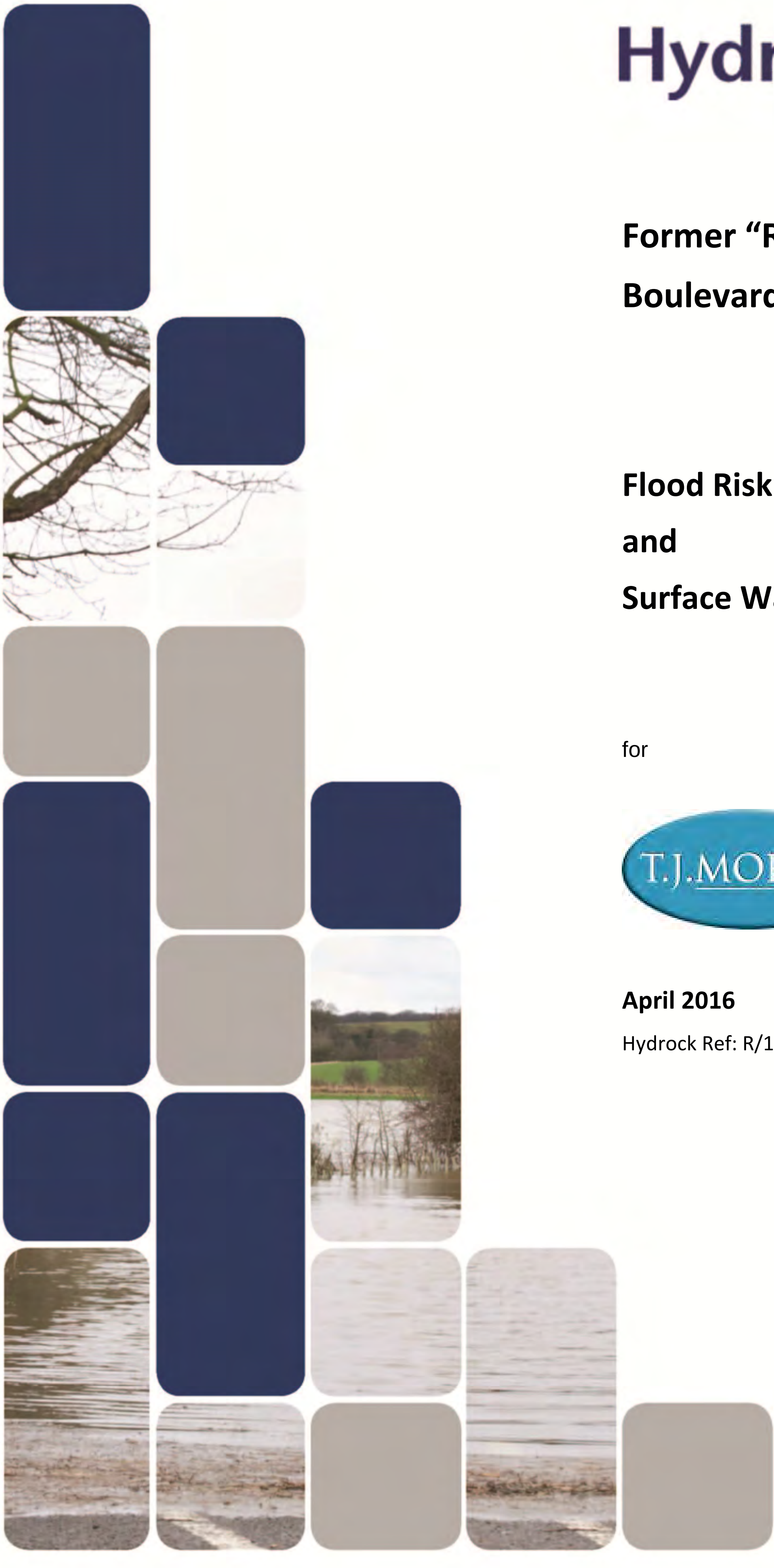

Former “Rayware” Site, Speke Boulevard, Liverpool

Flood Risk Assessment
and
Surface Water Drainage Strategy

for

April 2016

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1	07/03/2016	Draft
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CONTENTS

APPENDICES

EXECUTIVE SUMMARY

Flood Risk

The proposal is for the construction of a new retail-led regeneration scheme at Speke Boulevard, Liverpool.

This report has considered the flood risk posed to the site from all sources, as defined by the National Planning Policy Framework (NPPF) and the local Strategic Flood Risk Assessment (SFRA). The development lies outside of any fluvial flood risk areas, holding a Fluvial Flood Zone 1 (low risk) classification. Therefore, the development passes the requirements of the sequential test and the exception test is not required.

The assessment has also found the site to be at low risk of flooding from tidal and groundwater sources. The majority of the site is at low risk of surface water flooding. There are areas at medium/high risk of surface water flooding associated with hardstanding areas around existing buildings. To ensure the risk to the proposed buildings is low, the development will include improved drainage systems to direct rainfall to the nearest channel and gully and away from the new buildings.

There is a public combined sewer that runs through the eastern part of the site. This public sewer is currently built over and at present will remain so for the development. However any "Build Over" agreement that may be in place does not automatically transfer under new ownership. It will therefore be necessary to apply to United Utilities for a new Build Over agreement or to divert the sewer.

There is no residual flood risk from the site to the surrounding area, due to the flow restriction which ensures that the development does not increase the risk of surface water flooding to other adjacent neighbourhoods. Out of chamber or gully flooding for the extreme 100 year plus climate change storm event, may potentially occur within the development site and is classed as exceedance flows. Flood water from such events will be contained within the site but away from the units.

Surface Water Drainage Strategy

The surface water drainage strategy, as agreed with United Utilities, is to restrict the surface water discharge from the development to 230l/s prior to discharge into the existing public combined sewer. In turn, this will generate attenuation volumes which will be retained in geocellular storage.

Sustainable Drainage Systems (SuDS) in the form of Pollution Prevention and Site Control methods will be incorporated. A surface water drainage strategy forms part of this report.

1.0 INTRODUCTION

1.1 This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of our client T.J.Morris LTD, in support of a planning application to be submitted to Liverpool City Council for a proposed mixed use development on the former "Rayware" Site, Speke Boulevard, Liverpool.

1.2 Local Planning Authorities are advised by the Government's National Planning Policy Framework (*NPPF)* to consult the Environment Agency (EA) and Lead Local Flood Authority (LLFA) on development proposals in areas at risk of flooding and/or for sites greater than 1 hectare in area. The EA would require a Flood Risk Assessment to be submitted in support of the planning application for the proposed development.

To satisfy any potential concerns the EA and LLFA may have with the proposed commercial development on the Former "Rayware" Site, Speke Boulevard, Liverpool, this report has been prepared to assess the requirements of the *NPPF* through:

- Providing an assessment of whether the site is likely to be affected by flooding and whether it would increase flood risk elsewhere;
- Assessing whether the proposed development is appropriate in the suggested location;
- Detailing any measures necessary to mitigate any flood risk identified, to ensure that the proposed development and occupants would be safe, and that flood risk would not be increased elsewhere.

The report considers the requirements for undertaking a Flood Risk Assessment as stipulated in the *NPPF*. Only those requirements that are appropriate to a development of this nature have been considered in the compilation of this report.

This report has been prepared in accordance with current EA and LLFA policy. The EA's and LLFA's responses to the pre-development enquiries are included in Appendix C of this report.

2.0 DEVELOPMENT DESCRIPTION AND LOCATION

2.1 Site Location

2.1.1 The site is referenced in Table 1, and a location plan is provided in Figure 1.

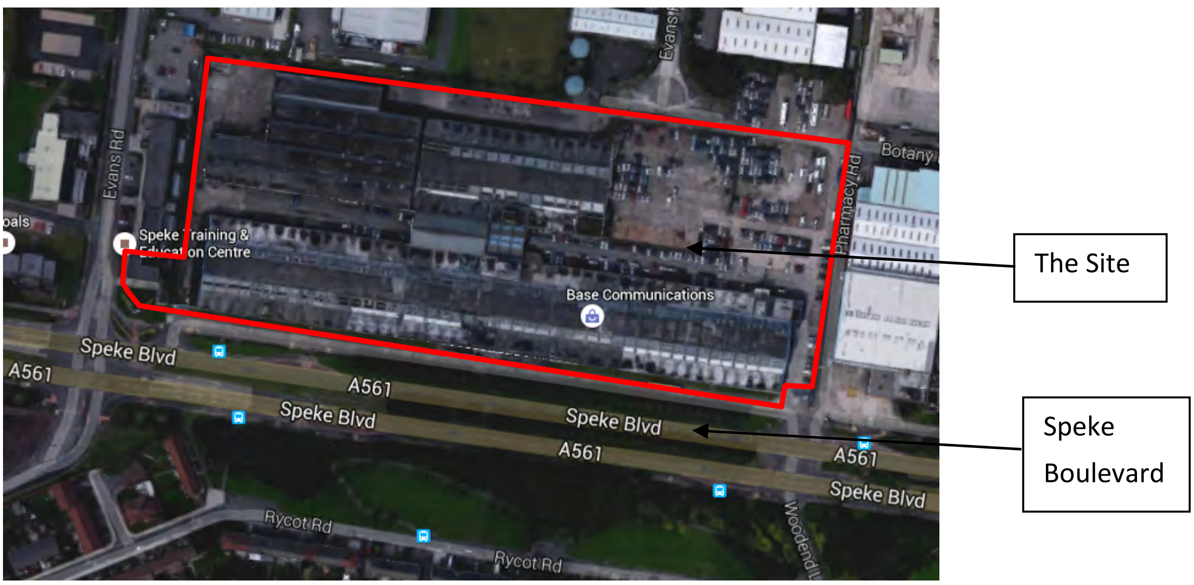
Table 1: Site Referencing Information

Item	Brief Description
Site name	Former “Rayware” Site, Speke Boulevard, Liverpool
Site address and location	Former “Rayware Site”, Speke Boulevard, Liverpool. Nearest postcode: L24 9HZ
Council Area	Liverpool City Council
Approximate Grid Reference	OS: 343051E, 383975N
General Locality	The site is located on brownfield land at the former “Rayware” Site, Speke Boulevard, Liverpool and is approximately 12.8km to the southeast of Liverpool City Centre.

2.2 Existing Site Description

2.2.1 Location Plan

Figure 1: Location Plan



2.2.2 Area

The site area is approximately 4.501ha.

2.2.3 Boundaries and Surrounding Land

Commercial development borders the site to the north, east and west. Speke Boulevard borders the site to the south, and beyond this lies residential properties. Evans Road lies along the western boundary. Pharmacy Road lies along the eastern boundary.

The site boundary is shown in the drawings contained within Appendix A of this report and also in Figure 1 above.

2.2.4 Existing Land Use and Access

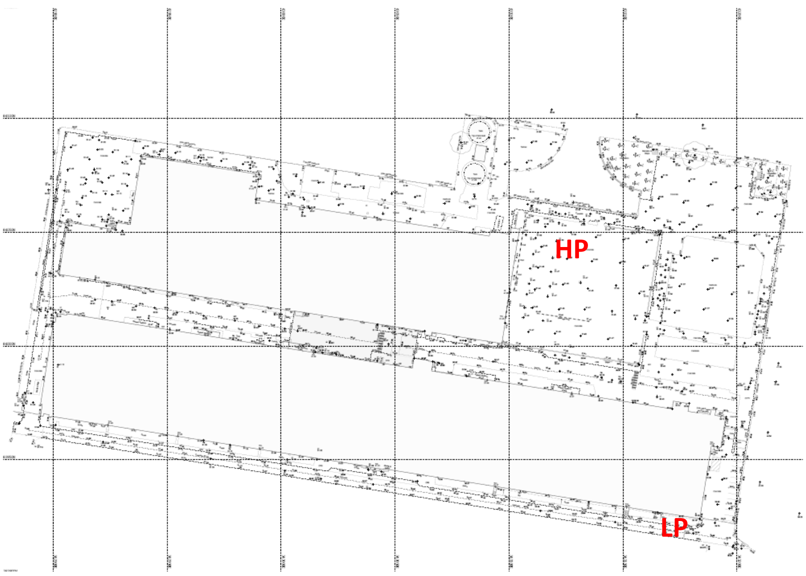
The site is classed as brownfield.

Vehicular access is available via Speke Boulevard to the south of the site.

2.2.5 Elevation and Topography

A site specific topographical survey has been undertaken and indicates that the site is predominantly flat. The highest level is in the north of the site at circa 31.54m Above Ordinance Datum (AOD) with the lowest level of 29.40m AOD in the southeast. Figure 2 shows the general fall across the site with the full survey located in Appendix B.

Figure 2: Extract of Topographical Survey



2.3 Development Proposals

2.3.1 Outline

The proposed development is part of a hybrid planning application for comprehensive retail-led regeneration comprising: demolition of existing buildings and cessation of temporary airport car parking use; full planning application for erection of 1no. flagship retail unit for Home Bargains (Class A1 non-food retail use with 30% ancillary food and drink for consumption off the premises) with associated external garden centre, 1no. building for Class A1 non-food retail use, and 1no. leisure/café/restaurant unit for Class A3 or Class D2 uses along with access and servicing arrangements, car parking, landscaping and associated highway works; outline planning application for up to 9,000 square metres of employment uses (Classes B1(c), B2 and B8) including details of access with all other matters reserved. Further details can be found in the Site Layout in Appendix A.

3.0 PLANNING POLICY AND CONSULTATION

3.1 National Planning Policy Framework (NPPF)

3.1.1 The flood maps provided by the Environment Agency (EA) locate the site within Flood Zone 1, i.e. land defined as having an annual probability of fluvial flooding of less than 1 in 1000 (<0.1%) in any year. As a requirement of the NPPF (2012), the proposed development has to satisfy the requirements of the Sequential Test and, where applicable, the Exception Test.

3.1.2 Sequential Test

Under the NPPF (2012), Flood Zone 1 is defined as low probability flood risk. The proposal is for a commercial development, which, in line with Table 2 of the technical guidance document is classified as 'Less Vulnerable'. Thus, according to the criteria in Table 3 (Flood Risk Vulnerability and Flood Zone 'Compatibility'), the site is classed as a Less Vulnerable development within Flood Zone 1 and as such, the 'Development is Appropriate'.

In light of this, the Exception test is not required. Table 2 and Table 3, referred to above, can be found in the Technical Guidance to the NPPF.

3.2 Strategic Flood Risk Assessment (SFRA)

3.2.1 SFRA's assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area, how drainage systems in the area should function and how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that regional planning bodies (RPB's) or local planning authorities should prepare SFRA's in consultation with the EA.

3.2.2 Liverpool City Council Planning Policy Department carried out a Strategic Flood Risk Assessment between June 2006 and January 2008, in accordance with Planning Policy Statement (PPS) 25 guidance (PPS 25 guidance is the previous planning document which has been superseded by the NPPF, the information in the SFRA is still valid). The purpose of the SFRA was to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, whilst taking into account future climate change predictions.

3.2.3 A summary of the main elements from the SFRA are detailed below. The full report can be obtained from the Liverpool City Council website.

- The SFRA provides a detailed understanding of flood risk across all areas and from all sources.
- Full Sequential and Exception tests to be carried out (where applicable).

- Development should be designed so there is no flooding to the development in a 1 in 30 year event, and so there is no property flooding in a 1 in 100 year plus climate change event.
- Surface water management, including the use of Sustainable Drainage Systems (SuDS), should be incorporated.
- The majority of Liverpool is considered to be an aquifer, with a series of groundwater contour lines.
- From Speke to Hale there are low cliffs which rise to a height of about 15m. The water in the River Mersey reaches the cliffs at high tide levels and they can suffer damage during storms.
- The closest record of surface water flooding to the site was in September 2002 on Speke Road between Speke Hall Road and Speke Retail Park.
- Groundwater levels is a potential issue in Liverpool as the water table is rising. This is likely to be encountered in low-lying areas and on a site by site basis. However, there is no known documented evidence of flooding from groundwater in the Mersey Estuary catchment. Therefore, it is considered that the current risk of flooding from this source is small compared to other sources.
- Postcodes areas identified as having experienced internal or external sewer flooding show a very low number of properties affected. Information regarding areas at risk of sewer flooding is not currently available.

3.3 Statutory Authority Correspondence

3.3.1 In compiling this report, liaison has taken place with the relevant authorities. Correspondence has been received from the Environment Agency, the Lead Local Flood Authority and United Utilities. Listed below is a summary of the correspondence with the full responses located in Appendix C.

3.3.2 Mr Steve Sayce from the Environment Agency confirmed that the site lies entirely within Flood Zone 1 and so they would not have any specific flood risk requirements. The Lead Local Flood Authority should be contacted.

3.3.3 Mr Dave Jackson, Engineer at Amey (Lead Local Flood Authority for the Liverpool Area) stated that the site has no history of flooding and is subject to no notable flooding from the predicted 1:30 year and 1:200 year flooding models. There are no watercourses (culverted, open and historic) shown on our records and the area is not susceptible to high groundwater levels. The maximum allowed flow from the site should be derived using the 1 in 2 critical rainfall event with a 30% reduction. The limiting discharge figure for the proposed development should be used in the design of the drainage system for the minimum requirements that flows up to the 1 in 30 year critical rainfall event are retained within the system and that for the 1 in 100 year + 30%

allowance, critical rainfall event there will be no flooding to any buildings and any excess volumes of water will be retained on site.

3.3.4 Mr John Lunt, Developer Query Engineer at United Utilities stated that United Utilities will require the new development to be designed and served using a separate drainage system combining on site just prior to connecting to the public combined sewerage system. Based on the survey data submitted United Utilities would agree to an allowable discharge rate of 230l/s that can discharge into the 450mm combined sewer crossing the site. In addition, there is a public sewer currently crossing the site which appears to be built over by the existing factory. Any “Build Over” Agreements currently in place for the site do not automatically transfer under new ownership and therefore due consideration for either protecting the sewer and/or diverting it should be taken into account.

4.0 DEFINITION OF FLOOD HAZARD

4.1 Sources of information

The NPPF (2012) requires the developer to consider the impact of runoff, generated by the proposed development, onto the downstream catchment, and to assess the risk of runoff from the surrounding district impacting on the developments footprint. Further, the report is to consider flood risk from all other sources. The following section defines the flood risk receptors and anticipated flood risk.

Table 2: Sources of information used in the identification of flood risk

Source of Information	Details
Environment Agency	Indicative Flood Map
Liverpool City Council	Strategic Flood Risk Assessment
United Utilities	Sewer Plans

4.2 Flooding from the Sea (Tidal)

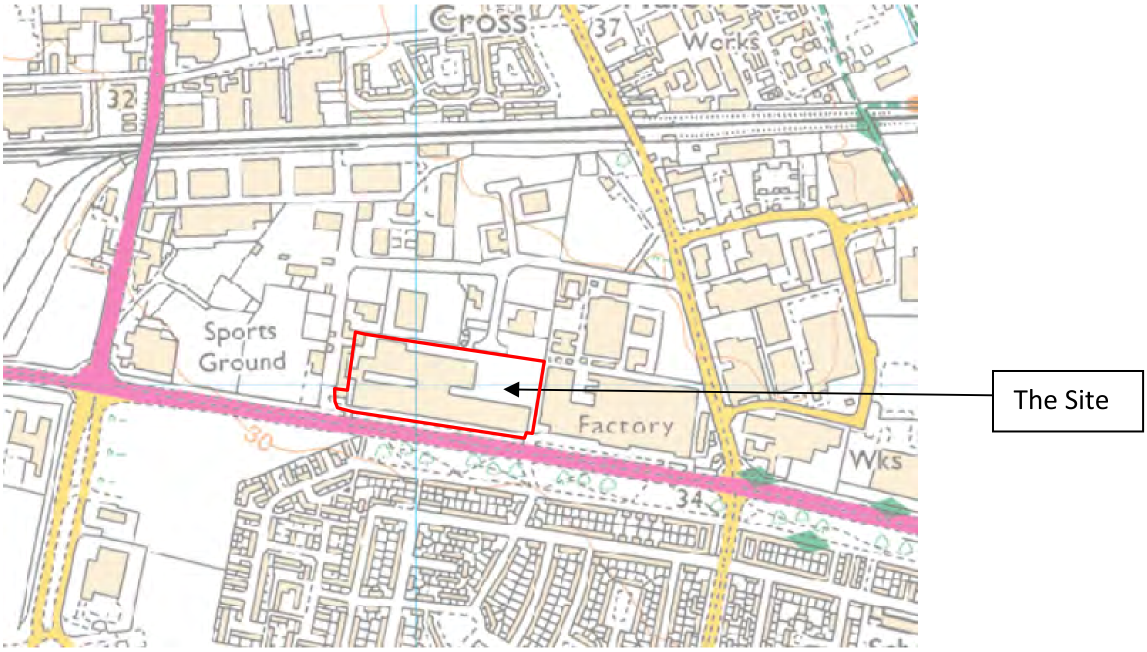
4.2.1 The site is over 2000m away from the tidally influenced River Mersey. Therefore, the site is not in close enough proximity to a coastline or a tidal river to be at risk of tidal flooding. As such the site is at low risk of tidal flooding.

4.3 Flooding from Rivers (Fluvial)

4.3.1 The River Mersey is located over 2000m to the south of the site. Rams Brook lies to the east of the site.

4.3.2 Figure 3 below locates the site on the Environment Agency’s indicative floodplain map. The site boundary lies outside of the current statistical fluvial floodwater model footprint generated by any local watercourses i.e. probability of annual fluvial flooding of less than 1 in 1000 (<0.1%) in any one year. Based on information from the Environment Agency Flood Maps, there is no evidence of fluvial flooding affecting the site. Therefore the risk of fluvial flooding at the site is considered to be low.

Figure 3: The Environment Agency's modelled flood outputs



EA's 100-year Indicative Floodplain

EA's 1000-year Indicative Floodplain

4.4 Flooding from the Land (Surface Water)

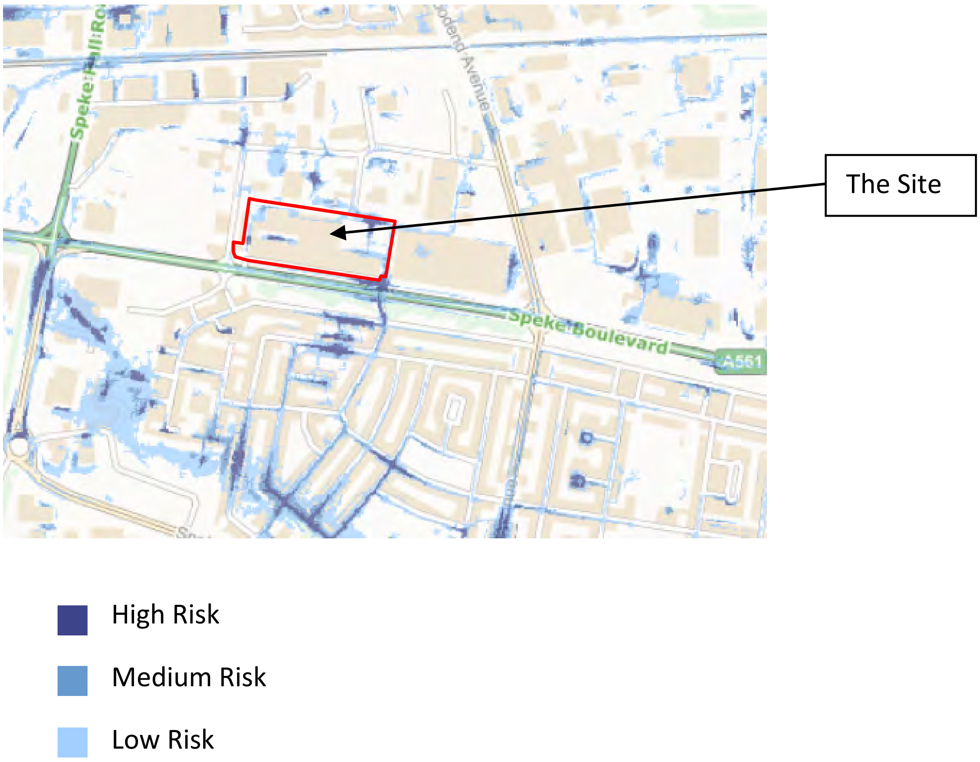
4.4.1 The overland flow would naturally route towards the nearest watercourse, stream or ditch. However, the exact route taken is defined by the local topography. The site currently benefits from existing onsite drainage which conveys surface water runoff into the surrounding combined sewer network and away from the site.

4.4.2 Surface water runoff from the surrounding areas will be picked up by highway drainage in the surrounding roads and conveyed away from the site.

4.4.3 A further consultation of the Environment Agency Surface Water Flood map indicates that the majority of the site is at very low risk of surface water flooding. There is an area at medium/high risk associated with the hardstanding areas around the existing buildings.

4.4.4 In light of this, the risk of flooding from the land for most of the site is considered to be low. Furthermore, the development site will include improved drainage systems to direct rainfall to the nearest channel and gully and away from the new retail buildings.

Figure 4: The Environment Agency's Indicative Surface Water Floodplain Map



4.5 Flooding from Groundwater

4.5.1 According to the British Geological Survey Maps the site is underlain by the Chester Pebble Beds Formation, classified as a Principal Aquifer. These are layers of rick that comprise high intergranular and/or fracture permeability and usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. Glacial Till also underlies the site. These deposits are classified as Unproductive Strata and have negligible significance for water supply or river base flow. The site does not lie within a Groundwater Source Protection Zone (SPZ).

4.5.2 The SFRA states that groundwater levels could be an issue in Liverpool as the water table is rising. However, there is no known documented evidence of flooding from groundwater in the Mersey Estuary Catchment.

4.5.3 Based on the available information, groundwater flood risk is considered to be low.

4.6 Flooding from Sewers/Highway Drains

4.6.1 The review of the United Utilities (UU) public sewer records indicates that there is a public combined sewer that runs through the eastern part of the site. The necessary United Utilities easement will need to be applied to this pipe or it may be subject to a diversion, this is to be agreed with United Utilities prior to detailed design stage. There is a public surface water sewer that runs through Evans Road to the west of the site.

4.6.2 The full extent of the existing UU sewers can be identified further in Appendix D. Therefore, the risk of flooding from sewers and highway drains is considered to be low.

4.7 Flooding from Artificial Sources

4.7.1 There are no canals or reservoirs in close proximity to the site. Therefore based on the available information the flood risk from artificial sources is considered to be low.

5.0 ASSESSMENT OF FLOOD RISK ON DEVELOPMENT SITE (PROBABILITY)

5.1 Summary

5.1.1 Table 3 considers each of the sources and defines in tabular format the probability of flood risk associated with each and the likely impacts.

Table 3: Flood Risk Summary

Source	Probability of Flood Risk	Impacts	Remarks
Tidal	Low	Low	Development site is not influenced.
Fluvial	Low	Low	Site is located within Flood Zone 1 and at low risk from flooding.
Surface (Overland Flood Flow)	Medium/High	Low	The Environment Agency surface water maps indicate that the majority of the site is at low risk of flooding. There is an area at medium/high risk associated with the hardstanding areas around the existing buildings. However improved drainage systems will ensure the risk to the developable area is low.
Sewers/Highway Drains	Low	Low	There is a public combined sewer within the east of the development. This sewer will either be associated with the necessary easements or will be diverted as part of the future development.
Groundwater	Low	Low	Based on the available information the risk from groundwater flooding is considered to be low.
Artificial Sources	Low	Low	Based on available data, flood risk from artificial sources is deemed to be low.

6.0 SURFACE WATER DRAINAGE STRATEGY

6.1 External Consultation

6.1.1 United Utilities have confirmed that an allowable discharge rate of 230l/s can discharge into the 450mm combined sewer crossing the site.

6.2 Existing Surface Water Runoff

6.2.1 The surface water runoff from the site currently discharges into the existing combined sewer that passes through the east of the site.

6.3 Geology

6.3.1 According to the BGS Maps the majority of the site apart from the northwestern corner is underlain by Glacial Till which typically comprises firm to stiff silty and clayey silts with varying amounts of sand, gravel, cobbles and occasional boulders. The site is also underlain by the Chester Pebble Beds formation of the Sherwood Sandstone Group. This layer is comprised of sandstone that is fine to coarse grained and commonly pebbly. Based on the geology, infiltration is a potentially viable SuDS technique and further infiltration tests should target the Chester Pebble Beds formation.

6.4 Sustainable Drainage Systems

6.4.1 SuDS Objectives

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed to manage both the environmental risks resulting from the urban runoff and to contribute, wherever possible, to environmental enhancement. Therefore, SuDS objectives are to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

6.4.2 SuDS Design Themes

A strong design theme is essential if maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale SuDS should link with the individual plot structure, planting and amenity areas, gaining multiple benefits from a limited area of land.

6.4.3 The SuDS Management Train

The 'Management Train Approach' should be central to the surface water drainage strategy of a proposed site. The main objective is the treatment and control of runoff as near to source as possible, thus protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

1. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes rainwater reuse.
2. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
3. **Site Control** – Management of water in a local area and can include below ground storage/attenuation, detention basins, large infiltration devices.
4. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

The drainage techniques for this development will seek to include, where possible, pollution prevention and site control measures.

6.4.4 SuDS Site Constraints

SuDS techniques are not suitable for all sites; therefore an assessment of the existing site is required so that SuDS limitations can be determined.

1. **Land Use Characteristics** – The size and type of development plot enables a range of pollution prevention and site control SuDS devices to be considered both above and below ground.
2. **Site Characteristics** – The use of infiltration a potentially viable SuDS technique, to be confirmed by further infiltration tests.
3. **Catchment Characteristics** – The site is classified as 'brownfield'. Current guidance would limit the discharge rate from the post developed site to not exceed existing brownfield rates and ideally provide a betterment.
4. **Environmental and Amenity Performance** – The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. These will also assist in offsetting the loss of pre-developed natural habitat. Maintenance plans will be prepared for all SuDS devices.

6.4.5 SuDS Design Philosophy

The SuDS philosophy for a development site is the promotion of Pollution Prevention and Site Control Techniques:

The following design philosophy is proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the existing private surface water sewerage system.
- Surface water discharge into the existing infrastructure in the east at a controlled rate.
- Pollution prevention measures.
- Site Control features, in the form of geocellular storage or oversized pipes, to accommodate the additional surface water runoff generated by the development site.
- Provision of suitable oil separators in line with Pollution Prevention Guidance 3 criteria (where applicable).
- Aim to limit, where possible, the impermeable fraction of development.

6.4.6 SuDS Parameters

It is proposed that the development site has two levels of treatment. Prevention and source control are considered as the first level of treatment and the site control as the second.

6.4.7 Prevention and Source Control – Principles and Objectives

The main objective of prevention and source control is the treatment and control of runoff as near to source as possible. Application of these techniques will require reduction of impermeable areas and techniques to restrict the runoff rates.

Prevention measures to be considered, where possible, as part of the overall approach to the management train at this site include rainwater harvesting. Typical examples are given in the SuDS Manual (Ciria C753) and are briefly described below. It must be noted that the effectiveness of each system is dependent on the final design as well as the actual site conditions.

Rainwater Harvesting - Similar to the use of water butts this prevention method stores rainwater runoff from roofs and external areas in below ground tanks. The water can then be used for irrigation purposes to the soft landscaping areas or alternatively pumped to an internal storage tank where the 'Grey' water can be used for WC's and washing machines.

Permeable surfacing - Block paved and/or specialised tar macadam provides a porous surfacing for the external areas that allows water to infiltrate through and into the underlying layers.

Water is temporally stored and either infiltrates to ground or is retained for controlled release into the drainage system.

6.4.8 Site Control – Principles and Objectives

Site control features such as ponds and basins can be designed to attenuate storm runoff and provide conditions for settlement of suspended solids. The benefits are that they satisfy the full range of SuDS requirements in terms of reducing the quantity of water, improving the quality of water and also providing the biodiversity enhancements.

Conventional piped drainage - Conventional piped drainage would be located in areas of the proposed scheme where 'over-the-edge' drainage is unsuitable. This would typically be in areas where kerbs are required, due to road user safety reasons, such as at roundabouts. Surface water runoff would be collected via conventional trapped gullies or combined kerb drainage systems, before discharging appropriately into SuDS units.

Geocellular Systems - Geocellular Systems can be used to control and manage runoff either as a soakaway or as a storage tank and can be tailored to suit the requirements of most sites. In addition they can be used for storing roof/rainwater before recycling. Geocellular Systems used for storage can be tailored to be used in contaminated land conditions to prevent infiltration.

6.5 Surface Water Drainage Strategy

6.5.1 Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. This is in-line with current guidance and recommendations from the EA.

6.5.2 In light of the findings from the SuDS review in Section 6.4, the following surface water drainage strategy will be implemented.

1. The SuDS management train approach will be incorporated.
2. Prevention measures will be the initial means of retaining the runoff. Infiltration is a potentially viable option for the site, to be confirmed following further testing.
3. Rainwater runoff from roofs and hard paved areas will be directed through the prevention measures and then via a new surface water gravity network to onsite geocellular storage. The new on-site storage will account for the additional surface water runoff generated by the site and prevent increased discharge for the extreme events.

4. Discharge from the development will be restricted 230 l/s as agreed with United Utilities.

6.6 Surface Water Drainage Proposals

6.6.1 Surface water runoff from the roof and external areas will be directed to the below ground gravity network. This water is considered to be generally clean and with limited contamination, and may be discharged directly to the existing drainage infrastructure and new SuDS Facilities. Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps, or by the use of sustainable drainage techniques.

6.6.2 Although it is envisaged that prevention measures may be included in the final scheme, for outline calculation purposes a gravity network, will serve the buildings, car park and highway, and direct runoff to "Site Control" geocellular storage prior to discharging into the combined sewer in the east of the site. The discharge rate from the geocellular storage will be restricted to 230 l/s as agreed with United Utilities.

6.6.3 Taking into account the allowable discharge rates, and assuming no preventative measures are incorporated and no infiltration to ground is possible then the worst case attenuation volumes are defined in Table 4. It is noted that these rates and volumes are preliminary for this outline assessment and are likely to alter at a detailed design stage when more site specific information is made available. The outline attenuation volumes in Table 4 have been derived using Micro Drainage Source Control Software.

6.6.4 The proposed impermeable areas for this site (quoted in Table 4 below) is based on 85% of the site area, taken from the Site Layout in Appendix A.

Table 4: Outline Attenuation Volumes

Estimated Impermeable Area (ha)	Approximate Attenuation Volumes		
	1yr Storm Event (230 l/s)	30yr Storm Event (230 l/s)	100yr Storm Event + 30% CC (230 l/s)
3.83	182m^3	420m^3	985m^3

6.6.5 The proposed drainage layout will be designed in accordance with Building Regulations guidance. SuDS guidance will be taken from Ciria C753. It is a requirement that the drainage systems be designed to not flood any part of the site in a 1 in 30 year return period design storm (3.33% annual probability of occurrence). The below ground surface water design may require that some areas of the hard standing areas experience minor flooding in extreme conditions beyond the 30 year design criteria. This is classed as Exceedance flooding or Secondary Storage and is common for this type of development. Any such flood water will be directed away from commercial units, where it will discharge into the drainage infrastructure as water levels recede. All exceedance flood water will be retained on-site up to the 100 year return period to prevent flood impact to the adjoining neighbours. All drainage designs will include the appropriate climate change allowance, in this case a 30% increase in rainfall.

6.7 Pollution Control

6.7.1 Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps, french drains with silt traps or by the use of Sustainable Drainage techniques. If appropriate, oil separators in line with Pollution Prevention Guidance criteria will be provided.

7.0 MANAGEMENT MEASURES, OFF SITE IMPACTS AND RESIDUAL RISK

7.1 Flood Risk Management Measures

7.1.1 The report has determined that the site is at low risk of flooding from tidal, fluvial, groundwater, sewers and artificial sources.

7.1.2 The majority of the site is at low risk of surface water flooding. There are areas at medium/high risk of surface water flooding associated with hardstanding areas around existing buildings. To ensure the risk to the proposed buildings is low, the development will include improved drainage systems to direct rainfall to the nearest channel and gully and away from the new buildings.

7.1.3 The surface water drainage strategy for the new development site is to direct all the surface water runoff from the new commercial development to surface water networks that flows into the existing combined sewer in the east of the site. Geocellular storage will be situated on the network at the low points of the site to retain the excess rainwater due to the outflow restriction. The new private surface water networks will be designed in line with current British Standard guidance up to the 100 year storm return period including an allowance for climate change. Beyond the 30 year criteria, minor out of chamber flooding may occur with flood water directed away from the commercial developments buildings where it will then be directed back in to the drainage network as the pipe water levels recede. No flood water will be allowed to discharge off the development site.

7.1.4 The use of SuDS with controlled (restricted) outflow in line with the required runoff rates will help mitigate any flood risk impact to the surrounding areas.

7.1.5 A private management company will be responsible for maintaining the gullies and drain cleansing to ensure that the surface water drainage system will always operate at its maximum efficiency.

7.1.6 Access and egress arrangements to and from the new development, should exceedance flooding occur, will be through the main access off the existing estate road.

7.2 Off Site Impacts

7.2.1 The report has justified that the risk of flooding to the new development layout is low. Thus, once the previously discussed mitigation measures have been implemented, the site has a low risk of flooding from all sources.

7.2.2 By including SuDS into the drainage system and by restricting the surface water runoff at its point of discharge, this will reduce surface water flooding impact onto the downstream catchments.

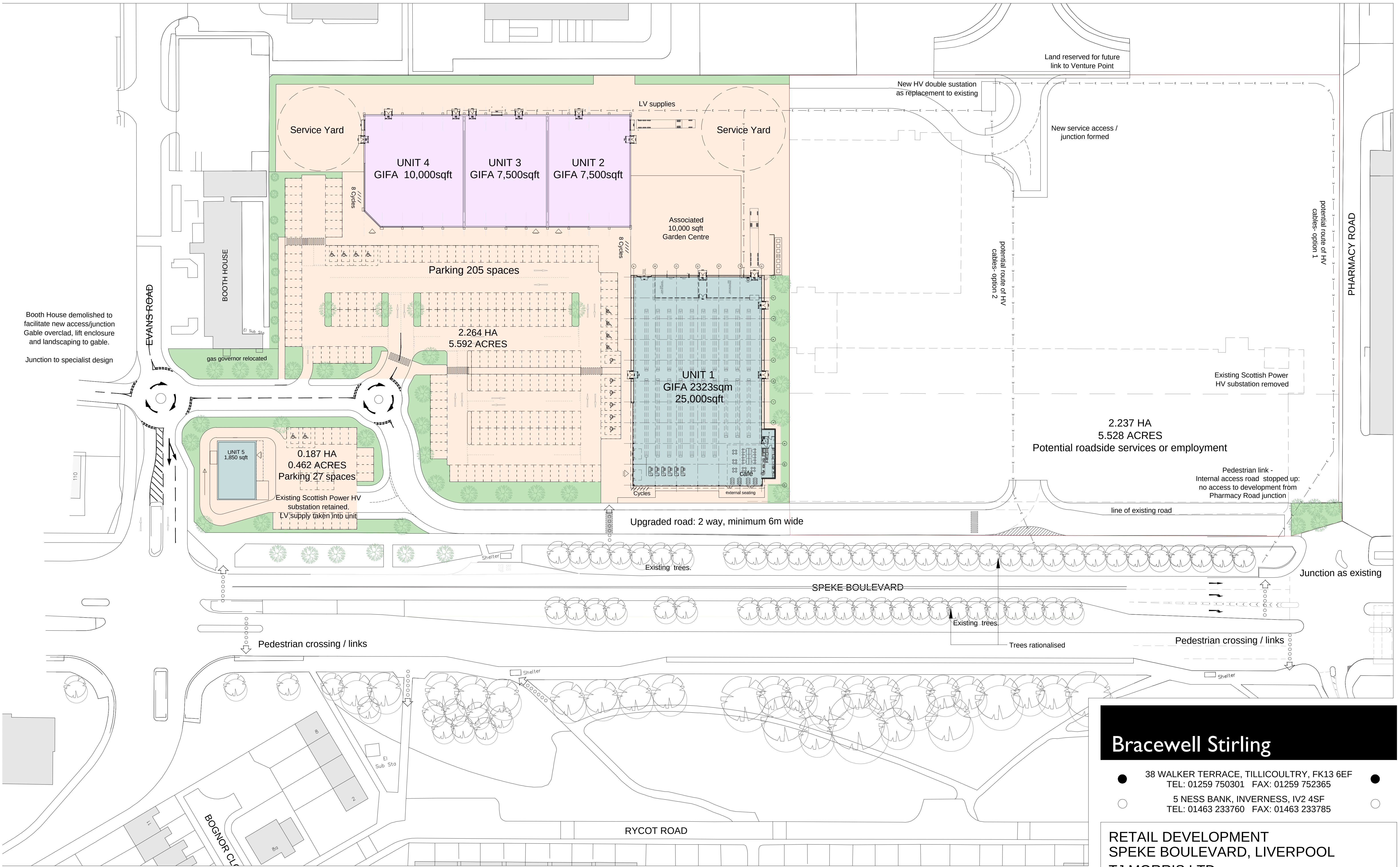
7.2.3 As there is no flood displacement or increased rate of runoff from the proposed development, this will prevent surface water flooding impact from the development onto the downstream catchments.

7.3 Residual Risk

7.3.1 Flood risk to people and property can be managed but it can never be completely removed; a residual risk remains after flood management or mitigation measures have been put in place. This relates to a rainfall event beyond what can be fully quantified. Should this occur then some out of chamber flooding could occur.

Appendix A – Site Plans

CONTENTS	
Identifier	**Name**
Bracewell Stirling Consulting	Proposed Masterplan. Drawing no. 4098/AL(0)100



MASTERPLAN 1:1000 @ A3

TOTAL SITE AREA:
4.501HA
11.12 ACRES.

N

0 10 20 30 40 50

Bracewell Stirling

38 WALKER TERRACE, TILLICOULTRY, FK13 6EF
TEL: 01259 750301 FAX: 01259 752365

5 NESS BANK, INVERNESS, IV2 4SF
TEL: 01463 233760 FAX: 01463 233785

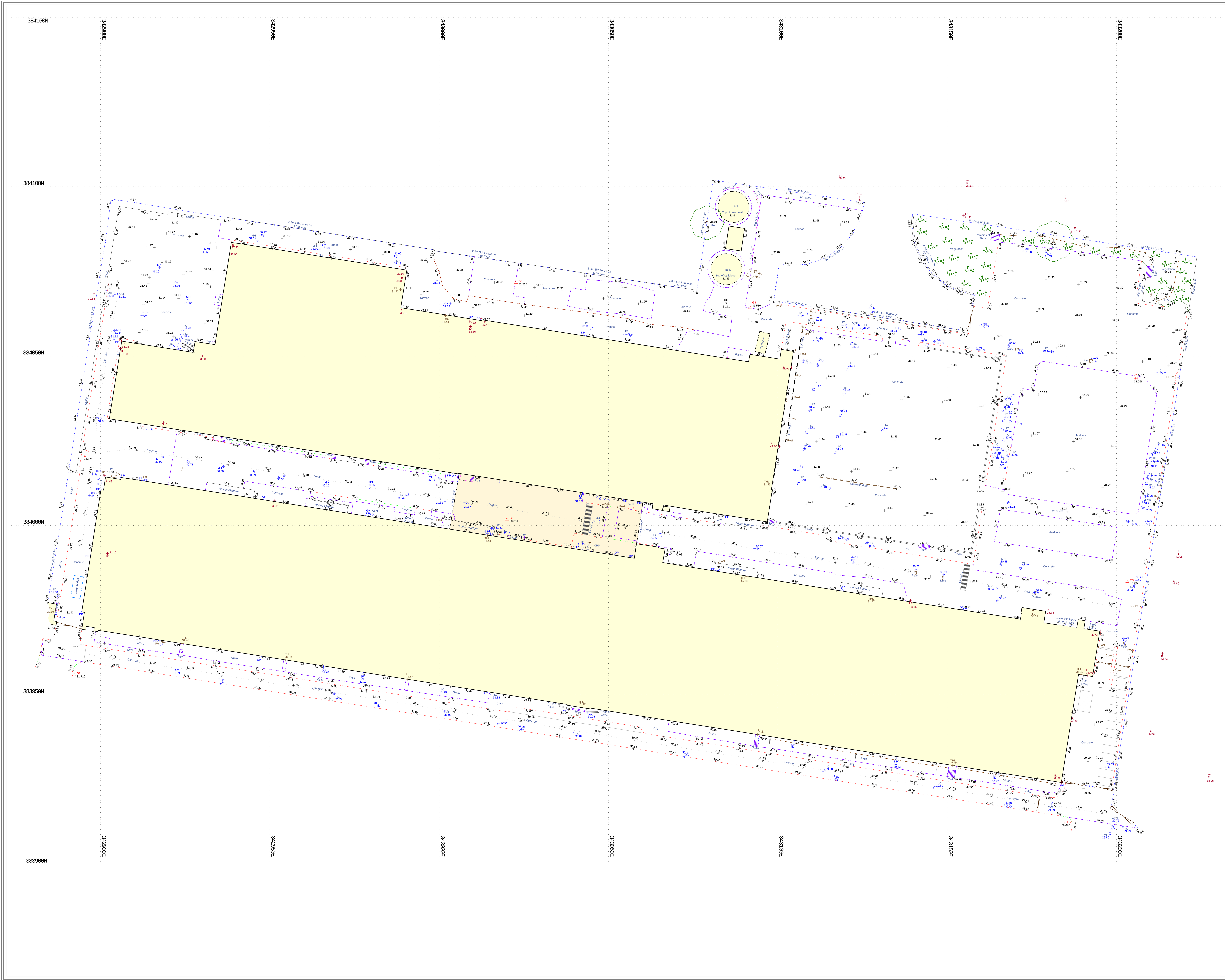
RETAIL DEVELOPMENT
SPEKE BOULEVARD, LIVERPOOL
TJ MORRIS LTD

PROPOSED MASTERPLAN

SCALE 1:1000	DATE 2015/11/12	BY jpc	
	PLANNING	DWG SIZE A3	
DWG NO	4098 / AL(0)100	REV	P4

Appendix B – Site Surveys

CONTENTS	
Identifier	**Name**
Greenhatch	Topographical Survey. Drawing no: 22815_T
Greenhatch	Underground Utility Survey. Drawing no: 22815_UG



N

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
G1	343186.7050	383912.2026	29.6700
G2	342892.2197	383955.9177	31.7160
G3	343203.1874	383983.4396	30.4320
G4	343205.7385	384044.3195	31.0976
G5	343091.8588	384064.2642	31.5096
G6	343022.6624	384071.6880	31.5179
G7	342896.0587	384021.9257	31.1739
G8	343020.0071	384001.7632	30.8013

OS Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

OS Buildings | *Surveyed Buildings*

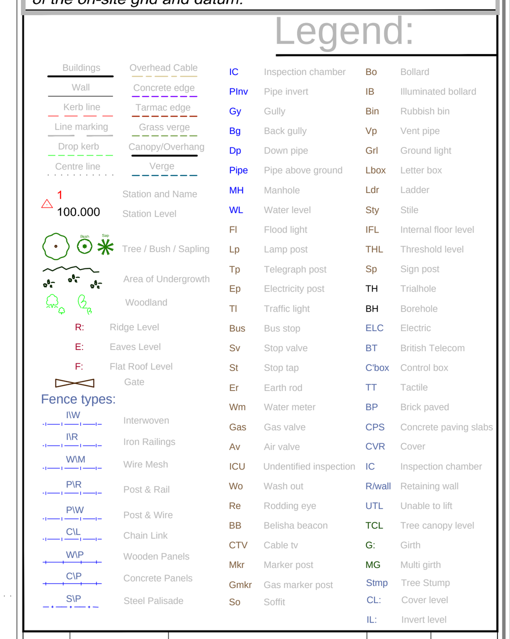
This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via Global Navigational Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models.
The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:



Rev	Date	Description	Drawn	Q. Ref

greenhatch group

- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk
www.greenhatch-group.co.uk

St Albans	Newcastle	Poland
Unit B, The Courtyard Alban Park St Albans Hertfordshire AL4 0LA t. (01727) 854481	24 Riverside Studios Amethyst Road Newcastle Bus. Park Newcastle-U-Tyne NE4 7YL t. (01912) 736391	ul. Panewnicka 91 40-761 Katowice Poland t. 0048 32 202 2292 www.greenhatch.pl

CLIENT

Quod

PROJECT

Former Rayworth site, 82 Evans Road, Speke, Liverpool

TITLE

Topographical Survey

SCALE	DATE
A1@ 1: 500	**14.12.2015**
DRAWN	QUALITY REF
LP	**A1439**

Level datum	See Notes
Grid orientation	See Notes
Job number	22815

Drawing No.	Rev.
22815_T_REV	0

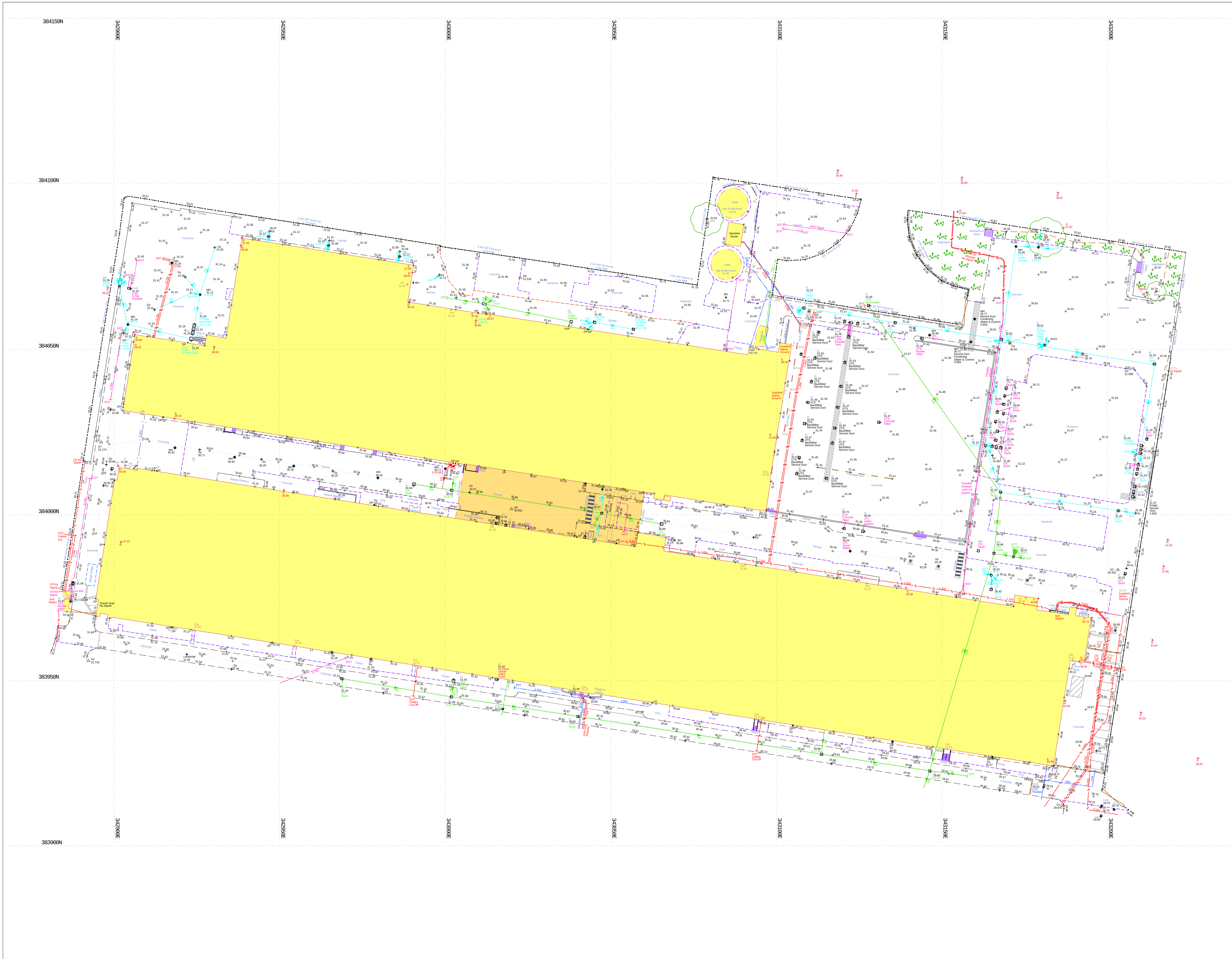
Comments

This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:



N

NOTES;

Main services to rear building supplied via service duct from front building. Sprinkler main to front building supplied from service duct from rear building.
Partial survey carried out of main drainage runs where accessible. CCTV survey to be carried out to confirm all drainage. Revised survey drawing to be issued.

UTILITY KEY

- ELECTRIC CABLE
- TELECOMS CABLE
- TV — CABLE TELEVISION
- COM — COMMUNICATION CABLE
- WATER PIPE
- GAS PIPE
- FOUL DRAINAGE
- CONTAMINATED SURFACE DRAINAGE
- SURFACE DRAINAGE
- COMBINED DRAINAGE
- PUMPING MAIN
- F — FUEL PIPE
- V — VENT PIPE
- O — OFFSET FILL PIPE
- G — GAUGE LINE
- VR — VAPOUR RECOVERY
- SERVICE DUCTS
- H — HEATING PIPES
- UNIDENTIFIED SIGNAL
- END OF TRACE

ABBREVIATIONS

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

DISCLAIMER

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

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

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

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

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

Rev	Date	Description	Drawn	Q. Ref.

greenhatch group

Topographical Surveys
Site Engineering
Utility / CCTV Surveys
Measured Building Surveys
3D Laser Scanning
Revit & BIM Models

Rowan House
Duffield Road
Little Eaton
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admin@greenhatch-group.co.uk
www.greenhatch-group.co.uk

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Newcastle
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Amethyst Road
Newcastle Bus. Park
Newcastle-U-Tyne
NE4 7YL
t. (01912) 736391

Poland
ul. Panewnicka 91
40-761 Katowice
Poland
t. 0048 32 202 2292
www.greenhatch.pl

CLIENT
Quod

PROJECT
Former Rayworth Site, 82 Evans Road, Speke Liverpool

TITLE
Underground Utility Survey

SCALE	DATE
A1@ 1: 500	21.12.15-07.01.16
DRAWN	QUALITY REF
DS	11543

Level datum	See Notes
Grid orientation	See Notes
Job number	22815
Drawing No.	Rev.
22815_UG	1

Comments
This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.
All dimensions should be checked on site prior to design and construction.
Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

Appendix C – Statutory Authority Correspondence

CONTENTS	
Identifier	**Name**
Environment Agency	Pre-development enquiry response email
LLFA	Pre-development enquiry response email
United Utilities	Pre-development enquiry response email

Eleanor Dale

From: Sayce, Stephen <stephen.sayce@environment-agency.gov.uk>
Sent: 11 December 2015 11:46
To: Sophie Eaton
Subject: RE: 151210/TB13 Pre Development Enquiry - Rayware Liverpool C151811

Hi Sophie

Its entirely FZ1 so we wouldn't have any specific flood risk requirements.

You should contact the Lead Local Flood Authority instead.

Kind Regards

Steve Sayce

The Environment Agency
Sustainable Places (Liverpool City Region)
Richard Fairclough House
Knutsford Road
Latchford, Warrington
Cheshire
WA4 1HT

Email: stephen.sayce@environment-agency.gov.uk
Team email: SPPlanning.RFH@environment-agency.gov.uk.

From: Sayce, Stephen **On Behalf Of** SPPlanning.RFH
Sent: 11 December 2015 11:35
To: Sayce, Stephen
Subject: FW: 151210/TB13 Pre Development Enquiry - Rayware Liverpool C151811

From: Enquiries, Unit
Sent: 10 December 2015 16:32

To: SophieEaton@hydrock.com
Subject: FW: 151210/TB13 Pre Development Enquiry - Rayware Liverpool C151811

Dear Sophie,

I have passed your enquiry to our Sustainable Places team for the relevant area and they will be in touch with you shortly.

The Freedom of Information Act and Environmental Information Regulations state that a public authority must respond to requests for information within 20 working days, but we aim to respond to all enquiries as quickly as we can.

You can find more information about our service commitment by clicking on the link below:

https://www.gov.uk/government/publications/environment-agency-customer-service-commitment

Should you wish to contact the Sustainable Places team directly, please use the contact details below. Please quote your Enquiry Reference 151210/TB13 in any correspondence with us regarding this matter.

Sustainable Places
Environment Agency
Greater Manchester, Merseyside and Cheshire Area
Richard Fairclough House
Knutsford Road
Latchford
Warrington
WA4 1HT

Tel: 03708 506506

Kind Regards,

Thomas Brabbs
Customer Advisor

NCCC – Part of National Operations
Tel: 03708 506 506
Web Site: www.gov.uk/environment-agency

Environment Agency, Quadrant 2, 99 Parkway Ave, Parkway Business Park, Sheffield, S9 4WF

Click an icon to keep in touch with us:-

So how did we do...?

Our National Customer Contact Centre relies on customer feedback, so we really value your thoughts on how we are doing. We will always make changes where we can to improve our service. This will only take three minutes to complete:

http://feedback1.environmentagency.uk.com/s3/NCCCsurvey

From: Sophie Eaton [mailto:SophieEaton@hydrock.com]
Sent: 08 December 2015 14:40
To: Enquiries, Unit
Cc: Automate - Manchester; Eleanor Dale
Subject: 151210/TB13 Pre Development Enquiry - Rayware Liverpool C151811

Dear Sir/Madam,

We would be grateful if you could provide us with a Pre Development Response for the proposed development of the Former Rayware Site, Speake Boulevard, Liverpool.

The majority of the site falls within the category of 'Flood Zone 1'. The site is proposed for commercial units. The site boundary is indicated in Red on the attached site plan. It is our intention to limit the discharge rates from this development to equal greenfield run off.

Please find attached the following documents to assist with your response.
- Pre development Enquiry Form - completed.
- Site plan - indicating proposed areas of development edged in Red.

I trust the attached is acceptable however should you require any further information and/or wish to discuss these matters further please do not hesitate to call me on the direct line telephone number below.

Thank you for your time on this matter.

Kind Regards,

Sophie

Sophie Eaton
Office Administrator

Hydrock
St Baldred's Hall, 239 Ashley Road, Hale, Cheshire WA15 9NE
Office: (0161) 233 0746
Email: SophieEaton@hydrock.com
www.hydrock.com

Eleanor Dale

From: Jackson, David <David.Jackson3@amey.co.uk>
Sent: 11 December 2015 14:31
To: Sophie Eaton
Subject: SPEKE BOULEVARD - RAYWARE
Attachments: LCC BROWNFIELD-GREENFIELD-FRA ADVICE.docx

Sophie

The site has no history of flooding and is subject to no notable flooding from the predicted 1:30yr & 1:200yr flooding models. There are no watercourses (culverted, open and historic) shown on our records and the area is not susceptible to high ground water levels.

I have attached a guidance note for the drainage requirements needed for a planning application.

If you need any further information then please contact me.

Thanks

DAVE JACKSON

Engineer | Consulting

Amey

t: 0151 498 6825 **l m:** 0780 9313978 | **e:** david.jackson3@amey.co.uk

Unit 3 | Matchworks | 142 Speke Road | Garston | Liverpool | L19 2PH

LCC GREENFIELD / BROWNFIELD SITES SURFACE WATER MANAGEMENT GUIDANCE

If the site has previously been developed it should be demonstrated that the drainage system is still operational for it to be classed as brownfield. Information should be obtained on the system, e.g. pipe diameters, levels, gradients, lengths, hydraulic controls, etc. These details should be used, along with the contributing area characteristics of the site, to set up a drainage model (or to inform another assessment method) in order to evaluate the peak flow rates at the outfalls from the existing site for the design return period events. The maximum allowed flow from the site should then be derived using the 1:2yr critical rainfall event with a 30% reduction applied to offer improvement.

The limiting discharge figure for the proposed development should be used in the design of the drainage system for the minimum requirement that flows for up to the 1:30yr critical rainfall event are retained within the system and that for the 1:100yr+30% climate change allowance, critical rainfall event there will be no flooding to any buildings and any excess volumes of water will be retained on site.

Notwithstanding the above, the existing site drainage constraints will also be taken into account when agreeing any discharge limits and the proposed flow should not exceed existing flows. For example if the existing site outfall was a 150mm dia pipe, irrespective of the area being drained, it would have a maximum flow capacity which may be lower than any proposed flows calculated using the above criteria, assuming a free discharge. Therefore discharge to the existing drainage system from the development would be effectively increased from the existing situation which is contrary to Environment Agency and National Planning Policy Framework guidance for flood risk and surface water management.

Where records of the previously developed system are not available and system characteristics cannot otherwise be determined, or if the drainage system is broken or blocked (or no longer operational), then the run-off characteristics should be defined as greenfield. If the site is classed as greenfield the flow rates from the development will be limited to the equivalent greenfield run off rates. For example the flow rate from the development for the 1:30yr critical rainfall event should not exceed the greenfield run off rate for the site for the 1:30 year rainfall event, likewise for the 1:2 & 1:100 year scenarios.

It should be noted that this discharge figure will satisfy planning requirements but the applicant should consult United Utilities to determine if they have any discharge restrictions, which could be more restrictive.

For all development s over 1ha a FRA (Flood Risk Assessment) will be required which should be based on the requirements as detailed in Environment Agency (Greater Manchester, Merseyside & Cheshire) Local Planning Standing Advice and NPPF guidance. The detail and technical complexity of a FRA will reflect the scale, nature and location of the development. Where available, reference should be made to the Strategic Flood Risk Assessment (SFRA) for locally specific guidance and information.

The following list sets out key information that should be submitted within a FRA for developments

- A location plan that includes geographical features, street names and identifies the catchment, watercourses or other bodies of water in the vicinity.

- A plan of the site showing existing site; development proposals; and identification of any structures (e.g. embankments), which may influence local flood flow overland or in any watercourses (e.g. culverts) present on the site.

- Site levels of both existing and proposed. Reference to Ordnance Datum, may be required where details of context of the site to its surroundings is needed.

- Details of the existing surface water drainage arrangements on site (if any) and the receptor e.g. soakaway, sewer, canal, watercourse etc.

- Proposals for surface water management that aims to not increase, and where practicable reduce the rate of runoff from the site as a result of the development

- Information about the surface water disposal measures already in place and estimates of the rates of run-off generated by the surfaces drained.

- An assessment of the volume of surface water run-off likely to be generated from the proposed development and confirmation of how any excess volumes would be retained within the development.

- Information regarding how the proposed drainage design will perform under the increased frequency and intensity of rainfall that is predicted as a result of climate change (30% for residential development & 20% for non- residential).

- Information about other potential sources of flooding, if any, that may affect the site e.g. streams, surface water run-off, sewers, groundwater, reservoirs, canals and other artificial sources or any combination of these; including details on how these sources of flooding will be managed safely within the development proposal.

It should be noted that the above list is not exhaustive but provides a framework for the FRA to be prepared.

For developments less than 1 ha a FRA will not be required but a drainage design statement should be provided proportional to the scale of the development and follow the same design principles with regards to the calculating the maximum design flow rates for the site.

Eleanor Dale

From: Lunt, John [mailto:John.Lunt@uuplc.co.uk]
Sent: 12 February 2016 09:02
To: Eleanor Dale <EleanorDale@hydrock.com>
Subject: RE: (UU ref: DE1814) Former Rayware Site, Speke Boulevard, Liverpool C151858 - REPEAT due 29/02

Hi Eleanor,

In reply and from the survey data submitted I can confirm that UU would allow a surface water discharge rate of 230 l/s communicate with the 450mm public combined sewer crossing the site.

Regards,

John

From: Eleanor Dale [mailto:EleanorDale@hydrock.com]
Sent: 11 February 2016 16:19
To: Lunt, John <John.Lunt@uuplc.co.uk>
Cc: Automate - Manchester <automatewa@hydrock.com>
Subject: RE: (UU ref: DE1814) Former Rayware Site, Speke Boulevard, Liverpool C151858 - REPEAT due 29/02

Hi John,

I have attached the topographical survey for the Speke Boulevard site, with drainage runs marked on. There is more than one connection for this site.

Thanks,

Eleanor

Eleanor Dale
Infrastructure Engineer

Hydrock
St Baldred's Hall, 239 Ashley Road, Hale, Cheshire WA15 9NE
Office: 0161 233 0746
Mobile: 07469856545
www.hydrock.com

From: Lunt, John [mailto:John.Lunt@uuplc.co.uk]
Sent: 11 February 2016 15:51
To: Eleanor Dale <EleanorDale@hydrock.com>
Cc: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: RE: (UU ref: DE1814) Former Rayware Site, Speke Boulevard, Liverpool C151858 - REPEAT due 29/02

Hi Eleanor,

Could you forward a copy of the survey report please as we will need to assess the number and size of connections before giving any formal consent?

Regards,

John

From: Eleanor Dale [mailto:EleanorDale@hydrock.com]
Sent: 08 February 2016 16:37
To: Lunt, John <John.Lunt@uuplc.co.uk>
Cc: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>; Automate - Manchester <automatewa@hydrock.com>
Subject: RE: (UU ref: DE1814) Former Rayware Site, Speke Boulevard, Liverpool C151858

Hi John,

Thank you for your response. We have had a drainage survey completed for the site which shows that all of the surface water currently discharges into the combined sewer that runs through the east of the site. We would look to reuse these existing connections. Could you please confirm the allowable runoff rate from the site?

Thanks,

Eleanor

Eleanor Dale
Infrastructure Engineer

Hydrock
St Baldred's Hall, 239 Ashley Road, Hale, Cheshire WA15 9NE
Office: 0161 233 0746
Mobile: 07469856545
www.hydrock.com

From: Lunt, John [mailto:John.Lunt@uuplc.co.uk]
Sent: 27 January 2016 12:04
To: Eleanor Dale <EleanorDale@hydrock.com>
Cc: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: (UU ref: DE1814) Former Rayware Site, Speke Boulevard, Liverpool

Hi Eleanor,

In reply, I can confirm that UU will require the new development to be designed and served using a separate drainage system combining on site just prior to communicating with the public combined sewerage system however please note, before UU could agree to any formal discharge rate the client will need to submit sufficient evidence of the previous developments drainage regime and the existing connectivity with the said public sewerage system taking in to consideration the number of connections and size of the same.

In addition to the comments above please note that there's a public sewer currently crossing the site which appears to be built over by the existing factory, I'm not aware if there's a formal build over agreement in place with UU for this and therefore just as an aide memoir, the client should be made aware that "Build Over" agreements do not transfer automatically under new ownership and therefore due consideration for either protecting the sewer and or diverting the same should be taken in to account.

If you have any queries or comments in relation to the above then please don't hesitate to get in touch.

Regards,

John

John Lunt
Developer Query Engineer
Developer Services and Planning
Operational Services
T: 01925 679411 (Int; 79411)
E-mail: wastewaterdeveloperservices@uuplc.co.uk
United Utilities.com

From: Eleanor Dale [mailto:EleanorDale@hydrock.com]
Sent: 13 January 2016 10:35
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Cc: Automate - Manchester <automatewa@hydrock.com>
Subject: Wastewater predevelopment enquiry Former "Rayware" Site, Speke Boulevard - C151811

Dear Sir/Madam,

Please find attached a completed Wastewater predevelopment enquiry for a proposed development at the Former "Rayware" Site, Speke Boulevard, Liverpool. The enquiry relates specifically to the allowable surface water discharge rate from the development and also where the surface water can discharge to. I have attached a site location plan with the site boundary marked in red. The proposed development will be a mixed use commercial development.

I look forward to hearing from you.

Yours faithfully,

Eleanor Dale

Eleanor Dale
Infrastructure Engineer

Hydrock
St Baldred's Hall, 239 Ashley Road, Hale, Cheshire WA15 9NE
Office: 0161 233 0746

Mobile: 07469856545

www.hydrock.com

Appendix D – United Utilities Sewer Records

CONTENTS	
Identifier	**Name**
United Utilities	Sewer Records

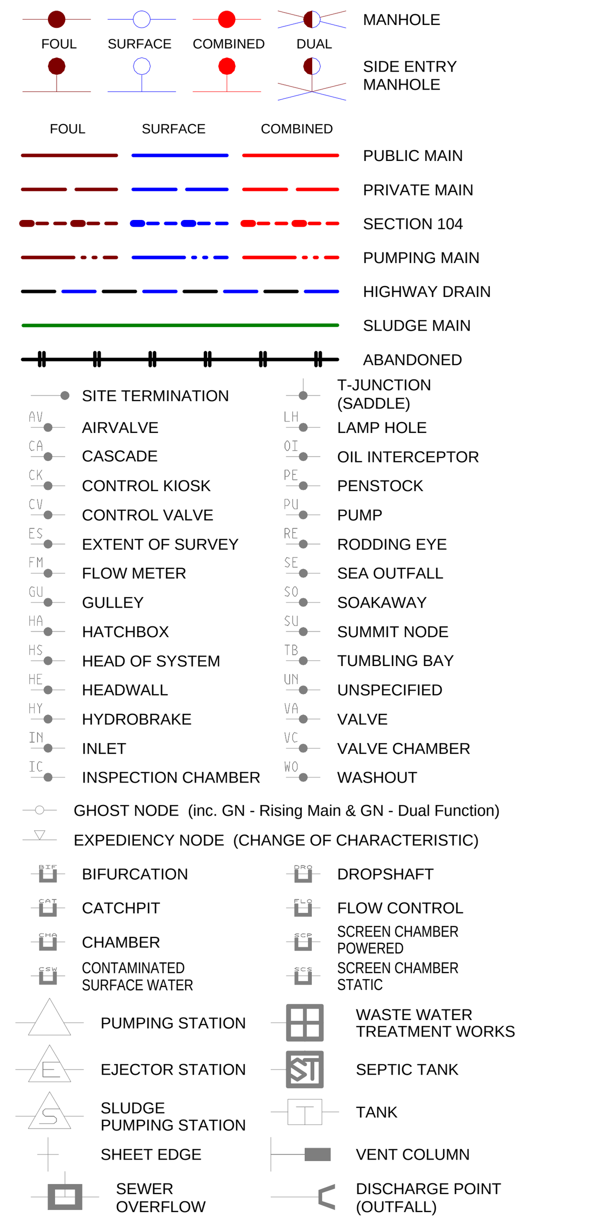
OS Sheet No: SJ4284SE

Scale 1:1250 Date: 12-Apr-2013

Printed by: Donna Camblin

Refno	Cover	Func	Type	Invert	Size.x	Size.y	Shape	Matl	Grad	Length
5101	29.98	S	M	25.61	375		C	VC	345	31.05
5102	32.18	S	M	28.93	375		C	VC		92.7
5103	32.16	F	M	28.6	225		C	VC		102.53
5104		S	G		375		C	VC		10
5105		F	G		225	710	C	VC		25.08
5106		S	Q	25.52	375		C	CO	400	32.02
5201	31.87	S	M	26.44	375		C	CO	87	36.67
5202	32.5	C	M	25.03	1050	730	E	BR	238	64.15
5203		S	Q	26.02	375		C	VC	89	36.67
5204		S	Q	12.28	375		C	CO	-2	24.41
5205		C	Q	24.76	1050	700	E	CO	222	59.91
5301	31.32	C	M	24.89	1050	700	E	CO	-353	31.8
5302	31.38	S	M	26.61	375		C	VC	-28	41.59
5303		S	M		300		C	VC		26
5304		C	M		1050	700	E	CO		26.12
5305		S	M		225		C	VC		24.41
5306		S	Q	28.12	375		C	CO	-28	42.58
5307		C	Q	24.98	1050	730	E	BR	-229	18.35
5308		S	L		225		C	VC		136.94
5400		S	L		225		C	VC		83.95
5401		C	M		750					56.22
5402	30.76	S	M	27.77	750		C	VC		62.37
5403	30.79	C	M	25.84	1000		C	CO		61.19
8001	33.45	F	M	27.7	300		C	VC	149	71.3
8002	33.64	S	M	29.26	1350		C	CO	862	34.5
8003	33.36	S	M	29.22	1350		C	CO	984	68.91
8101	33.96	F	M	28.17	300		C	VC	151	71.03
8102	33.7	S	M	29.38	1350		C	CO	494	44.47
8103	33.88	S	M	29.29	1350		C	CO	1167	35
8201	33.53	F	M	28.76	300		C	VC	144	85.09
8202	33.43	F	M	28.81	300		C	VC	151	7.54
8203	33.16	F	M	30.5	225		C	VC	30	48.78
8204	33.11	S	M	30.02	900		C	CO	590	41.33
8205	33.32	S	M	29.65	1200		C	CO	459	55.13
9201	33.35	F	M	29.35	150		C	VC	153	59.71
9202	33	F	M	29.6	150		C	VC	149	37.19
9203	33	S	M	30.13	900		C	CO	445	31.17
9204	33.2	S	M	30.06	900		C	CO	532	58.56
9401	35.97	F	M	33.81	150		C	PVC	147	70.37
9402	37.02	F	M	33.33	150		C	PVC	149	31.26
9403	37.07	S	M	33.73	300		C	PVC	191	28.67
9404	35.95	S	M	34.43	225		C	PVC	115	70.38
9405		F	M		150		C	VC		6.35
9406		S	M		150		C	VC		8.06

WASTE WATER SYMBOLOGY



Note - ALL flow direction arrows are BLUE - colour not significant

NODE TABLE ABBREVIATIONS

MANHOLE FUNCTION

F Foul
S Surface
C Combined
T Transition
O Overflow
U Unspecified

MANHOLE / NODE TYPE

M Manhole
J Junction
L Lamphole
H Hatchbox
R Rodding Eye
F Outfall
V Combined Sewer Overflow
P Pumping Station
S Soakaway
D Dual Function Manhole
W Treatment Works
Z Ghost in Rising Main
C Cascade
Y Gulley
E Ejector
O Oil Injector
I Inlet
B Hydrobrake
T Vent Column
X Valve
U Unspecified
Q Expediency Node
G Ghost (to allow pipe bends)

SEWER SHAPE

C Circular
E Egg
O Oval
F Flat Top
R Rectangular
S Square
T Trapezoidal
A Arch
B Barrel
H Horseshoe
U Unspecified

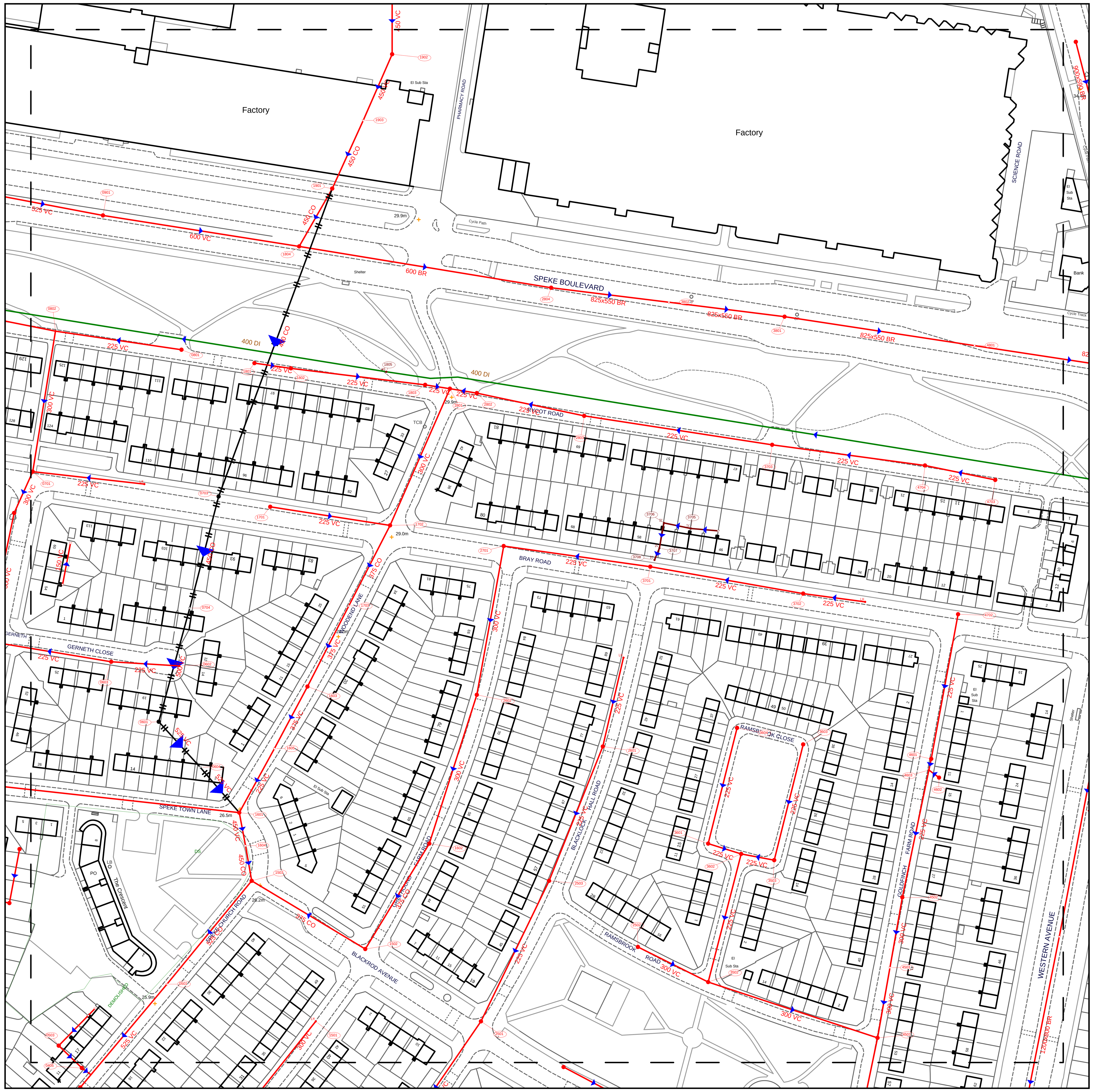
SEWER MATERIAL

AC Asbestos Cement
BR Brick
CI Cast Iron
SI Spun (Grey) Iron
CO Concrete
CS Concrete Segments (Bolted)
CS Concrete Segments (Unbolted)
CC Concrete Box Culvert
DI Ductile Iron
GR Glass Reinforced Concrete
GR Glass Reinforced Plastic
PS Plastic / Steel Composite
PV Polyvinyl Chloride
PE Polyethylene
RP Reinforced Plastic Matrix
ST Steel
VC Vitrified Clay (All Clayware)
PP Polypropylene
PF Pitch Fibre
MA Masonry - In Regular Courses
MA Masonry - Randomly Coursed
U Unspecified

OS Sheet No: SJ4284SE
Scale 1:1250 Date: 12-Apr-2013

44 Nodes
Sheet 1 of 1

United Utilities
SEWER RECORDS



Refno	Cover	Func	Type	Invert	Size.x	Size.y	Shape	Matl	Grad	Length
0501		C	Q	23.19	525		C	VC	117	65.3
0502		C	Q				C			4.73
0503		C	M				C			15.58
0504		C	Q				C			20.43
0601		C	M							
0602		C	L	25.56	225		C	VC	92	33.06
0603	27.19	C	M	25.17	225		C	VC	109	60.83
0604		C	Q							
0700		C	L	26.78	225		C	VC	92	54.33
0701	28.55	C	M	26.17	300		C	VC	81	21.93
0703	28.38	C	M							
0704		C	Q							
0706		C	Q		150		C	VC		20.33
0707		C	Q							
0801	29.34	C	M	27.8	225		C	VC		61.66
0802		C	J		300		C	VC		68.88
0901	30.84	C	M	27.18	600		C	VC	260	96.18
1501		C	L	24.26	300		C	VC	123	99.64
1502	26.02	C	M	24.27	375		C	CO	189	64.14
1503	26.13	C	M	23.75	525		C	CO	115	64.66
1601	26.35	C	M	24.11	450		C	VC	125	16.28
1602	27.18	C	M	24.71	375		C	CO	136	59.68
1603	27.54	C	M	24.62	375		C	VC	136	34
1604		C	Q	23.98	450		C	CO	123	17.26
1605		C	Q	24.37	225		C	VC	147	35.36
1701	28.36	C	M	26.74	225		C	VC	74	58.69
1702	28.86	C	M	25.15	375		C	CO	199	43.83
1703		C	Q	24.93	375		C	VC	191	43.83
1801	29.19	C	M	27.68	225		C	VC		17.84
1802		C	M		225		C	VC		65.49
1803	29.7	C	M	26.97	225		C	VC	202	12.12
1804	30.21	C	M	26.81	600		E	BR	169	123.63
1805		F	W		400		C	DI		198.65
1901		C	M		450			CO		32.25
1902		C	M		450		C	VC		34.93
1903		C	Q		450		C	CO		36.25
2501	25.76	C	M	23.86	300		C	VC	971	77.67
2502	27.4	C	M	25.92	300		C	VC	83	38.01
2503	27.2	C	M	25.24	225		C	VC	55	75.58
2600		C	L		225		C	VC		44.15
2601	27.19	C	M	25.36	225		C	VC	583	70.01
2602	28.35	C	M	26.58	300		C	VC	41	75.58
2701	29.51	C	M	27.74	300		C	VC	65	73.16
2801	29.86	C	M	26.83	300		C	VC	45	72.23
2802	30.04	C	M	27.9	225		C	VC	15	13.2
2803		C	M		225		C	VC		53.15
2804	30.65	C	M	26.08	825	550	E	BR	185	57.43
3502	27.56	C	M	25.46	300		C	VC	129	86.33
3503	28.64	C	M	26.96	225		C	VC		16.28
3601	28.61	C	M	26.81	225		C	VC		16.76
3602		C	M		225		C	VC		64.03
3603	29.82	C	M	28.35	225		C	VC	42	57.72
3604	29.74	C	M	28.22	225		C	VC	41	57.72
3701	30.1	C	M	28.56	225		C	VC	91	71.7
3702	30.77	C	M	29.3	225		C	VC	102	75.13
3703	31.31	C	M		225		C	VC		92.07
3704		F	Z				C			13.24
3705		F	J				C			13.39
3706		F	J				C			12.4
3707		F	J				C			6.14
3708		F	J							
3801	31.83	C	M	25.77	825	550	E	BR	300	93.06
3802		C	Q	25.77	825	550	E	BR	182	56.44
4501	28.1	C	M	24.69	375		C	CO	62	66.66
4502	29.19	C	M	27.09	300		C	VC	31	34.53
4503		C	Q	25.96	300		C	VC	31	34.53
4504		C	Q	22.48	1200	800	E	BR	240	143.75
4601	30.3	C	M	28.24	225		C	VC		5.49
4602		C	M		225			VC		6.15
4603		C	J		225		C	VC		62.95
4700		C	L		225		C	VC		30.27
4702		C	M		225		C	VC		71.2
4703		C	M		225		C	VC		34.71
4704	31.91	C	M	30.14	225		C	VC		74.67
4801		C	Q	25.77	825	550	E	BR	300	93.06

OS Sheet No: SJ4383NW

Scale 1:1250 Date: 12-Apr-2013

Printed by: Donna Camblin

WASTE WATER SYMBOLOGY

FOUL SURFACE COMBINED DUAL — MANHOLE

SIDE ENTRY MANHOLE

FOUL SURFACE COMBINED

PUBLIC MAIN
PRIVATE MAIN
SECTION 104
PUMPING MAIN
HIGHWAY DRAIN
SLUDGE MAIN
ABANDONED

SITE TERMINATION
AIRVALVE
CASCADE
CONTROL KIOSK
CONTROL VALVE
EXTENT OF SURVEY
FLOW METER
GULLEY
HATCHBOX
HEAD OF SYSTEM
HEADWALL
HYDROBRAKE
INLET
INSPECTION CHAMBER

T-JUNCTION (SADDLE)
LAMP HOLE
OIL INTERCEPTOR
PENSTOCK
PUMP
RODDING EYE
SEA OUTFALL
SOAKAWAY
SUMMIT NODE
TUMBLING BAY
UNSPECIFIED
VALVE
VALVE CHAMBER
WASHOUT

GHOST NODE (inc. GN - Rising Main & GN - Dual Function)
EXPEDIENCY NODE (CHANGE OF CHARACTERISTIC)

BIFURCATION
CATCHPIT
CHAMBER
CONTAMINATED SURFACE WATER
PUMPING STATION
EJECTOR STATION
SLUDGE PUMPING STATION
SHEET EDGE
SEWER OVERFLOW

DROPSHAFT
FLOW CONTROL
SCREEN CHAMBER POWERED
SCREEN CHAMBER STATIC
WASTE WATER TREATMENT WORKS
SEPTIC TANK
TANK
VENT COLUMN
DISCHARGE POINT (OUTFALL)

Note - ALL flow direction arrows are BLUE - colour not significant

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MANHOLE / NODE TYPE

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ST Steel
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MA Masonry - In Regular Courses
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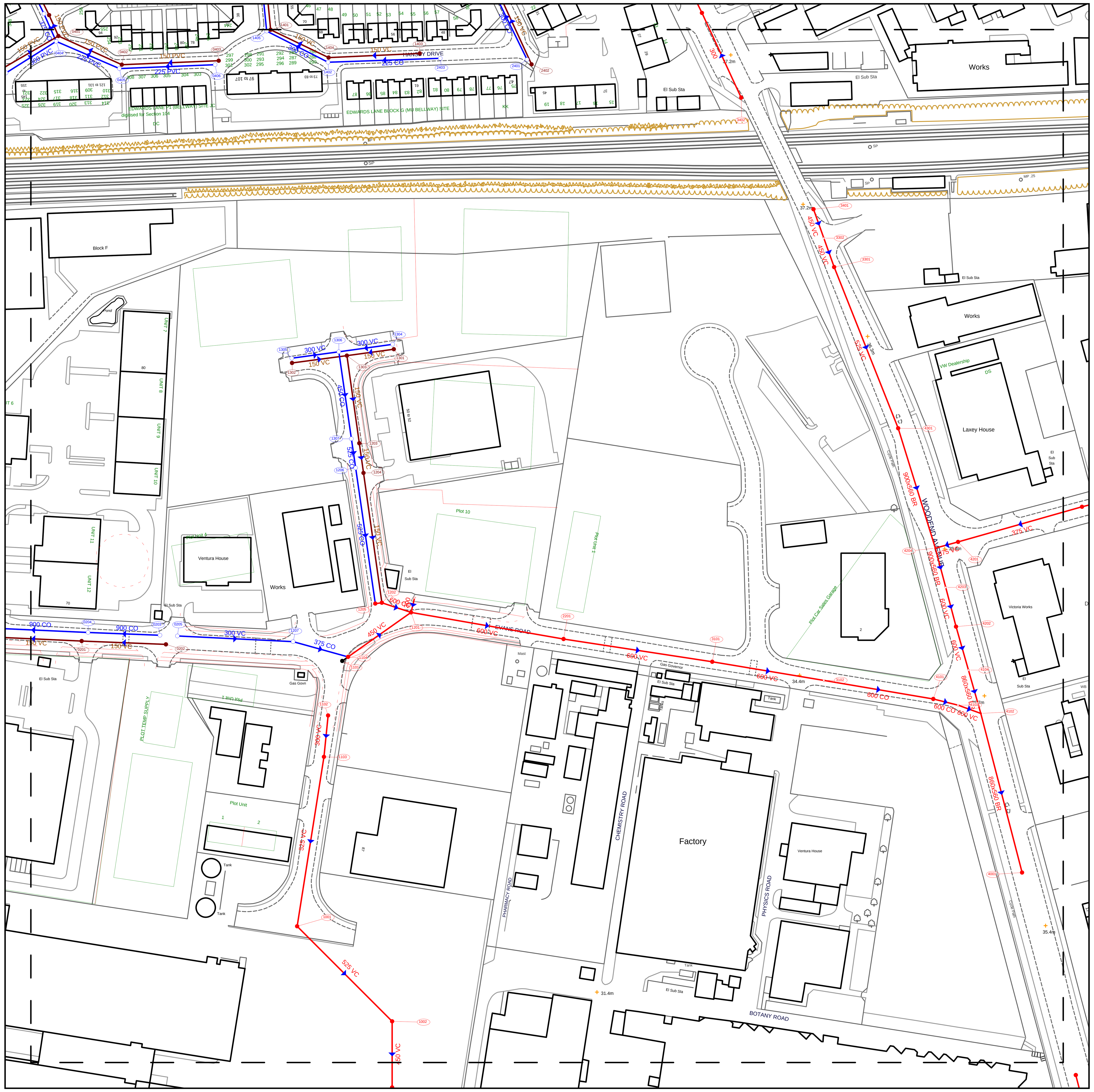
U Unspecified

OS Sheet No: SJ4383NW
Scale 1:1250 Date: 12-Apr-2013
75 Nodes
Sheet 1 of 1

United Utilities
SEWER RECORDS



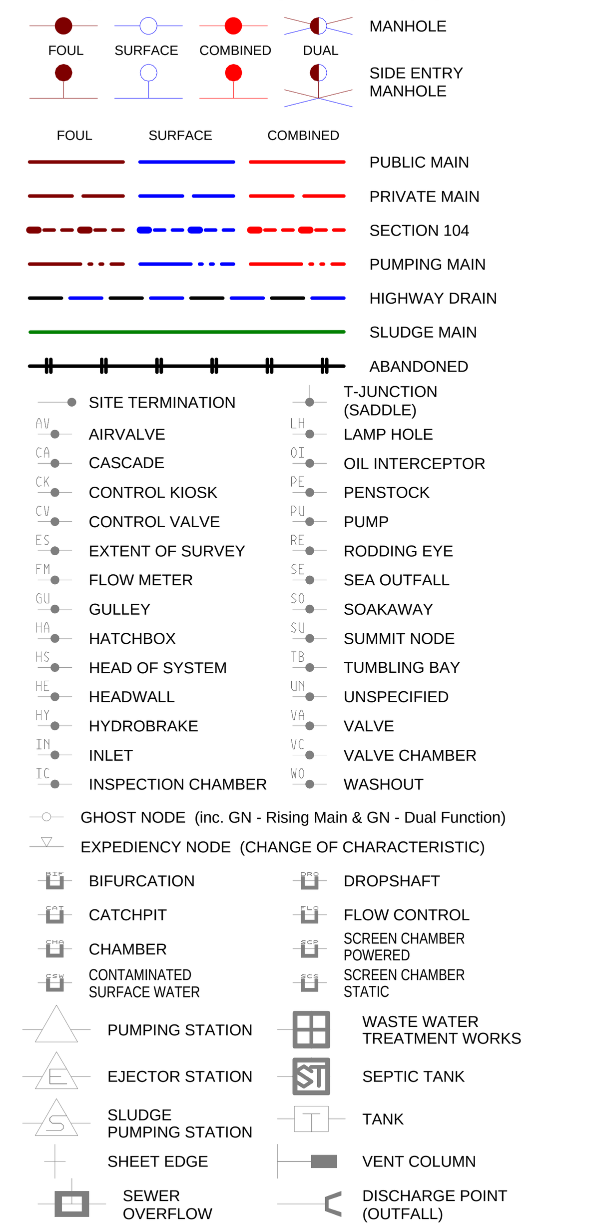
OS Sheet No: SJ4384SW

Scale 1:1250 Date: 12-Apr-2013

Printed by: Donna Camblin

Refno	Cover	Func	Type	Invert	Size.x	Size.y	Shape	Matl	Grad	Length
0201	32.77	F	M	29.91	150		C	VC	151	46.96
0202	32.9	F	M	30.19	150		C	VC	146	40.84
0203	32.78	S	M	30.52	900		C	CO	498	34.84
0204	32.65	S	M	30.45	900		C	CO	166	53.2
0205		S	M		300		C	VC		56.1
0401	36.95	F	M	33.12	150		C	PVC	158	11.07
0402	37.05	F	M	34.55	150		C	PVC	24	33.69
0403	36.45	F	M	34.87	150		C	PVC	147	46.96
0404	36.99	S	M	33.45	375		C	CO	39	14.57
0405	37.03	S	M	34.94	225		C	PVC	208	33.31
0406	36.51	S	M	35.2	225		C	PVC	178	46.36
1001	31.58	C	M	28.75	525		C	VC		65.05
1002		C	M		450		C	VC		32
1101	33.8	C	M							
1102	32.94	C	M	29.06	300		C	VC	287	20.1
1103	32.54	C	M	28.92	525		C	VC	519	83.02
1104		C	M		450		C	VC		37.31
1201	33.8	C	M	29.01	600		C	VC	288	74.96
1202		C	M		600		C	CO		14.89
1203		F	M		150		C	VC		14.52
1204		F	M		150		C	VC		63.44
1205		C	M				C			3.2
1206		S	M		525		C	CO		66.35
1207		S	M		375		C	CO		27.59
1301		F	M		150		C	VC		22.93
1302		F	M		150		C	VC		26.79
1303		F	M		150		C	VC		42.82
1304		S	M		300		C	VC		26.31
1305		S	M		300		C	VC		22.97
1306		S	M		450		C	CO		42.54
1307		S	M		525		C	CO		14.24
1401	36.79	F	M	34.59	150		C	VC	137	41.06
1402	37.18	S	M	35.18	300		C	CO	119	33.32
1403	38.74	F	M	36.61	150		C	VC	24	44.21
1404	37.13	F	M	34.8	150		C	VC	148	31.12
1405	36.76	S	M	34.9	300		C	CO	114	39.94
2201	34.5	C	M	28.75	600		C	VC	178	72.84
2401	37.26	S	M	35.29	300		C	CO	178	46.39
2402	37.13	F	M	35.73	150		C	VC	132	46.19
2403	37.18	S	M	35.51	225		C	CO	181	54.37
3101	34.39	C	M	28.34	600		C	VC	261	54.74
3102		C	Q	28.13	600		C	CO	256	53.76
3301	36.7	C	M	29.83	525		C	VC	215	83.93
3302		C	Q	32.09	450		C	VC	-9	14.87
3401	37.27	C	M	30.4	450		C	VC	-9	14.87
3402	37.3	C	M	33.49	300		C	U		45.19
4001	35.89	C	M							
4101	35.26	C	M	27.88	600		C	CO		12.37
4102		C	J		860	560	E	BR		79.56
4103		C	Q		600		C	VC		11.7
4104		C	Q		300					7.24
4104		C	Q		860	560	E	BR		21.84
4201	35.38	C	M	29.38	375		C	VC		11.4
4202	35.53	C	M	28.15	600		C	VC		21.84
4203		C	Q		600		C	VC		19.65
4204		C	J		900	560	E	BR		19.65
4301	35.49	C	M	29.41	900	560	E	BR		60.73

WASTE WATER SYMBOLOGY



Note - ALL flow direction arrows are BLUE - colour not significant

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MANHOLE / NODE TYPE

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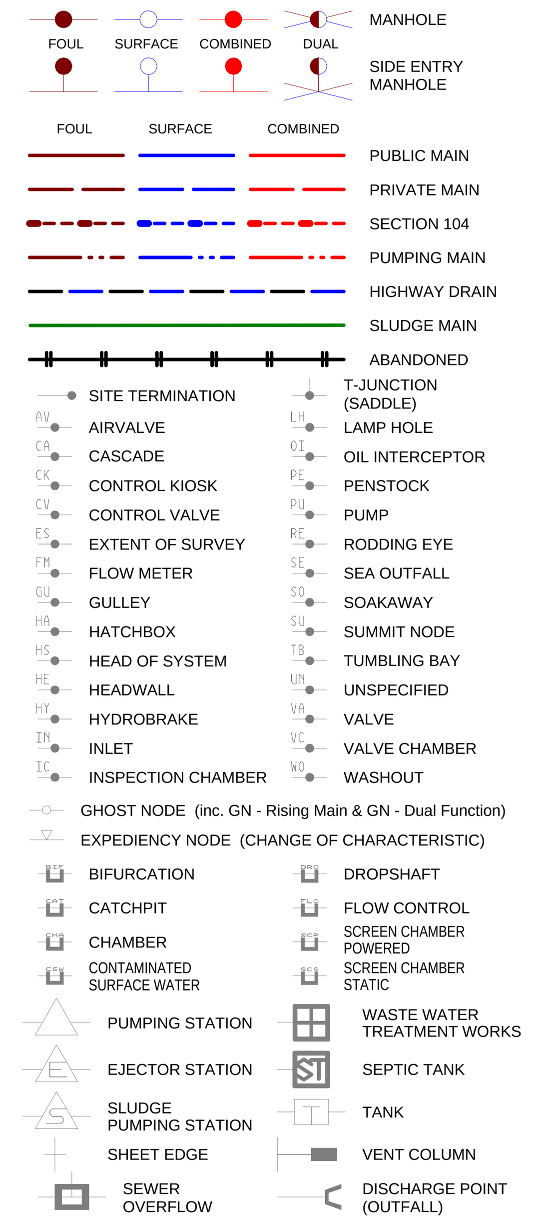
GR Glass Reinforced Concrete
GR Glass Reinforced Plastic
PS Plastic / Steel Composite
PV Polyvinyl Chloride
PE Polyethylene
RP Reinforced Plastic Matrix
ST Steel
VC Vitrified Clay (All Clayware)
PP Polypropylene
PF Pitch Fibre
MA Masonry - In Regular Courses
MA Masonry - Randomly Coursed
U Unspecified

OS Sheet No: SJ4384SW
Scale 1:1250 Date: 12-Apr-2013
57 Nodes
Sheet 1 of 1

United Utilities
SEWER RECORDS

Refno	Cover	Func	Type	Invert	Size.x	Size.y	Shape	Matl	Grad	Length
5500	25.31	F	M		300			VC		77.62
5901	28.75	C	M	22.54	525		C	CO		94.67
5902	28.76	S	M	21.55	450		C			112.78
6501	26.05	F	M	22.87	300		C	VC	250	32.46
6502	26.02	S	M	24.28	225		C	VC	457	22.86
6503	26.13	F	M	22.71	300		C	VC	318	38.2
6504	25.57	F	M	22.56	300			VC	328	75.37
6505		S	R	24.69	150				29	12.01
6600		S	R	24.98	150		C	VC	43	24.56
6602	25.32	S	M	24.5	225		C	VC	325	42.19
6605		S	R	25.1	150		C	VC	67	19.3
6606		F	R	25.03	150		C	VC	62	21.86
6700	26.87	S	M	25.57	225			VC	130	83.1
6701		S	M	24.93	225			VC	62	35.61
6901	30.52	C	M	23.46	525		C	CO	104	95.71
6902	30.53	S	M	24.03	450		C		40	98.62
7501	25.72	S	M	23.83	600		C	CO	168	38.66
7502	25.75	F	M	23.03	300		C	VC	162	22.74
7503	25.82	F	M	23.15	225		C	VC	305	15.27
7504	26.22	F	M	23.32	225		C	VC	147	23.54
7505	26.09	S	M		600		C			26.88
7506	26.07	S	M							
7507	25.76	S	M	23.04	675		C	CO		41.79
7508		S	Q							
7509	26.33	S	M		600		C			32.46
7510	26.44	S	M		600		C			26.09
7600	26.32	S	M	25.48	225			VC	61	49.48
7601	26.17	S	M	24.07	600		C	CO	184	25.75
7602	26.09	F	M	23.44	225		C	VC	137	31.5
7603	26.05	S	M	23.93	600		C	CO	836	58.49
7604	26.26	S	M	24.67	225		C	VC	36	10.44
7605	25.94	S	M	24.97	225		C	VC	139	41.71
7606	25.96	S	M							
7607	25.98	F	M		150		C			39.37
7608	25.82	S	M	24.74	150		C	VC	37	20.18
7609		S	Q	24.81	225		C	VC	64	19.28
7610		S	M		150		C			38.56
7611		F	Q							
7612		S	Q							
7613	25.86	F	M	23.21	225		C	VC	303	33.37
7700		S	R							
7701	26.41	S	M	24.16	600		C	CO	332	29.89
7702	26.41	F	M	23.81	225		C	VC	136	48.95
7703		S	R							
7705	26.9	S	M							
7707	26.72	F	M	24.49	225		C	VC	64	23.21
7708	26.75	S	M	24.38	600		C	CO	193	27.03
7709	26.6	F	M	24.11	225		C	VC	102	30.48
7710	26.57	S	M	24.24	600		C	CO	499	29.95
7711	26.95	F	M	24.97	225		C	VC	68	31.13
7712	27.01	S	M	24.55	525		C	CO	281	30.9
7713	27.38	S	M	25.86	300		C	VC	63	22.56
7714	27.57	S	M	26.03	300		C	VC	120	16.87
7715	26.73	F	M	25.7	150		C	VC	43	29.21
7716	26.74	S	M	25.15	225		C	VC	152	25.82
7717		S	Q	24.36	225		C	VC	-53	14.36
7718	26.33	F	M	25.05	225		C	VC	59	53.43
7719	26.99	F	M	25.23	225			VC	96	17.19
7720	26.31	S	M	25.25	225		C	VC	38	22.72
7721	26.95	S	M	25.5	225		C	VC	81	20.36
7722		S	Q	24.65	300		C	CO	203	34.53
7801	26.95	F	M	25.89	150		C	VC	97	16.45
7802	26.98	S	M	25.37	225		C	VC	98	17.55
7803	27.37	F	M	25.31	150		C	VC	84	22.59
7804	27.96	F	M	25.66	150		C	VC	86	25.68
7805	27.96	S	M	25.49	300		C	VC	78	26.4
7806	28.04	S	M	27.06	225		C	VC	60	32.31
7808	27.37	S	M	25.13	300		C	VC	141	21.1
7901	31.84	C	M	24.4	450		C	CO	104	97.38
7902	31.84	S	M	24.96	375		C		99	92.07
8500		C	M		375					92.97
8501	25.54	F	M							
8502	25.31	F	M		150		C			13.57
8503		S	M		675			CO		94.24

Refno	Cover	Func	Type	Invert	Size.x	Size.y	Shape	Matl	Grad	Length
8504	25.4	S	M	24.02	150		C	VC	103	27.94
8505	25.48	S	M		450		C			5.79
8506	25.26	S	M	23.42	450		C	CO	1072	10.72
8507		F	Q							
8508		S	M		450		C			30.02
8509		S	Q							
8510	26.22	F	M	24.42	225		C			55.9
8600		C	M		300					77.87
8601	25.71	F	M							
8602	25.55	F	M		225		C			34.79
8603	25.58	S	M	23.51	450		C	CO		7.38
8604	26.06	S	M	23.88	375		C	CO	168	46.91
8605	26.23	S	M	24.04	300		C	CO	316	25.29
8606	26.24	F	M	24.56	225		C	VC	187	72.81
8607	26.23	F	M	25.27	150		C	VC	76	45.8
8608	26.24	S	M	24.57	225		C	VC	135	51.13
8609	26.68	S	M	25.34	150		C	VC	30	28.29
8610	25.78	S	M	24.38	225		C	VC	139	49.92
8612		F	Q							
8701	26.48	S	M	24.27	300		C	CO	132	30.42
8702	26.59	F	M	24.81	225		C	VC	156	35.96
8704	27.61	S	M	25.09	225		C	VC	83	66.24
8705	27.64	F	M	25.48	225		C	VC	93	63.46
8706	27.46	S	M	25.95	150		C	VC	35	27.42
8707	27.77	F	M	26	150		C	VC	43	18.57
8708	27.75	S	M	26.54	300		C	VC	100	48.86
8709	28.29	F	M	26.5	150		C	VC	45	21.54
8710	28.16	F	M	27.11	150		C	VC	40	22.4
8711	28.18	S	M	27	225		C	VC	111	26.54
8712	26.34	S	M	24.83	225		C	VC	-28	11.79
8713	26.31	F	M	25.38	225		C	VC	26	8.63
8714		S	R		225			VC		24.05
8715		S	R							
8717		F	R	25.75	150		C	VC	35	29.39
8801	28.29	S	M	26.72	225		C	VC	160	25.61
8802	28.13	S	M							
8803	28.43	S	M							
8804	28.94	S	M							
8805	28.13	S	M							
8806	28.29	S	M	25.82	300		C	VC	82	26.93
8807	29.06	F	M	27.12	150		C	VC	55	78.55
8808	29.17	S	M	27.26	225		C	VC	35	47.08
8809	27.94	S	M	26.64	150		C		70	20.35
8810	28.05	S	M	26.35	150		C		56	25.08
8811	28.28	S	M	25.9	225		C	VC	164	13.09
8900		C	M		450		C			30.39
8901	30.58	S	M	28.83	225		C	VC	43	35.36
8902	31.59	S	M	26	375		C		83	85.99
8903	31.62	C	M		450		C			52.02
8904	32.29	C	M	27.07	450		C	CO	53	37.04
8905	32.28	S	M	29.15	400		C	CO	10	2.87
9501	25.86	C	M	23.29	450		C	CO	324	97.08
9502		C	M				C			19.18
9503		C	M				C			16.27
9504		C	J							
9505		C	Q		150		C	VC		6.72
9506		C	Q							
9601		C	M							155.73
9602	26.22	C	M	23.99	375		C	CO	107	74.15
9603		C	M				C			26.56
9700		C	L		225		C	VC		35.51
9701	27.44	C	M	24.56	375		C	CO	127	69.63
9702	28.41	C	M	25.9	300		C	VC	60	63.35
9703	27.36	C	M		225			VC		71.18
9704	28.77	C	M	26.74	225		C	VC	59	78.45
9800		C	M		300			VC		68.71
9801	29.88	F	M	28.38	150		C	VC	40	50.7
9802	29.96	S	M	27.97	225		C	VC	72	48.49
9803		F	Q		400		C	DI		84.63
9901	31.41	C	M	27.73	525		C	CO	147	45.7
9902		C	L		450		C	VC		7.3
9903		C	Q	27.42	525		C	VC	246	59.03
9904		F	Q		400		C	DI		528.57



Note - ALL flow direction arrows are BLUE - colour not significant

NODE TABLE ABBREVIATIONS

MANHOLE FUNCTION

F Foul
S Surface
C Combined
T Transition
O Overflow
U Unspecified

MANHOLE / NODE TYPE

M Manhole
J Junction
L Lamphole
H Hatchbox
R Rodding Eye
F Outfall
V Combined Sewer Overflow
P Pumping Station
S Soakaway
D Dual Function Manhole
W Treatment Works
Z Ghost in Rising Main
C Cascade
Y Gulley
E Ejector
O Oil Injector
I Inlet
B Hydrobrake
T Vent Column
X Valve
U Unspecified
Q Expediency Node
G Ghost (to allow pipe bends)

SEWER SHAPE

C Circular
E Egg
O Oval
F Flat Top
R Rectangular
S Square
T Trapezoidal
A Arch
B Barrel
H Horseshoe
U Unspecified

SEWER MATERIAL

AC Asbestos Cement
BR Brick
CI Cast Iron
SI Spun (Grey) Iron
CO Concrete
CS Concrete Segments (Bolted)
CS Concrete Segments (Unbolted)
CC Concrete Box Culvert
DI Ductile Iron
GR Glass Reinforced Concrete
GR Glass Reinforced Plastic
PS Plastic / Steel Composite
PV Polyvinyl Chloride
PE Polyethylene
RP Reinforced Plastic Matrix
ST Steel
VC Vitrified Clay (All Clayware)
PP Polypropylene
PF Pitch Fibre
MA Masonry - In Regular Courses
MA Masonry - Randomly Coursed
U Unspecified

OS Sheet No: SJ4283NE
Scale 1:1250 Date: 12-Apr-2013
147 Nodes
Sheet 1 of 1

United Utilities
SEWER RECORDS

OS Sheet No: SJ4283NE
Scale 1:1250 Date: 12-Apr-2013

Printed by: Donna Camblin

Appendix E – Hydrock Hydraulic Calculations

Proposed Drainage

I. 1 year summary Attenuation Volumes
II. 30 year summary Attenuation Volumes
III. 100 year summary Attenuation Volumes (Including the 30% allowance for Climate Change)

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	29.240	0.240	68.8	132.1	O K
30 min Summer	29.280	0.280	90.2	154.3	O K
60 min Summer	29.309	0.309	106.8	170.2	O K
120 min Summer	29.311	0.311	107.6	171.0	O K
180 min Summer	29.302	0.302	102.7	166.2	O K
240 min Summer	29.291	0.291	96.1	159.9	O K
360 min Summer	29.267	0.267	83.1	147.1	O K
480 min Summer	29.248	0.248	72.9	136.5	O K
600 min Summer	29.233	0.233	65.0	128.0	O K
720 min Summer	29.220	0.220	58.8	121.1	O K
960 min Summer	29.201	0.201	49.6	110.4	O K
1440 min Summer	29.175	0.175	38.6	96.3	O K
2160 min Summer	29.152	0.152	29.5	83.6	O K
2880 min Summer	29.137	0.137	24.4	75.4	O K
4320 min Summer	29.118	0.118	18.3	65.1	O K
5760 min Summer	29.107	0.107	15.0	58.6	O K
7200 min Summer	29.098	0.098	12.8	54.0	O K
8640 min Summer	29.092	0.092	11.2	50.4	O K
10080 min Summer	29.087	0.087	10.1	47.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	30.991	0.0	220.0	46
30 min Summer	20.215	0.0	287.8	52
60 min Summer	12.800	0.0	366.4	66
120 min Summer	7.942	0.0	455.0	94
180 min Summer	5.979	0.0	513.9	124
240 min Summer	4.882	0.0	559.7	154
360 min Summer	3.646	0.0	627.0	216
480 min Summer	2.956	0.0	677.8	276
600 min Summer	2.511	0.0	719.9	336
720 min Summer	2.199	0.0	756.3	396
960 min Summer	1.782	0.0	817.3	518
1440 min Summer	1.326	0.0	912.0	758
2160 min Summer	0.988	0.0	1020.4	1124
2880 min Summer	0.800	0.0	1102.3	1480
4320 min Summer	0.595	0.0	1228.7	2212
5760 min Summer	0.483	0.0	1330.4	2944
7200 min Summer	0.410	0.0	1413.8	3672
8640 min Summer	0.359	0.0	1485.9	4400
10080 min Summer	0.322	0.0	1549.4	5088

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	29.260	0.260	79.0	142.9	O K
30 min Winter	29.303	0.303	103.0	166.5	O K
60 min Winter	29.331	0.331	119.7	182.1	O K
120 min Winter	29.323	0.323	114.7	177.5	O K
180 min Winter	29.303	0.303	103.0	166.4	O K
240 min Winter	29.282	0.282	91.3	155.4	O K
360 min Winter	29.250	0.250	74.0	137.5	O K
480 min Winter	29.227	0.227	62.0	124.8	O K
600 min Winter	29.210	0.210	53.8	115.3	O K
720 min Winter	29.196	0.196	47.6	107.9	O K
960 min Winter	29.177	0.177	39.2	97.1	O K
1440 min Winter	29.152	0.152	29.5	83.5	O K
2160 min Winter	29.130	0.130	22.0	71.8	O K
2880 min Winter	29.117	0.117	18.0	64.4	O K
4320 min Winter	29.101	0.101	13.5	55.3	O K
5760 min Winter	29.090	0.090	10.9	49.6	O K
7200 min Winter	29.083	0.083	9.3	45.7	O K
8640 min Winter	29.078	0.078	8.1	42.7	O K
10080 min Winter	29.073	0.073	7.2	40.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	30.991	0.0	246.7	46
30 min Winter	20.215	0.0	322.6	51
60 min Winter	12.800	0.0	410.6	64
120 min Winter	7.942	0.0	509.8	94
180 min Winter	5.979	0.0	575.7	124
240 min Winter	4.882	0.0	627.0	156
360 min Winter	3.646	0.0	702.5	216
480 min Winter	2.956	0.0	759.3	278
600 min Winter	2.511	0.0	806.5	338
720 min Winter	2.199	0.0	847.2	398
960 min Winter	1.782	0.0	915.6	520
1440 min Winter	1.326	0.0	1021.8	764
2160 min Winter	0.988	0.0	1143.0	1128
2880 min Winter	0.800	0.0	1234.7	1480
4320 min Winter	0.595	0.0	1376.5	2196
5760 min Winter	0.483	0.0	1490.1	2944
7200 min Winter	0.410	0.0	1583.5	3640
8640 min Winter	0.359	0.0	1664.4	4344
10080 min Winter	0.322	0.0	1735.8	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.830

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.383	12	16	0.383	24	28	0.383	36	40	0.383
4	8	0.383	16	20	0.383	28	32	0.383			
8	12	0.383	20	24	0.383	32	36	0.383			

Model Details

Storage is Online Cover Level (m) 31.000

Tank or Pond Structure

Invert Level (m) 29.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	2.000	550.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0548-2300-1800-2300
Design Head (m)	1.800
Design Flow (l/s)	230.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	548
Invert Level (m)	29.000
Minimum Outlet Pipe Diameter (mm)	Error (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	229.9
Flush-Flo™	0.815	229.7
Kick-Flo®	1.412	204.2
Mean Flow over Head Range	-	184.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	13.3	1.600	217.1	5.000	379.4
0.200	49.3	1.800	229.9	5.500	397.6
0.300	101.4	2.000	242.1	6.000	415.0
0.400	160.8	2.200	253.6	6.500	431.6
0.500	215.4	2.400	264.7	7.000	447.7
0.600	225.1	2.600	275.2	7.500	463.1
0.800	229.7	3.000	295.2	8.000	478.1
1.000	227.3	3.500	318.4	8.500	492.6
1.200	220.1	4.000	340.0	9.000	506.6
1.400	205.7	4.500	360.2	9.500	520.3

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	29.456	0.456	193.3	251.0	O K
30 min Summer	29.561	0.561	223.0	308.6	O K
60 min Summer	29.658	0.658	227.4	362.0	O K
120 min Summer	29.630	0.630	226.4	346.7	O K
180 min Summer	29.567	0.567	223.4	312.0	O K
240 min Summer	29.511	0.511	219.7	281.3	O K
360 min Summer	29.447	0.447	188.5	246.0	O K
480 min Summer	29.404	0.404	163.0	222.0	O K
600 min Summer	29.371	0.371	143.6	204.2	O K
720 min Summer	29.346	0.346	128.6	190.4	O K
960 min Summer	29.309	0.309	106.8	170.0	O K
1440 min Summer	29.263	0.263	80.6	144.5	O K
2160 min Summer	29.223	0.223	60.0	122.5	O K
2880 min Summer	29.198	0.198	48.5	108.9	O K
4320 min Summer	29.168	0.168	35.6	92.2	O K
5760 min Summer	29.149	0.149	28.4	81.8	O K
7200 min Summer	29.136	0.136	23.8	74.5	O K
8640 min Summer	29.126	0.126	20.6	69.1	O K
10080 min Summer	29.118	0.118	18.2	64.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.035	0.0	543.5	45
30 min Summer	49.499	0.0	708.3	52
60 min Summer	30.811	0.0	883.8	68
120 min Summer	18.615	0.0	1068.1	98
180 min Summer	13.715	0.0	1180.6	126
240 min Summer	10.995	0.0	1262.0	154
360 min Summer	8.034	0.0	1383.4	214
480 min Summer	6.428	0.0	1475.7	274
600 min Summer	5.404	0.0	1550.7	334
720 min Summer	4.687	0.0	1614.1	394
960 min Summer	3.743	0.0	1718.6	514
1440 min Summer	2.723	0.0	1875.0	754
2160 min Summer	1.979	0.0	2045.3	1116
2880 min Summer	1.577	0.0	2172.6	1476
4320 min Summer	1.143	0.0	2362.7	2204
5760 min Summer	0.910	0.0	2508.7	2936
7200 min Summer	0.762	0.0	2625.4	3648
8640 min Summer	0.659	0.0	2724.0	4400
10080 min Summer	0.583	0.0	2809.1	5136

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	29.500	0.500	215.6	275.1	O K
30 min Winter	29.649	0.649	227.1	357.2	O K
60 min Winter	29.763	0.763	229.4	419.5	O K
120 min Winter	29.685	0.685	228.1	377.0	O K
180 min Winter	29.565	0.565	223.3	310.8	O K
240 min Winter	29.487	0.487	209.2	267.9	O K
360 min Winter	29.409	0.409	166.1	224.7	O K
480 min Winter	29.360	0.360	137.0	198.1	O K
600 min Winter	29.327	0.327	117.3	179.9	O K
720 min Winter	29.302	0.302	102.7	166.2	O K
960 min Winter	29.267	0.267	82.8	146.8	O K
1440 min Winter	29.224	0.224	60.8	123.4	O K
2160 min Winter	29.189	0.189	44.5	104.0	O K
2880 min Winter	29.168	0.168	35.6	92.1	O K
4320 min Winter	29.142	0.142	25.9	77.8	O K
5760 min Winter	29.126	0.126	20.6	69.1	O K
7200 min Winter	29.115	0.115	17.3	63.0	O K
8640 min Winter	29.106	0.106	14.9	58.3	O K
10080 min Winter	29.100	0.100	13.2	54.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	76.035	0.0	609.0	45
30 min Winter	49.499	0.0	793.6	53
60 min Winter	30.811	0.0	990.0	68
120 min Winter	18.615	0.0	1196.5	100
180 min Winter	13.715	0.0	1322.5	128
240 min Winter	10.995	0.0	1413.6	154
360 min Winter	8.034	0.0	1549.5	214
480 min Winter	6.428	0.0	1653.0	274
600 min Winter	5.404	0.0	1736.9	334
720 min Winter	4.687	0.0	1808.0	394
960 min Winter	3.743	0.0	1925.0	516
1440 min Winter	2.723	0.0	2100.3	758
2160 min Winter	1.979	0.0	2290.9	1116
2880 min Winter	1.577	0.0	2433.5	1472
4320 min Winter	1.143	0.0	2646.6	2200
5760 min Winter	0.910	0.0	2809.8	2936
7200 min Winter	0.762	0.0	2940.6	3624
8640 min Winter	0.659	0.0	3051.1	4320
10080 min Winter	0.583	0.0	3146.6	5048

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.830

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.383	12	16	0.383	24	28	0.383	36	40	0.383
4	8	0.383	16	20	0.383	28	32	0.383			
8	12	0.383	20	24	0.383	32	36	0.383			

Model Details

Storage is Online Cover Level (m) 31.000

Tank or Pond Structure

Invert Level (m) 29.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	2.000	550.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0548-2300-1800-2300
Design Head (m)	1.800
Design Flow (l/s)	230.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	548
Invert Level (m)	29.000
Minimum Outlet Pipe Diameter (mm)	Error (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	229.9
Flush-Flo™	0.815	229.7
Kick-Flo®	1.412	204.2
Mean Flow over Head Range	-	184.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	13.3	1.600	217.1	5.000	379.4
0.200	49.3	1.800	229.9	5.500	397.6
0.300	101.4	2.000	242.1	6.000	415.0
0.400	160.8	2.200	253.6	6.500	431.6
0.500	215.4	2.400	264.7	7.000	447.7
0.600	225.1	2.600	275.2	7.500	463.1
0.800	229.7	3.000	295.2	8.000	478.1
1.000	227.3	3.500	318.4	8.500	492.6
1.200	220.1	4.000	340.0	9.000	506.6
1.400	205.7	4.500	360.2	9.500	520.3

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	29.860	0.860	229.7	473.2	O K
30 min Summer	30.245	1.245	229.7	684.9	O K
60 min Summer	30.545	1.545	229.7	850.0	O K
120 min Summer	30.542	1.542	229.7	848.2	O K
180 min Summer	30.392	1.392	229.7	765.8	O K
240 min Summer	30.215	1.215	229.7	668.0	O K
360 min Summer	29.920	0.920	229.7	505.7	O K
480 min Summer	29.707	0.707	228.6	388.9	O K
600 min Summer	29.568	0.568	223.4	312.2	O K
720 min Summer	29.495	0.495	213.1	272.4	O K
960 min Summer	29.429	0.429	178.1	235.7	O K
1440 min Summer	29.355	0.355	133.7	195.2	O K
2160 min Summer	29.296	0.296	99.0	162.6	O K
2880 min Summer	29.260	0.260	79.3	143.2	O K
4320 min Summer	29.218	0.218	57.6	119.7	O K
5760 min Summer	29.192	0.192	45.6	105.4	O K
7200 min Summer	29.174	0.174	38.2	95.7	O K
8640 min Summer	29.161	0.161	32.8	88.3	O K
10080 min Summer	29.150	0.150	28.9	82.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	128.285	0.0	918.6	47
30 min Summer	84.226	0.0	1207.0	56
60 min Summer	52.662	0.0	1511.5	72
120 min Summer	31.800	0.0	1825.6	106
180 min Summer	23.353	0.0	2011.1	140
240 min Summer	18.644	0.0	2140.9	168
360 min Summer	13.543	0.0	2332.8	228
480 min Summer	10.792	0.0	2478.6	284
600 min Summer	9.043	0.0	2596.0	340
720 min Summer	7.823	0.0	2694.9	394
960 min Summer	6.219	0.0	2856.2	514
1440 min Summer	4.493	0.0	3095.2	754
2160 min Summer	3.241	0.0	3350.7	1112
2880 min Summer	2.568	0.0	3539.7	1476
4320 min Summer	1.847	0.0	3818.2	2204
5760 min Summer	1.461	0.0	4027.8	2936
7200 min Summer	1.217	0.0	4194.2	3664
8640 min Summer	1.048	0.0	4333.4	4400
10080 min Summer	0.923	0.0	4452.9	5136

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	30.021	1.021	229.7	561.7	O K
30 min Winter	30.481	1.481	229.7	814.6	O K
60 min Winter	30.790	1.790	229.7	984.5	Flood Risk
120 min Winter	30.750	1.750	229.7	962.5	Flood Risk
180 min Winter	30.531	1.531	229.7	842.0	O K
240 min Winter	30.242	1.242	229.7	683.2	O K
360 min Winter	29.785	0.785	229.6	431.9	O K
480 min Winter	29.537	0.537	221.5	295.6	O K
600 min Winter	29.461	0.461	195.7	253.5	O K
720 min Winter	29.418	0.418	171.6	229.8	O K
960 min Winter	29.362	0.362	137.9	199.0	O K
1440 min Winter	29.299	0.299	100.7	164.2	O K
2160 min Winter	29.248	0.248	72.9	136.5	O K
2880 min Winter	29.218	0.218	57.8	120.1	O K
4320 min Winter	29.183	0.183	41.7	100.4	O K
5760 min Winter	29.161	0.161	33.0	88.6	O K
7200 min Winter	29.146	0.146	27.5	80.5	O K
8640 min Winter	29.135	0.135	23.7	74.3	O K
10080 min Winter	29.127	0.127	20.9	69.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	128.285	0.0	1029.2	47
30 min Winter	84.226	0.0	1352.2	57
60 min Winter	52.662	0.0	1693.0	74
120 min Winter	31.800	0.0	2044.8	112
180 min Winter	23.353	0.0	2252.6	146
240 min Winter	18.644	0.0	2398.0	178
360 min Winter	13.543	0.0	2612.9	234
480 min Winter	10.792	0.0	2776.2	282
600 min Winter	9.043	0.0	2907.7	336
720 min Winter	7.823	0.0	3018.4	394
960 min Winter	6.219	0.0	3199.2	514
1440 min Winter	4.493	0.0	3467.0	754
2160 min Winter	3.241	0.0	3752.9	1116
2880 min Winter	2.568	0.0	3964.6	1480
4320 min Winter	1.847	0.0	4276.7	2204
5760 min Winter	1.461	0.0	4511.2	2896
7200 min Winter	1.217	0.0	4697.6	3672
8640 min Winter	1.048	0.0	4853.6	4400
10080 min Winter	0.923	0.0	4987.7	5088

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 3.830

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.383	12	16	0.383	24	28	0.383	36	40	0.383
4	8	0.383	16	20	0.383	28	32	0.383			
8	12	0.383	20	24	0.383	32	36	0.383			

Model Details

Storage is Online Cover Level (m) 31.000

Tank or Pond Structure

Invert Level (m) 29.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	2.000	550.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0548-2300-1800-2300
Design Head (m)	1.800
Design Flow (l/s)	230.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	548
Invert Level (m)	29.000
Minimum Outlet Pipe Diameter (mm)	Error (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

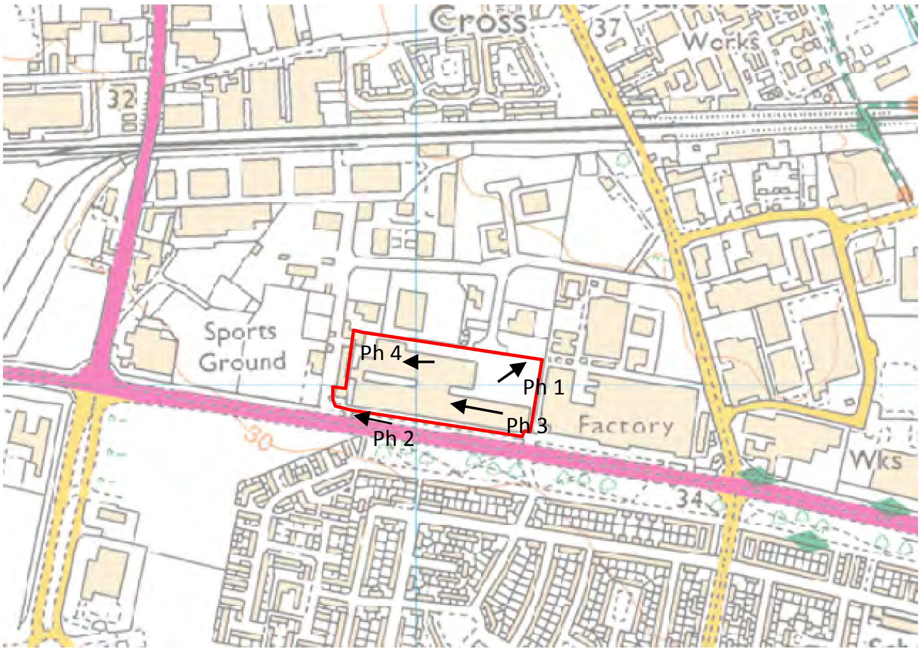
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	229.9
Flush-Flo™	0.815	229.7
Kick-Flo®	1.412	204.2
Mean Flow over Head Range	-	184.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	13.3	1.600	217.1	5.000	379.4
0.200	49.3	1.800	229.9	5.500	397.6
0.300	101.4	2.000	242.1	6.000	415.0
0.400	160.8	2.200	253.6	6.500	431.6
0.500	215.4	2.400	264.7	7.000	447.7
0.600	225.1	2.600	275.2	7.500	463.1
0.800	229.7	3.000	295.2	8.000	478.1
1.000	227.3	3.500	318.4	8.500	492.6
1.200	220.1	4.000	340.0	9.000	506.6
1.400	205.7	4.500	360.2	9.500	520.3

Appendix F – Site Photographs

Photograph Location Plan



Photograph 1 – View across the car park in the northeast of the site

Photograph 2 – View along Speke Boulevard on the southern site boundary

Photograph 3 – View inside the existing building in the south of the site

Photograph 4 – View inside the northern building on site.