) chance of flooding from rivers in a given year, including the effects of climate change
- Flood Zone 3 – Areas with more than 1% (1 in 1000) chance of flooding from rivers in a given year including the effects of climate change

The site is not shown to be located in a Flood Zone. Therefore, fluvial and tidal flooding is not considered to be a factor at the site. The closest area indicated to be in Flood Zone 2 is located approximately 230m south.

2.3.2 Surface Water Flood Risk

The NRW Flood Map for Planning delineates from pluvial sources into the three following categories:

- Low - *this area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%).*
- Medium - *this area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%).*
- High - *this area has a chance of flooding of greater than 1 in 30 (3.3%).*

The majority of the site is at not shown to be at risk of surface water flooding. There is a small area of Low risk that extends across the northern edge of the pitch this accumulates in the north west corner of the stadium pitch. This does not take account of specific surface water drainage measures. The risk of surface water flooding is therefore considered to be low.

2.3.3 Groundwater

Wrexham County Borough Council's Local Flood Risk Management Plan has identified no records of past groundwater flooding within the County Borough. The Dee Preliminary Flood Risk Assessment also confirms since 2011 there have been no recorded events of groundwater flooding within the Dee River Basin District. Therefore the risk of groundwater flooding is considered to be low.

2.3.4 Historic Flooding

According to the NRW Flood Map for Planning the site has not experienced historic flooding. The closest record of a historic flood is 7.5km south-east adjacent to the River Dee.

2.3.5 Risk from Reservoirs, Canal and Other Artificial Sources

The NRW online mapping suggests that the site is not located in an area at risk of flooding from reservoirs, canals or other artificial sources. Therefore, the risk of flooding from these sources is considered to be low.

2.3.6 Summary

The main risk to the site in terms of future flood risk is from extreme rainfall events causing overland flow and surface water flooding. This will be managed via the surface water drainage strategy summarised in this report.

2.4 Infiltration

Infiltration testing has been undertaken in accordance with BRE digest 365, the test results have only recently been received and these confirm that infiltration is a viable solution to managing the surface water from the development. This will be reviewed in detail at the next design stage and

during the SAB preapplication discussions prior to the full application being made. Table 2 below details the soakaway test results which can be found in Appendix 8. Figure 2 below shows local borehole data that identifies that the strata comprise of "compact to dense coarse brown sand with small to large gravel". The results are similar to the values indicated in table 25.1 from the CIRIA SuDS Manual shown below in figure 3.

Table 2 - Soakaway test results

Reference	Infiltration rate (m/sec)
TP01 – Test 1	7.3×10^{-4}
TP01 – Test 2	4.7×10^{-4}
TP01 – Test 3	4.0×10^{-4}
TP02 – Test 1	1.4×10^{-3}
TP02 – Test 2	5.2×10^{-4}
TP03 – Test 3	4.2×10^{-4}

Description of Strata	Legend	Depth	Thick-ness	Sample		SPT 'N' Value	Water levels and General Remarks
				Type	Depth		
ASH AND SOIL AND BRICK FILL		0.30	0.30				
COMPACT TO DENSE COARSE BROWN SAND WITH SMALL TO LARGE GRAVEL				SPT	0.91	13	
				SPT	1.83	26	
				SPT	2.74	39	
		3.66	3.76				B.H. DRY

Figure 2 – Bore hole data available on site taken 200m to the south of site

TABLE 25.1 Typical infiltration coefficients based on soil texture (after Bettess, 1996)			
Soil type/texture	ISO 14688-1 description (after Blake, 2010)	Typical infiltration coefficients (m/s)	
Good infiltration media			
• gravel	Sandy GRAVEL	$3 \times 10^{-4} - 3 \times 10^{-2}$	
• sand	Slightly silty slightly clayey SAND	$1 \times 10^{-5} - 5 \times 10^{-5}$	
• loamy sand	Silty slightly clayey SAND	$1 \times 10^{-4} - 3 \times 10^{-5}$	
• sandy loam	Silty clayey SAND	$1 \times 10^{-7} - 1 \times 10^{-6}$	
Poor infiltration media			
• loam	Very silty clayey SAND	$1 \times 10^{-7} - 5 \times 10^{-6}$	
• silt loam	Very sandy clayey SILT	$1 \times 10^{-7} - 1 \times 10^{-6}$	
• chalk (structureless)	N/A	$3 \times 10^{-8} - 3 \times 10^{-6}$	
• sandy clay loam	Very clayey silty SAND	$3 \times 10^{-10} - 3 \times 10^{-7}$	
Very poor infiltration media			
• silty clay loam	—	$1 \times 10^{-8} - 1 \times 10^{-6}$	
• clay	Can be any texture of soil described above	$< 3 \times 10^{-8}$	
• till		$3 \times 10^{-8} - 3 \times 10^{-6}$	
Other			
• rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill)	N/A	$3 \times 10^{-9} - 3 \times 10^{-5}$	

Figure 3 - Typical Infiltration Coefficients (CIRIA SuDS Manual, 2015)

2.5 Existing Site Drainage

2.5.1 Public Assets

The provided Welsh Water asset map is shown in figure 6.1. The Welsh Water sewer records indicate that a 150mm diameter foul water public sewer which currently serves part of the Racecourse Ground and the Turf Hotel crosses the south west of the site. This is indicated as a foul water sewer on the asset information but the lack of surface water infrastructure in the area could mean that this is actually a combined sewer. The records also indicate a 225mm diameter public combined sewer is located within Crispin Lane.



Figure 6.1: Extract from Welsh Water sewer record

2.5.2 Private Drainage

Topographical survey information and a site walkover confirms that the existing stand roof collects rainwater from the front and rear of the stand via above ground pipework. The pipework routes the collected surface water to the rear of the stand, it is currently not clear where this connects to below ground.



Figure 6.2: Roof positive drainage system

The surface water drainage to the concrete area between the pitch and the front of the stand is collected via gullies and below ground pipework but the final discharge location is unknown.

There appears to be no current positive drainage systems to the vegetated earth embankment or existing hardcore areas although part of these areas used to be a car showroom and industrial buildings and therefore would have had drainage networks associated with these.

Existing drainage and topographical information can be found in Appendix 1.

2.6 Existing Surface Water Run-Off

The proposed redline boundary area is 0.642ha of which

- 0.216ha – roof and some concrete hardstanding areas
- 0.202ha – existing hardcore area
- 0.224ha – existing green

Brownfield calculations using the Wallingford Procedure have been produced at this time until further survey has been undertaken to understand the actual drainage networks serving the Application Site.

Using the area of existing hardstanding and stand roof peak runoff rates have been calculated as indicated in Table 2.1.

Table 2.3: Peak Storm Runoff

Return Period	Peak Runoff Rate (l/s)
M1-5	51.37 l/s
M2-5	65.46 l/s
M30-5	118.2 l/s
M100-5	148.3 l/s
Based on site area = 0.216 ha	

Greenfield runoff rates have also been calculated for the full redline boundary of the site.

Table 2.2: Greenfield

Return Period	Peak Runoff Rate (l/s)
M1-5	1.1 l/s
M2-5	1.2 l/s
M30-5	2.6 l/s
M100-5	3.5 l/s
Based on site area = 0.642 ha	

3. DESIGN STANDARDS AND CRITERIA

3.1 Design Standards and Criteria

The proposed surface water and foul water drainage networks will be designed and installed to achieve self-cleaning velocity. Flows will generally be kept above 0.75 m/s to avoid erosion of the internal pipe surface, respectively, within the pipelines to ensure that self-cleaning velocities are achieved. This is subject to the condition, location, and level of the existing off-site drainage.

To give a long design life, with minimum embodied energy, the buried pipework will generally be:

- Externally: Vitrified clay and concrete, where possible; and
- Cast iron when laid below or cast within or through foundations or building structures.

Chambers will generally be either (subject to availability of space):

- Polypropylene inspection chambers (if less than 1.2m to invert level), or
- Pre-cast manholes (if deeper than 1.2m to invert and in areas subject to vehicle over-run).
- In-situ concrete manholes.
- Non-entry polypropylene inspection chamber will be used, where required, up to a depth of 3.0m.

Pipe diameters will generally be as follows:

- Foul water drainage – DN150, DN225 and DN300 to minimise the risk of blockage.

The development will be drained by dedicated and fully segregated surface and foul water systems designed in accordance with the following documents (where appropriate);

- Building Regulations - Approved Document Part H;
- BS EN 12056: Parts 1-5: Gravity Drainage Systems Inside Buildings;
- BS EN 752: Drain and Sewer Systems outside buildings;
- Sustainable Drainage Systems - Design manual for England and Wales (CIRIA C753);
- Sewers Sector Guidance 2019;
- SAB guidance criteria;
- Planning Policy Wales Edition 11;

3.2 Planning Policy

Planning Policy Wales Edition 11 February 2021 sets out the land use policies of the Welsh Government, Section 6.6 specifically is in relation to Water and Flood Risk and supplemented by a series of Technical Advice Notes (TANs), Welsh Government Circulars, and policy clarification letters, which together with PPW provide the national planning policy framework for Wales. TAN 15: Development and Flood Risk should be referred to for policy advice on development and flood risk.

Section 6.6.17 of the policy states that all new developments of more than one dwelling or where the area exceeds more than 100m² requires, alongside the planning process, approval from the SuDS Approval Body (SAB) before construction can commence.

The provision of SuDS must be considered as an integral part of the design of the new development and considered at the earliest possible stage when formulating the new proposals. The development proposals should incorporate the design for surface water management, based on principles which work with nature to facilitate the natural functioning of the water cycle. Designing for multiple benefits and green infrastructure should be secured wherever possible. The Interim Code of Practice

for Sustainable Drainage Systems 2004 gives guidance on the implementation of SuDS in new developments.

4. CONSULTATIONS

Initial consultations have been undertaken with Welsh Water (Dwr Cymru) and the SAB approval body for Wrexham County Borough Council with regards to discharge of proposed foul and surface water flows from the site and the use of SuDs on the site.

4.1 Wrexham County Borough Council – Sustainable Urban Drainage Approving Body (SAB)

A site meeting was attended by Lisa Sawyer (Ramboll) and Carole Wright & Kevin Edwards (Wrexham SAB officers), the proposed scheme was discussed along with SuDS implementation in accordance with relative guidance. Notes taken at the time of the meeting detailed that the scheme / SAB application should include;

- Water recycling as landscaping options appear to be limited.
- Green SuDS which gives other benefits than just water storage, eg biodiversity benefits from implementing a green roof with storage (not just a blue roof) and / or raingardens, swales adjacent to the hardstanding areas which included a complete water treatment train for all water collection.
- Infiltration testing results to prove whether this is possible within the design.

A preapplication SAB submission was made to Wrexham County Borough Council on 08.06.2022 and at the time of writing no response has been received.

Ramboll are also engaged with Wrexham County Borough Council regarding the phosphates permit and are working to assist in finding a suitable solution.

4.2 Dwr Cymru Welsh Water

Initial consultation via a pre-development enquiry has been submitted with Welsh Water in regard to connection of foul drainage and possible surface water drainage to the public sewer network and possible diversion of the public sewer which is currently within the Application Site. The response is shown within Appendix 05 and highlights that there is sufficient capacity within the network to receive the calculated flows, however it indicates that Five Fords Wate Water Treatment Works (WWTW) has a phosphate permit that needs to be discussed with the local planning authority.

5. PROPOSED FOUL WATER DRAINAGE STRATEGY

5.1 Intro

The following calculations have been based on work in progress Stage 2 architectural and MEP design layouts / information to provide a preliminary assessment of the likely foul drainage flow rates originating from the proposed development.

The existing stand is currently condemned and unused with the proposed stand to provide seating for up to 5500 fans.

At this stage, the calculations are based on a number of assumptions and estimates and therefore may be subject to further refinement as the wider infrastructure and architectural design is developed through Concept and Technical Design.

5.2 Methodology

Due to the nature of the proposed stand the peak foul flow rate will only occur for a short period of time on match days. Therefore, a four-hour peak period will be utilised for the calculations. All below ground drainage will be designed to sustain a self-cleansing velocity during quitter periods.

At this stage, above ground flow calculations have not been undertaken / finalised so flow rates are subject to change.

To assess the foul flow calculations the population & expected probability rates as outlined within BS EN 752 & BS EN 12056 will be calculated and will be compared to gain an understanding of the flow rate.

5.2.1 Probability Method

The number of appliances below are as per AFL Architects layout dated 13/06/2022. Number of stacks within kitchens have been assumed, along with floor gullies assumed within plant spaces. For these calculations 'System II: Single discharge stack system with small bore discharge branch pipes' will be utilised, and a frequency factor of 1.0 will be utilised which is used for 'Congested use, e.g., in toilets and/or showers open to public'.

The breakdown of the appliances are as follows:

- Ground floor (level 0):
 - 89 WC's (1.8 DU): 160.2 DU
 - 67 Wash hand basins (0.3 DU): 20.1 DU
 - 67 Urinals (0.5 DU): 33.5 DU
 - 3 FG's (assumed) (1.5 DU): 4.5 DU
- Level 1:
 - 13 WC's (1.8 DU): 23.4 DU
 - 13 Wash hand basins (0.3 DU): 3.9 DU
 - 4 Urinals (0.5 DU): 2.0 DU
 - 1 Shower (0.6 DU): 0.6 DU
- Level 2:
 - 14 WC's (1.8 DU): 25.2 DU
 - 13 Wash hand basins (0.3 DU): 3.9 DU
 - 10 Urinals (0.5 DU): 5.0 DU
 - 4 FG's (assumed) (1.5 DU): 6.0 DU
 - 4 Sinks (assumed) (0.8 DU): 3.2 DU
 - 2 Dishwashers (assumed) (0.8 DU): 1.6 DU

Peak foul flow, Q_{ww} can be calculated as follows:

$$Q_{ww} = k\sqrt{\sum DU}$$

Therefore,

$$Q_{ww} = 1.0 * \sqrt{293.1} = \mathbf{17.12 \text{ l/s}}$$
 (Average flow 2.85 l/s)

Note, this value is based upon assumptions made at stage 2 and may increase / decrease dependent on any design changes at detailed design.

5.2.2 Population Method

The expected population for the development will vary due to the nature of the development. However, for the purpose of these calculations the maximum capacity of the stand will be utilised as this would generate the highest flow.

AFL Architects have produced a capacity schedule, and this will be utilised at this stage. The capacity schedule states a total capacity of 5500. Note this does not include staff, so for the purpose of these calculations a value of 5550 will be used to provide an allowance for the total occupation during a match event.

To establish the expected flow per person 'Flows & Loads 4' will be utilised to determine the most suitable scenario. The most applicable activity would be 'Local community sports club, e.g. squash, rugby & football' which gives a base flow of 40 litres per person per day. Applying this value to the 5550 expected capacity of the stand, a total foul flow volume can be calculated.

Therefore;

$$U = 5550 \times 40 \text{ l/p/d} = \mathbf{222,000 \text{ litres}}$$

As mentioned previously, a four-hour duration for an event is being utilised for a peak value for the foul flows. The peak foul flow, Q_{pop} can be calculated as follows:

$$Q_{pop} = \frac{U \text{ (in litres)}}{t \text{ (in seconds)}} \text{ l/s}$$

Therefore,

$$Q_{pop} = \frac{222000 \text{ l}}{4 \times 60 \times 60 \text{ s}} = \mathbf{15.42 \text{ l/s}}$$

5.3 Summary of foul water flows

For planning, a flow rate of **16 l/s** will be assumed as the peak flow rate from the proposed stand redevelopment as this is an approximation of the median from the two calculated peak flow rates.

As assessment & survey of the existing public sewer that currently drains the Wrexham AFC stadium & nearby establishments. Sewer records indicate that this sewer is 150mm in diameter, should this be the case the capacity of this sewer is likely to be approximately for a peak flow of **14 l/s**. To accept the flow from the proposed stand extension, there are two options that must be considered:

- Upgrade works to the existing public sewer to allow for additional flow.

- Provision of an offline storage solution to store effluent flow during peak times (match days).

The latter is likely to be required. Further calculations will be required once further information on the public sewer / allowable flow rates are available. When this information is available further calculations will be carried out and further liaison with Welsh Water to fully understand the requirement for offline storage.

5.4 Nitrate Neutrality

The Kop Development team are currently engaged with Wrexham County Borough Council, considering options for managing and mitigating any risk of additional phosphates to the foul water network that may be encountered from the Kop Stand development. These options will be explored further with information and detail provided as the mitigation measures are develop.

6. PROPOSED SURFACE WATER DRAINAGE STRATEGY

6.1 SuDS Strategy & Hierarchy

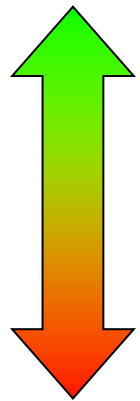
Sustainable Drainage Systems (SuDS) generally mimic the natural drainage patterns of the undeveloped site, allowing where possible, infiltration into the ground/attenuation, improving water quality and controlling outflow rates from the development.

The proposed surface water drainage system has been designed to incorporate the current SuDS principles and approaches. The following hierarchy for managing surface water has been considered:

- Water Reuse
- Living Roofs
- Basins and Ponds
- Infiltration Devices
- Permeable Surfaces
- Tank Systems

More desirable

Less desirable



6.1.1 Water Reuse

The use of rainwater harvesting for greywater use within the building would decrease the volume and rate of surface water runoff from the building. This would reduce the roof runoff in low return period events; however, it cannot be considered to reduce peak flows off-site since the drainage strategy has to assume that the rainwater tank is full and therefore overflowing. Rainwater harvesting is also not deemed economical for this type of development due to the peaks and troughs in usage therefore is unlikely to be used within this scheme.

6.1.2 Living Roofs

Planted roof areas which provide a degree of rainfall storage and attenuation for small return period storms although the attenuation volumes for the site will have to assume the green roof is fully saturated. Well, maintained green/brown roofs are able to decrease the volume of surface water runoff by up to 40% in low return period storms. A green roof could be incorporated with the blue roof but will increase the weight on the structure and could possibly require additional maintenance than a blue roof alone.

6.1.3 Basins and Ponds

Basins and ponds are not considered viable due to the limited external space on the proposed development site.

6.1.4 Infiltration Devices

Infiltration testing has confirmed that infiltration is a viable solution to managing surface water collected from site. Infiltration systems are to be further than 5m from any existing or proposed

substructure. The only space where this is likely to be possible will be in the proposed new access from Crispin Lane.

6.1.5 Permeable Surfaces

Permeable paving is considered for the external hard-landscaping areas. Permeable paving with below-ground sub-base attenuation can be used to help manage surface water run-off. In addition to storm-water attenuation, permeable paving also provides pollution control. The permeable pavement construction can be lined with an impermeable membrane, thus utilising the voids within the sub-base to provide attenuation. Perforated drainage pipes will convey water from the storage zone within the subgrade to the surface water drainage system. Alongside the permeable paving, rain gardens have been proposed, served by a series of perforated pipes.

6.1.6 Tank Systems

These have the advantage of having a high void ratio allowing it to attenuate large volumes. The use of a tank solution or large oversized pipework could be considered beneath the external circulation areas and could be incorporated with conveyance if connections are shallow to prevent pumping.

6.2 Proposed Surface Water Drainage Strategy

The proposed surface water drainage system for the Applications Site shall be designed to adhere to the following criteria:

- No surcharging of pipework during storms up to a 1:2-year annual probability
- No flooding to occur on suit during storms up to a 1:30-year annual probability
- No flooding of third-party land or buildings during storms up to a 1:100-year annual probability + 40% increased allowance for climate change.

It is acceptable to allow car parks or areas of soft landscaping to flood during 1:100-year annual probability events providing that it does not impact safe access/egress to the development for emergency services, emergency escape routes or impact third-parties.

Ground/Infiltration

Infiltration testing in accordance with BRE Digest 365 has only recently been undertaken (post completion of the planning design) which has confirmed that the infiltration rates are suitable for an infiltration lead strategy to be progressed at the detailed design stage. The test results can be found in Appendix 8 and for the purpose of the design the infiltration rate will be set at 7.3×10^{-4} m/s.

Since positive infiltration testing results have now been received the design will be updated during the next stage of the design to include infiltration and limit (and potentially omit) any discharge into the sewer. This approach will be discussed as part of the SAB preapplication / full SAB application process.

Surface Water Sewer or Combined Sewer

There are no surface water sewers located in the vicinity of the site according to the available survey information. There is a combined public sewer located in the south of the site that discharges towards the south. This is the location that Welsh Water identified as having capacity for the development and that should be used as the outfall location for the development.

As a last resort if all water cannot be dealt with via infiltration the surface water will discharge at a restricted flow rate via the existing foul water sewer.

In accordance with Building Regulations Part H, it is proposed that foul and surface water drainage systems will be kept separate up until the point of discharge into the public sewer network.

Details of the preliminary drainage strategy can be found within Appendix 6. Infiltration testing has been recently carried out (post planning design), the design will be rationalised further at the next design stage to promote an infiltration led strategy where feasible.

The surface water drainage strategy has been designed to incorporate the below SuDS features;

- Rainwater harvesting
- Green Roofs
- Permeable paving
- Rain gardens
- Geocellular attenuation tank

There are a number of driving factors behind the selection of the discharge rate for the proposed development.

- Restrictions imposed by SAB to suit local and site development plans.
- Restrictions imposed by Welsh Water to suit local public sewer capacity.
- Restrictions imposed by BREEAM to achieve certain credits (if applicable).
- Capacity of the existing downstream system.
- Infiltration rates.
- Proposed site layout and adjacencies dictating viable space for attenuation or SuDS.

At this stage there are still a number of options which need to be reviewed following the outcome of the initial site investigation and consultations.

Infiltration testing has been recently carried out (post planning design) and has identified that it is feasible to manage surface water where possible via infiltration. The infiltration rate that will be used for the purpose of the design is 7.3×10^{-4} m/s.

For the purpose of this drainage strategy report the design has been carried out to achieve a restricted flow rate of 3.5 l/s for the peak storm of 1 in 100-year storm event with an allowance of 40% for climate change.

An SAB preapplication has been submitted to Wrexham County Borough Council based on this methodology and the detailed design will be progressed in accordance with the response of this submission.

The surface water will be collected on the roof through the implementation of a green / blue roof which will provide biodiversity benefits as well as assisting in managing the flows from the roof at source. Rainwater harvesting will also be implemented within the design with discussions ongoing with the club regarding the best usage of this. Initial discussions have highlighted that the use for the pitch irrigation would be most beneficial and the detail of this will be progressed during detailed design.

Surface water collected from the external areas will be treated and attenuated through the implementation of permeable paving / surfaces with subbase attenuation. Rain gardens have been incorporated into the permeable paving to provide added benefits to the amenity space and biodiversity. Due to the low restriction of the flow rate a geocellular attenuation tank has been included due to its high void ratio and ability to store large volumes of water.

The surface water will be restricted through the use of a hydrobrake flow control device that will be designed to restrict the flow rate to 3.5 l/s for the 1 in 100-year storm event with an allowance of 40% for climate change.

6.2.1 Pollution Control and Water Quality

Water quality treatment is provided to the surface water run-off through the following methods as detailed in the CIRIA 753 SuDS manual (CIRIA, 2015):

- Filtration and settlement - removal of silt or suspended solids (with associated pollutants).
- Biodegradation – chemical dissolution of organic contaminants such as oil, petrol and diesel by bacteria, fungi, or other biological means within the pavement layers.
- Adsorption – adhesion of contaminant particles to sand and gravel material surfaces within the pavement build-up. Dependent on factors such as aggregate type, structure, texture, and moisture content.

In line with CIRIA C753 The SuDS Manual Section 26.7 the land uses for the development and corresponding pollution hazard indices are shown in the table below:

Land Use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Roof	Low	0.3	0.2	0.05
Non-residential car parking and low traffic access road	Low	0.5	0.4	0.4

Table 6 - Pollution Hazard Indices (reproduced from CIRIA C753 Table 26.2)

The pollution hazard for the site is low, due to the site boundary comprising of the roof and a small area of external finishes. The sustainable drainage systems proposed satisfy the requirement to mitigate pollutants given the higher pollution mitigation indexes as shown in the below table:

Land Use	Total Suspended Solids	Metals	Hydrocarbons
Rain Gardens / Bioretention	0.8	0.8	0.8
Permeable Paving	0.7	0.6	0.7

Table 7 - SuDS Mitigation Indices (reproduced from CIRIA C753 Table 26.4)

7. SITE & PROJECT CONSTRAINTS

The table below details the site-specific constraints which have been evaluated in order to determine the most appropriate drainage solution. Where elements are yet to be fully considered, this is noted alongside any additional comments. If the constraints lead to a specific risk, this have been highlighted and transferred to the Risk Register within Section 7.

Site / Project Constraints	Potential Impact on Development	Considered in Current Drainage Strategy	Comments
Sensitive environmental receptors	Restrictions on foul and surface water discharge location and quality; inclusion of additional polishing techniques such as separators, reed beds etc.	Yes/No	Discharge is to local utility sewerage systems. Connection into Welsh Water combined sewer proposed.
Presence of contamination	Restricts the use of infiltration for surface water disposal	Yes/No	Ground investigation survey to be carried out to identify any sources of contamination.
Presence of shallow aquifers	Restricts the use of infiltration for surface water disposal	Yes/No	Not identified in desk study.
Presence of nearby watercourses	Restrictions on discharging water quality	Yes/No	Foul and surface water to connect into the existing Welsh Water combined sewer.
Flood zone / flood relief areas	Limitations on SUDS systems that can be used (retention of attenuation capacity during flood events)	Yes/No	Development site is in Flood Zone A taken from the Natural Resource Wales Flood Risk Map.
Infiltrations rates (at required location/depth)	Applicability of infiltration devices for surface water disposal; size of infiltration devices	Yes/No	Infiltration rates recently received that identify that an infiltration lead strategy is feasible. Strategy to be taken forward at the next design stage and during discussions with the SAB via preapplication meetings.
Groundwater level	Restricts infiltration potential; authorities may prevent discharge from potential sources of pollution, i.e. paved areas. Pumping in excavations.	Yes/No	To be confirmed following ground investigation and ground water monitoring, not identified during infiltration testing.
Buried obstructions	May require localised removal within drainage locations or drainage to be re-routed around obstruction	Yes/No	Following demolition of the existing stand any existing obstructions to be surveyed and where applicable grubbed out and removed.
Foul water discharge point locations and invert levels	May require pumping; restrictions on pipe routing (shortest length); additional protection to shallow drains.	Yes/No	Proposed site levels to be confirmed and drainage strategy reviewed. Proposed foul water discharge to be via gravity where applicable into existing Welsh Water infrastructure. Pumping only to be considered if gravity connections are not viable.
Surface water discharge point locations and invert levels	May require pumping; restrictions on pipe routing (shortest length); additional protection to shallow drains.	Yes/No	Proposed site levels to be confirmed and drainage strategy reviewed. Proposed foul water discharge to be via gravity where applicable into existing Welsh Water infrastructure. Pumping only to be considered if gravity connections are not viable.
Availability of foul water infrastructure nearby	May require ‘self-sufficiency’ i.e. packaged treatment units, reed beds etc.	Yes/No	Existing drainage outfall systems to be utilised for disposal to utility sewerage systems. WW confirmed capacity for foul water.
Off-site drainage infrastructure capacity	Upgrading of water company assets; use of flow restrictors; additional storage/attenuation	Yes/No	Existing drainage outfall systems to be utilised for disposal to utility sewerage systems. WW contacted to assess available capacity in public sewer. WW advised that capacity for the foul water is available, the surface water discharge will be reduced so assumed acceptable.
Allowable discharging flow rates	Impacts on volume of attenuation required	Yes/No	The drainage strategy requires SAB approval, a SAB preapplication will be submitted prior to the planning submission. Flow rates will be agreed as part of this application process.
Allowable discharging flow volumes	Allowable impermeable area/volume of long-term attenuation	Yes/No	The drainage strategy requires SAB approval, a SAB preapplication will be submitted prior to the planning submission. Flow rates will be agreed as part of this application process.
Specific authority requirements	Limits SUDS systems / materials specifications that can be used	Yes/No	The drainage strategy requires SAB approval, a SAB preapplication will be submitted prior to the planning submission.
Easements for services, rivers, critical infrastructure	Reduces available space; restricts drainage element locations	Yes/No	Diversions and abandonment considered.
BREAAM credit requirement	Enhanced restriction of surface water discharge requiring additional controls and increased attenuation	Yes/No	Not considered at this stage, design in accordance with requirements from SAB officer.
Available external area (space for SUDS)	Limits SUDS systems that can be used (low land take)	Yes/No	Surface water drainage strategy proposals to integrate SuDS features, i.e. rain gardens, porous paving, and below ground attenuation tanks as well as rain water harvesting into the design.
Land use (appropriateness for open water)	Limits SUDS systems that can be used (health and safety)	Yes/No	Not considered due to nature of project and pedestrian access.
Traffic level type/volume	Pervious paving foundation thickness	Yes/No	Infrequent use by traffic; i.e. pedestrian access with emergency vehicles / maintenance vehicles only. This to be checked against pavement design and frost heave requirements at later design stage.
Construction phasing	Position of attenuation; pipe routing; temporary oversizing of elements due to temporary retention of buildings	Yes/No	Not considered at this stage.
Construction hoarding lines/access routes	Position of attenuation, SuDS, pipe routing	Yes/No	Not considered at this stage.
Future development (i.e. extensions)	Oversizing of elements to provide additional capacity	Yes/No	No further expansion is considered.

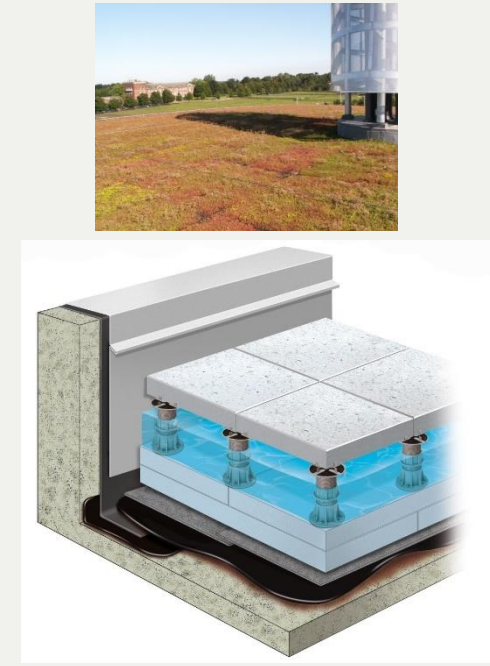
Need for new outlets / headwalls to watercourses	Additional correspondence (fees) with authorities; construction of headwall to approved standards; issues relating to banks/bed (scour)	Yes /No	Foul and surface water to connect into the existing Welsh Water combined sewer.
Abnormal foul water discharge requirements (i.e. laboratories)	Separate laboratory waste; chemically and temperature resistant pipework; inclusion of sample chambers; inclusion of grease separators.	Yes/ No	Not applicable, domestic foul wastewater discharge only.
Retained trees	Limitation in excavation location/depth to prevent root damage.	Yes/ No	Not applicable
Maintenance requirements	Required maintenance regime is not acceptable to client requiring amendments to proposed drainage scheme.	Yes/ No	Maintenance of SuDS & drainage system is required to be undertaken by the maintenance team. O&M in accordance with the CIRIA SuDS Manual.

8. SURFACE WATER DRAINAGE OPTIONS (SUDS MATRIX)

The use of sustainable drainage systems (SuDS) is mandatory for new surface water drainage systems within the UK. SuDS can be used as source control (interception of surface water), conveyance, storage/attenuation (porous/permeable paving with perforated pipes and tanks) and discharge dependent on various site conditions using vortex flow control devices. The table below describes many of the SuDS approaches that are available and explains their advantages, disadvantages and appropriateness for use on the proposed development site.

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Retention	Balancing pond		Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation.	Good removal of pollutants can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits.	No reduction in runoff volume, land take may limit use in high density sites.	No – Special considerations prevent this from being implemented.
	Subsurface storage		Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.	Modular and flexible, dual usage (infiltration/storage, high void ratios, can be installed beneath trafficked and soft landscaped areas.	No water quality treatment unless paired with petrol interceptor,	Yes – This will be considered in the drainage design.
Wetland	Shallow wetland Extended detention wetland Pond wetland Pocket wetland Submerged gravel wetland Wetland channel		Wetlands provide stormwater attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants They can provide significant ecological benefits.	Good pollutant removal and if lined can be used where groundwater is vulnerable. Good community acceptability, ecological and amenity benefits.	Land take is high, requires baseflow, little reduction in runoff volume, not suitable for steep sites.	No – Special considerations prevent this from being implemented.
Infiltration	Infiltration trench Infiltration basin Soakaway		Surface water runoff can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated.	Reduces the volume of runoff, effective at pollutant removal, contributes to groundwater recharge, simple and cost-effective, easy performance observation.	Requires appropriate pre-treatment, basins require a large flat area, offset from foundations.	Infiltration test results identify that infiltration is a viable solution to managing surface water on site.

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
	Surface sand filter Sub-surface sand filter Perimeter sand filter		Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required.	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations.	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2m required, possible odor problems, high capital and maintenance cost.	Infiltration test results identify that infiltration is a viable solution to managing surface water on site.
	Bioretention / filter swale		Vegetated strips of land designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system.	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit capability, effective pre-treatment option	Requires landscaping and management, large land requirement, not suitable for steep sites, no significant attenuation or reduction of flows.	Infiltration test results identify that infiltration is a viable solution to managing surface water on site.
	Filter trench / drain		Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water runoff.	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site landscaping and fit well beside roads and car parks.	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material.	Yes - This will be considered in the drainage design.
Detention	Detention basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility.	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain.	Land take, little reduction in runoff volume, detention depths constrained by levels.	No – Special considerations prevent this from being implemented.
	Enhanced dry swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces runoff rates and volumes, low cost.	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking.	Yes - This will be considered in the drainage design.
	Enhanced wet swale					
Conveyance	Conveyance swales		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation. Possible reduction in runoff volume via plant uptake and infiltration.	Potential trip/wheel hazard, disabled access issues.	No – Due to the site nature with a lot of footfall the trip hazard element would cause a potential issue.
	Rills					

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Source control	Green / Brown roof / Blue roof		Multi-layered system that covers the roof of a building with vegetation cover / landscaping / blue roof over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption.	Additional weight, not appropriate for steep / sloped roofs, maintenance of roof vegetation.	Yes - This will be considered in the drainage design.
	Rainwater harvesting		Uses rainwater coming from roofs to supply toilets, washing machines and irrigation systems. Harvested rainwater is stored underground and is substituted for potable water mains supply, reducing both site discharge and water consumption.	Can provide source control of storm water runoff, reduces demand on mains water.	Use is dependent on demand requirements, contributing surface area, and seasonal rainfall characteristics	Yes - This will be considered in the drainage design.
	Rain Garden		Vegetated strips of land designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system.	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit capability, effective pre-treatment option. Can be orientated to take roof drainage.	Requires landscaping and management, large land requirement, not suitable for steep sites, no significant attenuation or reduction of flows.	Yes - This will be considered in the drainage design.

9. OPERATION AND MAINTENANCE PLAN

Maintenance requirements are the responsibility of the Wrexham Association Football Club maintenance team. The below tables summarise the maintenance requirements of the proposed drainage features. For further details on the below ground drainage operation and maintenance please refer to the Operation and Maintenance Manual reference “WRX-RAM-XX-XX-RP-C-00003”.

Table 9 - Manholes, catchpits, and inspection chambers maintenance summary.

Action	Details	Frequency
Monitoring and Inspection /Testing	Check condition of inlets, outlets, vents, overflows, flow controls, covers and chambers	Monthly for the first three months following commission; Six-monthly thereafter or 48 hours after major storm event
	Inspect all manholes and catch-pit sumps for any sediment, trash, debris, and any other pollutants	Monthly for the first three months following commission; Six-monthly thereafter or 48 hours after major storm event
Regular Maintenance	Repair inlets, outlets, vents, overflows, flow controls, covers and chambers	Monthly for the first three months following commission; Six-monthly thereafter or 48 hours after major storm event
	Remove sediment, trash, debris and any other pollutants from manholes and catchpit sumps to ensure correct performance	Monthly for the first three months following commission; Six-monthly thereafter or 48 hours after major storm event
Occasional Maintenance	Replace covers and frames as necessary	As required
	Repair exposed concrete and surfacing as necessary	As required
Remediation	Replace malfunctioning parts or structures.	As required

Table 10 - Pipes maintenance summary.

Action	Details	Frequency
Monitoring and Inspection /Testing	Initial water test to be done prior to CCTV survey	Once, upon completion of development
	Initial inspection should be provided as post construction CCTV survey	Once, upon completion of development
	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action	Monthly for the first three months following commission; Three-monthly thereafter or 48 hours after major storm event
Occasional Maintenance	Check and remove large vegetation growth near pipe runs	Six-monthly
	Rod through poorly performing runs as initial remediation.	As required
Remediation	If continued poor performance, jet and CCTV survey poorly performing runs.	As required
	Seek advice as to remediation techniques suitable for the type of performance issue and location	As required, if above does not improve performance

Table 11 - Permeable paving maintenance summary.

Action	Details	Frequency
Monitoring and Inspection / Testing	Initial inspection	Monthly for the first three months following commission;
	Inspect for evidence of poor operation and/or weed growth- if required, take remedial action	Three-monthly or 48 hours after major storm event
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over entire surface)	Once a year after autumn leaf fall, or reduced frequency as required, based on site specific observations of clogging. Attention to be paid to areas where water runs onto permeable surface from adjacent impermeable areas as this area is the most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributory adjacent areas	As required
	Removal or management of weeds using glyphosate applied directly onto weeds	Annually or as required
	Remediate any landscaping, which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
Remediation	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users. Replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years, or as required (if infiltration is reduced due to clogging)

Table 12 - Flow control device maintenance summary.

Action	Details	Frequency
Monitoring and Inspection /Testing	Inspect for evidence of poor operation	Six-monthly
	Inspect inlet for blockages and clogging. Jetting and CCTV survey may be required	Monthly for the first three months following commission; Six-monthly thereafter or 48 hours after major storm event
	Inspect for accumulation of sediment	Monthly for the first three months following commission; Six-monthly thereafter or 48 hours after major storm event
Regular Maintenance	Remove debris and sediment	Monthly or as required
	Clean out of unit as per the manufacturer's recommendations	Annually or as required
Remediation	Repair or replace malfunctioning parts	As required

Table 13 - Rain gardens maintenance summary.

Action	Details	Frequency
Monitoring and Inspection /Testing	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary.	Three-monthly or 48 hours after major storm event
	Check operation of under-drains by inspection of flows after rain.	Annually or as required
	Assess plants for disease infection, poor growth, invasive species etc, and replace when necessary.	Three-monthly or 48 hours after major storm event
	Inspect inlets and outlets for blockages.	Three-monthly or 48 hours after major storm event
Regular Maintenance	Remove debris and sediment, litter and weeds, including any build-up from around inlets or from forebays.	Three-monthly or 48 hours after major storm event
	Replace plants to maintain plant density	As required
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required.	As required
	Repair accumulations of silt by raking surface mulch, scarifying the surface of medium and replace mulch.	As required
Remediation	Remove/ replace filter medium and vegetation	As required, likely to be > 20 years

10. CONCLUSION AND NEXT STEPS

Below are the key points summarising the drainage strategy design proposals.

1. The surface water runoff generated from the proposed site will be managed using the following appropriate SuDS techniques:
 - Rainwater harvesting
 - Rain gardens
 - Permeable paving
 - Green Roofs
2. The site is located within Flood Zone 1 and as such, has a low probability of flooding. According to the Natural Resource Wales flood map. A Flood Risk Assessment is not required if the development is in Flood Zone 1 and is:
 - Smaller than one hectare;
 - Is not affected by sources of flooding other than rivers and the sea.
3. Surface water drainage will be designed up to the 1 in 100-year storm event with an allowance of 40% for climate change. This will ensure that the peak rate of storm water leaving the developed site is controlled and accounted for within the design.
4. Infiltration test results can be found in Appendix 8 and for the purpose of the design the infiltration rate will be set at 7.3×10^{-4} m/s. Infiltration testing was carried out in accordance with BRE Digest 365.
5. Infiltration test results were recently received (post planning design), the test results indicate it is viable to manage surface water using an infiltration lead strategy. The design will be reviewed to manage surface water through infiltration at the next design stage. This strategy will be further discussed with the SAB officer as part of the SAB preapplication advice.
6. A new connection into the Welsh Water public drainage network will be required as there is limited existing surface water infrastructure the site. Construction of drainage will be to adoptable standards.
7. The foul water discharge from the proposed development will be managed via a gravity drainage connection into the Welsh Water public sewer located to the south of the development.
8. A predevelopment enquiry has been submitted to Welsh Water to confirm there is available capacity within the network. Formal approval to connect will be made at a more detailed design stage.
9. Consultation with Welsh Water and Wrexham County Borough Council acting as the Lead Local Flood Authority (LLFA) / SAB to receive formal approval for the overarching principles of the proposed drainage strategy including discharge rates, surface water attenuation volumes and any additional requirements, is to be undertaken.
10. Confirmation of the invert levels and approval of construction methods of new manholes onto Welsh Water public sewers is required.

APPENDIX 1

SITE LOCATION PLAN

NOTES
All dimensions and levels to be checked on site
Any discrepancies are to be reported to the Architect before any work commences
This drawing shall not be scaled to ascertain any dimensions, work to figured dimensions only
This drawing shall not be reproduced without express written permission from AFL Architects Ltd.

DISCLAIMER
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P5	13.06.22	WR	WIP Issue
P4	20.05.22	WR	Boundaries Updated
P3	16.05.22	WR	Site Boundaries Added
P2	13.05.22	WR	WIP ISSUE
P1	08.04.2022	WR	First Issue - Floodlight positions added for coordination purposes

rev no.	rev date	rev by	description
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project

KOP Redevelopment

location

Racecourse Stadium

Employer

client



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key plan



drawing title

Proposed Site Plan

AFL job number	scale @ A1	drawn VR	checked NT
211509	1 : 500	rev date	13.06.22

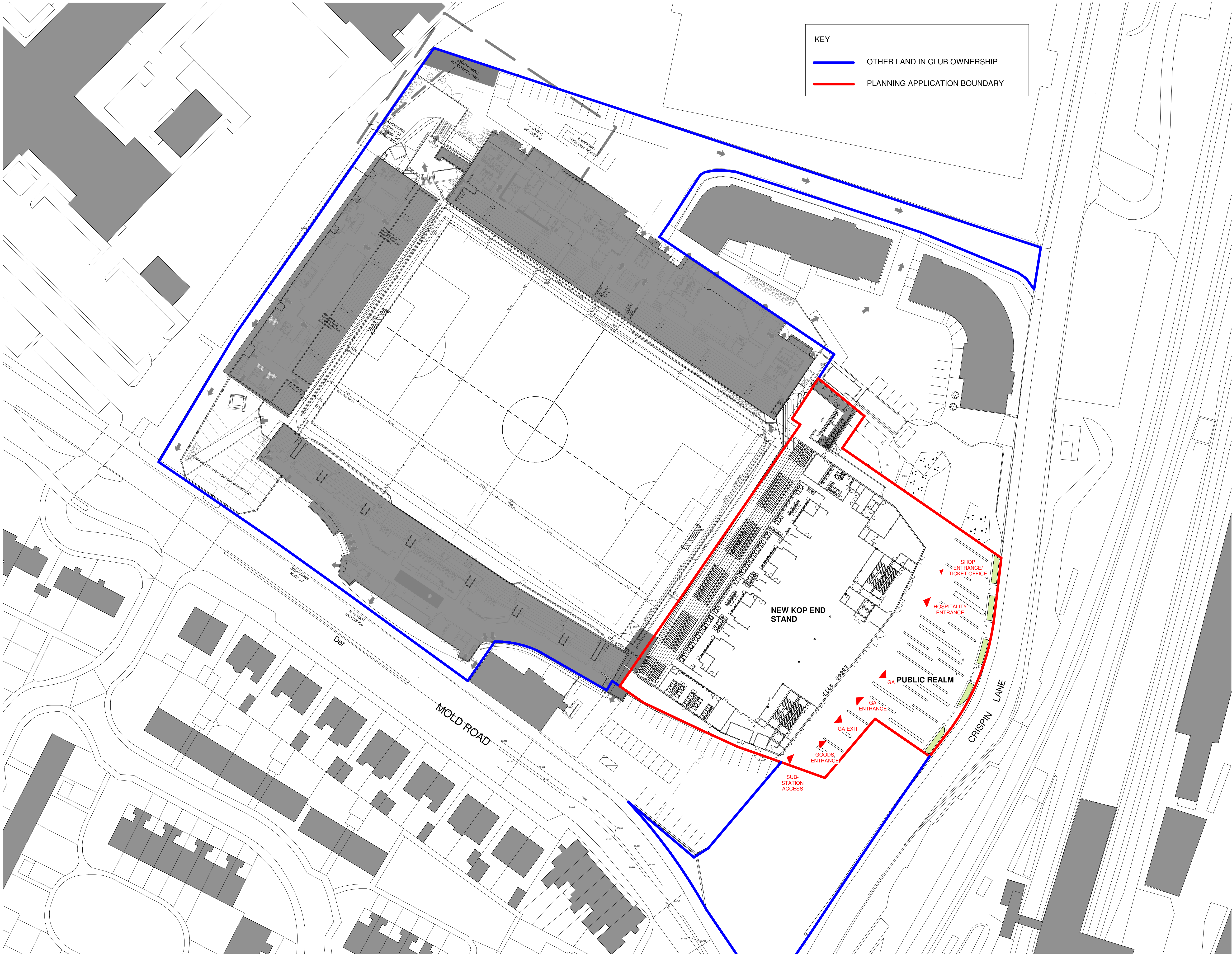
dwg purpose	status	rev
INFORMATION	S2	P5

bim project origin zone level type role 5-digit no.
211509-AFL-ZZ-ZZ-DR-A-00101

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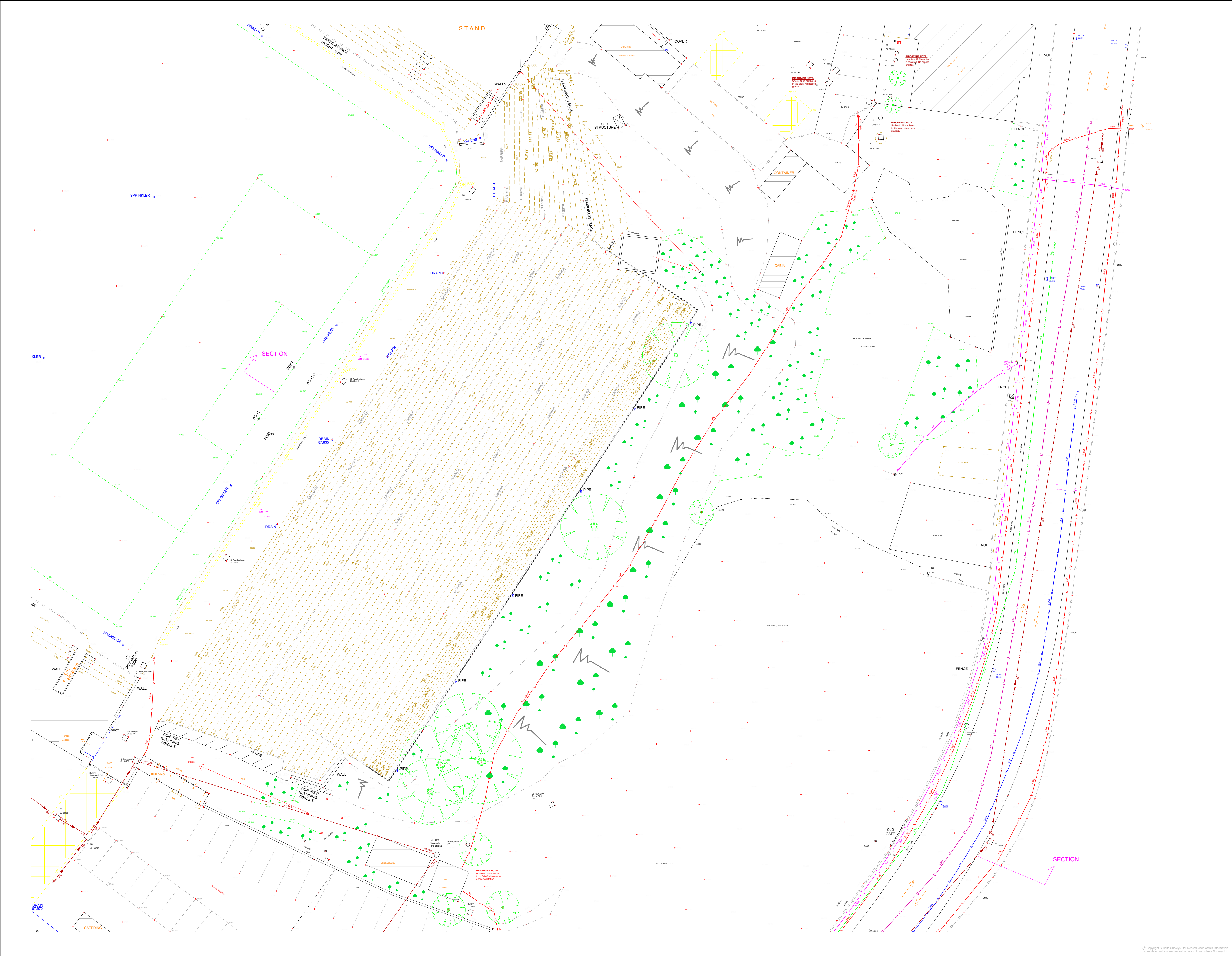
OTHER LAND IN CLUB OWNERSHIP

PLANNING APPLICATION BOUNDARY



APPENDIX 2

TOPOGRAPHIC & UTILITY SURVEY



NOTES

SURVEY CO-ORDINATE SCHEDULE

STATION	EASTING	NORTHING	ELEVATION	STATION	EASTING	NORTHING	HEIGHT
1	44 00 00	51 00 00	100.00	2	44 00 00	51 00 00	100.00

LAND SURVEY INFORMATION

GRID: X
VERTICAL DATUM: X
HEIGHT ESTABLISHED VIA TRIMBLE VRS NOW NETWORK
COMMERCIAL RTK GPS CORRECTION SERVICE
LOCAL SCALE FACTOR: X

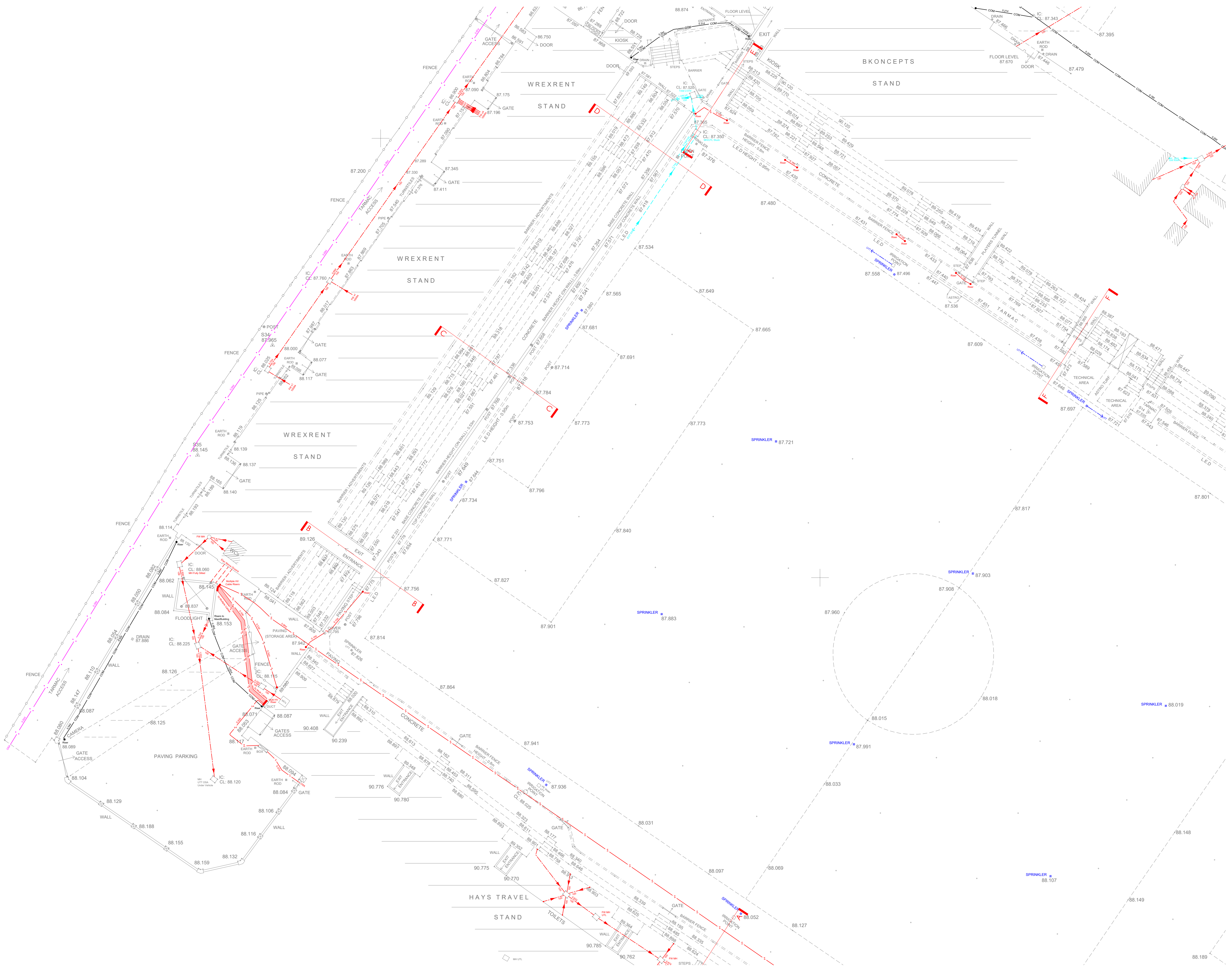
Electromagnetic and/or Ground Penetrating Radar techniques have been used to locate/map underground utilities and features on this drawing. Subsite Surveys Ltd has made every endeavour to make sure that the information contained within this drawing is accurate and of the highest quality. Subsite Surveys Ltd has used any record drawings provided by the client or by the Statutory Utility Providers, at the client's request, at the time of the survey. Any information taken from these drawings (e.g. pipe size and position) is not guaranteed. Historic record information is often incomplete and inaccurate and cannot be relied upon.

Subsite Surveys Ltd is not liable for any topographical survey that has not been undertaken by us. Any inaccuracies relating to topographical plans/development plans/Ordinance Survey data that we have to control over is the liability of the customer. Where quoted, depth information of underground services/features is stated. Depths are generally within +/-10% accurate, but cannot be guaranteed. Any depths shown are drains are usually to invert (base of drainage channel) unless otherwise stated.

The completeness of any underground survey cannot be 100% guaranteed and the results from these types of surveys are not infallible. If the location or depth of services/features is of particular importance to a project then it is strongly advised that discussions are held with Subsite Surveys Ltd regarding any possible limitations or anomalies. It is also strongly advised that trial excavations should be undertaken to confirm survey results. We cannot be held responsible for any inaccuracies beyond those that could be reasonably expected by a competent company.

ABBREVIATIONS (Land & Utilities)

AV	ADDITIONAL VENT	CO	COINTEGRATED	ES	ESSENTIAL POINT
BA	BEST AVAILABLE	CU	CULVERT	GA	GAUGE
BE	BEST AVAILABLE	DA	DRAINAGE	GP	GROUND PENETRATING RADAR
BM	BENCH MARK	DE	DEVELOPMENT	HA	HARDWARE
BR	BURIED	DI	DRAINAGE	IP	INVERT
BS	BEST AVAILABLE	DU	DRAINAGE	LA	LANDSCAPE
BT	BEST AVAILABLE	EA	EARTH	LP	LANDSCAPE
BU	BEST AVAILABLE	EB	EARTH	LS	LANDSCAPE
CA	CABLE	EC	EARTH	LT	LANDSCAPE
CB	CABLE	ED	EARTH	LU	LANDSCAPE
CC	CABLE	EE	EARTH	LV	LANDSCAPE
CD	CABLE	EF	EARTH	LV	LANDSCAPE
CE	CABLE	EG	EARTH	LV	LANDSCAPE
CF	CABLE	EH	EARTH	LV	LANDSCAPE
CG	CABLE	EI	EARTH	LV	LANDSCAPE
CH	CABLE	EJ	EARTH	LV	LANDSCAPE
CI	CABLE	EK	EARTH	LV	LANDSCAPE
CJ	CABLE	EL	EARTH	LV	LANDSCAPE
CK	CABLE	EM	EARTH	LV	LANDSCAPE
CL	CABLE	EN	EARTH	LV	LANDSCAPE
CM	CABLE	EO	EARTH	LV	LANDSCAPE
CN	CABLE	EP	EARTH	LV	LANDSCAPE
CO	CABLE	EQ	EARTH	LV	LANDSCAPE
CP	CABLE	ER	EARTH	LV	LANDSCAPE
CQ	CABLE	ES	EARTH	LV	LANDSCAPE
CR	CABLE	ET	EARTH	LV	LANDSCAPE
CS	CABLE	EU	EARTH	LV	LANDSCAPE
CT	CABLE	EV	EARTH	LV	LANDSCAPE
CU	CABLE	EW	EARTH	LV	LANDSCAPE
CV	CABLE	EX	EARTH	LV	LANDSCAPE
CW	CABLE	EY	EARTH	LV	LANDSCAPE
CX	CABLE	EZ	EARTH	LV	LANDSCAPE
CY	CABLE	FA	FUEL	LV	LANDSCAPE
CA	CABLE	FB	FUEL	LV	LANDSCAPE
CB	CABLE	FC	FUEL	LV	LANDSCAPE
CC	CABLE	FD	FUEL	LV	LANDSCAPE
CD	CABLE	FE	FUEL	LV	LANDSCAPE
CE	CABLE	FF	FUEL	LV	LANDSCAPE
CF	CABLE	FG	FUEL	LV	LANDSCAPE
CG	CABLE	FH	FUEL	LV	LANDSCAPE
CH	CABLE	FI	FUEL	LV	LANDSCAPE
CI	CABLE	FJ	FUEL	LV	LANDSCAPE
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CK	CABLE	FL	FUEL	LV	LANDSCAPE
CL	CABLE	FM	FUEL	LV	LANDSCAPE
CM	CABLE	FN	FUEL	LV	LANDSCAPE
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CO	CABLE	FP	FUEL	LV	LANDSCAPE
CP	CABLE	FQ	FUEL	LV	LANDSCAPE
CQ	CABLE	FR	FUEL	LV	LANDSCAPE
CR	CABLE	FS	FUEL	LV	LANDSCAPE
CS	CABLE	FT	FUEL	LV	LANDSCAPE
CT	CABLE	FU	FUEL	LV	LANDSCAPE
CU	CABLE	FV	FUEL	LV	LANDSCAPE
CV	CABLE	FW	FUEL	LV	LANDSCAPE
CW	CABLE	FX	FUEL	LV	LANDSCAPE
CX	CABLE	FY	FUEL	LV	LANDSCAPE
CY	CABLE	FZ	FUEL	LV	LANDSCAPE
CA	CABLE	GA	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CB	CABLE	GB	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CC	CABLE	GC	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CD	CABLE	GD	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CE	CABLE	GE	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CF	CABLE	GF	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CG	CABLE	GG	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CH	CABLE	GH	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CI	CABLE	GI	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CJ	CABLE	GO	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CK	CABLE	GP	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CL	CABLE	GQ	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CM	CABLE	GR	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CN	CABLE	GS	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CO	CABLE	GT	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CP	CABLE	GU	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CQ	CABLE	GV	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CR	CABLE	GW	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CS	CABLE	GX	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CT	CABLE	GY	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CU	CABLE	GZ	GAUGE </td <td>LV</td> <td>LANDSCAPE</td>	LV	LANDSCAPE
CV	CABLE	HA	HARDWARE	LV	LANDSCAPE
CW	CABLE	HB	HARDWARE	LV	LANDSCAPE
CX	CABLE	HC	HARDWARE	LV	LANDSCAPE
CY	CABLE	HD	HARDWARE	LV	LANDSCAPE
CA	CABLE	HE	HARDWARE	LV	LANDSCAPE
CB	CABLE	HF	HARDWARE	LV	LANDSCAPE
CC	CABLE	HG	HARDWARE	LV	LANDSCAPE
CD	CABLE	HH	HARDWARE	LV	LANDSCAPE
CE	CABLE	HI	HARDWARE	LV	LANDSCAPE
CF	CABLE	HJ	HARDWARE	LV	LANDSCAPE
CG	CABLE	HK	HARDWARE	LV	LANDSCAPE
CH	CABLE	HL	HARDWARE	LV	LANDSCAPE
CI	CABLE	HM	HARDWARE	LV	LANDSCAPE
CJ	CABLE	HN	HARDWARE	LV	LANDSCAPE
CK	CABLE	HO	HARDWARE	LV	LANDSCAPE
CL	CABLE	HP	HARDWARE	LV	LANDSCAPE
CM	CABLE	HQ	HARDWARE	LV	LANDSCAPE
CN	CABLE	HR	HARDWARE	LV	LANDSCAPE
CO	CABLE	HS	HARDWARE	LV	LANDSCAPE
CP	CABLE	HT	HARDWARE	LV	LANDSCAPE
CQ	CABLE	HU	HARDWARE	LV	LANDSCAPE
CR	CABLE	HV	HARDWARE	LV	LANDSCAPE
CS	CABLE	HW	HARDWARE	LV	LANDSCAPE
CT	CABLE	HX	HARDWARE	LV	LANDSCAPE
CU	CABLE	HY	HARDWARE	LV	LANDSCAPE
CV	CABLE	HZ	HARDWARE	LV	LANDSCAPE
CW	CABLE	IA	INVERT	LV	LANDSCAPE
CX	CABLE	IB	INVERT	LV	LANDSCAPE
CY	CABLE	IC	INVERT	LV	LANDSCAPE
CA	CABLE	ID	INVERT	LV	LANDSCAPE
CB	CABLE	IE	INVERT	LV	LANDSCAPE
CC	CABLE	IF	INVERT	LV	LANDSCAPE
CD	CABLE	IG	INVERT	LV	LANDSCAPE
CE	CABLE	IH	INVERT	LV	LANDSCAPE
CF	CABLE	II	INVERT	LV	LANDSCAPE
CG	CABLE	IJ	INVERT	LV	LANDSCAPE
CH	CABLE	IK	INVERT	LV	LANDSCAPE
CI	CABLE	IL	INVERT	LV	LANDSCAPE
CJ	CABLE	IM	INVERT	LV	LANDSCAPE
CK	CABLE	IN	INVERT	LV	LANDSCAPE
CL	CABLE	IO	INVERT	LV	LANDSCAPE
CM	CABLE	IP	INVERT	LV	LANDSCAPE
CN	CABLE	IQ	INVERT	LV	LANDSCAPE
CO	CABLE	IR	INVERT	LV	LANDSCAPE
CP	CABLE	IS	INVERT	LV	LANDSCAPE
CQ	CABLE	IT	INVERT	LV	LANDSCAPE
CR	CABLE	IU	INVERT	LV	LANDSCAPE
CS	CABLE	IV	INVERT	LV	LANDSCAPE
CT	CABLE	IW	INVERT	LV	LANDSCAPE
CU	CABLE	IX	INVERT	LV	LANDSCAPE
CV	CABLE	IY	INVERT	LV	LANDSCAPE
CW	CABLE	IZ	INVERT	LV	LANDSCAPE
CX	CABLE	JA	JUNCTION	LV	LANDSCAPE
CY	CABLE	JB	JUNCTION	LV	LANDSCAPE
CA	CABLE	JC	JUNCTION	LV	LANDSCAPE
CB	CABLE	JD	JUNCTION	LV	LANDSCAPE
CC	CABLE	JE	JUNCTION	LV	LANDSCAPE
CD	CABLE	JF	JUNCTION	LV	LANDSCAPE
CE	CABLE	JG	JUNCTION	LV	LANDSCAPE
CF	CABLE	JH	JUNCTION	LV	LANDSCAPE
CG	CABLE	JI	JUNCTION	LV	LANDSCAPE
CH	CABLE	JO	JUNCTION	LV	LANDSCAPE
CI	CABLE	JP	JUNCTION	LV	LANDSCAPE
CJ	CABLE	JQ	JUNCTION	LV	LANDSCAPE
CK	CABLE	JR	JUNCTION	LV	LANDSCAPE
CL	CABLE	JS	JUNCTION	LV	LANDSCAPE
CM	CABLE	JT	JUNCTION	LV	LANDSCAPE
CN	CABLE	JU	JUNCTION	LV	LANDSCAPE
CO	CABLE	JV	JUNCTION	LV	LANDSCAPE
CP	CABLE	JW	JUNCTION	LV	LANDSCAPE
CQ	CABLE	JX	JUNCTION	LV	LANDSCAPE
CR	CABLE	JY	JUNCTION	LV	LANDSCAPE
CS	CABLE	JZ	JUNCTION	LV	LANDSCAPE
CT	CABLE	KA	KITCHEN	LV	LANDSCAPE
CU	CABLE	KB	KITCHEN	LV	LANDSCAPE
CV	CABLE	KC	KITCHEN	LV	LANDSCAPE
CW	CABLE	KD	KITCHEN	LV	LANDSCAPE
CX	CABLE	KE	KITCHEN	LV	LANDSCAPE
CY	CABLE	KF	KITCHEN	LV	LANDSCAPE
CA	CABLE	KG	KITCHEN	LV	LANDSCAPE
CB	CABLE	KH	KITCHEN	LV	LANDSCAPE
CC	CABLE	KI	KITCHEN	LV	LANDSCAPE
CD	CABLE	KJ	KITCHEN	LV	LANDSCAPE
CE	CABLE	KK	KITCHEN	LV	LANDSCAPE
CF	CABLE	KL	KITCHEN	LV	LANDSCAPE
CG	CABLE	KM	KITCHEN	LV	LANDSCAPE
CH	CABLE	KN	KITCHEN	LV	LANDSCAPE
CI	CABLE	KO	KITCHEN	LV	LANDSCAPE
CJ	CABLE	KP	KITCHEN	LV	LANDSCAPE
CK	CABLE	KQ	KITCHEN	LV	LANDSCAPE
CL	CABLE	KR	KITCHEN	LV	LANDSCAPE
CM	CABLE	KS	KITCHEN	LV	LANDSCAPE
CN	CABLE	KT	KITCHEN	LV	LANDSCAPE
CO	CABLE	KU	KITCHEN	LV	LANDSCAPE
CP	CABLE	KV	KITCHEN	LV	LANDSCAPE
CQ	CABLE	KW	KITCHEN	LV	LANDSCAPE
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CT	CABLE	KZ	KITCHEN	LV	LANDSCAPE
CU	CABLE	LA	LANDSCAPE	LV	LANDSCAPE
CV	CABLE	LB	LANDSCAPE	LV	LANDSCAPE
CW	CABLE	LC	LANDSCAPE	LV	LANDSCAPE
CX	CABLE	LD	LANDSCAPE	LV	LANDSCAPE
CY	CABLE	LE	LANDSCAPE	LV	LANDSCAPE
CA	CABLE	LF	LANDSCAPE	LV	LANDSCAPE
CB	CABLE	LG	LANDSCAPE	LV	LANDSCAPE
CC	CABLE	LH	LANDSCAPE	LV	LANDSCAPE
CD	CABLE	LI	LANDSCAPE	LV	LANDSCAPE
CE	CABLE	LJ	LANDSCAPE	LV	LANDSCAPE
CF	CABLE	LK	LANDSCAPE	LV	LANDSCAPE
CG	CABLE	LM	LANDSCAPE	LV	LANDSCAPE
CH	CABLE	LN	LANDSCAPE	LV	LANDSCAPE
CI	CABLE	LO	LANDSCAPE	LV	LANDSCAPE
CJ	CABLE	LP	LANDSCAPE	LV	LANDSCAPE
CK	CABLE	LQ	LANDSCAPE	LV	LANDSCAPE
CL	CABLE	LR	LANDSCAPE	LV	LANDSCAPE
CM	CABLE	LS	LANDSCAPE	LV	LANDSCAPE
CN	CABLE	LT	LANDSCAPE	LV	LANDSCAPE
CO	CABLE	LU	LANDSCAPE	LV	LANDSCAPE
CP	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CQ	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CR	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CS	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CT	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CA	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CB	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CC	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CF	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CG	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CH	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CI	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CJ	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CK	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CL	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CM	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CO	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CP	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CQ	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CR	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CV	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CB	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CE	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CF	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CG	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CH	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CI	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CJ	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CK	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CL	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CM	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CN	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CO	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CP	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CQ	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CS	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CT	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
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CA	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CB	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CC	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CD	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CE	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CF	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CG	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CH	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CI	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CJ	CABLE	LV	LANDSCAPE	LV	LANDSCAPE
CK	CABLE	LV	LANDSCAPE		



NOTES

SURVEY CO-ORDINATE SCHEDULE

STATION	EASTING	NORTHING	HEIGHT
1	87.496	87.479	87.479
2	87.496	87.479	87.479
3	87.496	87.479	87.479
4	87.496	87.479	87.479
5	87.496	87.479	87.479
6	87.496	87.479	87.479
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9	87.496	87.479	87.479
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13	87.496	87.479	87.479
14	87.496	87.479	87.479
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93	87.496	87.479	87.479
94	87.496	87.479	87.479
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96	87.496	87.479	87.479
97	87.496	87.479	87.479
98	87.496	87.479	87.479
99	87.496	87.479	87.479
100	87.496	87.479	87.479

LAND SURVEY INFORMATION

GRID: X
VERTICAL DATUM: X
HEIGHT ESTABLISHED VIA TRIMBLE VES NAV NOW NETWORK
COMMERCIAL RTK GPS CORRECTION SERVICE
LOCAL SCALE FACTOR: X

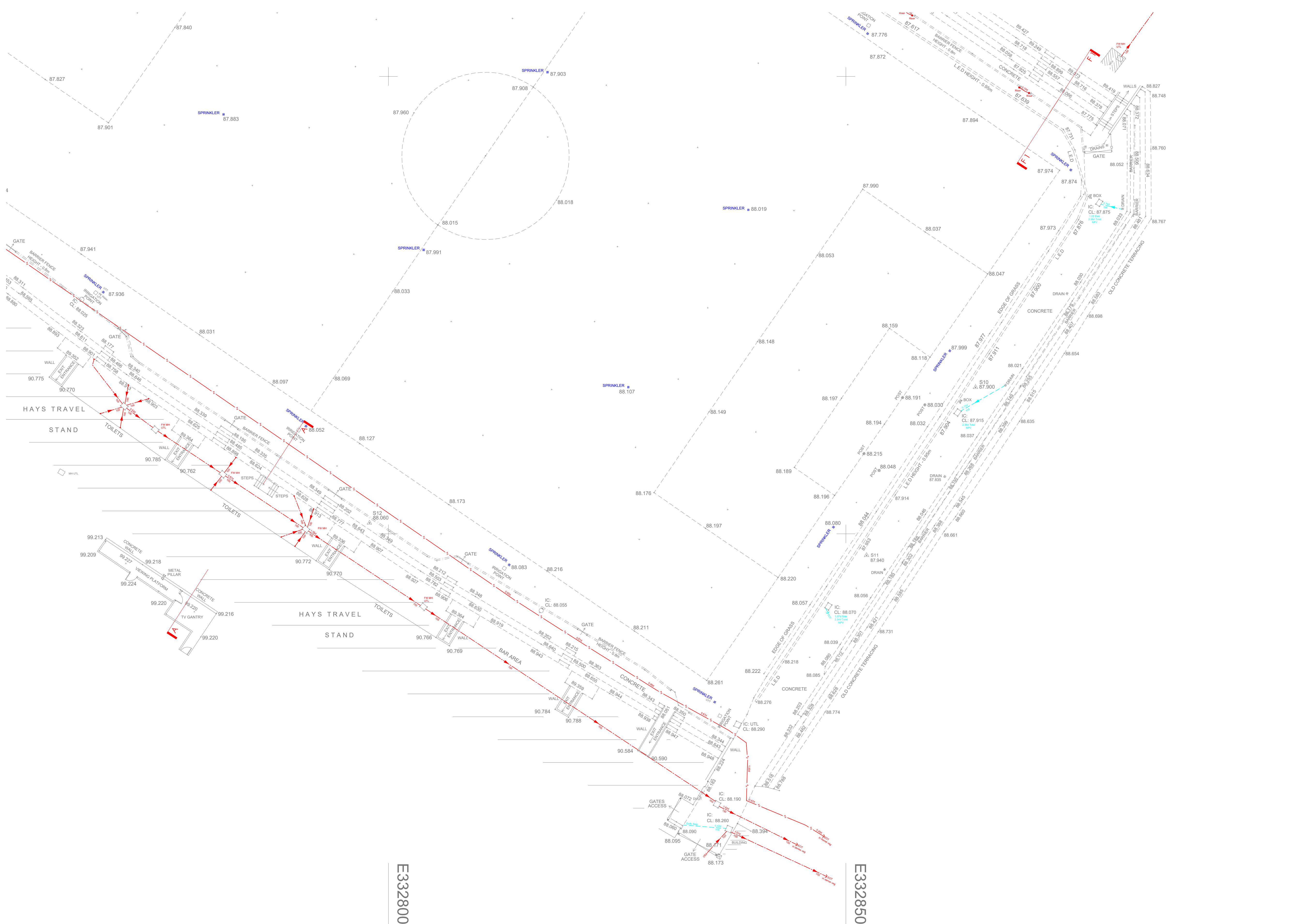
Electromagnetic and/or Ground Penetrating Radar techniques have been used to locate/map underground utilities and features on this drawing. Subsite Surveys Ltd has made every endeavour to make sure that the information contained within this drawing is accurate and of the highest quality. Subsite Surveys Ltd has used any record drawings provided by the client or by the Statutory Utility Providers, at the client's request, at the time of the survey. Any information taken from these drawings (e.g. pipe size and position) is not guaranteed. Historic record information is often incomplete and inaccurate and cannot be relied upon.

Subsite Surveys Ltd is not liable for any topographical survey that has not been undertaken by us. Any inaccuracies relating to topographical plans/development plans/Ordnance Survey data that we have to control over is the liability of the customer. Where quoted, depth information of underground services/features is stated. Depths are generally within +/- 10% accurate, but cannot be guaranteed. Any depths shown are drains are usually to invert (base of drainage channel) unless otherwise stated.

The completeness of any underground survey cannot be 100% guaranteed and the results from these types of surveys are not infallible. If the location or depth of services/features is of particular importance to a project then it is strongly advised that discussions are held with Subsite Surveys Ltd regarding any possible limitations or anomalies. It is also strongly advised that trial excavations should be undertaken to confirm survey results. We cannot be held responsible for any inaccuracies beyond those that could be reasonably expected by a competent company.

ABBREVIATIONS (Land & Utilities)

AA	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AB	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AC	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AD	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AE	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AF	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AG	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AH	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AI	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AJ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AK	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AL	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AM	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AN	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AO	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AP	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AQ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AR	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AS	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AT	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AV	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AW	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AX	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AY	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
AZ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BA	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BB	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BC	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BD	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BE	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BF	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BG	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BH	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BI	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BJ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BK	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BL	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BM	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BN	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BO	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BP	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BQ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BR	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BS	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BT	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BV	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BW	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BX	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BY	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
BZ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CA	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CB	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CC	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CD	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CE	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CF	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CG	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CH	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CI	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CJ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CK	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CL	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CM	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CN	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CO	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CP	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CQ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CR	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CS	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
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CV	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CW	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CX	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CY	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
CZ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DA	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DB	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DC	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DD	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DE	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DF	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DG	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DH	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DI	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DJ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DK	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DL	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DM	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DN	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DO	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DP	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DQ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DR	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DS	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DT	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DV	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DW	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DX	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DY	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
DZ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
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EB	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
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EO	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
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EV	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
EW	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
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FV	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
FW	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
FX	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
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GJ	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
GK	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
GL	ADDITIONAL	AD	ADDITIONAL	AD	ADDITIONAL
GM					



E332800

E332850

NOTES

SURVEY CO-ORDINATE SCHEDULE

STATION	EASTING	NORTHING	ELEVATION	STATION	EASTING	NORTHING	ELEVATION
1	87.827	87.901	87.840	2	88.018	88.015	88.019
3	88.031	88.033	88.052	4	88.053	88.037	88.037
5	88.053	88.037	88.037	6	88.053	88.037	88.037
7	88.053	88.037	88.037	8	88.053	88.037	88.037
9	88.053	88.037	88.037	10	88.053	88.037	88.037
11	88.053	88.037	88.037	12	88.053	88.037	88.037
13	88.053	88.037	88.037	14	88.053	88.037	88.037
15	88.053	88.037	88.037	16	88.053	88.037	88.037
17	88.053	88.037	88.037	18	88.053	88.037	88.037
19	88.053	88.037	88.037	20	88.053	88.037	88.037
21	88.053	88.037	88.037	22	88.053	88.037	88.037
23	88.053	88.037	88.037	24	88.053	88.037	88.037
25	88.053	88.037	88.037	26	88.053	88.037	88.037
27	88.053	88.037	88.037	28	88.053	88.037	88.037
29	88.053	88.037	88.037	30	88.053	88.037	88.037
31	88.053	88.037	88.037	32	88.053	88.037	88.037
33	88.053	88.037	88.037	34	88.053	88.037	88.037
35	88.053	88.037	88.037	36	88.053	88.037	88.037
37	88.053	88.037	88.037	38	88.053	88.037	88.037
39	88.053	88.037	88.037	40	88.053	88.037	88.037
41	88.053	88.037	88.037	42	88.053	88.037	88.037
43	88.053	88.037	88.037	44	88.053	88.037	88.037
45	88.053	88.037	88.037	46	88.053	88.037	88.037
47	88.053	88.037	88.037	48	88.053	88.037	88.037
49	88.053	88.037	88.037	50	88.053	88.037	88.037
51	88.053	88.037	88.037	52	88.053	88.037	88.037
53	88.053	88.037	88.037	54	88.053	88.037	88.037
55	88.053	88.037	88.037	56	88.053	88.037	88.037
57	88.053	88.037	88.037	58	88.053	88.037	88.037
59	88.053	88.037	88.037	60	88.053	88.037	88.037
61	88.053	88.037	88.037	62	88.053	88.037	88.037
63	88.053	88.037	88.037	64	88.053	88.037	88.037
65	88.053	88.037	88.037	66	88.053	88.037	88.037
67	88.053	88.037	88.037	68	88.053	88.037	88.037
69	88.053	88.037	88.037	70	88.053	88.037	88.037
71	88.053	88.037	88.037	72	88.053	88.037	88.037
73	88.053	88.037	88.037	74	88.053	88.037	88.037
75	88.053	88.037	88.037	76	88.053	88.037	88.037
77	88.053	88.037	88.037	78	88.053	88.037	88.037
79	88.053	88.037	88.037	80	88.053	88.037	88.037
81	88.053	88.037	88.037	82	88.053	88.037	88.037
83	88.053	88.037	88.037	84	88.053	88.037	88.037
85	88.053	88.037	88.037	86	88.053	88.037	88.037
87	88.053	88.037	88.037	88	88.053	88.037	88.037
89	88.053	88.037	88.037	90	88.053	88.037	88.037
91	88.053	88.037	88.037	92	88.053	88.037	88.037
93	88.053	88.037	88.037	94	88.053	88.037	88.037
95	88.053	88.037	88.037	96	88.053	88.037	88.037
97	88.053	88.037	88.037	98	88.053	88.037	88.037
99	88.053	88.037	88.037	100	88.053	88.037	88.037

LAND SURVEY INFORMATION

GRID: X
VERTICAL DATUM: X
HEIGHT ESTABLISHED VIA TRIMBLE VLS NOW NETWORK
COMMERCIAL RTK GPS CORRECTION SERVICE
LOCAL SCALE FACTOR: X

Electromagnetic and/or Ground Penetrating Radar techniques have been used to locate/map underground utilities and features on this drawing. Subsite Surveys Ltd has made every endeavour to make sure that the information contained within this drawing is accurate and of the highest quality. Subsite Surveys Ltd has used any record drawings provided by the client or by the Statutory Utility Providers, at the client's request, at the time of the survey. Any information taken from these drawings (e.g. pipe size and position) is not guaranteed. Historic record information is often incomplete and inaccurate and cannot be relied upon.

Subsite Surveys Ltd is not liable for any topographical survey that has not been undertaken by us. Any inaccuracies relating to topographical plans/development plans/Ordinance Survey data that we have no control over is the liability of the customer. Where quoted, depth information of underground services/features is stated. Depths are generally within +/- 10% accurate, but cannot be guaranteed. Any depths shown are drains are usually to invert (base of drainage channel) unless otherwise stated.

The completeness of any underground survey cannot be 100% guaranteed and the results from these types of surveys are not infallible. If the location or depth of services/features is of particular importance to a project then it is strongly advised that discussions are held with Subsite Surveys Ltd regarding any possible limitations or anomalies. It is also strongly advised that trial excavations should be undertaken to confirm survey results. We cannot be held responsible for any inaccuracies beyond those that could be reasonably expected by a competent company.

ABBREVIATIONS (Land & Utilities)

Abbreviation	Full Name	Abbreviation	Full Name
AV	ASBESTOS	CO	COINTEGRATION
BA	BARRIER	DA	DRAINAGE
BE	BED	EA	EARTH
BL	BLOCK	FA	FUEL
BR	BURIED	GA	GAS
BU	BURIED	HA	HEATING
CA	CABLE	HO	HEATING
CB	CABLE	IO	INDUSTRIAL
CC	CABLE	LA	LAND
CD	CABLE	LE	LEAD
CE	CABLE	LI	LIGHT
CF	CABLE	LO	LOAD
CG	CABLE	LP	LOAD
CH	CABLE	LS	LOAD
CI	CABLE	LT	LOAD
CJ	CABLE	LU	LOAD
CK	CABLE	LV	LOAD
CL	CABLE	LY	LOAD
CM	CABLE	LA	LAND
CN	CABLE	LE	LEAD
CO	CABLE	LI	LIGHT
CP	CABLE	LO	LOAD
CQ	CABLE	LP	LOAD
CR	CABLE	LS	LOAD
CS	CABLE	LT	LOAD
CT	CABLE	LU	LOAD
CU	CABLE	LV	LOAD
CV	CABLE	LY	LOAD
CW	CABLE	LA	LAND
CX	CABLE	LE	LEAD
CY	CABLE	LI	LIGHT
CZ	CABLE	LO	LOAD
DA	DRAINAGE	EA	EARTH
DB	DRAINAGE	FA	FUEL
DC	DRAINAGE	GA	GAS
DD	DRAINAGE	HA	HEATING
DE	DRAINAGE	HO	HEATING
DF	DRAINAGE	IO	INDUSTRIAL
DG	DRAINAGE	LA	LAND
DH	DRAINAGE	LE	LEAD
DI	DRAINAGE	LI	LIGHT
DJ	DRAINAGE	LO	LOAD
DK	DRAINAGE	LP	LOAD
DL	DRAINAGE	LS	LOAD
DM	DRAINAGE	LT	LOAD
DN	DRAINAGE	LU	LOAD
DO	DRAINAGE	LV	LOAD
DP	DRAINAGE	LY	LOAD
DQ	DRAINAGE	LA	LAND
DR	DRAINAGE	LE	LEAD
DS	DRAINAGE	LI	LIGHT
DT	DRAINAGE	LO	LOAD
DU	DRAINAGE	LP	LOAD
DV	DRAINAGE	LS	LOAD
DW	DRAINAGE	LT	LOAD
DX	DRAINAGE	LU	LOAD
DY	DRAINAGE	LV	LOAD
DZ	DRAINAGE	LY	LOAD
EA	EARTH	FA	FUEL
EB	EARTH	GA	GAS
EC	EARTH	HA	HEATING
ED	EARTH	HO	HEATING
EE	EARTH	IO	INDUSTRIAL
EF	EARTH	LA	LAND
EG	EARTH	LE	LEAD
EH	EARTH	LI	LIGHT
EI	EARTH	LO	LOAD
EJ	EARTH	LP	LOAD
EK	EARTH	LS	LOAD
EL	EARTH	LT	LOAD
EM	EARTH	LU	LOAD
EN	EARTH	LV	LOAD
EO	EARTH	LY	LOAD
EP	EARTH	LA	LAND
EQ	EARTH	LE	LEAD
ER	EARTH	LI	LIGHT
ES	EARTH	LO	LOAD
ET	EARTH	LP	LOAD
EU	EARTH	LS	LOAD
EV	EARTH	LT	LOAD
EW	EARTH	LU	LOAD
EX	EARTH	LV	LOAD
EY	EARTH	LY	LOAD
EZ	EARTH	LA	LAND
FA	FUEL	GA	GAS
FB	FUEL	HA	HEATING
FC	FUEL	HO	HEATING
FD	FUEL	IO	INDUSTRIAL
FE	FUEL	LA	LAND
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FY	FUEL	LA	LAND
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HB	HEATING	IO	INDUSTRIAL
HC	HEATING	LA	LAND
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APPENDIX 3

WELSH WATER ASSET MAP INFORMATION



Dŵr Cymru
Welsh Water

Sewer Plan PPA0006032



LEGEND(Representative of most common features)

Waste networks:

	Foul chamber		Surface water chamber		Outfall
	Combined chamber		Combined sewer overflow		Lampole
	Special purpose chamber		Storm Overflow		Rising main
	Treatment works		Gravity sewer		Private sewer
	Pumping station		Private sewer subject to Sect. 104 adoption agreement		Private Sewer Transfer
	NB: Sewer symbol colour indicates the type.		Lateral Drain		Inspection Chamber
	RED - Combined				
	GREEN - Surface Water				
	BROWN - Foul				
	Purple - Former S24 sewers (for indicative purposes only)				

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation.

Dŵr Cymru Cylindedig (the Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the understanding that it is based on the best information available and is not warranted as to its correctness in the event of excavations or other works made in the vicinity of the Company's apparatus. The error of location appears to be carrying out any excavations with care. The information which is supplied by the Company is given as in accordance with statutory requirements of sections 103 and 109 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not include the whereabouts of water mains, surface water drains, lateral drains or other pipes and any excavation should be made in September 1998 or, if that is not the preferred time, the records should be updated prior to the start of the excavation. It must be understood that the furnishing of this information is entirely without prejudice to the provisions of the New Roads and Street Works Act 1991 and the Company's liability to be compensated for any damage to be anticipated.

**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

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Map Ref: 332905.350930
Map scale: 1:1750
Printed by: Natalie Walmsley
Printed on: 23 Sep 2021

APPENDIX 4

WELSH WATER PREDEVELOPMENT ENQUIRY RESPONSE

Ramboll
Lisa Sawyer
Caldicot
NP26 9AN

Date: 23/09/2021
Our Ref: PPA0006032

Dear Lisa,

Site: Wrexham Football Club.

Development: New stand and associated external paved areas.

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

APPRAISAL

Firstly, we note that the proposal relates to proposed development at Wrexham Football Club and acknowledge that the site comprises of a potential windfall development with no allocated status in the Local Development Plan (LDP). Accordingly, whilst it does not appear an assessment has been previously undertaken of the public sewerage and watermains systems, we offer the following comments as part of our appraisal of this development.

Please note, notwithstanding the following assessment, we would advise there is also a mandatory requirement to undertake pre-application consultation with all 'Specialist Consultees', including Dwr Cymru Welsh Water as the statutory water and sewerage undertaker, in accordance with Schedule 4 of Town & Country Planning (Development Management Procedure) (Wales) (Amendment) Order 2016. As a major development, amounting to more than 1000 sqm, you will be statutorily required to consult Welsh Water and a substantive response will be issued within 28 days from the date of the notice as per the requirements of Article 2E.

Public Sewerage Network

The proposed development site is located in the immediate vicinity of a separate sewerage system, comprising foul and surface water public sewers, which drains to Five Fords Wastewater Treatment Works (WwTW).

We can advise that Five Fords WwTW does have a phosphate permit. You will need to discuss this matter further with the local planning authority.

This site is crossed by public sewers with their approximate positions being marked on the attached Statutory Public Sewer Record. In accordance with the Water Industry Act 1991, Dwr Cymru Welsh Water requires access to its apparatus at all times in order to carry out maintenance and repairs. No part of any building will be permitted within the protection zone of the public sewers measured 3 metres either side of the centreline. Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection is provided in the attached Advice & Guidance note.

You are also advised that some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect the proposal. In order to assist you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

Surface Water Drainage

As of 7th January 2019, this proposed development may be subject to Schedule 3 of the Flood and Water Management Act 2010. The development therefore may require approval of Sustainable Drainage Systems (SuDS) features, in accordance with the 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems'. As highlighted in these standards, the developer is required to explore and fully exhaust all surface water drainage options in accordance with a hierarchy which states that discharge to a combined sewer shall only be made as a last resort. Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to a surface water drainage body in liaison with the Land Drainage Authority and/or Natural Resources Wales.

It is therefore recommended that the developer consult with Wrexham Council, as the determining SuDS Approval Body (SAB), in relation to their proposals for SuDS features. Please note, DCWW is a statutory consultee to the SAB application process and will provide comments to any SuDS proposals by response to SAB consultation. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note.

In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

Foul Water Drainage – Sewerage Network

We have considered the impact of foul flows generated by the proposed development and concluded that flows can be accommodated within the public sewerage system. We advise that the flows should be connected to the combined sewer at or downstream of manhole SJ32508905 located within existing site to the South West.



Welsh Water is owned by Glas Cymru – a 'not-for-profit' company.
Mae Dwr Cymru yn eiddo i Glas Cymru – cwmni 'nid-er-elw'.

We welcome correspondence in
Welsh and English

Dŵr Cymru Cyf, a limited company registered in
Wales no 2366777. Registered office: Pentwyn Road,
Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng
Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn
Nelson, Treharris, Morgannwg Ganol CF46 6LY.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account. However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water Industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com.

Trade Effluent

If the development will give rise to a new discharge (or alter an existing discharge) of trade effluent, directly or indirectly to the public sewerage system, then a Discharge Consent under Section 118 of the Water Industry Act 1991 is required from Dwr Cymru / Welsh Water. Please note that the issuing of a Discharge Consent is independent of the planning process and a consent may be refused although planning permission is granted.

SEWERAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

WATER SUPPLY

We do not serve this area with a potable water supply, we would advise consulting the local water supplier to discuss proposals.

Our response is based on the information provided by your application. Should the proposal alter during the course of the application process we kindly request that we are re-consulted and reserve the right to make new representation.

If you have any queries please contact the undersigned on 0800 917 2652 or via email at developer.services@dwrcymru.com



Welsh Water is owned by Glas Cymru – a ‘not-for-profit’ company.
Mae Dwr Cymru yn eiddo i Glas Cymru – cwmni ‘nid-er-elw’.

We welcome correspondence in
Welsh and English

Dŵr Cymru Cyf, a limited company registered in
Wales no 2366777. Registered office: Pentwyn Road,
Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng
Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn
Nelson, Treharris, Morgannwg Ganol CF46 6LY.

Please quote our reference number in all communications and correspondence.

Yours faithfully,

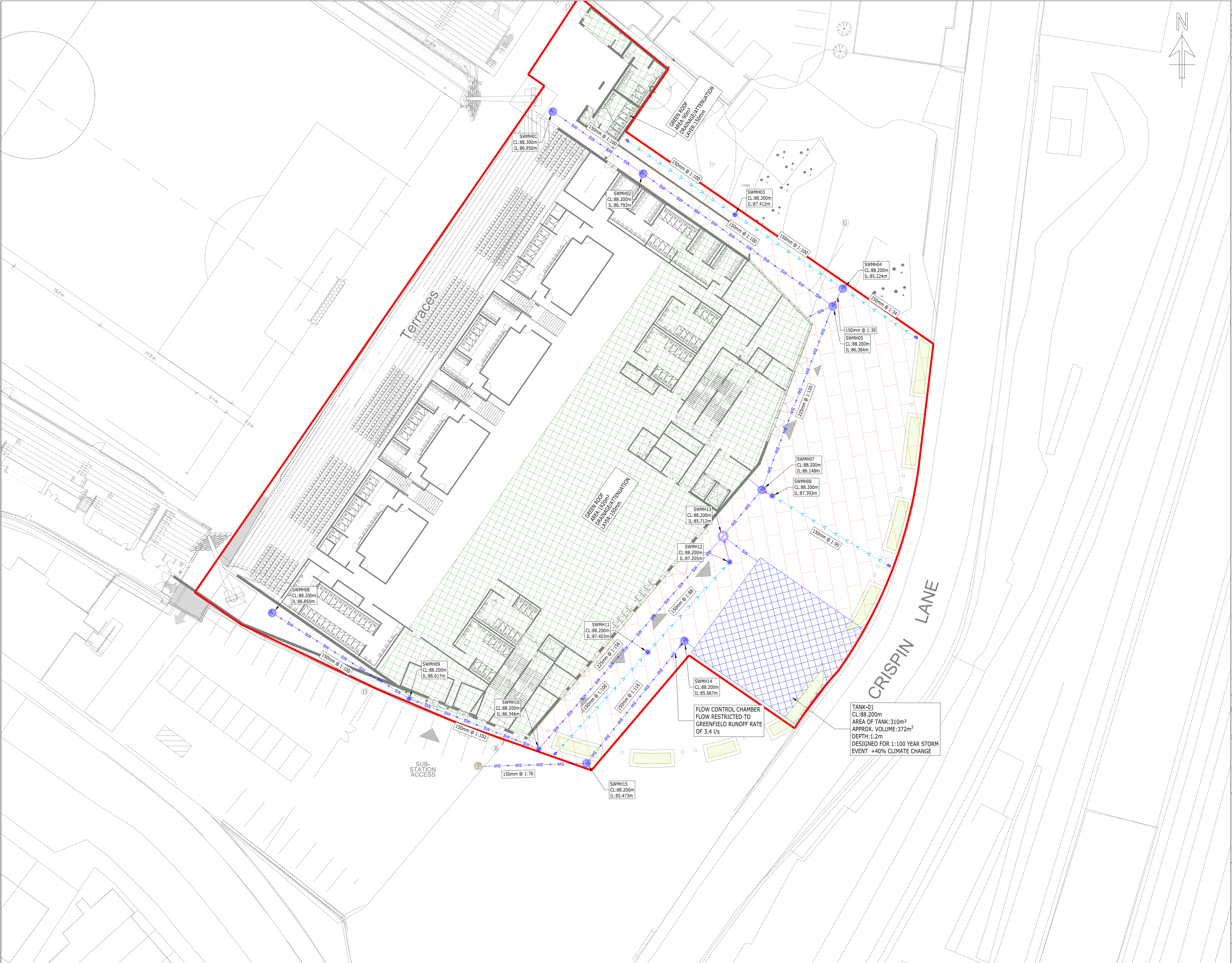


Owain George
Planning Liaison Manager
Developer Services

Please Note that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.

APPENDIX 5

DRAINAGE STRATEGY DRAWING



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Notes

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- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTURAL, STRUCTURAL AND M&E DRAWINGS.
- THIS IS NOT AN INSTALLATION DRAWING NOR A CO-ORDINATION DRAWING.
- PLEASE REFER THE MICRODRAINAGE WINDES MODEL FOR LEVELS OF THE NETWORK.
- THE COVER LEVEL IS ASSUMED AS +88.2m FOR THE ENTIRE POROUS CAR PARK. THIS ASSUMPTION IS MADE IN REFERENCE TO MISSING DATA.

KEY:

- SITE BOUNDARY
- SURFACE WATER DRAINAGE
- SURFACE WATER PERFORATED PIPE
- SURFACE WATER DRAINAGE MANHOLE
- PROPOSED COMBINED WATER MANHOLE
- CATCHPIT
- BACKDROP
- HYDROBRAKE
- INSPECTION CHAMBER
- RODDING EYE
- GEOCELLULAR ATTENUATION TANK
- GREEN ROOF
- PERMEABLE PAVING
- RAIN GARDEN

P01	ISSUED FOR INFORMATION	24.06 2022	S5 JW	LS
Rev	Description	Date	By Chk	App

ISSUED FOR INFORMATION

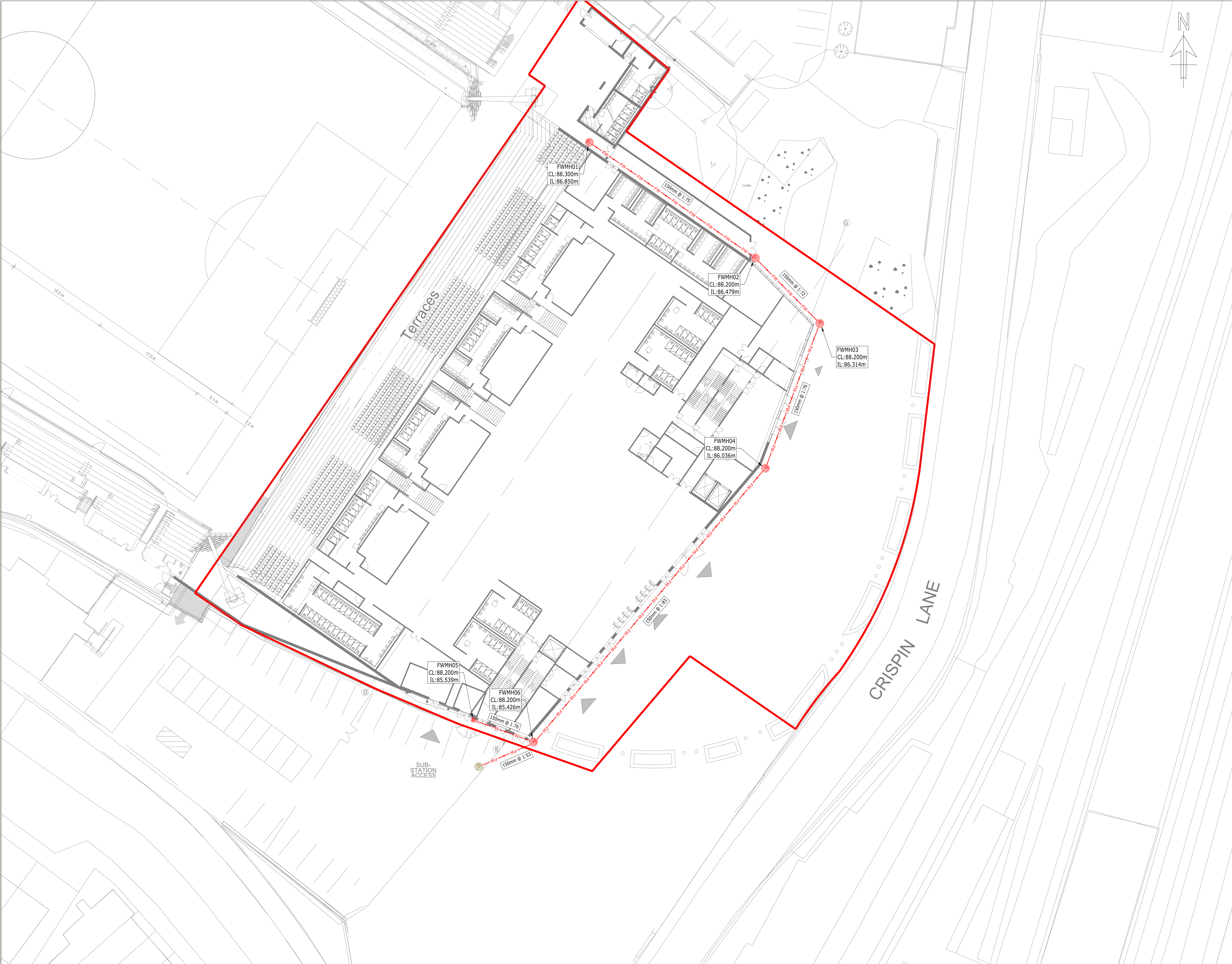
WREXHAM FC-KOP
STAND REDEVELOPMENT

RAMBOLL

tel 020 7631 5291 london@ramboll.co.uk
www.ramboll.co.uk

SURFACE WATER
DRAINAGE LAYOUT

Project No:	Scale (@A1):	Drawn:	Date:
1620012485	1:250	SHSV	JUN 2022
Drawing No:	RAM-XX-XX-DR-C-00100		Rev:
			P01



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- THIS IS NOT AN INSTALLATION DRAWING NOR A CO-ORDINATION DRAWING.
- PLEASE REFER THE MICRODRAINAGE WINDES MODEL FOR LEVELS OF THE NETWORK.
- THE COVER LEVEL IS ASSUMED AS +88.2m FOR THE ENTIRE POROUS CAR PARK. THIS ASSUMPTION IS MADE IN REFERENCE TO MISSING DATA.
- THE ALIGNMENT OF THE WELSH WATER SEWER IS ASSUMED AND MIGHT CHANGE WITH FUTURE SURVEY.

KEY:

- SITE BOUNDARY
- FOUL WATER DRAINAGE
- PROPOSED FOUL WATER MANHOLE
- PROPOSED COMBINED WATER MANHOLE
- INSPECTION CHAMBER

P01	ISSUED FOR INFORMATION	24.06 2022	S5 JW	LS
Rev	Description	Date	By Chk	App

ISSUED FOR INFORMATION

WREXHAM FC-KOP
STAND REDEVELOPMENT

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FOUL WATER
DRAINAGE LAYOUT

Project No:	Scale (@A1):	Drawn:	Date:
1620012485	1:250	SHSV	JUN 2022
Drawing No:	RAM-XX-XX-DR-C-00101		Rev:
			P01

APPENDIX 6

SURFACE WATER HYDRAULIC CALCULATIONS

Ramboll UK Ltd		Page 1
240 Blackfriars Road London SE1 8NW		
Date 01/07/2022 11:50 File COMBINED SW.MDX	Designed by JWOOD Checked by	
Micro Drainage Network 2020.1		

STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

« - Indicates pipe capacity < flow

Network Results Table

Ramboll UK Ltd

240 Blackfriars Road
London
SE1 8NW

Date 01/07/2022 11:50
File COMBINED SW.MDX

Micro Drainage

Designed by JWOOD
Checked by

Network 2020.1

Page 2



Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S4.001	18.799	0.188	100.0	0.000	0.00	0.0	1.300	o	150	Pipe/Conduit	
S5.000	14.517	0.376	38.6	0.031	5.00	0.0	1.300	o	150	Pipe/Conduit	
S4.002	2.946	0.074	40.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	28.279	0.236	120.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.000	20.647	0.207	100.0	0.056	5.00	0.0	1.300	o	150	Pipe/Conduit	
S6.001	0.661	0.017	40.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	7.334	0.061	120.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S7.000	23.272	0.233	100.0	0.006	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	19.646	0.196	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S8.000	17.986	0.180	100.0	0.139	5.00	0.0	0.600	o	100	Pipe/Conduit	
S8.001	5.949	15.249	0.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S7.002	41.866	0.259	161.6	0.010	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.000	12.298	0.123	100.0	0.139	5.00	0.0	0.600	o	100	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S4.001	54.39	5.70	87.412	0.020	0.0	0.0	0.0	0.90	15.8	3.1
S5.000	56.61	5.17	87.600	0.031	0.0	0.0	0.0	1.45	25.6	4.7
S4.002	54.26	5.73	87.224	0.051	0.0	0.0	0.0	1.60	28.2	7.5
S1.002	52.44	6.21	86.384	0.215	0.0	0.0	0.0	1.19	47.4	30.6
S6.000	55.68	5.38	87.600	0.056	0.0	0.0	0.0	0.90	15.8	8.4
S6.001	55.65	5.39	87.393	0.056	0.0	0.0	0.0	1.60	28.2	8.4
S1.003	52.06	6.31	86.148	0.271	0.0	0.0	0.0	1.19	47.4	38.2
S7.000	55.67	5.39	86.850	0.006	0.0	0.0	0.0	1.00	17.8	0.9
S7.001	54.33	5.71	86.617	0.006	0.0	0.0	0.0	1.00	17.8	0.9
S8.000	55.65	5.39	101.900	0.139	0.0	0.0	0.0	0.77	6.0«	20.9
S8.001	55.62	5.40	101.720	0.139	0.0	0.0	0.0	12.50	98.2	20.9
S7.002	51.78	6.39	86.346	0.155	0.0	0.0	0.0	1.03	40.8	21.7
S9.000	56.18	5.27	101.900	0.139	0.0	0.0	0.0	0.77	6.0«	21.2

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Ramboll UK Ltd		Page 4																				
240 Blackfriars Road London SE1 8NW																						
Date 01/07/2022 11:50 File COMBINED SW.MDX	Designed by JWOOD Checked by																					
Micro Drainage		Network 2020.1																				
Simulation Criteria for Storm <table><tr><td>Rainfall Model</td><td>FSR</td><td>Profile Type</td><td>Summer</td></tr><tr><td>Return Period (years)</td><td>2</td><td>Cv (Summer)</td><td>0.750</td></tr><tr><td>Region</td><td>England and Wales</td><td>Cv (Winter)</td><td>0.840</td></tr><tr><td>M5-60 (mm)</td><td>18.000</td><td>Storm Duration (mins)</td><td>30</td></tr><tr><td>Ratio R</td><td>0.331</td><td></td><td></td></tr></table>			Rainfall Model	FSR	Profile Type	Summer	Return Period (years)	2	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.000	Storm Duration (mins)	30	Ratio R	0.331		
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Ramboll UK Ltd		Page 5																																		
240 Blackfriars Road London SE1 8NW																																				
Date 01/07/2022 11:50 File COMBINED SW.MDX	Designed by JWOOD Checked by																																			
Micro Drainage		Network 2020.1																																		
<u>Online Controls for Storm</u> <u>Orifice Manhole: SGR D`, DS/PN: S2.001, Volume (m³): 0.5</u></p> <p>Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 91.317</p> <p><u>Orifice Manhole: SGR A`, DS/PN: S3.001, Volume (m³): 0.6</u> Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 101.763 <u>Orifice Manhole: S4, DS/PN: S4.002, Volume (m³): 1.7</u> Diameter (m) 0.075 Discharge Coefficient 0.600 Invert Level (m) 87.224 <u>Orifice Manhole: S6, DS/PN: S6.001, Volume (m³): 1.3</u> Diameter (m) 0.075 Discharge Coefficient 0.600 Invert Level (m) 87.393 <u>Orifice Manhole: SGR C`, DS/PN: S8.001, Volume (m³): 0.7</u></p> <p>Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 101.720</p> <p><u>Orifice Manhole: SGR B`, DS/PN: S9.001, Volume (m³): 0.6</u> Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 101.777 <u>Orifice Manhole: S12, DS/PN: S10.002, Volume (m³): 0.3</u> Diameter (m) 0.075 Discharge Coefficient 0.600 Invert Level (m) 87.205 <u>Hydro-Brake® Optimum Manhole: S14(Hydrobrake), DS/PN: S1.006, Volume (m³): 3.2</u> <table><tr><td>Unit Reference</td><td>MD-SHE-0081-3400-1415-3400</td></tr><tr><td>Design Head (m)</td><td>1.415</td></tr><tr><td>Design Flow (l/s)</td><td>3.4</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>81</td></tr><tr><td>Invert Level (m)</td><td>85.667</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>100</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1200</td></tr></table> <table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>1.415</td><td>3.4</td></tr><tr><td>Flush-Flo™</td><td>0.355</td><td>3.1</td></tr><tr><td>Kick-Flo®</td><td>0.727</td><td>2.5</td></tr></table>			Unit Reference	MD-SHE-0081-3400-1415-3400	Design Head (m)	1.415	Design Flow (l/s)	3.4	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	81	Invert Level (m)	85.667	Minimum Outlet Pipe Diameter (mm)	100	Suggested Manhole Diameter (mm)	1200	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.415	3.4	Flush-Flo™	0.355	3.1	Kick-Flo®	0.727	2.5
Unit Reference	MD-SHE-0081-3400-1415-3400																																			
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Application	Surface																																			
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240 Blackfriars Road London SE1 8NW																																																																										
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Micro Drainage		Network 2020.1																																																																								
<u>Hydro-Brake® Optimum Manhole: S14(Hydrobrake), DS/PN: S1.006, Volume (m³):</u> <u>3.2</u>																																																																										
Control PointsHead (m) Flow (l/s) Mean Flow over Head Range-2.8 The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>2.4</td><td>1.200</td><td>3.1</td><td>3.000</td><td>4.8</td><td>7.000</td><td>7.2</td></tr><tr><td>0.200</td><td>3.0</td><td>1.400</td><td>3.4</td><td>3.500</td><td>5.2</td><td>7.500</td><td>7.4</td></tr><tr><td>0.300</td><td>3.1</td><td>1.600</td><td>3.6</td><td>4.000</td><td>5.5</td><td>8.000</td><td>7.6</td></tr><tr><td>0.400</td><td>3.1</td><td>1.800</td><td>3.8</td><td>4.500</td><td>5.8</td><td>8.500</td><td>7.9</td></tr><tr><td>0.500</td><td>3.1</td><td>2.000</td><td>4.0</td><td>5.000</td><td>6.1</td><td>9.000</td><td>8.1</td></tr><tr><td>0.600</td><td>2.9</td><td>2.200</td><td>4.2</td><td>5.500</td><td>6.4</td><td>9.500</td><td>8.3</td></tr><tr><td>0.800</td><td>2.6</td><td>2.400</td><td>4.3</td><td>6.000</td><td>6.7</td><td></td><td></td></tr><tr><td>1.000</td><td>2.9</td><td>2.600</td><td>4.5</td><td>6.500</td><td>6.9</td><td></td><td></td></tr></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	2.4	1.200	3.1	3.000	4.8	7.000	7.2	0.200	3.0	1.400	3.4	3.500	5.2	7.500	7.4	0.300	3.1	1.600	3.6	4.000	5.5	8.000	7.6	0.400	3.1	1.800	3.8	4.500	5.8	8.500	7.9	0.500	3.1	2.000	4.0	5.000	6.1	9.000	8.1	0.600	2.9	2.200	4.2	5.500	6.4	9.500	8.3	0.800	2.6	2.400	4.3	6.000	6.7			1.000	2.9	2.600	4.5	6.500	6.9		
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
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240 Blackfriars Road London SE1 8NW																										
Date 01/07/2022 11:50 File COMBINED SW.MDX	Designed by JWOOD Checked by																									
Micro Drainage	Network 2020.1																									
<u>Storage Structures for Storm</u>																										
<u>Tank or Pond Manhole: SGR D, DS/PN: S2.000</u>																										
Invert Level (m) 91.400																										
<table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>90.0</td><td>0.150</td><td>90.0</td><td>0.151</td><td>0.0</td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	90.0	0.150	90.0	0.151	0.0												
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																					
0.000	90.0	0.150	90.0	0.151	0.0																					
<u>Tank or Pond Manhole: SGR A, DS/PN: S3.000</u>																										
Invert Level (m) 101.900																										
<table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>640.0</td><td>0.150</td><td>640.0</td><td>0.151</td><td>0.0</td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	640.0	0.150	640.0	0.151	0.0												
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																					
0.000	640.0	0.150	640.0	0.151	0.0																					
<u>Porous Car Park Manhole: SRE 1, DS/PN: S4.000</u>																										
<table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>5.0</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>37.6</td></tr><tr><td>Max Percolation (l/s)</td><td>52.2</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>87.750</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0	Membrane Percolation (mm/hr)	1000	Length (m)	37.6	Max Percolation (l/s)	52.2	Slope (1:X)	100.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	87.750	Cap Volume Depth (m)	0.350
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0																							
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Max Percolation (l/s)	52.2	Slope (1:X)	100.0																							
Safety Factor	2.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	87.750	Cap Volume Depth (m)	0.350																							
<u>Porous Car Park Manhole: SRE 2, DS/PN: S5.000</u>																										
<table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>15.4</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>14.5</td></tr><tr><td>Max Percolation (l/s)</td><td>62.0</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>87.750</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.4	Membrane Percolation (mm/hr)	1000	Length (m)	14.5	Max Percolation (l/s)	62.0	Slope (1:X)	100.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	87.750	Cap Volume Depth (m)	0.350
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.4																							
Membrane Percolation (mm/hr)	1000	Length (m)	14.5																							
Max Percolation (l/s)	62.0	Slope (1:X)	100.0																							
Safety Factor	2.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	87.750	Cap Volume Depth (m)	0.350																							
<u>Porous Car Park Manhole: SRE 3, DS/PN: S6.000</u>																										
<table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>23.7</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>20.7</td></tr><tr><td>Max Percolation (l/s)</td><td>136.3</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>87.750</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table>			Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	23.7	Membrane Percolation (mm/hr)	1000	Length (m)	20.7	Max Percolation (l/s)	136.3	Slope (1:X)	100.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	87.750	Cap Volume Depth (m)	0.350
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Max Percolation (l/s)	136.3	Slope (1:X)	100.0																							
Safety Factor	2.0	Depression Storage (mm)	5																							
Porosity	0.30	Evaporation (mm/day)	3																							
Invert Level (m)	87.750	Cap Volume Depth (m)	0.350																							
<u>Tank or Pond Manhole: SGR C, DS/PN: S8.000</u>																										
Invert Level (m) 101.900																										
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Micro Drainage Network 2020.1																																																														
<u>Tank or Pond Manhole: SGR C, DS/PN: S8.000</u> <table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>640.0</td><td>0.150</td><td>640.0</td><td>0.151</td><td>0.0</td></tr></table> <u>Tank or Pond Manhole: SGR B, DS/PN: S9.000</u> Invert Level (m) 101.900 <table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>640.0</td><td>0.150</td><td>640.0</td><td>0.151</td><td>0.0</td></tr></table> <u>Porous Car Park Manhole: SRE 4, DS/PN: S10.000</u> <table><tr><td>Infiltration Coefficient Base (m/hr)</td><td>0.00000</td><td>Width (m)</td><td>10.4</td></tr><tr><td>Membrane Percolation (mm/hr)</td><td>1000</td><td>Length (m)</td><td>25.3</td></tr><tr><td>Max Percolation (l/s)</td><td>73.1</td><td>Slope (1:X)</td><td>100.0</td></tr><tr><td>Safety Factor</td><td>2.0</td><td>Depression Storage (mm)</td><td>5</td></tr><tr><td>Porosity</td><td>0.30</td><td>Evaporation (mm/day)</td><td>3</td></tr><tr><td>Invert Level (m)</td><td>87.750</td><td>Cap Volume Depth (m)</td><td>0.350</td></tr></table> <u>Tank or Pond Manhole: STank, DS/PN: S1.005</u> Invert Level (m) 85.940 <table><tr><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td><td>Depth (m)</td><td>Area (m²)</td></tr><tr><td>0.000</td><td>310.0</td><td>1.200</td><td>310.0</td><td>1.201</td><td>0.0</td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	640.0	0.150	640.0	0.151	0.0	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	640.0	0.150	640.0	0.151	0.0	Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.4	Membrane Percolation (mm/hr)	1000	Length (m)	25.3	Max Percolation (l/s)	73.1	Slope (1:X)	100.0	Safety Factor	2.0	Depression Storage (mm)	5	Porosity	0.30	Evaporation (mm/day)	3	Invert Level (m)	87.750	Cap Volume Depth (m)	0.350	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	310.0	1.200	310.0	1.201	0.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																																																									
0.000	640.0	0.150	640.0	0.151	0.0																																																									
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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 9
 Number of Online Controls 8 Number of Time/Area Diagrams 0
 Number of Offline Controls 0 Number of Real Time Controls 0

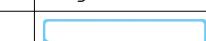
Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.322
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	S1	1440 Winter	100	+40%			
S2.000	SGR D	60 Winter	100	+40%			
S2.001	SGR D`	60 Winter	100	+40%			
S1.001	S2	1440 Winter	100	+40%	100/960 Winter		
S3.000	SGR A	360 Winter	100	+40%	100/240 Winter		
S3.001	SGR A`	360 Winter	100	+40%	30/30 Winter		
S4.000	SRE 1	30 Winter	100	+40%	100/15 Summer		
S4.001	S3	30 Winter	100	+40%	30/15 Summer		
S5.000	SRE 2	30 Winter	100	+40%	100/15 Summer		
S4.002	S4	30 Winter	100	+40%	30/15 Summer		
S1.002	S5 (backdrop)	1440 Winter	100	+40%	100/240 Winter		
S6.000	SRE 3	30 Winter	100	+40%	30/15 Summer		
S6.001	S6	30 Winter	100	+40%	30/15 Summer		
S1.003	S7 (backdrop)	1440 Winter	100	+40%	30/960 Winter		
S7.000	S8	1440 Winter	100	+40%	100/960 Winter		
S7.001	S9	1440 Winter	100	+40%	100/360 Winter		
S8.000	SGR C	360 Winter	100	+40%	100/240 Winter		
S8.001	SGR C`	360 Winter	100	+40%	30/30 Winter		
S7.002	S10	1440 Winter	100	+40%	100/240 Summer		
S9.000	SGR B	360 Winter	100	+40%	100/120 Winter		

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1		87.100	0.000	0.000	0.03			0.5
S2.000	SGR D		91.429	-0.071	0.000	0.18			1.1
S2.001	SGR D`		91.387	-0.030	0.000	0.03			1.1
S1.001	S2		87.100	0.158	0.000	0.05			0.8
S3.000	SGR A		102.009	0.009	0.000	0.39			2.3
S3.001	SGR A`		101.988	0.125	0.000	0.04			2.3
S4.000	SRE 1		87.870	0.120	0.000	0.35		11	5.6
S4.001	S3		87.850	0.288	0.000	0.28			4.2
S5.000	SRE 2		87.850	0.100	0.000	0.34		9	8.8
S4.002	S4		87.829	0.456	0.000	0.52			8.8
S1.002	S5 (backdrop)		87.100	0.491	0.000	0.10			4.4
S6.000	SRE 3		87.886	0.136	0.000	0.67		14	10.7
S6.001	S6		87.839	0.296	0.000	0.69			7.5
S1.003	S7 (backdrop)		87.097	0.724	0.000	0.17			6.1
S7.000	S8		87.098	0.098	0.000	0.01			0.2
S7.001	S9		87.098	0.331	0.000	0.01			0.2
S8.000	SGR C		102.007	0.007	0.000	0.42			2.5
S8.001	SGR C`		101.976	0.156	0.000	0.03			2.5
S7.002	S10		87.098	0.527	0.000	0.07			2.8
S9.000	SGR B		102.011	0.011	0.000	0.38			2.3

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S2.000	SGR D	FLOOD RISK*	
S2.001	SGR D`	OK	
S1.001	S2	SURCHARGED	
S3.000	SGR A	FLOOD RISK*	
S3.001	SGR A`	FLOOD RISK	
S4.000	SRE 1	SURCHARGED*	
S4.001	S3	SURCHARGED	
S5.000	SRE 2	SURCHARGED*	
S4.002	S4	SURCHARGED	
S1.002	S5 (backdrop)	SURCHARGED	
S6.000	SRE 3	SURCHARGED*	
S6.001	S6	SURCHARGED	
S1.003	S7 (backdrop)	SURCHARGED	
S7.000	S8	SURCHARGED	
S7.001	S9	SURCHARGED	
S8.000	SGR C	FLOOD RISK*	
S8.001	SGR C`	FLOOD RISK	
S7.002	S10	SURCHARGED	
S9.000	SGR B	FLOOD RISK*	

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Network 2020.1

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S9.001	SGR B`	360 Winter	100	+40%	30/30 Winter		
S10.000	SRE 4	30 Winter	100	+40%	100/15 Summer		
S10.001	S11	30 Winter	100	+40%	30/15 Summer		
S10.002	S12	15 Winter	100	+40%			
S1.004	S13(backdrop)	1440 Winter	100	+40%	30/360 Winter		
S1.005	STank	1440 Winter	100	+40%	30/30 Winter		
S1.006	S14(Hydrobrake)	1440 Winter	100	+40%	1/15 Summer		
S1.007	S15	1440 Winter	100	+40%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)
S9.001	SGR B`		101.992	0.115	0.000	0.03		
S10.000	SRE 4		87.883	0.133	0.000	0.74		9
S10.001	S11		87.826	0.274	0.000	0.56		
S10.002	S12		87.355	0.000	0.000	0.47		
S1.004	S13(backdrop)		87.096	0.784	0.000	0.13		
S1.005	STank		87.093	1.063	0.000	0.20		
S1.006	S14(Hydrobrake)		87.076	1.259	0.000	0.20		
S1.007	S15		85.519	-0.104	0.000	0.20		

PN	US/MH Name	Pipe Flow (l/s)	Status	Level Exceeded
S9.001	SGR B`	2.3	FLOOD RISK	
S10.000	SRE 4	11.7	SURCHARGED*	
S10.001	S11	8.5	SURCHARGED	
S10.002	S12	8.4	SURCHARGED*	
S1.004	S13(backdrop)	12.1	SURCHARGED	
S1.005	STank	3.4	SURCHARGED	
S1.006	S14(Hydrobrake)	3.4	SURCHARGED	
S1.007	S15	3.4	OK	

APPENDIX 7

FOUL WATER CALCULATIONS

LOCATION	Wrexham
Project :	Wrexham AFC - Kop stand
Project No :	1620012485
Title :	Proposed foul water flow rates
Revision:	P01

Made by : JW
Date : 28.06.2022
Checked by : PC
Date : 28.06.2022

APPLIANCE	Discharge Units ¹⁾ (du/l/s)	Number of appliances ²⁾	Total of du's (l/s)
Toilet Bowl with flushing box	1.8	116	208.8
Basin	0.3	93	27.9
Bath	0.8		0
Shower Tray	0.6	1	0.6
Kitchen Sink	0.8	4	3.2
Urinal	0.5	81	40.5
Washing Machine	1.5		0
Dishwasher	0.8	2	1.6
Floor Gully	1.5	7	10.5
Bidet	0.5		0
Drinking fountain	0.05		0
Sprinkling tap	0.3		0

(ΣDu) total load (du-l/s) for this location	293.1
--	--------------

Total waste flow rate based on equation (l/s) (Q_{ww}) = K (√ du's)	17.12
Any pumped waste discharge (l/s) (Q_p)	0.00
Any continuous discharge (e.g. condensate etc) (l/s) (Q_c)	0.00
Peak design flow rate for stack/location (Q_{tot}) (l/s)	17.12

Average flow (l/s)	2.85 *
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*average flow rates dependant upon fitting usage and building operation hours

Frequency of use factors (K)	
Intermittent use-e.g. domestic/guesthouse/	0.50
Frequent use- e.g. Restaurant/Office	0.70
Congested use- e.g. Public use	1.00
Special use- e.g. laboratory	1.20

Enter Frequency of use factor (from above)	1.00
---	-------------

Designers notes :
 1) Wastewater discharge units in accordance with BS EN 12056-2:2000 table 2
 2) The calculations are based on CZWG drawings issued 17/07/2013 1944-00-SK01-1000-P01

APPENDIX 8

INFILTRATION TEST RESULTS

Dear Wrexham AFC Limited,

Please find below the results of your Infiltration testing. The information contained below is a summary of the site works carried out on 13th July 2022.

Geology

An examination of the available British Geological Survey data of the area for the site has been examined and indicates that the site has superficial drift deposits composed of Glaciofluvial Sheet Deposits (sand and gravel), and bedrock deposits recorded as the Etruria Formation (mudstone).

Fieldworks

The programme of this investigation included the excavation of two trial pits. The locations of the soakaway tests were selected by the client. During this work, the soils encountered were logged in general accordance with BS5930: 1990, as amended in 2007.

Percolation Testing

During the soakaway tests the water achieved a fall from 75% to 25% of the effective depth of the storage volume. The results obtained from the soakaway tests are summarised below:

WS	Dimensions (m)	Depth (m)	Soil Description	Infiltration Rate (m/sec)	Drainage Characteristics
TP01 test1	1.95 x 0.70	2.50	Dark brown gravelly SAND.	7.3E-4	Good
TP01 test2	1.95 x 0.70	2.50	Dark brown gravelly SAND.	4.7E-4	Good
TP01 test3	1.95 x 0.70	2.50	Dark brown gravelly SAND.	4.0E-4	Good
TP02 test1	1.80 x 0.70	2.50	Dark brown gravelly SAND.	1.4E-3	Good
TP02 test2	1.80 x 0.70	2.50	Dark brown gravelly SAND.	5.2E-4	Good
TP02 test3	1.80 x 0.70	2.50	Dark brown gravelly SAND.	4.2E-4	Good

Conclusion

The soils encountered beneath the site were found to be predominantly SAND. The soakage rates obtained during the investigation were found to be good and permeable. Given the data from the test, it is considered that the use of soakaways is suitable for this site.

References

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.
- British Standards Institution (1999) BS5930: *Code of practice for site investigations*, B.S.I., London.
- British Standards Institution (2007), Amendment No 1, BS5930: *Code of practice for site investigations*, B.S.I., London.

Please do contact me on 01243 787150 or 07758 162624 should you have any questions.

Regards

A handwritten signature in grey ink, appearing to read 'N Hammond', with a stylized circular flourish at the beginning.

Nick Hammond
Geo-Environmental Engineer



Appendix A





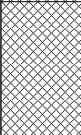
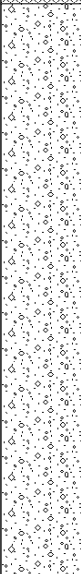
Site Investigation Plan



Kop Stand - Wrexham
YEX4390
Jul-22

Appendix B



				Trial Pit Log			TrialPit No TP02 Sheet 1 of 1	
Project Name: Kop Stand, Wrexham AFC				Project No. YEX4390		Co-ords: - Level:		Date 13/07/2022
Location: Mold Road, Wrexham, LL11 2AH						Dimensions (m):		Scale 1:25
Client: Gardiner & Theobald						Depth 2.50		Logged LB
Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.15			MADE GROUND. Grey fine to coarse angular COBBLES and GRAVEL of concrete	
							MADE GROUND. Blackish brown gravelly SAND containing occasional concrete, brick, metal debris and plastic bottles	
				0.60			Dark brown very gravelly cobbly fine to medium SAND. Gravel is fine to coarse rounded to subangular of sandstone, mudstone and siltstone. Cobbles of sandstone.	1
				2.50			End of Pit at 2.50m	2
								3
								4
								5

Remarks: No groundwater encountered. Excavation sides collapsing.

Stability:


Appendix C

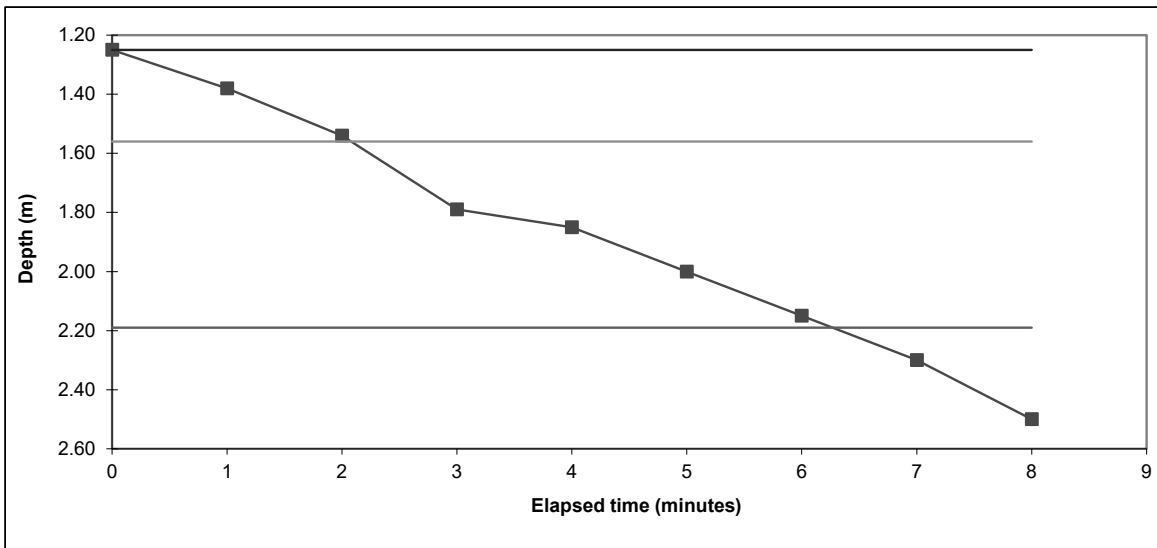


Your Environment

Soakaway Test

Trial Pit No:	TP01	Test No:	1	Date:	13/07/2022
Length (m):	1.950	Datum Height:		0.00 m agl	
Width (m):	0.70	Granular infill:	None		
Depth (m):	2.50	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.250		
1	1.380		
2	1.540		
3	1.790		
4	1.850		
5	2.000		
6	2.150		
7	2.300		
8	2.500		



Start water depth for analysis (mbgl)	1.25		
75% effective depth (mbgl):	1.56	Elapsed time (mins):	2.1
50% effective depth (mbgl):	1.88		
25% effective depth (mbgl):	2.19	Elapsed time (mins):	6.3
Base of soakage zone (mbgl):	2.50		

Volume outflow between 75% and 25% effective depth (m ³):	0.860
Mean surface area of outflow (m ²):	4.65
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	4.2

Soil infiltration rate (m/s):	7.3E-4
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Remarks	Results processed following BRE 365 (2007). 800L of water used for the test
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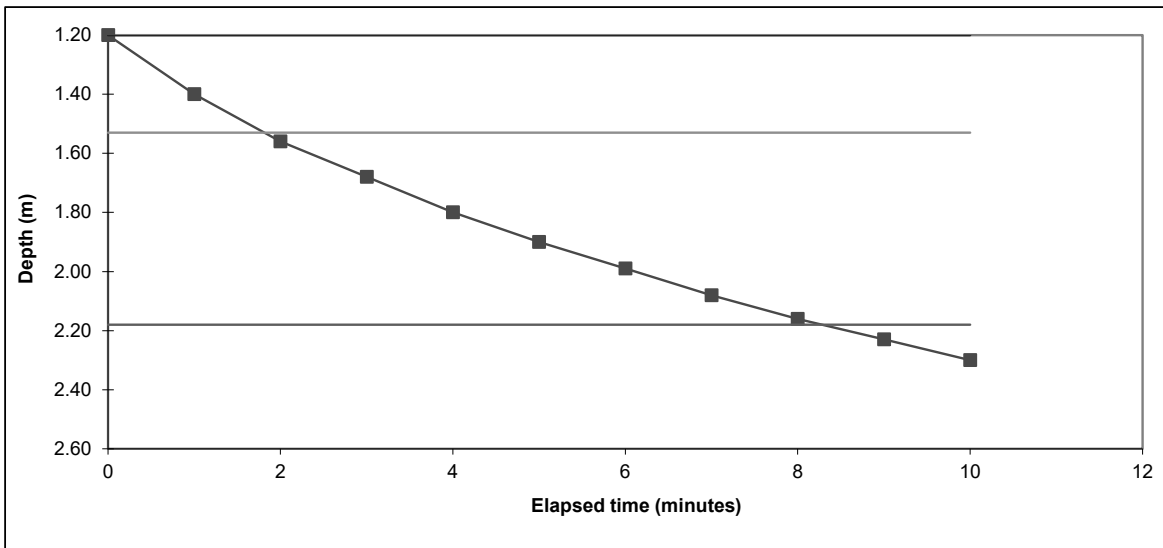
Client:	Wrexham AFC Limited	TP01
Site:	Kop Stand, Wrexham AFC	

Your Environment

Soakaway Test

Trial Pit No:	TP01	Test No:	2	Date:	13/07/2022
Length (m):	1.950	Datum Height:		0.00 m agl	
Width (m):	0.70	Granular infill:	None		
Depth (m):	2.50	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.200		
1	1.400		
2	1.560		
3	1.680		
4	1.800		
5	1.900		
6	1.990		
7	2.080		
8	2.160		
9	2.230		
10	2.300		



Start water depth for analysis (mbgl)	1.20		
75% effective depth (mbgl):	1.53	Elapsed time (mins):	1.8
50% effective depth (mbgl):	1.85		
25% effective depth (mbgl):	2.18	Elapsed time (mins):	8.3
Base of soakage zone (mbgl):	2.50		
Volume outflow between 75% and 25% effective depth (m ³):			0.887
Mean surface area of outflow (m ²):			4.81
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			6.5

Soil infiltration rate (m/s):	4.7E-4
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Remarks	Results processed following BRE 365 (2007). 800L of water used for the test
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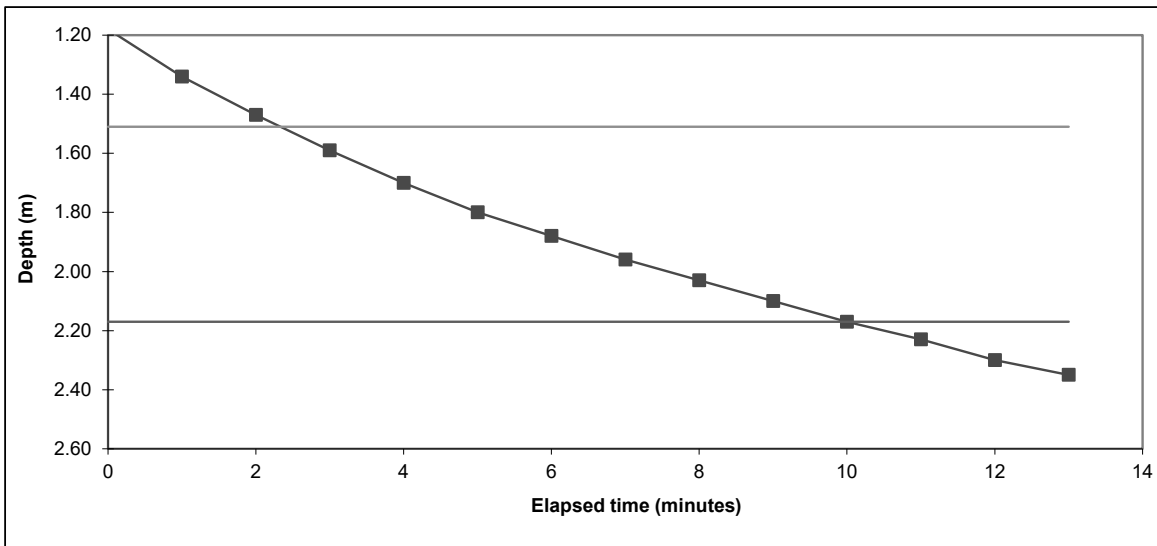
Client:	Wrexham AFC Limited	TP01
Site:	Kop Stand, Wrexham AFC	

Your Environment

Soakaway Test

Trial Pit No:	TP01	Test No:	3	Date:	13/07/2022
Length (m):	1.950	Datum Height:		0.00 m agl	
Width (m):	0.70	Granular infill:	None		
Depth (m):	2.50	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.180		
1	1.340		
2	1.470		
3	1.590		
4	1.700		
5	1.800		
6	1.880		
7	1.960		
8	2.030		
9	2.100		
10	2.170		
11	2.230		
12	2.300		
13	2.350		



Start water depth for analysis (mbgl)	1.18		
75% effective depth (mbgl):	1.51	Elapsed time (mins):	2.3
50% effective depth (mbgl):	1.84		
25% effective depth (mbgl):	2.17	Elapsed time (mins):	10.0
Base of soakage zone (mbgl):	2.50		
Volume outflow between 75% and 25% effective depth (m ³):		0.901	
Mean surface area of outflow (m ²):		4.86	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):		7.7	

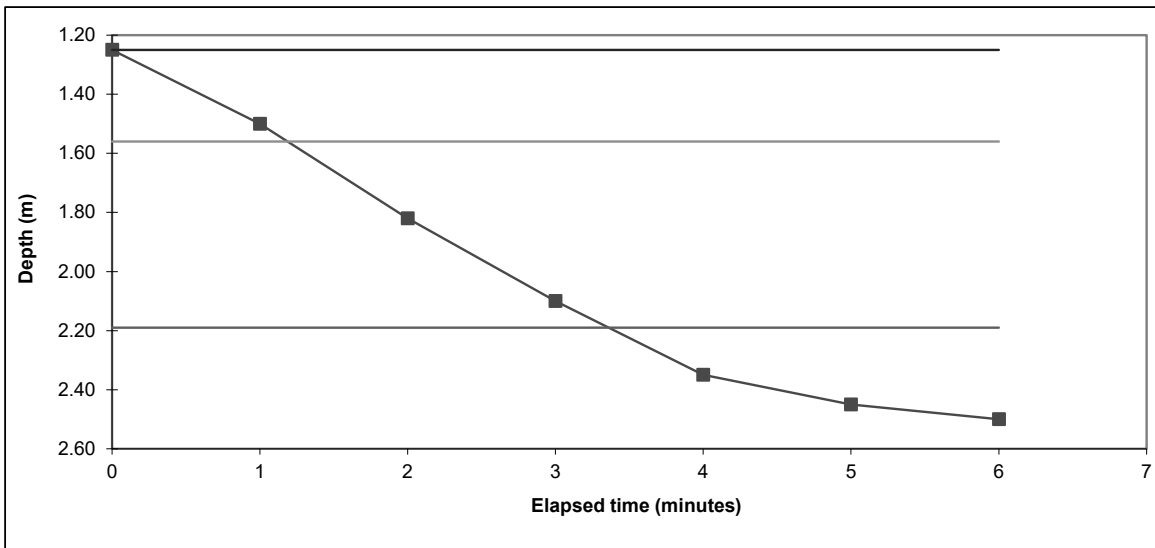
Soil infiltration rate (m/s):	4.0E-4
Remarks	Results processed following BRE 365 (2007). 800L of water used for the test

Client:	Wrexham AFC Limited	TP01
Site:	Kop Stand, Wrexham AFC	

Your Environment

Soakaway Test

Trial Pit No:	TP02	Test No:	1	Date:	13/07/2022
Length (m):	1.800	Datum Height:		0.00 m agl	
Width (m):	0.70	Granular infill:	None		
Depth (m):	2.50	Porosity of infill:	1	(assumed)	
	Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)	
	0	1.250			
	1	1.500			
	2	1.820			
	3	2.100			
	4	2.350			
	5	2.450			
	6	2.500			



Start water depth for analysis (mbgl)	1.25		
75% effective depth (mbgl):	1.56	Elapsed time (mins):	1.2
50% effective depth (mbgl):	1.88		
25% effective depth (mbgl):	2.19	Elapsed time (mins):	3.4
Base of soakage zone (mbgl):	2.50		
Volume outflow between 75% and 25% effective depth (m ³):		0.794	
Mean surface area of outflow (m ²):		4.36	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):		2.2	

Soil infiltration rate (m/s):	1.4E-3
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Remarks	Results processed following BRE 365 (2007). 800L of water used for the test
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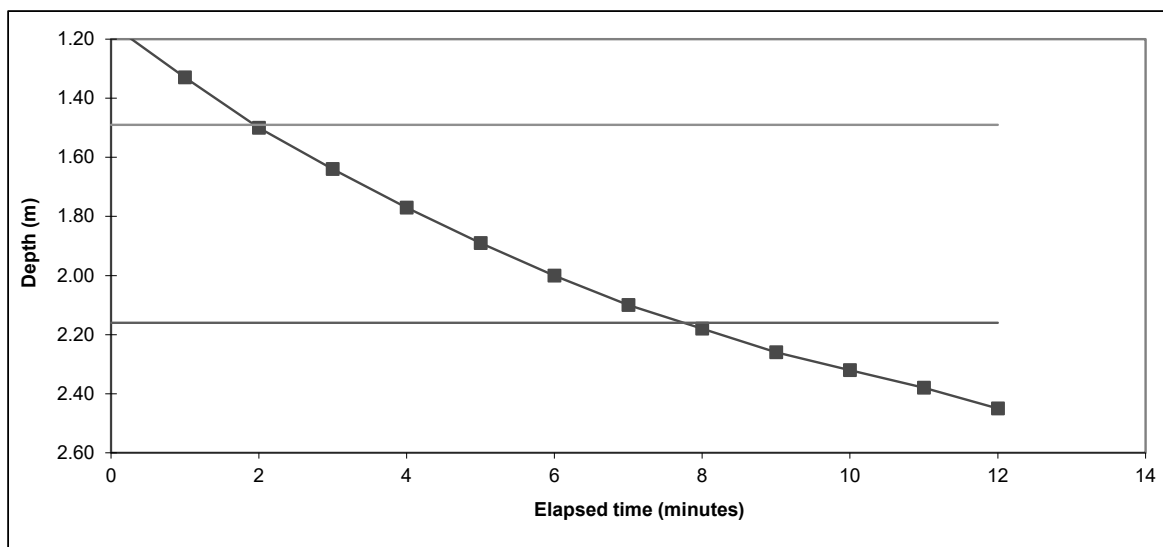
Client:	Wrexham AFC Limited	TP02
Site:	Kop Stand, Wrexham AFC	

Your Environment

Soakaway Test

Trial Pit No:	TP02	Test No:	2	Date:	13/07/2022
Length (m):	1.800	Datum Height:		0.00 m agl	
Width (m):	0.70	Granular infill:	None		
Depth (m):	2.50	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.150		
1	1.330		
2	1.500		
3	1.640		
4	1.770		
5	1.890		
6	2.000		
7	2.100		
8	2.180		
9	2.260		
10	2.320		
11	2.380		
12	2.450		



Start water depth for analysis (mbgl)	1.15		
75% effective depth (mbgl):	1.49	Elapsed time (mins):	1.9
50% effective depth (mbgl):	1.83		
25% effective depth (mbgl):	2.16	Elapsed time (mins):	7.8
Base of soakage zone (mbgl):	2.50		
Volume outflow between 75% and 25% effective depth (m ³):			0.844
Mean surface area of outflow (m ²):			4.61
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			5.9

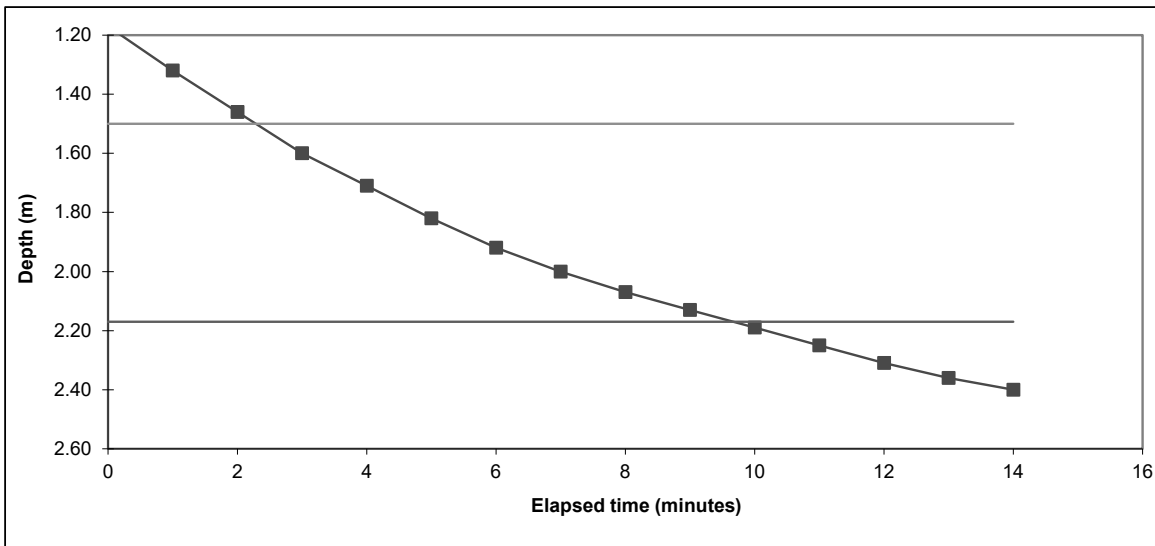
Soil infiltration rate (m/s):	5.2E-4
Remarks	Results processed following BRE 365 (2007). 800L of water used for the test

Client:	Wrexham AFC Limited	TP02
Site:	Kop Stand, Wrexham AFC	

Your Environment

Soakaway Test

Trial Pit No:	TP02	Test No:	3	Date:	13/07/2022
Length (m):	1.950	Datum Height:	0.00 m agl		
Width (m):	0.70	Granular infill:	None		
Depth (m):	2.50	Porosity of infill:	1	(assumed)	
Elapsed time (minutes)		Water Depth (m below datum)		Elapsed time (minutes)	
		Water Depth (m below datum)			
0		1.170		14	
1		1.320			
2		1.460			
3		1.600			
4		1.710			
5		1.820			
6		1.920			
7		2.000			
8		2.070			
9		2.130			
10		2.190			
11		2.250			
12		2.310			
13		2.360			



Start water depth for analysis (mbgl)	1.17		
75% effective depth (mbgl):	1.50	Elapsed time (mins):	2.3
50% effective depth (mbgl):	1.84		
25% effective depth (mbgl):	2.17	Elapsed time (mins):	9.7
Base of soakage zone (mbgl):	2.50		
Volume outflow between 75% and 25% effective depth (m ³):	0.915		
Mean surface area of outflow (m ²):	4.86		
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):	7.4		

Soil infiltration rate (m/s):	4.2E-4
Remarks	Results processed following BRE 365 (2007). 800L of water used for the test

Client:	Wrexham AFC Limited	TP02
Site:	Kop Stand, Wrexham AFC	

Appendix D



YEX4390
TP01 Photos

