THOMAS CONSULTING
STRUCTURAL & CIVIL DESIGN ENGINEERS

TC/T19360/2021/06

FLOOD RISK ASSESSMENT

AND

DRAINAGE STRATEGY

AT

Land Adjacent to Waters Edge
Whitehaven
CA28 9PD

FOR

Gleeson Homes

REPORT VERIFICATION

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Checked	Matt Johnson BSc (Hons)
Verified	Kieron Hounslow BEng (Hons) CEng MIStructE

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1 INTRODUCTION

1.1 Project Scope / Client Brief

Thomas Consulting has been commissioned by Gleeson Homes to carry out a site-specific flood risk assessment and drainage strategy report in accordance with the National Planning Policy Framework (NPPF) to support a planning application that fulfils the requirements of the statutory local authorities.

1.2 Site Location & Topography

The site is located 1.8 miles south of the town of Whitehaven at the Land Adjacent to Waters Edge, Whitehaven, CA28 9PD and this report is to support the development of a new Housing Development. The approximate Ordnance Survey (OS) grid reference for the site is 296680E 516290N and the location of the site is shown on Figure 1.

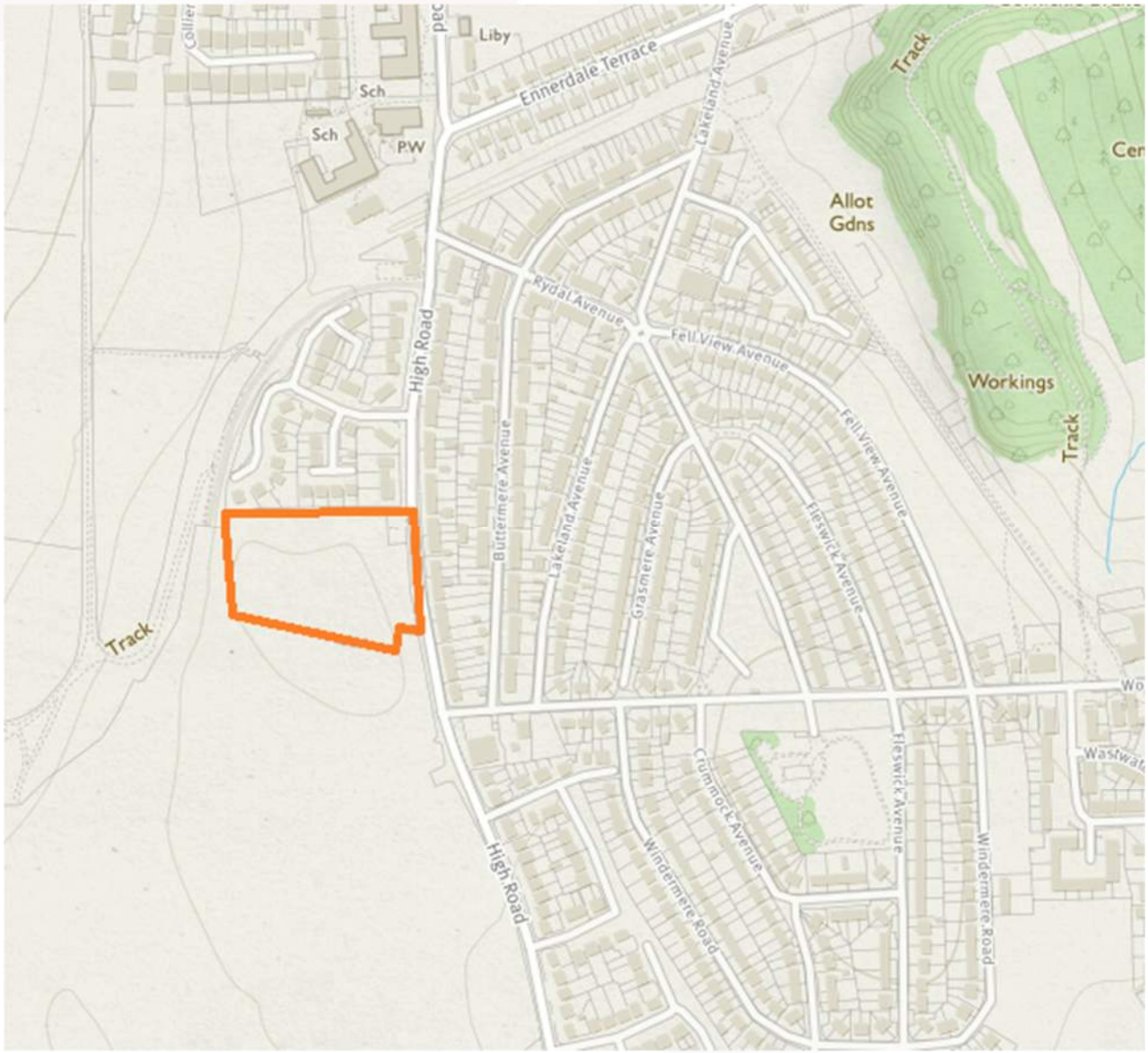

Figure 1: Site location plan (Source: OS Maps, 2020)

The site covers a total area of approximately 1.37 ha and comprises derelict land belonging to the former Rhodia Chemical Works. The land is generally flat with average elevations of around 95 m AOD and is

currently made up of fill comprising demolition material and hardstanding material to the southeast. The site is bound to the north by existing residential dwellings, to the east by High Road and more residential dwellings. The south and west are currently unused derelict land most likely also part of the old Chemical Works. A topographical survey to Ordnance Datum has been provided by Gibson Surveying & Mapping Ltd and can be seen on Drawing Number GH/WE/TS01 included in Appendix A. The topographical survey shows that there is little variation in ground levels across the site other than the highlighted stockpiles. It is understood the client proposes to remove the stockpiles off site prior to any development works

It is the client's intention to build 40 new residential dwellings over the entire site area with associated highways, driveways and pedestrian access into the site. Drawing Number 1839/001 by Ashwood Design Associates Ltd included in Appendix B, shows access to the proposed site being provided via 1 main access road, with 3 additional roads providing access to dwellings across the site. Both the main access road and associated pedestrian access points will be offered for adoption to Cumbria County Council (CCC) along with any main drainage features serving the site to United Utilities (UU).

1.3 National Planning Policy Framework and Planning Practice Guidelines

The NPPF and its Planning Practice Guidance (PPG) states any development other than the following outlined below is classed as a major development.

- Minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square meters.
- Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
- Householder development: For example, sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

The guidance also states that a site-specific flood risk assessment is required for the following site proposals.

- A site proposed in Flood Zone 2 or 3 including minor development and change of use in development type to a more vulnerable class.
- More than 1 hectare (ha) in Flood Zone 1
- Less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs)
- In an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency

1.4 Environment Agency Flood Map for Planning

National Planning Policy Framework (NPPF) Flood Zones comprise Flood Zone 1, Flood Zone 2 and Flood Zone 3. The Environment Agency's Indicative Flood Map for Planning (Figure 2) shows that the site is located within the NPPF defined Flood Zone 1.

Flood Zones are based on an areas Annual Exceedance Probability (AEP) of River or Sea Flooding. For example, Flood Zone 1 has a 'Low Probability' of flooding as it has an AEP of <0.1% (Less than 1 in 1000 year) of occurring in any one year. Flood Zone 2 has a 'Medium Probability' having an AEP of 0.1-1.0% (1 in 1000 – 1 in 100 year) chance of river flooding, or 0.1-0.5% (1 in 1000 – 1 in 200 year) chance of tidal/sea flooding.

Flood Zone 3 is split between 'a' and 'b' classifications. Flood Zone 3a has a 'High Probability' of flooding as it has an AEP of >1.0% (More than 1 in 100 year) chance of river flooding, or >0.5% (More than 1 in 200 year) chance of sea/tidal flooding. Flood Zone 3b (The Functional Floodplain) comprises land where water has to flow or be stored in times of flooding. Local planning authorities should identity in the Strategic Flood Risk Assessments areas of a functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map for Planning).

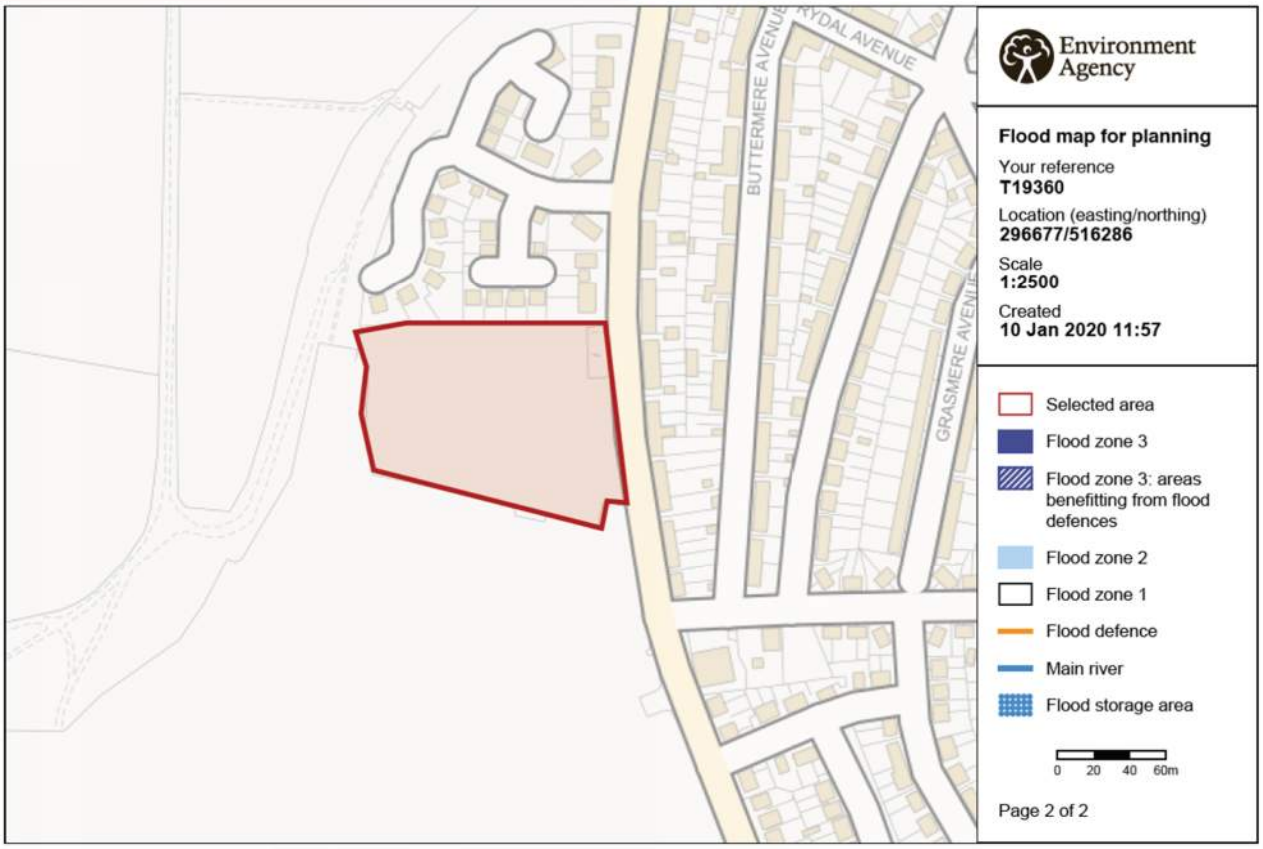

Figure 2: Environment Agency Flood Zone Map (Source: Environment Agency, 2018, GOV.UK)

1.5 Development Classification

The PPG separates each development into a vulnerability class. These classifications can be found in Figure 3, whilst in Figure 4 permittable development in relation to its classification is shown.

Vulnerability Classification	Development
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk • Essential utility infrastructure, which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood • Wind turbines
Highly Vulnerable	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operation during flooding. • Emergency dispersal points • Basement dwellings • Caravans, mobile homes and park homes intended for permanent residential use • Installations requiring hazardous substances consent
More Vulnerable	• Hospitals • Residential institutions such as residential care homes, children's homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and education establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short let caravans and camping, subject to a specific warning and evacuation plan
Less Vulnerable	• Police, ambulance and fire stations which are NOT required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distributions; non-residential institutions not included in the 'more vulnerable' class; and assemble and leisure. • Land and buildings used for agriculture and forestry • Waste treatment (except landfill & hazardous waste facilities) • Minerals working & processing (except for sand & gravel working) • Water treatment works which do not need to remain operational during times of flood • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water-Compatible Development	• Flood control infrastructure • Water transmission infrastructure & pumping stations • Sewage transmission infrastructure & pumping stations • Sand & gravel working • Docks, marinas and wharves • Navigation facilities • Ministry of Defence installations • Ship building, repairing & dismantling, dockside fish processing & refrigeration & compatible activities requiring a waterside location • Water based recreation (excluding sleeping accommodation) • Lifeguard and coastguard stations • Amenity open space, nature conservation & biodiversity, outdoor sports and recreation and essential facilities such as changing rooms • Essential ancillary sleeping or residential accommodation for staff required by uses in this category subject to a specific warning & evacuation plan.

Figure 3: NPPF Flood Risk Vulnerability Classification (Source: National Planning Practice Guidance, 2014)

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 4: NPPF Flood Risk Vulnerability Classification (Source: National Planning Practice Guidance, 2014)

1.6 The Proposed Development in Relation to Planning Requirement

Even though the site is located in Flood Zone 1, the proposed development footprint is over 1ha. Therefore, a flood risk assessment is required and will accompany a surface and foul water drainage strategy. The development is classed as major in accordance with the Town and Country Planning Order, 2015 by DEFRA and the EA as the proposals are over 1ha and over 10 dwellings. In accordance with Figure 3 the size is classed as more vulnerable to flood risk. Figure 4 shows that more vulnerable developments are acceptable in Flood Zone 1.

2 SITE CHARACTERISTICS

2.1 Geological Assessment

A desk-based study has been carried out to analyse the basic site geology. British Geological Survey (BGS) and Land Information Systems (LandIS) provide mapping which indicates the characteristics of the soil, superficial and bedrock layers across the site Table 1.

Principal Aquifers - These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary A Aquifers - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Secondary B Aquifers - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons, and weathering. These are generally the water-bearing parts of the former non-aquifers.

Secondary (Undifferentiated) Aquifers - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

Geological Assessment			
Geological Layer	**Classification**	**Description**	**Aquifer Class**
Soil	Soilscape 6	Freely draining to local groundwater and rivers	N/A
Superficial (Drift)	Till	Devensian – Diamicton	Secondary Undifferentiated
Bedrock (Solid)	Whitehaven Sandstone Formation	Sandstone	Secondary A

Table 1: Geological Assessment

Magic maps which are available online provide data on vulnerability zones such as source protections zones and/or groundwater vulnerability zones. The maps indicate there are no Groundwater Source Protection Zones or Groundwater Abstraction Licenses within 5 km of the site. The development site overlies a productive aquifer with “Medium – High” vulnerability.

2.2 Existing Surrounding Natural or Manmade Drainage Features

According to the EA Main River Maps the closest known watercourse is 1.2km east from the site. This watercourse is called Pow Beck and is 3.01km in length running south from the town of Whitehaven.

Reference to the UU sewer records (included in Appendix C), indicates that there as numerous sewers surrounding the site, with no sewers directly crossing the site boundary.

- 100mm Surface Water Sewer – Located to the front of 24 Snaefell Terrace heading north.

- 100mm Combined Sewer – Located to the rear of 28 Snaefell Terrace heading north.

- 100mm Combined Sewer – Located to the rear of 29 Snaefell Terrace heading south.

- 100mm Surface Water Sewer – Located to the front of 31 Snaefell Terrace heading south.

- 225mm Foul Water Sewer – Located approximately 200m to the west of the site heading north.

It is clear that the existing UU records are incomplete, as the development located to the north of the proposed site is shown as having no sewers available. Appendix E shows the drainage for the Phase 1 Story Homes development site. A connection is available within the Gleeson Homes land curtilage to discharge into this adjacent sites drainage network.

2.3 Geotechnical Assessment

FWS Geological & Geo-Environmental Consultants (FWS) undertook a Phase 1 and Phase 2 Geoenvironmental investigation (Report No. 8190OR03/October 2019). Intrusive investigations were carried out across the site between the 22nd and 23rd of August 2019, which consisted of 10 trial pits being dug to a depth of between 1.4 – 3m deep to examine the natural strata make-up and any buried obstructions, 5 mini-percussion boreholes for SPT tests to be carried out at a depth between 2 – 4.45m, 7 machine excavated inspections pits in the stockpiles, chemical and geotechnical testing and monitoring wells for groundwater.

General ground conditions consisted of made ground to be at depths between 0.3 and >1.5m deep across the site, underlain by glacial till extending to depths of up to 4.45m bgl. Weathered sandstone bedrock was recovered at a depth between 0.4 and 2.3m bgl to the southeast of the site.

Groundwater seepages were encountered in the boreholes or trial pits at depths between 0.3 and 1.2m bgl. Further monitoring reports can be found in FWS's report, and any more recent visits can be obtained by contacting FWS.

3 ASSESSMENT OF FLOOD RISK

3.1 Explanation of Flood Risk

Flood events are often referred to as their probability of occurrence. This occurrence is usually related to how often a storm may return in any single year Table 2 shows the storm return periods and how they are expressed as a fraction and percentage in common terminology.

Storm Return Period (Years)	Annual Exceedance Probability (AEP)	
	Fraction	Percentage
2	0.5	50%
10	0.1	10%
25	0.04	4%
50	0.02	2%
100	0.01	1%
200	0.005	0.5%
500	0.002	0.2%
1000	0.001	0.1%

Table 2: Storm Return Period Probabilities

3.2 Flooding Resulting from the Rivers and/or Sea

Figure 5 shows the EA fluvial flood map derived from the DEFRA online portal. This map indicates areas which may be at risk of flooding from rivers and the sea. High risk is classed as a >3.3% Annual Exceedance Probability (AEP) event and is shown in dark blue. Medium risk is an AEP event of between 3.3-1% and is shown in blue. Low risk is an AEP event of between 1-0.1% and is shown in light blue. Very Low risk is an AEP event of <0.1% and is shown in white.

The site is not located in proximity to a main river. The nearest main river/watercourse is Pow Beck located 1.2km east of the site and is 3.01km in length running south from the town of Whitehaven. This poses no flood risk to the site. The fluvial flood map shown in Figure 5 indicates the site is at very low risk of fluvial flooding. The maps show the latest information provided by the EA and considers the protections provided by current flood defences. However climate change is not assessed as part of the map's information.

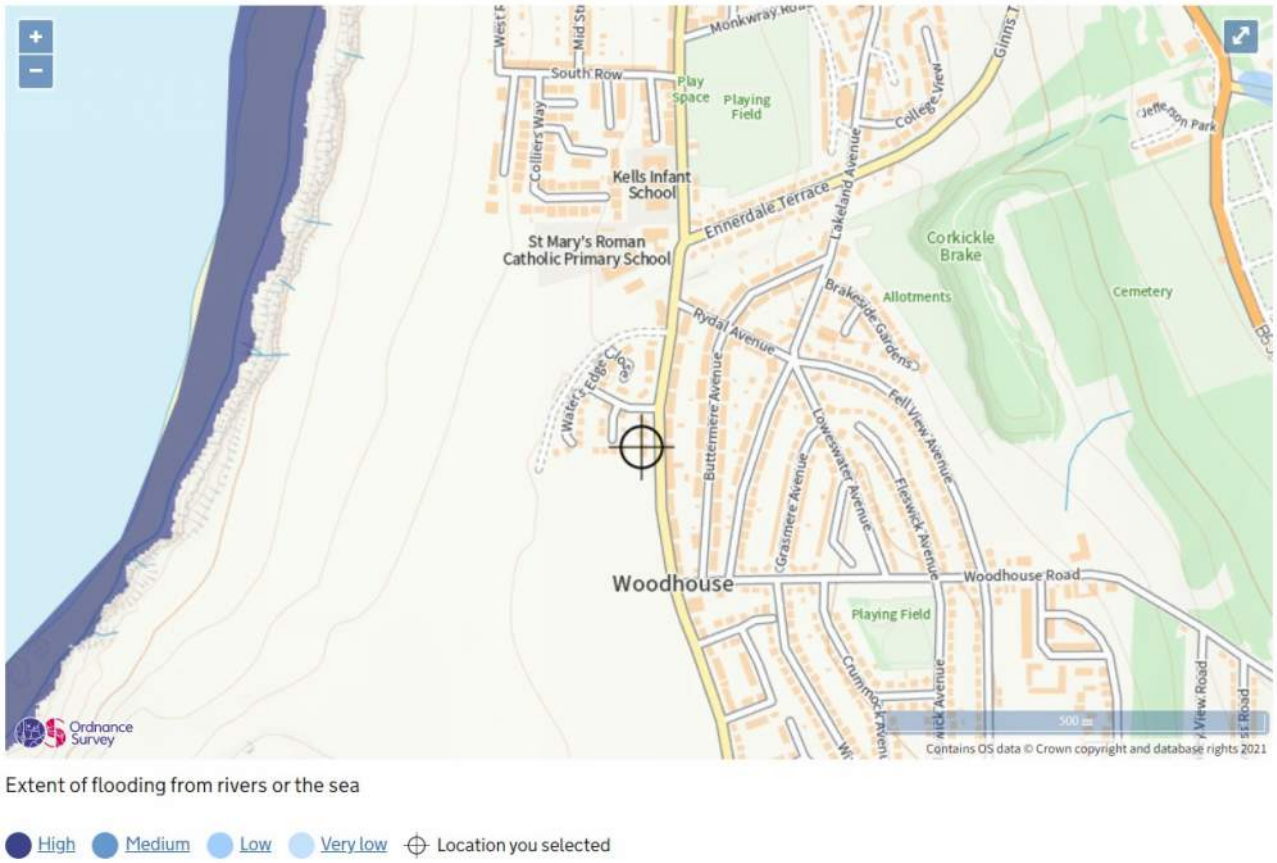

Figure 5: Environment Agency Fluvial Flood Map (Source: Environment Agency, 2021, GOV.UK)

3.3 Flooding Resulting from Surface Water

Also available on the DEFRA online portal are maps provided by the EA showing areas known to be affected by surface water flooding. These maps are based on historic flooding information received from statutory authorities and a generalised model based on digital terrain modelling.

The maps work in the same colour coding as described above for the fluvial maps where High Risk AEP events are displayed in Dark Blue, Medium Risk in Blue, Low Risk in Light Blue and Very Low Risk in White. Figure 6 shows the site is predominantly not at risk of surface water flooding.

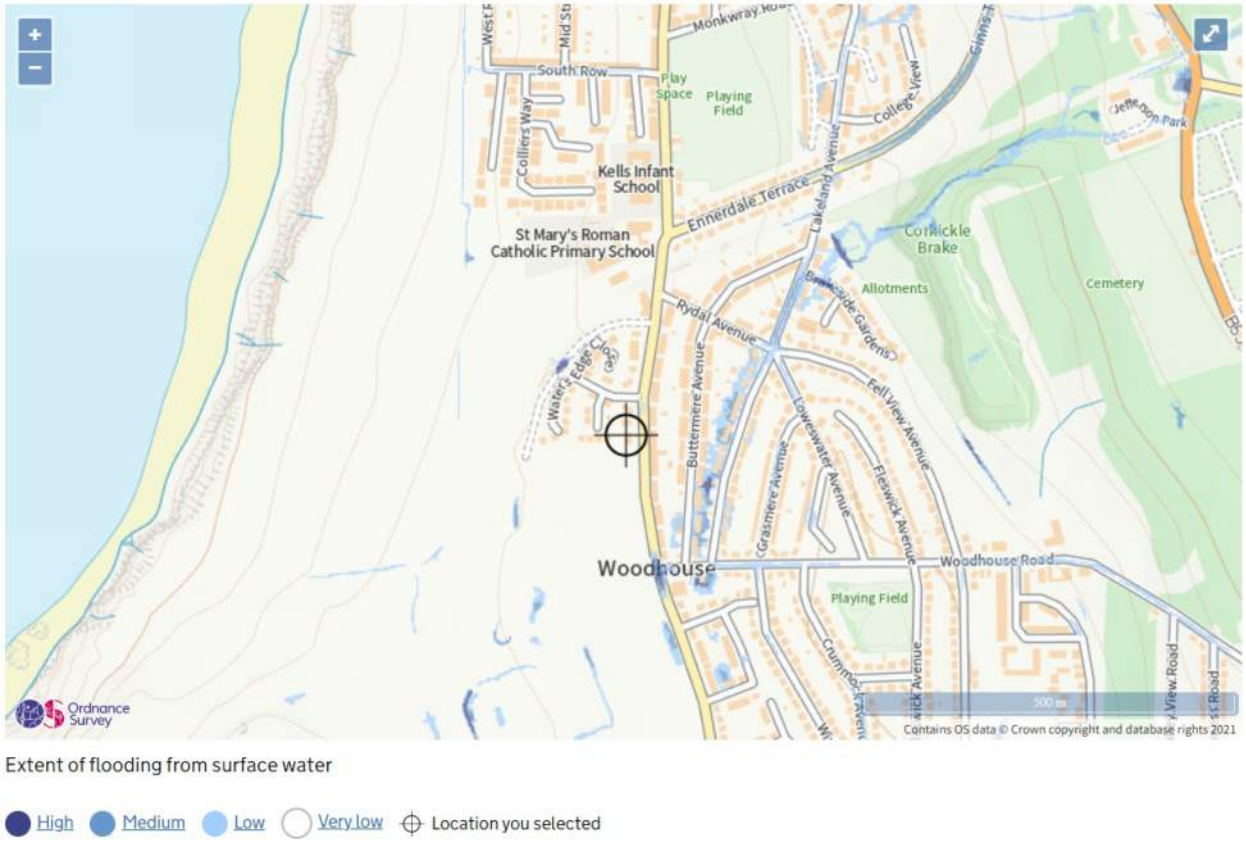

Figure 6: Environment Agency Surface Water Flood Map (Source: Environment Agency, 2021, GOV.UK)

3.4 Flooding Resulting from Other Sources

BGS records were not included in the ground investigation report, but intrusive investigations did discover evidence of shallow groundwater. As the monitoring was taken during the season considered to be the "wettest" part of the year it would be reasonable to assume groundwater issues would not worsen to cause any flooding issues. However, careful consideration to the SuDS provided across the site must be assessed, most likely ruling out any open space storage where groundwater could positively ingress and compromise storage provisions.

The DEFRA portal also provides Reservoir Flood Maps produced by the EA, in which a copy for the area can be seen in Figure 7. This map indicates the maximum extent of flooding from reservoirs highlighted in light blue. As can be seen the site is not at risk of flooding from reservoirs and has no other canals or artificial sources nearby that pose any risk of flooding.

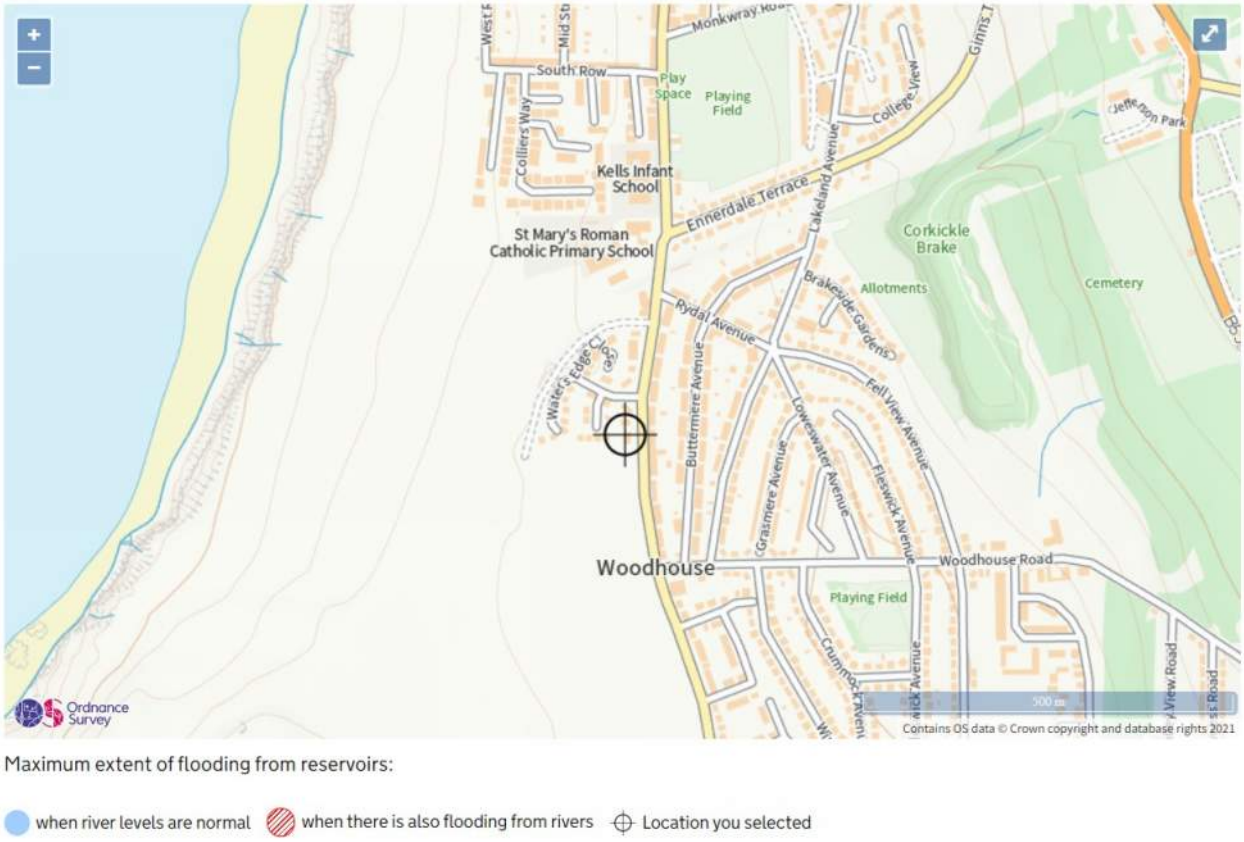

Figure 7: Environment Agency Reservoir Flood Map (Source: Environment Agency, 2021, GOV.UK)

4 SURFACE WATER DRAINAGE STRATEGY

4.1 Catchment Assessment

A catchment assessment has been completed in AutoCAD to determine the different types of proposed land cover with the results demonstrated in Table 3.

Catchment Assessment	
Type of Land	**Associate Area m^2 (Ha)**
Roof Areas + 10%	2697 (0.270)
Paved Areas	2039 (0.204)
Road/Parking Areas	1406 (0.141)
Landscaped Areas	7558 (0.756)

Table 3: Catchment Assessment on Proposed Development

As can be seen above the land is divided so that roads cover 10% of the site, roof areas 20% of the site, paved areas 15% and the remainder of the site is occupied with landscaped and garden areas (55%). Which results in a 45% / 55% permeable / impermeable land split.

4.2 Urban Creep

Urban Creep is not a statutory requirement, however, to account for future increases in impermeable area through the development of extensions and/or alterations to habitable dwellings an increase of 10% has been applied to associated roof areas.

4.3 Climate Change

Climate Change projections indicate that worsening rainfall events are to occur over the next few decades. To account for the effects of climate change in accordance with guidance outlined by the Environment Agency an uplift allowance of 40% has been added to the 100-year return period to increase the worst-case scenario for the design of the drainage network.

4.4 Proposed Runoff Rates

Runoff calculations have been provided in Appendix D and have been completed using the UK SuDS HR Wallingford online portal. Below in Table 4 is a summary of the results.

Peak Rate of Runoff (l/s) Assessment			
Return Period	**Greenfield**	**Post-Development Brownfield**	**Proposed Post-Development Restriction**
Q1	9.3	44.8	6.0
QBAR	10.7		6.0
Q30	18.2	108.3	6.0
Q100	22.3	138.2	6.0
Q100 + 40% CC		193.5	6.0

Table 4: Surface Water Rate of Runoff Results

4.5 SuDS Hierarchy

All surface water drainage designs are to follow the SuDS Hierarchy outlined within the SuDS Manual. This hierarchy requires the designer to attempt infiltration methods, prior to proposing disposal to a watercourse. If the above two are not possible then consideration can be made to the disposal of surface water to the public sewer network. However, a connection to a dedicated sewer (i.e. surface water or foul) should always be sought in preference to the connection to a combined sewer.

4.6 Design Parameters

The following design parameters have been utilised within the drainage model;

- The volumetric runoff coefficient is the volume of surface water which eventually runs off an impermeable surface following reduction due to infiltration, depression storage, initial wetting and evaporation. Default industry standards are 0.75 for summer and 0.84 for winter. However, it has been requested that these are both set to 1.0 by the Lead Local Flood Authority meaning that all water falling on impermeable areas will enter the below ground drainage system. This provides conservative design as the effect of evaporation, initial wetting and ponding are ignored.

- The calculations use the latest FEH 2013 rainfall data from the CEH web service.

- Simulations include the 2-year return period, 30-year return period and the 100-year return period plus 40% climate change

- Storms have been simulated to durations of up to 1440 minutes. If flooding occurs at the longest time step, this duration will be increased until flooding subsides.

4.7 Surface Water Drainage Proposals

A number of SuDS components have been considered for the development of the site. **Green Roofs** were discounted due to cost and limitations of water volume retention. These are also not typically deemed suitable for conventional houses due to the roof pitch. **Soakaways & Permeable Paving** were not considered due to underlying ground conditions explained above in Section 4.6. **Water Butts** are a viable option for almost any residential site, but their effectiveness is reliant on the residents utilising the stored water and/or emptying them before they flood and therefore, they are not considered as a SuDS device and are optional for a resident to install and maintain. **Swales** were considered but not utilised for this particular development as the site does not possess the required large open areas needed to make swales effective. There are also no open water retention features in which swales typically integrate with. A **Detention Basin / Pond** was not considered viable due to a lack of effective outfall available and insufficient open space following the allocation of an accessible POS area.

Based on the above the following SuDS methods are considered to be the most suitable and effective for the development:

- Geocellular Storage Tanks
- Oversized Pipework
- Restricted Run-Off Discharge (Flow Control Chamber)

Between January and March 2020 the Gleeson Homes, Waters Edge site was being designed by Ashwood Design Associates and Thomas Consulting (TC). The site was to be purchased by Gleeson Homes on the basis Story Homes who currently owned the land would provide an accessible drainage connection for both surface and foul water through their Phase 1 site which had been completed and occupied. This was due to the knowledge there was no other known foul drainage points around the site and the land was impermeable with no watercourses within the vicinity. Story Homes had designed their system and were in the process of having the system adopted (The existing drainage layout can be found in Appendix E).

It became clear during the early design process that if standards were adhered to and a 50% reduction to the existing brownfield runoff (32.4l/s) was proposed it would cause issues for the existing Story Homes site, which was only designed to discharge at greenfield runoff rate (15.5l/s). Observing the plans there was no allowance for storage in the Phase 1 Story Homes site, even though the land was being sold based on a positive connection being provided. Therefore, discussions were opened up with Story Homes which continued through April to September, concluding in a flow rate that Story Homes could accept from our site to their system, whilst providing an improvement to their system to accept this agreed flow rate.

The Story Homes Phase 1 improvement works which were received in September can be found in Appendix F. It is to be understood from this point that all Phase 1 improvement and remediation work is being delt with by Story Homes in co-ordination with United Utilities, proceeding through the adoption process and that TC must design the system with a restricted flow rate of 6l/s.

As can be seen in in Section 4.4 of this report this is 4.7l/s below greenfield runoff, therefore is a significant improvement to the site. Furthermore, the consideration to cost effectiveness of storing this volume of water must be made.

The SuDS have been sized to contain a future 1% AEP event of critical duration. Future climate change (40%) and urban creep (10% to housing area only) is accounted for. Although much of the paving areas surrounding the dwellings will not be positively drained, they have also been included within the drainage catchment areas for conservative design. The proposed foul and surface water drainage layout is included in Appendix G.

It is proposed the entirety of the dwellings roof runoff, paved runoff and surrounding access road is to be drained via rainwater downpipes, gullies and channel drains into a standalone surface water drainage network where runoff will be restricted to 6l/s prior to being discharged into the public sewer, located at the northwest corner of the proposed site.

It is proposed that four stacks of geocellular crates (400mm deep) are used within the lower landscaped area of the proposed development therefore only requiring a minimum of 900mm cover. The crates will form an attenuation structure of 232m² providing 353m³ of storage (inclusive of void reduction). The geocellular tank will be accompanied by approx. 55m of oversized (900mm dia.) pipe. This size was chosen so that adoptable standard can be achieved within the carriageway and PVC pipework can be utilised. Finally, runoff discharge will be restricted prior to the site boundary and existing manhole (connection location) to 6l/s.

The system has been designed to adoptable standards with a minimum of 1.2m cover in hard standing areas and 0.9m cover in soft landscaped area. The system has been designed so that no surcharging occurs for a 2 year event, no flooding for a 30 year event and LLFA recommendations of no flooding for the 100 year event plus 40% climate change.

4.8 Exceedance Routing

The drainage model has been designed as to store a 100-year return period, plus the effects of climate change and urban creep. In the rare case storm events of greater severity which are not required for analysis occur, exceedance routes have been carefully considered so that flooding wouldn't affect any habitable and/or critical areas. MHS8 would only flood beyond the 1 in 600-year events whereby the highway would capture any flooding and hold it until the storm subsides and is captures back into the system. Before this area would affect the surrounding dwellings MHS2 would flood and send exceedance flows down the site, contained by the highway, and discharge these flows west to the landscaped areas which fall towards the coastline.

4.9 Treatment Processes

Treatment of the surface water run-off from impermeable will be via advanced silt traps, which will be placed upstream plot drainage and the geocellular attenuation tank.

4.10 SuDS Maintenance

All drainage on the site is to be offered for adoption to United Utilities as part of a Section 104 agreement. As the site possesses a geocellular tank that is for attenuation use only there is a possibility UU may not adopt the attenuation device as this is still open to interpretation following the new Design and Construction Guidance (DCG) (superseding Sewers for Adoption). Guidance on UU's adoptable standards with regards to attenuation tanks can be found in the March 2020 technical note and September 2021 general FAQ notes. As there is uncertainty about its eligibility an Management and Maintenance Plan has been made available following the appropriate guidance referenced 'T19360/2021/01 Sustainable Urban Drainage System Management and Maintenance Plan'

5 FOUL WATER DRAINAGE STRATEGY

Foul water from the site shall be connected to the existing foul water sewer provided by the Story Homes Phase 1 site located within the site boundary to the northwest of the site as can be seen in the drainage layout drawing in Appendix G. As this sewer is currently under approval for adoption and Story Homes have agreed a connection there is no requirements for a connection application to UU. Preliminary foul water discharge calculations have been undertaken in accordance with the DCG. The estimated predicted peak design flow rate from the development is 1.94l/s.

6 CONCLUSIONS

- The site is located within Flood Zone 1.
- The proposed development is classed as a major development and according to the NPPF's PPG as a residential development the site is classed as more vulnerable to flood risk. More vulnerable developments are deemed acceptable in Flood Zone 1.
- Groundwater was encountered during intrusive ground investigations at levels between 0.3 and 1.2m bgl. It has been recommended careful considerations of SuDS is made for the proposed development, avoiding any open space storage structures and infiltration methods that could worsen the existing natural ground water table.
- The site is at very low risk of flooding from fluvial sources, surface water and artificial sources.
- The site is currently brownfield and is deemed to have impermeable properties due to shallow groundwater ingress.
- Surface water runoff shall be collected via a combination of downpipes, channel drains and gullies and drained via a dedicated surface water system. Via this system discharge off site shall be restricted to 6l/s (4.7l/s under greenfield runoff rate) and storage provided for surcharging surface water via oversized pipework and a geocellular attenuation tank. The proposed system will be connected via an existing surface water manhole provided by the Story Homes Phase 1 site within the site boundary.
- The foul water is to be drained via plot drainage to a dedicated foul water sewer connecting to an existing foul water manhole provided by the Story Homes Phase 1 site within the site boundary.
- All drainage is to be gravity fed and designed in accordance with the DCG and UU S104 guidance documents so that the systems can be offered up for adoption. Treatment is to be provided in the form of advanced silt traps across the site.
- The site layout and drainage systems have been designed to ensure that there is no increased risk of flooding on or off site as a result of extreme rainfall, lack of maintenance, blockages, or other causes. The measures that will be implemented comprise additional flows allowed for adding 10% urban creep to the roof catchment and an additional 40% allowance for climate change.

7 REFERENCES

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United Utilities Sewer Records

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D.B Boorman, J.M. Hollis & A. Lilly, 1995. Hydrology of soil types, Report No. 126. (IoH126) Institute of Hydrology, November 1995.

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CIRIA Report C753, The SUDS Manual, Version 6, 2015.

CIRIA Report C635, Designing for Exceedance in Urban Drainage – Good Practice, 2006.

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APPENDIX A

TOPOGRAPHIC SURVEY

Notes :-

DO NOT SCALE FROM DRAWING
DIMENSIONS TO BE TAKEN ON SITE

Site Grid

Ordnance Survey Grid & Datum
(Trimble GPS System OSTN15 Transformation)
RTK Network

SURVEY STATIONS				
Name	Easting	Northing	Height	Remark
R1	296756.113	516328.442	97.142	
R2	296758.192	516295.057	97.214	
R3	296750.327	516262.368	96.881	
R4	296765.074	516235.178	96.602	
S1	296763.927	516235.054	94.157	
S2	296758.915	516266.790	94.462	
S3	296756.278	516307.140	94.817	
S4	296754.578	516341.592	94.559	
STNF	296747.473	516306.166	94.766	

PRISM VOLUMES : PROJECTION TO Bases		
Group	Volumes	
	Cut/Material	Fill/Void
Stockpile 01	5699.499	0.000
Stockpile 02	1246.814	0.000
Stockpile 03	889.507	0.000
Stockpile 04	804.789	0.000
Total	8640.609	0.000

REV	AMENDMENT	DRAWN	DATE

Water's Edge
High Road
Whitehaven
JOB TITLE

Gleeson Homes
CLIENT

Topographical
Survey
DRAWING TITLE

1:200 @ A0 SCALE	J D Gibson DRAWN
14/08/2019 DATE	J D Gibson APPROVED

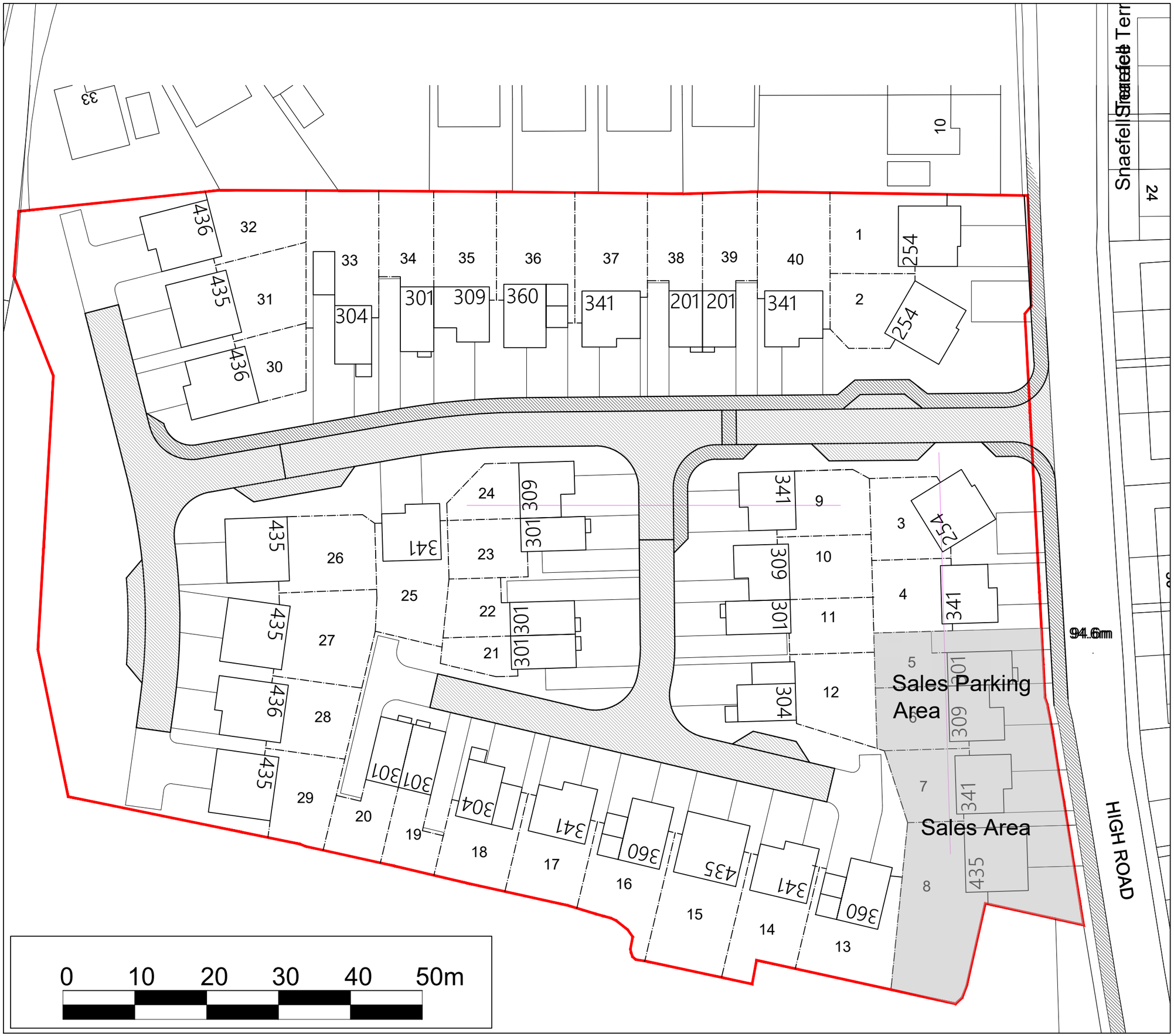
GSM
GIBSON SURVEYING & MAPPING

Gibson Surveying and Mapping Ltd
21 West View,
Crook,
County Durham.
DL159EY.
Mob. 07896698645
Tel. 01388 764106
email : info@gsmsurvey.co.uk
www.gsmsurvey.co.uk

PROJECT No.	DRG No.	REV
	GH/WE/TS01	

APPENDIX B

ARCHITECTS LAYOUT PLANS



NOTES AND AMENDMENTS

REVISIONS

Rev	Description	Drawn	Date

House Type	Quantity
201	2
254	3
301	8
309	4
304	3
341	8
360	3
435	6
436	3
Total#	40

ASHWOOD DESIGN ASSOCIATES LTD
Solway House Business Centre, Parkhouse Road, Carlisle CA6 4BY
t 01228 510616 e admin@ashwooddesign.co.uk
f 01228 520861 w www.ashwooddesign.co.uk

Purpose: Planning

Client: Gleeson Homes

Project: Waters Edge

Title: Site Layout

Scale:	Sheet Size:	Drawn:	Date:
1:500	A3	jc	03/2019

Project No:	Drawing No:	Revision:
1839	001	c

APPENDIX C

UU SEWER RECORDS

How to contact us:

United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP

Telephone:

E-mai

Thomas Consulting Ltd

3
Friar Street,
Lancaster, Lancashire
LA1 1PZ

FAO:

Your Ref: T19360 - Waters Edge
Our Ref: UUPS-ORD-144839
Date: 10/01/2020

Dear Sirs

Location: Waters Edge Whitehaven

I acknowledge with thanks your request dated 09/01/2020 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. http://www.unitedutilities.com/work-near-asset.aspx .

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please contact us .

Yours Faithfully,

Karen McCormack
Property Searches Manager

United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP

TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

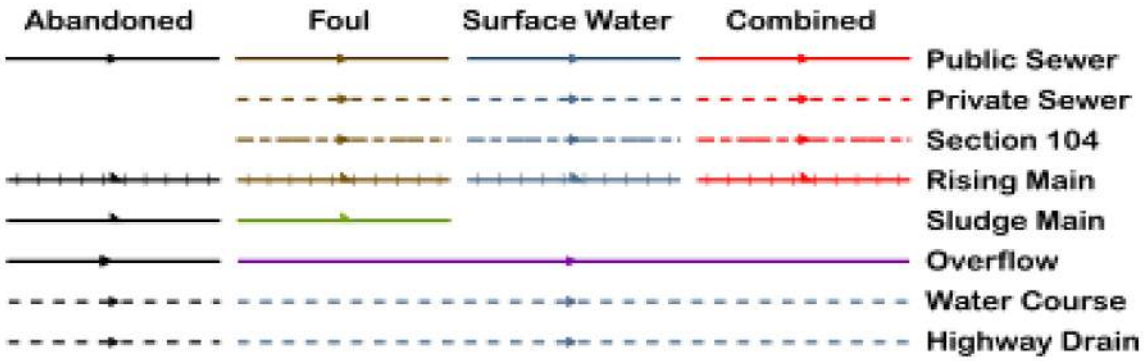
These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

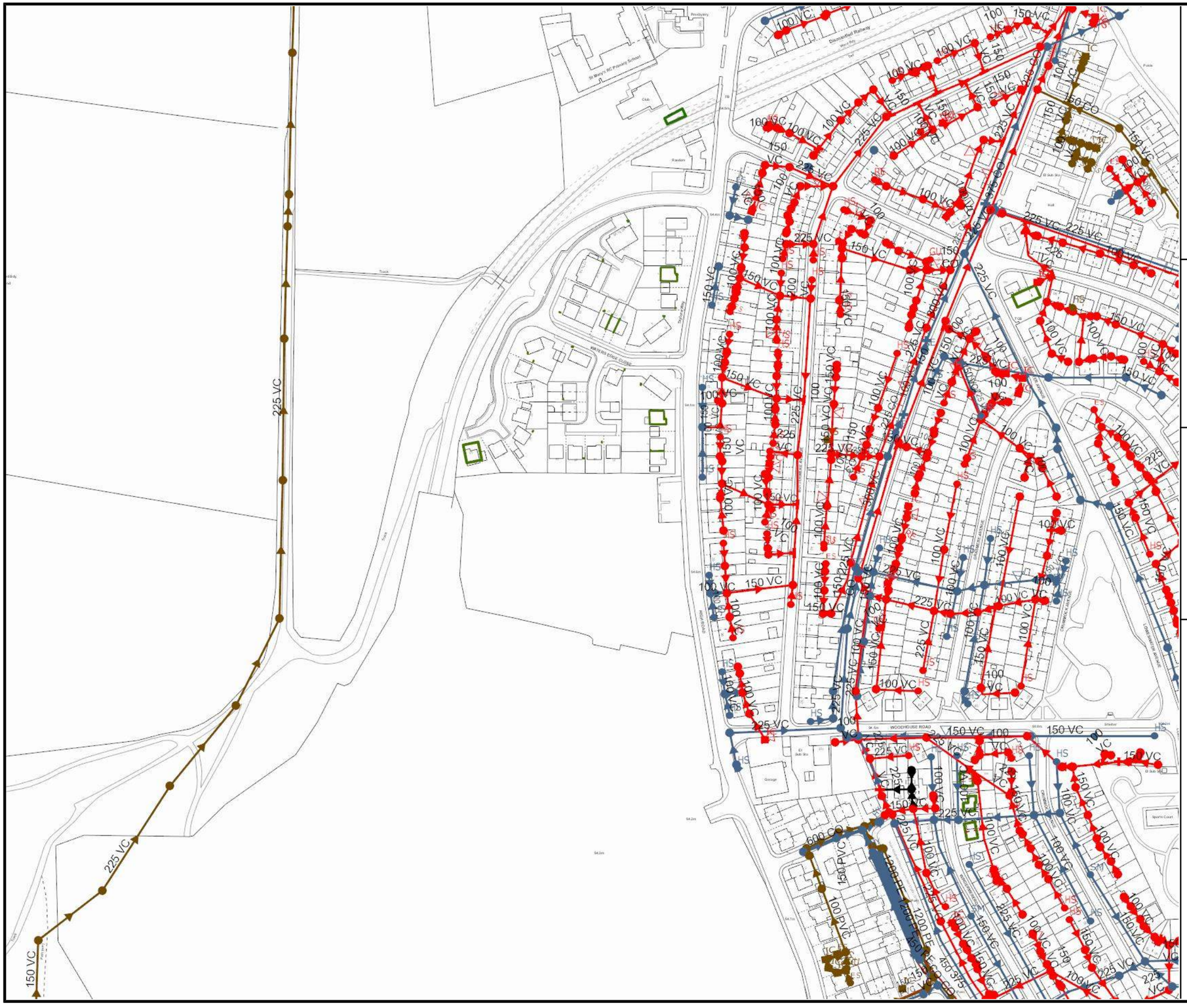
United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP

Wastewater Symbology



All point assets follow the standard colour convention:	red – combined	brown - foul
	blue – surface water	purple - overflow

- Manhole
- HS Head of System
- ES Extent of Survey
- RE Rodding Eye
- IN Inlet
- DP Discharge Point
- HY Vortex
- PE Penstock
- WO Washout Chamber
- VA Valve
- AV Air Valve
- NRV Non Return Valve
- SO Soakaway
- GU Gully
- CA Cascade
- FM Flow Meter
- HA Hatch Box
- OI Oil Interceptor
- SM Summit
- DS Drop Shaft
- OP Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- IC Inspection Chamber
- Bifurcation Chamber
- LH Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- T Network Storage Tank
- V Sewer Overflow
- WwTW Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- CK Control Kiosk
- Change of Characteristic



United Utilities
helping life flow smoothly

SEWER RECORDS

Address or Site Reference

Waters Edge Whitehaven,

Scale: 1:2500
Date: 10/01/2020

Printed by: Property Searches

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

APPENDIX D

CALCULATIONS

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Julian Pearson
Site name:	Water's Edge
Site location:	Whitehaven

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

Site Details

Latitude:	54.53095° N
Longitude:	3.5979° W
Reference:	2445338315
Date:	Mar 02 2020 11:04

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1.37

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1058	1058
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	10.72	10.72
1 in 1 year (l/s):	9.33	9.33
1 in 30 years (l/s):	18.23	18.23
1 in 100 year (l/s):	22.31	22.31
1 in 200 years (l/s):	25.42	25.42

THOMAS CONSULTING STRUCTURAL & CIVIL DESIGN ENGINEERS	Brownfield Runoff Estimation			
	Job Name:	Waters Edge, Whiteheaven		
	Contract Number:	T19360	Date:	17/11/2021
	Engineer:	JP	Checker:	MJ

Calculation Brief

This spreadsheet has been developed to assist in estimating and documenting the brownfield runoff rates for pre-developed sites. The calculation helps demonstrate the changes a development may have on peak runoff rates and outlines any proposed restrictions for post-development runoff

Information Source

This spreadhseet has been created using information obtained from CIRIA Report C753 - The SuDS Manual, V6 - 2015. Section 24.5 provides guidance on "Previously Developed Sites: Peak Runoff Rate and Runoff Volume Estimation. The calculation uses the "Modified Rational Method" to determine peak rates of runoff for different return periods.

Pre-Development Peak Runoff Rate Workings

EQ 24.5 Page 520 of the SuDS Manual: Q = 2.78 C i A

Where;

Q: Design event peak rate of runoff (l/s)

C: Non-dimensional runoff coefficient which is dependent on the catchment characteristics

i: rainfall intensity for the design return period (in mm/hr) and for a duration equal to the "time of concentration of the network

A: Total catchment area being drained (ha)

C: C is made up of the volumetric runoff coefficient Cv and routing coefficient Cr. The SuDS Manual Section 24.6.2 states the Cr should be set at 1.3, whereas the Cv can be altered between 0.8 and 1.0 depending how effectively the catchment is drained. Therefore, the Cv will be mainted as 0.9.

Cv Cr	
Cv =	0.9
Cr =	1.3

i: The SuDS Manual provides an initial assessment rainfall intensity assumption, however, for conservative design the Modified Rational Method outlined in Voume 4 of the Wallingford Prodedure - HR Wallingford 1981, will be used.

M5-60 Rainfall Depth	16	mm
Ratio R	0.26	
Storm Duration	15	minutes
Duration Factor	0.573333	

M1 - 15	Depth	5.6	mm	Intensity	22.5 mm/hr
M5-15	Depth	9.2	mm	Intensity	36.7 mm/hr
M30 - 15	Depth	13.6	mm	Intensity	54.2 mm/hr
M100 - 15	Depth	17.3	mm	Intensity	69.2 mm/hr

A: Pre-Development Impermeable Area 0 ha

Therefore;

1 Year Return Period (l/s)	0.0
30 Year Return Period (l/s)	0.0
100 Year Return Period (l/s)	0.0

THOMAS CONSULTING STRUCTURAL & CIVIL DESIGN ENGINEERS	Brownfield Runoff Estimation			
	Job Name:	Waters Edge, Whiteheaven		
	Contract Number:	T19360	Date:	17/11/2021
	Engineer:	JP	Checker:	MJ

Post-Development Peak Runoff Rate Workings

Where;

A: Post-Development Impermeable Area 0.614 ha

Therefore;

1 Year Return Period	44.8
30 Year Return Period	108.3
100 Year Return Period	138.2

Pre- and Post-Development Estimated Runoff Rate Summary

Pre-Development Runoff Rates		Post-Development Un-Restricted Runoff Rates		Post-Development Proposed Restricted Runoff Rate	
Q1	0.0 l/s	Q1	44.8 l/s	Q1	6.0 l/s
Q30	0.0 l/s	Q30	108.3 l/s	Q30	6.0 l/s
Q100	0.0 l/s	Q100	138.2 l/s	Q100	6.0 l/s

Refences

- CIRIA Report 753, The SuDS Manual, Version 6, 2015
- The Wallingford Procedure, The Modified Rational Method, Volume 4, 1981
- UK SuDS.com, HR Wallingford, Online Tools

Notes

The pre-development brownfield runoff rate has been set at 0 as only the post-development brownfield rates are to be analysed. Runoff rates are to be restricted beyond greenfield Qbar.

Design Settings

Rainfall Methodology	FEH-13	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	✓
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	15.00	Minimum Backdrop Height (m)	0.900		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Sump (m)	Easting (m)	Northing (m)	Depth (m)
1	0.107	15.00	94.537	1200		296722.226	516310.932	1.425
8	0.027	15.00	94.528	1200		296714.859	516261.813	1.425
11	0.020	15.00	95.601	1200		296665.293	516273.537	2.401
9	0.071	15.00	95.361	1200		296692.032	516267.304	2.412
10	0.027	15.00	95.174	1200		296694.101	516278.141	2.291
2	0.122	15.00	94.199	1200		296693.775	516310.558	1.754
3	0.046	15.00	94.233	1200		296668.928	516310.259	1.893
6	0.034	15.00	94.904	1800		296623.527	516275.029	3.879
7	0.028	15.00	94.476	1800		296623.485	516292.044	3.484
4	0.070	15.00	94.080	1800		296621.416	516301.950	3.121
5	0.054	15.00	93.686	1800	0.300	296613.942	516331.225	3.072
Existing SW MH			93.000	1500		296609.459	516336.463	2.211
Offline Storage Out		15.00	94.000			296617.706	516300.111	2.420
Offline Storage In			94.000			296614.206	516279.028	2.420
Offline Storage Dummy		15.00	94.000			296614.206	516272.640	2.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	27.715	0.600	93.112	92.520	0.592	46.8	225	15.32	50.0
3.000	8	9	23.045	0.600	93.103	92.949	0.154	150.0	225	15.38	50.0
4.000	11	9	27.625	0.600	93.200	92.949	0.251	110.1	225	15.44	50.0
3.001	9	10	11.059	0.600	92.949	92.883	0.066	167.6	225	15.63	50.0
3.002	10	2	32.772	0.600	92.883	92.520	0.363	90.3	225	16.14	50.0
1.001	2	3	25.686	0.600	92.445	92.340	0.105	244.6	300	16.56	50.0
1.002	3	4	46.467	0.600	92.340	91.559	0.781	59.5	300	17.33	50.0
2.000	6	7	16.404	0.600	91.025	90.992	0.033	500.0	900	15.26	50.0
2.001	7	4	16.255	0.600	90.992	90.959	0.033	500.0	900	15.51	50.0
1.003	4	5	22.447	0.600	90.959	90.914	0.045	500.0	900	17.51	50.0
1.004	5	Existing SW MH	12.512	0.600	90.914	90.789	0.125	100.0	300	17.59	50.0
5.000	Offline Storage Out	4	4.141	0.600	91.580	91.559	0.021	200.0	300	15.06	27.6
6.000	Offline Storage Dummy	Offline Storage In	6.388	0.600	91.800	91.580	0.220	29.0	100	15.07	27.6

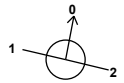
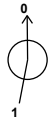
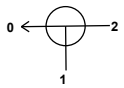
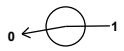
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.916	76.2	19.3	1.200	1.454	0.107	0.0	77	1.605
3.000	1.065	42.3	4.9	1.200	2.187	0.027	0.0	51	0.714
4.000	1.245	49.5	3.6	2.176	2.187	0.020	0.0	41	0.730
3.001	1.007	40.0	21.3	2.187	2.066	0.118	0.0	116	1.021
3.002	1.376	54.7	26.2	2.066	1.454	0.145	0.0	109	1.361
1.001	1.001	70.7	67.6	1.454	1.593	0.374	0.0	236	1.133
1.002	2.042	144.3	75.9	1.593	2.221	0.420	0.0	154	2.065
2.000	1.394	886.9	6.1	2.979	2.584	0.034	0.0	52	0.414
2.001	1.394	886.9	11.2	2.584	2.221	0.062	0.0	69	0.495
1.003	1.394	886.9	99.7	2.221	1.872	0.552	0.0	202	0.940
1.004	1.572	111.1	109.5	2.472	1.911	0.606	0.0	243	1.781
5.000	1.108	78.3	0.0	2.120	2.221	0.000	0.0	0	0.000
6.000	1.437	11.3	0.0	2.100	2.320	0.000	0.0	0	0.000

Pipeline Schedule

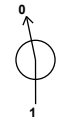
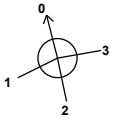
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	27.715	46.8	225	Circular	94.537	93.112	1.200	94.199	92.520	1.454
3.000	23.045	150.0	225	Circular	94.528	93.103	1.200	95.361	92.949	2.187
4.000	27.625	110.1	225	Circular	95.601	93.200	2.176	95.361	92.949	2.187
3.001	11.059	167.6	225	Circular	95.361	92.949	2.187	95.174	92.883	2.066
3.002	32.772	90.3	225	Circular	95.174	92.883	2.066	94.199	92.520	1.454
1.001	25.686	244.6	300	Circular	94.199	92.445	1.454	94.233	92.340	1.593
1.002	46.467	59.5	300	Circular	94.233	92.340	1.593	94.080	91.559	2.221
2.000	16.404	500.0	900	Circular	94.904	91.025	2.979	94.476	90.992	2.584
2.001	16.255	500.0	900	Circular	94.476	90.992	2.584	94.080	90.959	2.221
1.003	22.447	500.0	900	Circular	94.080	90.959	2.221	93.686	90.914	1.872
1.004	12.512	100.0	300	Circular	93.686	90.914	2.472	93.000	90.789	1.911
5.000	4.141	200.0	300	Circular	94.000	91.580	2.120	94.080	91.559	2.221
6.000	6.388	29.0	100	Circular	94.000	91.800	2.100	94.000	91.580	2.320

Link	US Node	Dia (mm)	Sump (m)	Node Type	MH Type	DS Node	Dia (mm)	Sump (m)	Node Type	MH Type
1.000	1	1200		Manhole	Adoptable	2	1200		Manhole	Adoptable
3.000	8	1200		Manhole	Adoptable	9	1200		Manhole	Adoptable
4.000	11	1200		Manhole	Adoptable	9	1200		Manhole	Adoptable
3.001	9	1200		Manhole	Adoptable	10	1200		Manhole	Adoptable
3.002	10	1200		Manhole	Adoptable	2	1200		Manhole	Adoptable
1.001	2	1200		Manhole	Adoptable	3	1200		Manhole	Adoptable
1.002	3	1200		Manhole	Adoptable	4	1800		Manhole	Adoptable
2.000	6	1800		Manhole	Adoptable	7	1800		Manhole	Adoptable
2.001	7	1800		Manhole	Adoptable	4	1800		Manhole	Adoptable
1.003	4	1800		Manhole	Adoptable	5	1800	0.300	Manhole	Adoptable
1.004	5	1800	0.300	Manhole	Adoptable	Existing SW MH	1500		Manhole	Adoptable
5.000	Offline Storage Out			Junction		4	1800		Manhole	Adoptable
6.000	Offline Storage Dummy			Junction		Offline Storage In			Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Sump (m)	Connections	Link	IL (m)	Dia (mm)
1	296722.226	516310.932	94.537	1.425	1200					
							0	1.000	93.112	225
8	296714.859	516261.813	94.528	1.425	1200					
							0	3.000	93.103	225
11	296665.293	516273.537	95.601	2.401	1200					
							0	4.000	93.200	225
9	296692.032	516267.304	95.361	2.412	1200			1	4.000	92.949	225
								2	3.000	92.949	225
								0	3.001	92.949	225
10	296694.101	516278.141	95.174	2.291	1200			1	3.001	92.883	225
								0	3.002	92.883	225
2	296693.775	516310.558	94.199	1.754	1200			1	3.002	92.520	225
								2	1.000	92.520	225
								0	1.001	92.445	300
3	296668.928	516310.259	94.233	1.893	1200			1	1.001	92.340	300
								0	1.002	92.340	300
6	296623.527	516275.029	94.904	3.879	1800					
							0	2.000	91.025	900

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Sump (m)	Connections	Link	IL (m)	Dia (mm)
7	296623.485	516292.044	94.476	3.484	1800		 1	2.000	90.992	900
							0	2.001	90.992	900
4	296621.416	516301.950	94.080	3.121	1800		 1	5.000	91.559	300
							2	2.001	90.959	900
							3	1.002	91.559	300
							0	1.003	90.959	900
5	296613.942	516331.225	93.686	3.072	1800	0.300	 1	1.003	90.914	900
							0	1.004	90.914	300
Existing SW MH	296609.459	516336.463	93.000	2.211	1500		 1	1.004	90.789	300
Offline Storage Out	296617.706	516300.111	94.000	2.420						
							0	5.000	91.580	300
Offline Storage In	296614.206	516279.028	94.000	2.420			1	6.000	91.580	100
Offline Storage Dummy	296614.206	516272.640	94.000	2.200						
							0	6.000	91.800	100

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Detailed	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	✓	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	40	0	0
30	0	0	0				

Node 5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	90.914	Product Number	CTL-SHE-0096-6000-2400-6000
Design Depth (m)	2.400	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.0	Min Node Diameter (mm)	1200

Node Offline Storage Out Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Main Channel Length (m)	21.370
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	91.580	Main Channel Slope (1:X)	100000.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.010

Inlets

Offline Storage In

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	232.0	0.0	1.600	232.0	0.0	1.601	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 96.45%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	23	93.164	0.052	8.9	0.1362	0.0000	OK
30 minute summer	8	25	93.138	0.035	2.2	0.0523	0.0000	OK
30 minute summer	11	24	93.228	0.028	1.7	0.0369	0.0000	OK
30 minute summer	9	24	93.029	0.080	9.8	0.1370	0.0000	OK
30 minute summer	10	24	92.956	0.073	12.0	0.0998	0.0000	OK
30 minute summer	2	24	92.586	0.141	31.0	0.3563	0.0000	OK
30 minute summer	3	24	92.442	0.102	34.8	0.1654	0.0000	OK
480 minute summer	6	352	91.770	0.745	2.9	2.0270	0.0000	OK
480 minute summer	7	352	91.770	0.778	6.6	2.1050	0.0000	OK
480 minute summer	4	352	91.770	0.811	20.2	2.4278	0.0000	OK
480 minute summer	5	352	91.770	0.856	7.8	2.5119	0.0000	SURCHARGED
15 minute summer	Existing SW MH	1	90.789	0.000	4.7	0.0000	0.0000	OK
480 minute summer	Offline Storage Out	352	91.770	0.190	18.2	0.0000	0.0000	OK
480 minute summer	Offline Storage In	352	91.770	0.190	12.1	0.0000	0.0000	OK
15 minute summer	Offline Storage Dummy	1	91.800	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	1	1.000	2	8.9	1.193	0.117	0.2302	
30 minute summer	8	3.000	9	2.2	0.284	0.052	0.1892	
30 minute summer	11	4.000	9	1.7	0.232	0.034	0.2135	
30 minute summer	9	3.001	10	9.8	0.827	0.245	0.1310	
30 minute summer	10	3.002	2	12.0	1.096	0.219	0.3586	
30 minute summer	2	1.001	3	31.0	1.156	0.438	0.6909	
30 minute summer	3	1.002	4	34.8	1.674	0.241	1.1009	
480 minute summer	6	2.000	7	-1.7	0.127	-0.002	9.3833	
480 minute summer	7	2.001	4	-5.6	0.058	-0.006	9.6264	
480 minute summer	4	1.003	5	5.9	0.183	0.007	13.7417	
480 minute summer	5	Hydro-Brake®	Existing SW MH	4.7				161.6
480 minute summer	Offline Storage Out	5.000	4	-18.2	-1.343	-0.233	0.2072	
480 minute summer	Offline Storage In	Flow through pond	Offline Storage Out	-12.1	-0.074	-0.003	41.9241	
15 minute summer	Offline Storage Dummy	6.000	Offline Storage In	0.0	0.000	0.000	0.0006	

Results for 30 year Critical Storm Duration. Lowest mass balance: 96.45%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	1	38	93.194	0.082	21.6	0.2146	0.0000	OK
60 minute summer	8	38	93.157	0.054	5.5	0.0821	0.0000	OK
30 minute summer	11	24	93.243	0.043	4.0	0.0558	0.0000	OK
60 minute summer	9	38	93.083	0.134	23.9	0.2299	0.0000	OK
60 minute summer	10	38	93.001	0.118	29.4	0.1610	0.0000	OK
60 minute summer	2	38	92.691	0.246	75.7	0.6194	0.0000	OK
30 minute summer	3	20	92.506	0.166	83.8	0.2677	0.0000	OK
360 minute winter	6	352	92.313	1.288	2.1	3.5041	0.0000	SURCHARGED
360 minute winter	7	352	92.313	1.321	5.0	3.5741	0.0000	SURCHARGED
360 minute winter	4	352	92.313	1.354	31.0	4.0534	0.0000	SURCHARGED
360 minute winter	5	352	92.313	1.399	8.1	4.1055	0.0000	SURCHARGED
15 minute summer	Existing SW MH	1	90.789	0.000	4.7	0.0000	0.0000	OK
360 minute winter	Offline Storage Out	352	92.313	0.733	29.0	0.0000	0.0000	SURCHARGED
360 minute winter	Offline Storage In	352	92.313	0.733	14.5	0.0000	0.0000	OK
360 minute winter	Offline Storage Dummy	352	92.313	0.513	0.2	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	1	1.000	2	21.6	1.177	0.283	0.6272	
60 minute summer	8	3.000	9	5.5	0.350	0.130	0.3681	
30 minute summer	11	4.000	9	4.0	0.279	0.081	0.4093	
60 minute summer	9	3.001	10	23.9	1.048	0.596	0.2521	
60 minute summer	10	3.002	2	29.4	1.152	0.537	0.8737	
60 minute summer	2	1.001	3	75.5	1.477	1.068	1.2964	
30 minute summer	3	1.002	4	83.8	2.057	0.580	2.4783	
360 minute winter	6	2.000	7	1.6	0.113	0.002	10.3964	
360 minute winter	7	2.001	4	-4.1	0.061	-0.005	10.3020	
360 minute winter	4	1.003	5	6.3	0.183	0.007	14.2263	
360 minute winter	5	Hydro-Brake®	Existing SW MH	4.7				152.9
360 minute winter	Offline Storage Out	5.000	4	-29.0	-1.259	-0.371	0.2916	
360 minute winter	Offline Storage In	Flow through pond	Offline Storage Out	-14.5	-0.081	-0.004	161.6746	
360 minute winter	Offline Storage Dummy	6.000	Offline Storage In	-0.2	-0.026	-0.013	0.0500	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 96.45%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	1	42	93.847	0.735	40.8	1.9348	0.0000	SURCHARGED
60 minute summer	8	43	94.099	0.996	10.3	1.5034	0.0000	SURCHARGED
60 minute summer	11	43	94.096	0.896	8.0	1.1630	0.0000	SURCHARGED
60 minute summer	9	43	94.090	1.141	39.4	1.9625	0.0000	SURCHARGED
60 minute summer	10	43	94.004	1.121	47.1	1.5321	0.0000	SURCHARGED
60 minute summer	2	42	93.690	1.245	125.7	3.1402	0.0000	SURCHARGED
360 minute winter	3	344	93.297	0.957	43.9	1.5472	0.0000	SURCHARGED
360 minute winter	6	336	93.297	2.272	11.7	6.1806	0.0000	SURCHARGED
360 minute winter	7	336	93.298	2.306	14.0	6.2387	0.0000	SURCHARGED
360 minute winter	4	344	93.297	2.338	56.7	6.9983	0.0000	SURCHARGED
360 minute winter	5	344	93.299	2.385	7.4	6.9976	0.0000	SURCHARGED
15 minute summer	Existing SW MH	1	90.789	0.000	4.7	0.0000	0.0000	OK
360 minute winter	Offline Storage Out	352	93.313	1.733	55.2	0.0000	0.0000	SURCHARGED
360 minute winter	Offline Storage In	344	93.325	1.745	27.6	0.0000	0.0000	OK
360 minute winter	Offline Storage Dummy	344	93.294	1.494	2.3	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	1	1.000	2	37.6	1.176	0.494	1.1023	
60 minute summer	8	3.000	9	9.6	0.379	0.226	0.9165	
60 minute summer	11	4.000	9	9.0	0.301	0.182	1.0987	
60 minute summer	9	3.001	10	38.2	1.124	0.954	0.4398	
60 minute summer	10	3.002	2	47.2	1.186	0.862	1.3034	
60 minute summer	2	1.001	3	123.3	1.752	1.744	1.8088	
360 minute winter	3	1.002	4	43.9	1.192	0.304	3.2722	
360 minute winter	6	2.000	7	13.6	0.141	0.015	10.3964	
360 minute winter	7	2.001	4	-9.9	0.080	-0.011	10.3020	
360 minute winter	4	1.003	5	7.0	0.219	0.008	14.2263	
360 minute winter	5	Hydro-Brake®	Existing SW MH	6.0				184.1
360 minute winter	Offline Storage Out	5.000	4	-55.2	-1.200	-0.705	0.2916	
360 minute winter	Offline Storage In	Flow through pond	Offline Storage Out	-27.6	-0.061	-0.007	354.5635	
360 minute winter	Offline Storage Dummy	6.000	Offline Storage In	-2.3	-0.296	-0.205	0.0500	

APPENDIX E

STORY HOMES PHASE 1 EXISTING DRAINAGE PLAN

S21 to be constructed on existing culvert. It is imperative that the position and invert of the existing culvert in confirmed by excavation prior to ANY work on site.

Approx line of existing 375mm piped watercourse

Existing 225mm combined public sewer

Manhole invert to be confirmed, data taken from sewer records

F15 to be constructed on existing sewer. It is imperative that the position and invert of the existing sewer in confirmed by excavation prior to ANY work on site.

Legal boundary taken from 'oveday-plan-27 jan 2015' (story Homes) blue line

Localised fill to give 1200mm cover to storage pipes. Max regrade 1:15 0.5m high bank on north boundary

Localised fill to proposed cover level max 1:15 re-grade

Connections from phase2 no storage allowance within phase 1, as instructed by Story Homes (SB)

Potential Landscape Buffer

HIGH ROAD

Snaefell Terrace

ROAD 1

ROAD 2

ROAD 2A

ROAD 3

RD3A

RD4A

POS

Manhole construction – refer to CPA technical bulletin Sept 2001 outlining changes to relevent Britishe Product Standards BS5911–200:1994.
All precast concret products are to be kitemarked or they will be rejected as part of an adoptable system. Manhole cover slabs to BS5911
Manhole covers to have a clear opening of 600 x 600mm and shall be class D400 to BSEN124 with 150mm deep frames.
Filled ground must be filled and consolidated under the supervision of UU before any sewer works are carried out.
All adoptable sewers to be BSI kitemarked,
Plastic channels are not acceptable
All custom built ironwork to be hot dipped galvanised prior to final fitting.
United Utilities are not obliged to accept filter drain / land drainagerunoff into the public sewer network or adoptable drainage network (directly or indirectly). An alternative method of disposal of land drainage runoff will therefore be required.
Cover slabs must carry the BSI kitemark or will be rejected by UU inspector. Where the clear opening of a kitmarked product is differant to that of the cover and frame a load bearing slab should be fitted bove the cover slab to bring the size down to 600x600mm for UU specified cover size. Please refer to CPSA technical bulletin Autumn 2004 for kitemarked cover slab opening sizes.
Sulphate resistant cement (C20–DC2) and precast concrete productes must be used or a laboratory report provided proving that such precautions are not nessesary.

Sewers to be laid in class S bedding (150mm graular bed and surround. Where depth of cover is less then 1.2m in highways and verges (or less then 900mm in non vehile access areas) then a concrete slab should be provided above the granular bed and surround.
The chamber size of manholes with more then one connection in them may need to be increased one increment to accomodate the connection and bends.
Contractors should be aware of significantly large diameter pipes and manhole chamber rings proposed in this design and precautions should be taken in movement and placing of such items. Also to be considered is the depth of excavation of the drainage works especially the large diameter components up to 6m deep excavations.
All adoptable sewer works and materials to be in accordance with Sewers for Adoption 6th edition. The relevant British / European and United Utilities standards / requirements / addendum & kitemarked
The adoptable sewers shall be a min 1.0m and manholes 0.5m from the kerb and service margins
Sewers must have 5m clearance from trees and hedges see SfA6 for restrictions on tree planting / types
Bedding and backfill material to conform with the Water Industry specification 4–08–02 (table A2)

EXISTING CHANNEL AND FOOTPATH LEVELS TO BE CONFIRMED PRIOR TO ANYCONSTRUCTION
ALL EXISTING DRAINAGE INVERTS, LOCATIONS & PIPE SIZES TO BE CONFIRMED

PROPOSED STREET LIGHTING
5m Aluminium column
Urbis Axia LED cool white luminair
Post mounted
5deg tilt
Optic setting 16LED Wh 5079 31313F
UMSUG code 410210005100
Zodion SS6 photocell (35/18)

See Urbis specifction and drawing for full details
Specification as provided by Story Homes.

Aco channel or similar located either in front of garage or on back edge to prevent drive water discharging on to highway see private drainage layout for further clarification

DRAINAGE STATEMENT

SURFACE WATER
It is intended to discharge surface water from the development to the existing land drainage / watercourse adjacent the site. Site investigations have located a number of existing pipes watercourses discharging to the existing cliff however it has been identified that two of the three are in poor condition. Discussions with David bechelli (Copeland land drainage dept) identified the existing 375mm piped watercourse north of the development would be more suitable due to its excellant condition. In that we aredischargeing to a watercourse the discharge rate from the site should be limited to greenfield runoff. Using ICPSUDS we have calculated the 1year greenfield runoff as 15.8 lts/sec, this includes a 27% allowence for the partially urbanized catchments ie existing concrete hardstanding (formally buildings).
The SW design will incorporate twin 2400mm diam on line storage pipes sized to discharge 15.5 lts/sec for the 100year including 30% climate change

FOUL WATER
It is intended to incorperate a 150mm diameter foul sewer network within the site terminating on the north west boundary. A foul water requisition will be served on United Utilities to provide the off site sewer and connection.

FLOOD ROUTING
The site is designed such that any flooding within the development due to blockage or inadequate maintenance will discharge via road gullies on the northwest boundary of the site. Overland flows will take water away from the site, through the footpath tunnel and into the adjacent fields. The natural topography will encourage flows toward the cliffs and down to the sea.
Offsite overland flow from High Street will be routed through the site via road 1 from where it will take the same route to the sea.

S. F4–F15, S4–S18 & S3–S4 revised following changes to legal boundary and survey of F15 invert 16–3–15
R. S17A added 24–10–14
Q. Easements added to road3 gullies, Service strip added to roads 3&4, Lighting added to sootpath/steps, Footway extended on road1, footway added in front of 19–20, 26,27 34–38 6–10–14
P. S4–S21 & F4–F18 revised, minor layout changes 26–9–14
N. Annotation clarified on storage pipe. 10–7–14
M. Plots 33 & 34 revised, private drainage adjusted throughout, street lighting added 26–6–14
L. S15–22–23–24–17–25–18–19 revised 19–6–14
K. Drainage statement revised 21–1–14
J. Full drainage re–design, FFL adjusted 31–10–13
H. Revised in line with new planning layout 28–7–13
H. Revised in line with new planning layout 28–7–13
G. Road 2A sewers revised 1–3–13
F. Plots 16–19 revised floor level 28–2–13
E. Drainage annotation revised in line with client instruction 27–2–13
D. Plots 20 & 21 FFL revised following client instruction 25–2–13
C. Plots 10, 20, 21, 36,& 40 FFL revised following client instruction path / steps removed from plots 18 & 19 25–2–13
B. Drainage statement added 12–2–13
A. Revised in line with planning layout, floor levels amended 11–2–13

R.A.B. ENGINEERING DESIGN LTD
21 BURNCROSS DRIVE
SHEFFIELD S35 1DJ
TEL.(0114)2570576

Story Homes

Waters Edge Tamar, Whitehaven
Engineering layout

DRAWN BY rab

SCALE 1:500 / 1:1000 DATE Feb13

DRAWING No 976–1 REV s

PRELIMINARY ONLY

APPENDIX F

STORY HOMES PHASE 1 IMPROVEMENT WORKS

21108 – Waters Edge – Surface Water Statement

28 September 2021

Introduction

To be read in conjunction with Coast Consulting Engineers drawing reference 21108/02/P3.

Coast Consulting Engineers have been commissioned by Story Homes to provide a design for modifications to an existing gravity fed surface water drainage system at Waters Edge, Whitehaven. The system is located within a residential development constructed by Story Homes.

It is proposed that the existing residential development will be further extended to the south by another developer with surface water discharging into the Story Homes system.

The modifications are required to ensure that the existing Story Homes system falls in line with current planning standards and storage is provided to accommodate the 100-year event with a 40% allowance for climate change within the modified system.

Existing system

The existing surface water system was designed during 2013 and was constructed in line with the relevant standards. The design drawings include the following statement with regards to surface water discharge.

SURFACE WATER
It is intended to discharge surface water from the development to the existing land drainage / watercourse adjacent the site. Site investigations have located a number of existing pipes watercourses discharging to the existing cliff however it has been identified that two of the three are in poor condition. Discussions with David bechelli (Copeland land drainage dept) identified the existing 375mm piped watercourse north of the development would be more suitable due to its excellant condition. In that we aredischargeing to a watercourse the discharge rate from the site should be limited to greenfield runoff. Using ICPSUDS we have calculated the 1year greenfield runoff as 15.8 lts/sec, this includes a 27% allowence for the partially urbanized catchments ie existing concrete hardstanding (formally buildings).
The SW design will incorporate twin 2400mm diam on line storage pipes sized to discharge 15.8 lts/sec for the 100year including 30% climate change
A surface water requisition will be served on United Utilities to provide the off site sewer and connection.

Within the system designed during 2013, an allowance of 6 l/s was provided to accommodate flows from the extension land to the south.

Proposed system

The proposed surface water system for the extension land has been designed by a 3rd party consultant engineer on behalf of the developer. The proposals include a flow control to restrict discharge to 6 l/s and a storage system to accommodate the 100 year event with a 40% allowance for climate change. Coast Consulting Engineers have been provided with a copy of the proposed calculations to allow both the existing and proposed system to be assessed as one network.

Modifications to the existing system

Surface water calculations have been produced by Coast using Micro Drainage software. A copy of the MDX file and PDF copies of the calculations are provided for review by the LLFA.

The calculations are an amalgamation of the 2013 Story Homes calculations and the 3rd party calculations produced for the developer of the extension land.

For ease of reference, the manholes on the existing network are prefixed with the letter S and the extension network with the letter G.

The unmodified calculations show that for the 100 year event with a 40% allowance for climate change, a volume of flooding of approximately 80m3 occurs at manhole S25, within the network, Manhole S25 is the existing flow control chamber, with a pass forward rate of 15.8 l/s.

Due to constraints with land ownership and topography, it is not possible to provide additional storage at manhole S25, so an alternative location has been agreed with Story Homes.

It is proposed to retrofit manhole S14 with a flow control to restrict the downstream discharge rate to 6.2 l/s. In order to accommodate attenuated flows, a number of options have been considered. The use of surface SuDS features such as basins or swales cannot provide the required volume of storage due to site constraints. Oversized pipes are an uneconomical solution and would require that significant disruption to the existing highways is incurred. The proposed storage system is an offline cellular storage system, with a volume of 82.1m3. The cellular storage system will be located within an existing area of public open space, off the existing public highway.

The cellular storage system will be maintained by an appointed management company. At the time of writing, United Utilities Ltd will not adopt offline cellular storage systems.

Conclusion

The proposed solution satisfies the brief provided by Story Homes, to mitigate flooding for the 100-year event with a 40% allowance for climate change, as a result of the development of the extension land.

Richard Hall

Coast Consulting Engineers

10m3 FLOODING AT MANHOLE S25HB

S25HB
EXISTING FLOW CONTROL
RESTRICTED TO 15.8 L/S

INSET A

CONTINUED ABOVE. REFER TO INSET A

OFFLINE POLYSTORM CELLULAR STORAGE SYSTEM
IL 88.209
VOLUME 82.1m3. 100 year +40%

360 No. CRATES IN 2 LAYERS (180 PER LAYER)
CRATE DIMENSIONS 1.0x0.5x0.4m DP

IL 88.109

SS14
PROPOSED FLOW CONTROL
RESTRICTED TO 6.2 L/S
107mmØ ORIFICE

ADDITIONAL STORAGE AND FLOW CONTROL HIGHLIGHTED IN BLUE.
STORAGE REQUIRED TO TAKE ACCOUNT OF CURRENT LEGISLATION AND CONTAIN FLOWS FOR 100 YEAR EVENT WITH A 40% ALLOWANCE FOR CLIMATE CHANGE.

PROPOSED SURFACE WATER DRAINAGE WITHIN CLOUDED AREA TO CONNECT INTO EXISTING MANHOLE S8.
DESIGN BY OTHERS.
CALCULATIONS FOR STORY HOMES SUBMISSION ARE BASED UPON CALCULATIONS PROVIDED BY DEVELOPER OF NEW DEVELOPMENT.

G5HB
PROPOSED FLOW CONTROL
RESTRICTED TO 6 L/S

GEOCELLULAR ATTENUATION STORAGE
232m² x 1.6m Deep (371m³)
Ground Level = 94.080
(Cover = 900mm)
Soffit = 93.180
Invert = 91.580

V x ADVERTISEMENT BOARDS

Potential Landscape Buffer

Sales Centre

Highways
1. All excavations below adopted highways to be backfilled with Type 1 and compacted in layers not exceeding 150mm.
2. Highway Authority to be contacted as soon as Contractor is on site to enable early discussions with the Clerk of Works.

General Drainage
3. Manhole/inspespectionchamber covers in trafficked areas to be loading type D400 and B125 in non-trafficked areas.
4. All gullies to be trapped as shown on the details drawings.

Adopted Drainage
5. Position and levels of existing manholes and sewers are to be checked on site as soon as possible and preferably before site activities commence.
6. The sewer connection is to be carried out by an NWL Approved Contractor.
7. This drawing is to be read in conjunction with the drainage details drawings.
8. For proposed adopted drainage pipes with less than 900mm cover in areas not subjected to vehicular loading and less than 1200mm in vehicular loading areas to be concrete protected.
9. Adopted drainage is to comply with 'Sewers for Adoption 6th Edition'.
10. Pipe surround to be granular type 's' unless noted otherwise.

Private Drainage
11. Private drainage is to comply with all statutory requirements and accord with BS EN 752 and Building Regulations Approved Document H.
12. Pipe bedding should granular unless noted otherwise and the granular material to be to BS882:Pt 2 and to Building Regulations Part H.
13. Pipe sizes to be 100mm u.n.o..
14. For drainage pipes to be cast in concrete to have rocker pipes either side of concrete.

LOCATION, COVER AND INVERT LEVELS OF EXISTING ADOPTED SEWERS TO BE VERIFIED BY CONTRACTOR PRIOR TO COMMENCEMENT

LOCATION OF EXISTING SEWERS ARE INTERPRETED FROM UU SEWER RECORDS AND THE TOPOGRAPHICAL SURVEY. CONFIRMATION OF EACH POINT OF CONNECTION SHOULD BE MADE BY THE CONTRACTOR PRIOR TO ANY WORKS ON SITE.

ALL CONNECTIONS FOR FOUL AND SURFACE WATER TO THE PUBLIC SYSTEM WILL BE SUBJECT TO A SECTION 106 AGREEMENT WITH UNITED UTILITIES

Issue	Date	Description	By	Chkd	Appd
P3	05/10/21	Planning Issue	RH	RH	PL
P2	28/09/21	Planning Issue	RH	RH	PL
P1	09/09/21	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS
7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client: STORY HOMES

Job Title: WATERS EDGE

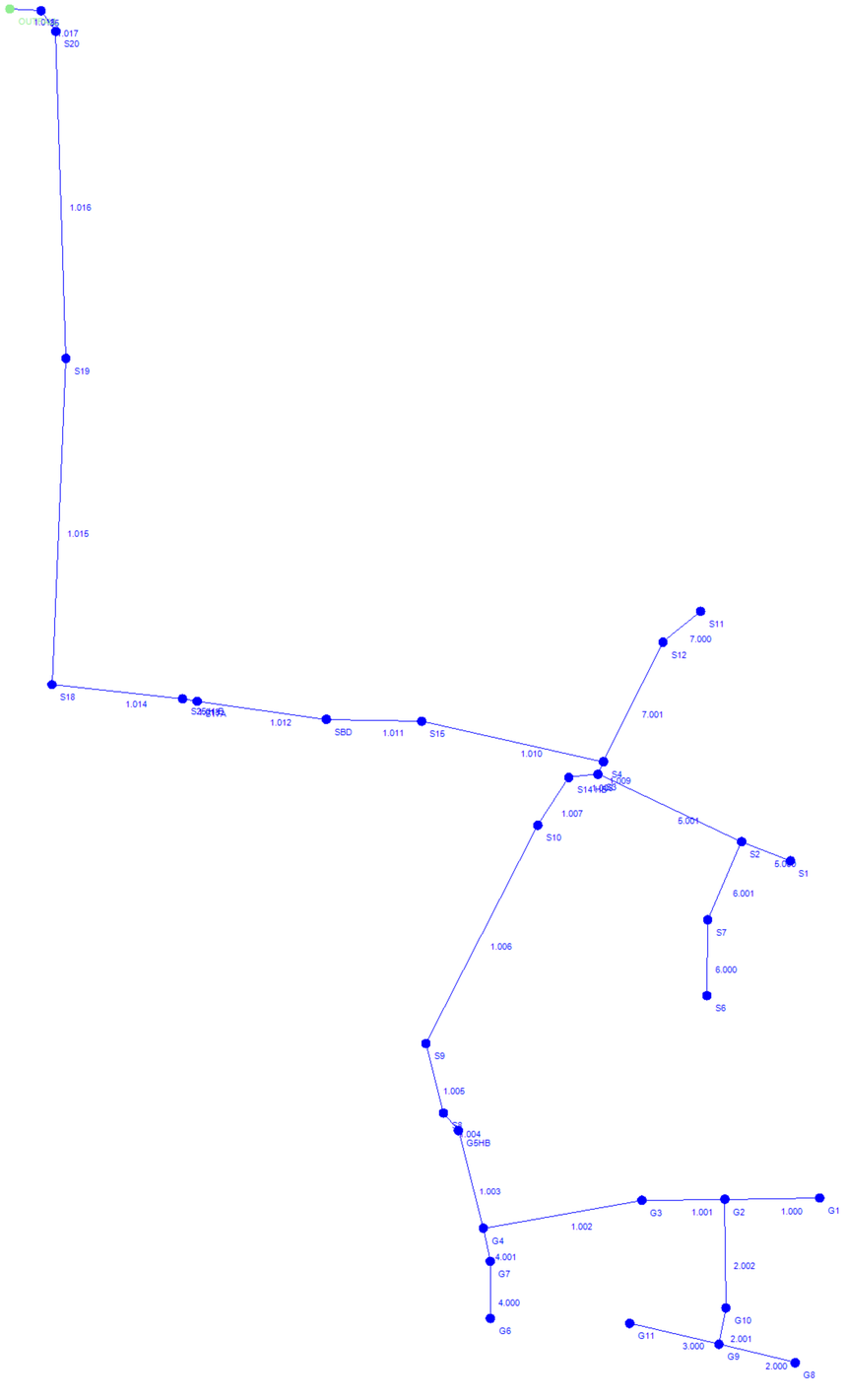
Drawing Title: PROPOSED MODIFICATIONS TO EXISTING SURFACE WATER NETWORK

Scale at A0: 1:250

Drawing Status: PRELIMINARY

Job No: 21108 | Drawing No: 02 | Issue: P3

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 28/09/2021 18:26 File 210902 Coast - 61s gleeson add flow control pipe storage.MDX	Designed by Richard Checked by	
Innovyze	Network 2020.1	



STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	28.454	0.592	48.1	0.146	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	23.478	0.154	152.5	0.049	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	27.456	0.251	109.4	0.065	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	11.033	0.066	167.2	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	32.419	0.363	89.3	0.091	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	24.849	0.105	236.7	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	48.233	0.781	61.8	0.064	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	17.015	0.033	515.6	0.047	5.00	0.0	0.600	o	900	Pipe/Conduit	
4.001	10.120	0.033	306.7	0.019	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.003	30.214	0.045	671.4	0.052	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.004	6.917	0.125	55.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	21.476	0.689	31.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	5.25	93.112	0.146	0.0	0.0	0.0	1.89	75.2	0.0
2.000	0.00	5.37	93.103	0.049	0.0	0.0	0.0	1.06	42.0	0.0
3.000	0.00	5.37	93.200	0.065	0.0	0.0	0.0	1.25	49.7	0.0
2.001	0.00	5.55	92.949	0.120	0.0	0.0	0.0	1.01	40.1	0.0
2.002	0.00	5.94	92.883	0.211	0.0	0.0	0.0	1.38	55.0	0.0
1.001	0.00	6.35	92.445	0.398	0.0	0.0	0.0	1.02	71.9	0.0
1.002	0.00	6.75	92.340	0.462	0.0	0.0	0.0	2.00	141.7	0.0
4.000	0.00	5.21	91.025	0.047	0.0	0.0	0.0	1.37	873.4	0.0
4.001	0.00	5.30	90.992	0.066	0.0	0.0	0.0	1.78	1134.9	0.0
1.003	0.00	7.17	90.959	0.580	0.0	0.0	0.0	1.20	764.4	0.0
1.004	0.00	7.22	90.914	0.580	0.0	0.0	0.0	2.12	149.7	0.0
1.005	0.00	7.35	90.789	0.580	0.0	0.0	0.0	2.83	199.8	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.006	73.572	0.845	87.1	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	17.057	1.246	13.7	0.072	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	8.804	0.987	8.9	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	15.717	0.692	22.7	0.192	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.000	22.811	0.407	56.0	0.086	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	25.533	0.458	55.7	0.048	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	47.526	2.784	17.1	0.085	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	4.121	0.567	7.3	0.085	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	14.555	0.391	37.2	0.063	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	40.117	0.338	118.7	0.138	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	55.804	2.979	18.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	28.556	3.245	8.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.006	0.00	8.08	90.100	0.650	0.0	0.0	0.0	1.69	119.2	0.0
1.007	0.00	8.15	89.255	0.722	0.0	0.0	0.0	4.27	301.9	0.0
1.008	0.00	8.17	88.009	0.751	0.0	0.0	0.0	5.29	374.3	0.0
5.000	0.00	5.12	91.324	0.192	0.0	0.0	0.0	2.12	37.5	0.0
6.000	0.00	5.28	91.497	0.086	0.0	0.0	0.0	1.35	23.8	0.0
6.001	0.00	5.60	91.090	0.134	0.0	0.0	0.0	1.35	23.9	0.0
5.001	0.00	5.85	90.557	0.411	0.0	0.0	0.0	3.18	126.5	0.0
1.009	0.00	8.18	87.022	1.247	0.0	0.0	0.0	5.87	414.7	0.0
7.000	0.00	5.15	87.334	0.063	0.0	0.0	0.0	1.65	29.2	0.0
7.001	0.00	5.70	86.868	0.201	0.0	0.0	0.0	1.20	47.7	0.0
1.010	0.00	8.41	86.380	1.448	0.0	0.0	0.0	4.20	464.2	0.0
1.011	0.00	8.48	83.401	1.448	0.0	0.0	0.0	6.14	678.0	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.012	39.083	0.361	108.3	0.000	0.00	0.0	0.600	oo	-1	Pipe/Conduit	
1.013	4.456	0.282	15.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.014	39.353	0.752	52.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.015	97.974	2.817	34.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.016	97.961	4.494	21.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.017	7.649	0.097	78.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.018	9.348	0.093	100.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.012	0.00	8.60	78.614	1.448	0.0	0.0	0.0	5.49	49647.8	0.0
1.013	0.00	8.62	78.253	1.448	0.0	0.0	0.0	5.13	816.6	0.0
1.014	0.00	8.98	77.971	1.448	0.0	0.0	0.0	1.81	72.1	0.0
1.015	0.00	9.71	77.219	1.448	0.0	0.0	0.0	2.23	88.5	0.0
1.016	0.00	10.29	74.402	1.448	0.0	0.0	0.0	2.81	111.9	0.0
1.017	0.00	10.38	69.908	1.448	0.0	0.0	0.0	1.47	58.6	0.0
1.018	0.00	10.50	69.811	1.448	0.0	0.0	0.0	1.30	51.8	0.0

Free Flowing Outfall Details for 210902 COAST.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.018	OUTFALL	71.000	69.718	0.000	0	0

Simulation Criteria for 210902 COAST.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Simulation Criteria for 210902 COAST.SWS

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.260		

Online Controls for 210902 COAST.SWS

Hydro-Brake® Optimum Manhole: G5HB, DS/PN: 1.004, Volume (m³): 25.1

Unit Reference	MD-SHE-0093-6000-2772-6000
Design Head (m)	2.772
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	93
Invert Level (m)	90.914
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.772	6.0	Kick-Flo®	0.828	3.4
Flush-Flo™	0.404	4.3	Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	1.200	4.1	3.000	6.2	7.000	9.3
0.200	3.9	1.400	4.4	3.500	6.7	7.500	9.6
0.300	4.2	1.600	4.6	4.000	7.1	8.000	9.9
0.400	4.3	1.800	4.9	4.500	7.5	8.500	10.2
0.500	4.2	2.000	5.1	5.000	7.9	9.000	10.5
0.600	4.1	2.200	5.4	5.500	8.3	9.500	10.7
0.800	3.6	2.400	5.6	6.000	8.6		
1.000	3.7	2.600	5.8	6.500	9.0		

Hydro-Brake® Optimum Manhole: S14 HB, DS/PN: 1.008, Volume (m³): 5.3

Unit Reference	MD-SHE-0107-6200-1653-6200
Design Head (m)	1.653
Design Flow (l/s)	6.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	88.009
Minimum Outlet Pipe Diameter (mm)	150

Hydro-Brake® Optimum Manhole: S14 HB, DS/PN: 1.008, Volume (m³): 5.3

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.653	6.2	Kick-Flo®	0.955	4.8
Flush-Flo™	0.469	6.0	Mean Flow over Head Range	-	5.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.3	3.000	8.2	7.000	12.2
0.200	5.3	1.400	5.7	3.500	8.8	7.500	12.7
0.300	5.8	1.600	6.1	4.000	9.4	8.000	13.1
0.400	6.0	1.800	6.4	4.500	9.9	8.500	13.4
0.500	6.0	2.000	6.8	5.000	10.4	9.000	13.8
0.600	5.9	2.200	7.1	5.500	10.9	9.500	14.2
0.800	5.6	2.400	7.4	6.000	11.4		
1.000	4.9	2.600	7.7	6.500	11.8		

Hydro-Brake® Optimum Manhole: S25 H-B, DS/PN: 1.014, Volume (m³): 6.6

Unit Reference	MD-SHE-0144-1580-3510-1580
Design Head (m)	3.510
Design Flow (l/s)	15.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	144
Invert Level (m)	77.971
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.510	15.8	Kick-Flo®	1.287	9.8
Flush-Flo™	0.623	12.5	Mean Flow over Head Range	-	12.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.200	10.2	0.300	11.4	0.400	12.1

Hydro-Brake® Optimum Manhole: S25 H-B, DS/PN: 1.014, Volume (m³): 6.6

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.500	12.4	1.800	11.5	4.000	16.8	7.500	22.7
0.600	12.5	2.000	12.1	4.500	17.8	8.000	23.4
0.800	12.4	2.200	12.7	5.000	18.7	8.500	24.1
1.000	11.9	2.400	13.2	5.500	19.6	9.000	24.8
1.200	10.7	2.600	13.7	6.000	20.4	9.500	25.5
1.400	10.2	3.000	14.7	6.500	21.2		
1.600	10.9	3.500	15.8	7.000	22.0		

Storage Structures for 210902 COAST.SWS

Cellular Storage Manhole: G5HB, DS/PN: 1.004

Invert Level (m) 90.914 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	0.0	0.0	2.221	232.0	0.0
0.620	0.0	0.0	2.222	0.0	0.0
0.621	232.0	0.0			

Cellular Storage Manhole: S14 HB, DS/PN: 1.008

Invert Level (m) 88.209 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	0.0	0.0	1.100	108.0	0.0
0.299	0.0	0.0	1.101	0.0	0.0
0.300	108.0	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.259
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	G1	15 Winter	2	+0%					93.190
2.000	G8	15 Winter	2	+0%					93.163
3.000	G11	15 Winter	2	+0%					93.264
2.001	G9	15 Winter	2	+0%					93.052
2.002	G10	15 Winter	2	+0%					92.991
1.001	G2	15 Winter	2	+0%					92.634
1.002	G3	15 Winter	2	+0%					92.470
4.000	G6	240 Winter	2	+0%					91.655
4.001	G7	240 Winter	2	+0%					91.656
1.003	G4	240 Winter	2	+0%					91.656
1.004	G5HB	240 Winter	2	+0%	2/15 Summer				91.655
1.005	S8	1440 Winter	2	+0%					90.820
1.006	S9	15 Winter	2	+0%					90.164
1.007	S10	15 Winter	2	+0%					89.309
1.008	S14 HB	120 Winter	2	+0%	2/15 Summer				88.615

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	G1	-0.147	0.000	0.26			18.1	OK	
2.000	G8	-0.165	0.000	0.16			6.0	OK	
3.000	G11	-0.161	0.000	0.17			7.9	OK	
2.001	G9	-0.122	0.000	0.43			14.7	OK	
2.002	G10	-0.117	0.000	0.46			23.9	OK	
1.001	G2	-0.111	0.000	0.71			45.4	OK	
1.002	G3	-0.170	0.000	0.39			51.9	OK	
4.000	G6	-0.270	0.000	0.00			1.4	OK	
4.001	G7	-0.236	0.000	0.00			1.5	OK	
1.003	G4	-0.203	0.000	0.03			17.4	OK	
1.004	G5HB	0.441	0.000	0.05		147	4.3	SURCHARGED	
1.005	S8	-0.269	0.000	0.02			4.3	OK	
1.006	S9	-0.236	0.000	0.10			11.4	OK	
1.007	S10	-0.246	0.000	0.07			18.9	OK	
1.008	S14 HB	0.306	0.000	0.02		69	6.0	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
5.000	S1	15 Winter	2	+0%					91.417
6.000	S6	15 Winter	2	+0%					91.570
6.001	S7	15 Winter	2	+0%					91.183
5.001	S2	15 Winter	2	+0%					90.656
1.009	S3	15 Winter	2	+0%					87.142
7.000	S11	15 Winter	2	+0%					87.389
7.001	S12	15 Winter	2	+0%					86.981
1.010	S4	15 Winter	2	+0%					86.493
1.011	S15	15 Winter	2	+0%					83.495
1.012	SBD	240 Winter	2	+0%					79.040
1.013	S17A	240 Winter	2	+0%	2/15 Summer				79.040
1.014	S25 H-B	180 Winter	2	+0%	2/15 Summer				79.149
1.015	S18	960 Winter	2	+0%					77.274
1.016	S19	1440 Winter	2	+0%					74.451
1.017	S20	1440 Winter	2	+0%					69.987
1.018	35	1440 Winter	2	+0%					69.892

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.000	S1	-0.057	0.000	0.68			23.7	OK	
6.000	S6	-0.077	0.000	0.47			10.5	OK	
6.001	S7	-0.057	0.000	0.69			15.7	OK	
5.001	S2	-0.126	0.000	0.40			48.2	OK	
1.009	S3	-0.180	0.000	0.33			63.2	OK	
7.000	S11	-0.095	0.000	0.29			7.8	OK	
7.001	S12	-0.112	0.000	0.50			22.5	OK	
1.010	S4	-0.262	0.000	0.20			85.7	OK	
1.011	S15	-0.281	0.000	0.14			85.5	OK	
1.012	SBD	-1.974	0.000	0.00			28.5	OK	
1.013	S17A	0.337	0.000	0.06			18.8	SURCHARGED	
1.014	S25 H-B	0.953	0.000	0.17			11.9	SURCHARGED	
1.015	S18	-0.170	0.000	0.14			11.9	OK	
1.016	S19	-0.176	0.000	0.11			11.9	OK	
1.017	S20	-0.146	0.000	0.27			11.9	OK	
1.018	35	-0.144	0.000	0.28			11.9	OK	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	28.454	0.592	48.1	0.146	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	23.478	0.154	152.5	0.049	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	27.456	0.251	109.4	0.065	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	11.033	0.066	167.2	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	32.419	0.363	89.3	0.091	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	24.849	0.105	236.7	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	48.233	0.781	61.8	0.064	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	17.015	0.033	515.6	0.047	5.00	0.0	0.600	o	900	Pipe/Conduit	
4.001	10.120	0.033	306.7	0.019	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.003	30.214	0.045	671.4	0.052	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.004	6.917	0.125	55.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	21.476	0.689	31.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	5.25	93.112	0.146	0.0	0.0	0.0	1.89	75.2	0.0
2.000	0.00	5.37	93.103	0.049	0.0	0.0	0.0	1.06	42.0	0.0
3.000	0.00	5.37	93.200	0.065	0.0	0.0	0.0	1.25	49.7	0.0
2.001	0.00	5.55	92.949	0.120	0.0	0.0	0.0	1.01	40.1	0.0
2.002	0.00	5.94	92.883	0.211	0.0	0.0	0.0	1.38	55.0	0.0
1.001	0.00	6.35	92.445	0.398	0.0	0.0	0.0	1.02	71.9	0.0
1.002	0.00	6.75	92.340	0.462	0.0	0.0	0.0	2.00	141.7	0.0
4.000	0.00	5.21	91.025	0.047	0.0	0.0	0.0	1.37	873.4	0.0
4.001	0.00	5.30	90.992	0.066	0.0	0.0	0.0	1.78	1134.9	0.0
1.003	0.00	7.17	90.959	0.580	0.0	0.0	0.0	1.20	764.4	0.0
1.004	0.00	7.22	90.914	0.580	0.0	0.0	0.0	2.12	149.7	0.0
1.005	0.00	7.35	90.789	0.580	0.0	0.0	0.0	2.83	199.8	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.006	73.572	0.845	87.1	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	17.057	1.246	13.7	0.072	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	8.804	0.987	8.9	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	15.717	0.692	22.7	0.192	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.000	22.811	0.407	56.0	0.086	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	25.533	0.458	55.7	0.048	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	47.526	2.784	17.1	0.085	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	4.121	0.567	7.3	0.085	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	14.555	0.391	37.2	0.063	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	40.117	0.338	118.7	0.138	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	55.804	2.979	18.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	28.556	3.245	8.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.006	0.00	8.08	90.100	0.650	0.0	0.0	0.0	1.69	119.2	0.0
1.007	0.00	8.15	89.255	0.722	0.0	0.0	0.0	4.27	301.9	0.0
1.008	0.00	8.17	88.009	0.751	0.0	0.0	0.0	5.29	374.3	0.0
5.000	0.00	5.12	91.324	0.192	0.0	0.0	0.0	2.12	37.5	0.0
6.000	0.00	5.28	91.497	0.086	0.0	0.0	0.0	1.35	23.8	0.0
6.001	0.00	5.60	91.090	0.134	0.0	0.0	0.0	1.35	23.9	0.0
5.001	0.00	5.85	90.557	0.411	0.0	0.0	0.0	3.18	126.5	0.0
1.009	0.00	8.18	87.022	1.247	0.0	0.0	0.0	5.87	414.7	0.0
7.000	0.00	5.15	87.334	0.063	0.0	0.0	0.0	1.65	29.2	0.0
7.001	0.00	5.70	86.868	0.201	0.0	0.0	0.0	1.20	47.7	0.0
1.010	0.00	8.41	86.380	1.448	0.0	0.0	0.0	4.20	464.2	0.0
1.011	0.00	8.48	83.401	1.448	0.0	0.0	0.0	6.14	678.0	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.012	39.083	0.361	108.3	0.000	0.00	0.0	0.600	oo	-1	Pipe/Conduit	
1.013	4.456	0.282	15.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.014	39.353	0.752	52.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.015	97.974	2.817	34.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.016	97.961	4.494	21.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.017	7.649	0.097	78.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.018	9.348	0.093	100.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.012	0.00	8.60	78.614	1.448	0.0	0.0	0.0	5.49	49647.8	0.0
1.013	0.00	8.62	78.253	1.448	0.0	0.0	0.0	5.13	816.6	0.0
1.014	0.00	8.98	77.971	1.448	0.0	0.0	0.0	1.81	72.1	0.0
1.015	0.00	9.71	77.219	1.448	0.0	0.0	0.0	2.23	88.5	0.0
1.016	0.00	10.29	74.402	1.448	0.0	0.0	0.0	2.81	111.9	0.0
1.017	0.00	10.38	69.908	1.448	0.0	0.0	0.0	1.47	58.6	0.0
1.018	0.00	10.50	69.811	1.448	0.0	0.0	0.0	1.30	51.8	0.0

Free Flowing Outfall Details for 210902 COAST.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.018	OUTFALL	71.000	69.718	0.000	0	0

Simulation Criteria for 210902 COAST.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Simulation Criteria for 210902 COAST.SWS

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.260		

Online Controls for 210902 COAST.SWS

Hydro-Brake® Optimum Manhole: G5HB, DS/PN: 1.004, Volume (m³): 25.1

Unit Reference	MD-SHE-0093-6000-2772-6000
Design Head (m)	2.772
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	93
Invert Level (m)	90.914
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.772	6.0	Kick-Flo®	0.828	3.4
Flush-Flo™	0.404	4.3	Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	1.200	4.1	3.000	6.2	7.000	9.3
0.200	3.9	1.400	4.4	3.500	6.7	7.500	9.6
0.300	4.2	1.600	4.6	4.000	7.1	8.000	9.9
0.400	4.3	1.800	4.9	4.500	7.5	8.500	10.2
0.500	4.2	2.000	5.1	5.000	7.9	9.000	10.5
0.600	4.1	2.200	5.4	5.500	8.3	9.500	10.7
0.800	3.6	2.400	5.6	6.000	8.6		
1.000	3.7	2.600	5.8	6.500	9.0		

Hydro-Brake® Optimum Manhole: S14 HB, DS/PN: 1.008, Volume (m³): 5.3

Unit Reference	MD-SHE-0107-6200-1653-6200
Design Head (m)	1.653
Design Flow (l/s)	6.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	88.009
Minimum Outlet Pipe Diameter (mm)	150

Hydro-Brake® Optimum Manhole: S14 HB, DS/PN: 1.008, Volume (m³): 5.3

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.653	6.2	Kick-Flo®	0.955	4.8
Flush-Flo™	0.469	6.0	Mean Flow over Head Range	-	5.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.3	3.000	8.2	7.000	12.2
0.200	5.3	1.400	5.7	3.500	8.8	7.500	12.7
0.300	5.8	1.600	6.1	4.000	9.4	8.000	13.1
0.400	6.0	1.800	6.4	4.500	9.9	8.500	13.4
0.500	6.0	2.000	6.8	5.000	10.4	9.000	13.8
0.600	5.9	2.200	7.1	5.500	10.9	9.500	14.2
0.800	5.6	2.400	7.4	6.000	11.4		
1.000	4.9	2.600	7.7	6.500	11.8		

Hydro-Brake® Optimum Manhole: S25 H-B, DS/PN: 1.014, Volume (m³): 6.6

Unit Reference	MD-SHE-0144-1580-3510-1580
Design Head (m)	3.510
Design Flow (l/s)	15.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	144
Invert Level (m)	77.971
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.510	15.8	Kick-Flo®	1.287	9.8
Flush-Flo™	0.623	12.5	Mean Flow over Head Range	-	12.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.200	10.2	0.300	11.4	0.400	12.1

Hydro-Brake® Optimum Manhole: S25 H-B, DS/PN: 1.014, Volume (m³): 6.6

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.500	12.4	1.800	11.5	4.000	16.8	7.500	22.7
0.600	12.5	2.000	12.1	4.500	17.8	8.000	23.4
0.800	12.4	2.200	12.7	5.000	18.7	8.500	24.1
1.000	11.9	2.400	13.2	5.500	19.6	9.000	24.8
1.200	10.7	2.600	13.7	6.000	20.4	9.500	25.5
1.400	10.2	3.000	14.7	6.500	21.2		
1.600	10.9	3.500	15.8	7.000	22.0		

Storage Structures for 210902 COAST.SWS

Cellular Storage Manhole: G5HB, DS/PN: 1.004

Invert Level (m) 90.914 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	0.0	0.0	2.221	232.0	0.0
0.620	0.0	0.0	2.222	0.0	0.0
0.621	232.0	0.0			

Cellular Storage Manhole: S14 HB, DS/PN: 1.008

Invert Level (m) 88.209 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	0.0	0.0	1.100	108.0	0.0
0.299	0.0	0.0	1.101	0.0	0.0
0.300	108.0	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.259
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	G1	15 Winter	30	+0%					93.223
2.000	G8	15 Winter	30	+0%					93.187
3.000	G11	15 Winter	30	+0%					93.289
2.001	G9	15 Winter	30	+0%					93.129
2.002	G10	15 Winter	30	+0%					93.091
1.001	G2	15 Winter	30	+0%	30/15 Summer				92.818
1.002	G3	15 Winter	30	+0%					92.534
4.000	G6	360 Winter	30	+0%	30/180 Winter				91.992
4.001	G7	360 Winter	30	+0%	30/120 Winter				91.992
1.003	G4	360 Winter	30	+0%	30/120 Winter				91.992
1.004	G5HB	360 Winter	30	+0%	30/15 Summer				91.992
1.005	S8	960 Winter	30	+0%					90.820
1.006	S9	15 Winter	30	+0%					90.188
1.007	S10	15 Winter	30	+0%					89.333
1.008	S14 HB	240 Winter	30	+0%	30/15 Summer				88.820

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	G1	-0.114	0.000	0.48			33.8	OK	
2.000	G8	-0.141	0.000	0.29			11.1	OK	
3.000	G11	-0.136	0.000	0.32			14.8	OK	
2.001	G9	-0.045	0.000	0.83			28.0	OK	
2.002	G10	-0.017	0.000	0.87			44.7	OK	
1.001	G2	0.073	0.000	1.34			85.8	SURCHARGED	
1.002	G3	-0.106	0.000	0.74			98.2	OK	
4.000	G6	0.067	0.000	0.00			1.9	SURCHARGED	
4.001	G7	0.100	0.000	0.00			2.3	SURCHARGED	
1.003	G4	0.133	0.000	0.05			24.4	SURCHARGED	
1.004	G5HB	0.778	0.000	0.05		334	4.3	SURCHARGED	
1.005	S8	-0.269	0.000	0.02			4.3	OK	
1.006	S9	-0.212	0.000	0.18			21.0	OK	
1.007	S10	-0.222	0.000	0.15			38.7	OK	
1.008	S14 HB	0.511	0.000	0.02		158	6.0	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
5.000	S1	15 Winter	30	+0%	30/15 Summer				91.669
6.000	S6	15 Winter	30	+0%	30/15 Winter				91.668
6.001	S7	15 Winter	30	+0%	30/15 Summer				91.416
5.001	S2	15 Winter	30	+0%					90.697
1.009	S3	15 Winter	30	+0%					87.188
7.000	S11	15 Winter	30	+0%					87.413
7.001	S12	15 Winter	30	+0%	30/15 Summer				87.109
1.010	S4	15 Winter	30	+0%					86.535
1.011	S15	15 Winter	30	+0%					83.531
1.012	SBD	480 Winter	30	+0%					79.646
1.013	S17A	480 Winter	30	+0%	30/15 Summer				79.646
1.014	S25 H-B	480 Winter	30	+0%	30/15 Summer				79.761
1.015	S18	1440 Winter	30	+0%					77.274
1.016	S19	1440 Winter	30	+0%					74.451
1.017	S20	1440 Winter	30	+0%					69.987
1.018	35	1440 Winter	30	+0%					69.892

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.000	S1	0.195	0.000	1.13			39.1	SURCHARGED	
6.000	S6	0.021	0.000	0.81			18.2	SURCHARGED	
6.001	S7	0.176	0.000	1.18			26.7	SURCHARGED	
5.001	S2	-0.085	0.000	0.69			83.5	OK	
1.009	S3	-0.134	0.000	0.58			108.7	OK	
7.000	S11	-0.071	0.000	0.54			14.5	OK	
7.001	S12	0.016	0.000	1.03			46.5	SURCHARGED	
1.010	S4	-0.220	0.000	0.36			155.0	OK	
1.011	S15	-0.245	0.000	0.26			155.2	OK	
1.012	SBD	-1.368	0.000	0.00			32.3	OK	
1.013	S17A	0.943	0.000	0.06			18.3	SURCHARGED	
1.014	S25 H-B	1.565	0.000	0.17			11.9	SURCHARGED	
1.015	S18	-0.170	0.000	0.14			11.9	OK	
1.016	S19	-0.176	0.000	0.11			11.9	OK	
1.017	S20	-0.146	0.000	0.27			11.9	OK	
1.018	35	-0.144	0.000	0.28			11.9	OK	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	28.454	0.592	48.1	0.146	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	23.478	0.154	152.5	0.049	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	27.456	0.251	109.4	0.065	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	11.033	0.066	167.2	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	32.419	0.363	89.3	0.091	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	24.849	0.105	236.7	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	48.233	0.781	61.8	0.064	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	17.015	0.033	515.6	0.047	5.00	0.0	0.600	o	900	Pipe/Conduit	
4.001	10.120	0.033	306.7	0.019	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.003	30.214	0.045	671.4	0.052	0.00	0.0	0.600	o	900	Pipe/Conduit	
1.004	6.917	0.125	55.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	21.476	0.689	31.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	5.25	93.112	0.146	0.0	0.0	0.0	1.89	75.2	0.0
2.000	0.00	5.37	93.103	0.049	0.0	0.0	0.0	1.06	42.0	0.0
3.000	0.00	5.37	93.200	0.065	0.0	0.0	0.0	1.25	49.7	0.0
2.001	0.00	5.55	92.949	0.120	0.0	0.0	0.0	1.01	40.1	0.0
2.002	0.00	5.94	92.883	0.211	0.0	0.0	0.0	1.38	55.0	0.0
1.001	0.00	6.35	92.445	0.398	0.0	0.0	0.0	1.02	71.9	0.0
1.002	0.00	6.75	92.340	0.462	0.0	0.0	0.0	2.00	141.7	0.0
4.000	0.00	5.21	91.025	0.047	0.0	0.0	0.0	1.37	873.4	0.0
4.001	0.00	5.30	90.992	0.066	0.0	0.0	0.0	1.78	1134.9	0.0
1.003	0.00	7.17	90.959	0.580	0.0	0.0	0.0	1.20	764.4	0.0
1.004	0.00	7.22	90.914	0.580	0.0	0.0	0.0	2.12	149.7	0.0
1.005	0.00	7.35	90.789	0.580	0.0	0.0	0.0	2.83	199.8	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.006	73.572	0.845	87.1	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	17.057	1.246	13.7	0.072	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	8.804	0.987	8.9	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	15.717	0.692	22.7	0.192	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.000	22.811	0.407	56.0	0.086	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	25.533	0.458	55.7	0.048	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	47.526	2.784	17.1	0.085	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	4.121	0.567	7.3	0.085	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	14.555	0.391	37.2	0.063	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	40.117	0.338	118.7	0.138	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.010	55.804	2.979	18.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	28.556	3.245	8.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.006	0.00	8.08	90.100	0.650	0.0	0.0	0.0	1.69	119.2	0.0
1.007	0.00	8.15	89.255	0.722	0.0	0.0	0.0	4.27	301.9	0.0
1.008	0.00	8.17	88.009	0.751	0.0	0.0	0.0	5.29	374.3	0.0
5.000	0.00	5.12	91.324	0.192	0.0	0.0	0.0	2.12	37.5	0.0
6.000	0.00	5.28	91.497	0.086	0.0	0.0	0.0	1.35	23.8	0.0
6.001	0.00	5.60	91.090	0.134	0.0	0.0	0.0	1.35	23.9	0.0
5.001	0.00	5.85	90.557	0.411	0.0	0.0	0.0	3.18	126.5	0.0
1.009	0.00	8.18	87.022	1.247	0.0	0.0	0.0	5.87	414.7	0.0
7.000	0.00	5.15	87.334	0.063	0.0	0.0	0.0	1.65	29.2	0.0
7.001	0.00	5.70	86.868	0.201	0.0	0.0	0.0	1.20	47.7	0.0
1.010	0.00	8.41	86.380	1.448	0.0	0.0	0.0	4.20	464.2	0.0
1.011	0.00	8.48	83.401	1.448	0.0	0.0	0.0	6.14	678.0	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 210902 COAST.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.012	39.083	0.361	108.3	0.000	0.00	0.0	0.600	oo	-1	Pipe/Conduit	
1.013	4.456	0.282	15.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.014	39.353	0.752	52.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.015	97.974	2.817	34.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.016	97.961	4.494	21.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.017	7.649	0.097	78.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.018	9.348	0.093	100.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.012	0.00	8.60	78.614	1.448	0.0	0.0	0.0	5.49	49647.8	0.0
1.013	0.00	8.62	78.253	1.448	0.0	0.0	0.0	5.13	816.6	0.0
1.014	0.00	8.98	77.971	1.448	0.0	0.0	0.0	1.81	72.1	0.0
1.015	0.00	9.71	77.219	1.448	0.0	0.0	0.0	2.23	88.5	0.0
1.016	0.00	10.29	74.402	1.448	0.0	0.0	0.0	2.81	111.9	0.0
1.017	0.00	10.38	69.908	1.448	0.0	0.0	0.0	1.47	58.6	0.0
1.018	0.00	10.50	69.811	1.448	0.0	0.0	0.0	1.30	51.8	0.0

Free Flowing Outfall Details for 210902 COAST.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.018	OUTFALL	71.000	69.718	0.000	0	0

Simulation Criteria for 210902 COAST.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Simulation Criteria for 210902 COAST.SWS

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.000	Storm Duration (mins)	30
Ratio R	0.260		

Online Controls for 210902 COAST.SWS

Hydro-Brake® Optimum Manhole: G5HB, DS/PN: 1.004, Volume (m³): 25.1

Unit Reference	MD-SHE-0093-6000-2772-6000
Design Head (m)	2.772
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	93
Invert Level (m)	90.914
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.772	6.0	Kick-Flo®	0.828	3.4
Flush-Flo™	0.404	4.3	Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	1.200	4.1	3.000	6.2	7.000	9.3
0.200	3.9	1.400	4.4	3.500	6.7	7.500	9.6
0.300	4.2	1.600	4.6	4.000	7.1	8.000	9.9
0.400	4.3	1.800	4.9	4.500	7.5	8.500	10.2
0.500	4.2	2.000	5.1	5.000	7.9	9.000	10.5
0.600	4.1	2.200	5.4	5.500	8.3	9.500	10.7
0.800	3.6	2.400	5.6	6.000	8.6		
1.000	3.7	2.600	5.8	6.500	9.0		

Hydro-Brake® Optimum Manhole: S14 HB, DS/PN: 1.008, Volume (m³): 5.3

Unit Reference	MD-SHE-0107-6200-1653-6200
Design Head (m)	1.653
Design Flow (l/s)	6.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	88.009
Minimum Outlet Pipe Diameter (mm)	150

Hydro-Brake® Optimum Manhole: S14 HB, DS/PN: 1.008, Volume (m³): 5.3

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.653	6.2	Kick-Flo®	0.955	4.8
Flush-Flo™	0.469	6.0	Mean Flow over Head Range	-	5.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.3	3.000	8.2	7.000	12.2
0.200	5.3	1.400	5.7	3.500	8.8	7.500	12.7
0.300	5.8	1.600	6.1	4.000	9.4	8.000	13.1
0.400	6.0	1.800	6.4	4.500	9.9	8.500	13.4
0.500	6.0	2.000	6.8	5.000	10.4	9.000	13.8
0.600	5.9	2.200	7.1	5.500	10.9	9.500	14.2
0.800	5.6	2.400	7.4	6.000	11.4		
1.000	4.9	2.600	7.7	6.500	11.8		

Hydro-Brake® Optimum Manhole: S25 H-B, DS/PN: 1.014, Volume (m³): 6.6

Unit Reference	MD-SHE-0144-1580-3510-1580
Design Head (m)	3.510
Design Flow (l/s)	15.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	144
Invert Level (m)	77.971
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.510	15.8	Kick-Flo®	1.287	9.8
Flush-Flo™	0.623	12.5	Mean Flow over Head Range	-	12.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	0.200	10.2	0.300	11.4	0.400	12.1

Hydro-Brake® Optimum Manhole: S25 H-B, DS/PN: 1.014, Volume (m³): 6.6

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.500	12.4	1.800	11.5	4.000	16.8	7.500	22.7
0.600	12.5	2.000	12.1	4.500	17.8	8.000	23.4
0.800	12.4	2.200	12.7	5.000	18.7	8.500	24.1
1.000	11.9	2.400	13.2	5.500	19.6	9.000	24.8
1.200	10.7	2.600	13.7	6.000	20.4	9.500	25.5
1.400	10.2	3.000	14.7	6.500	21.2		
1.600	10.9	3.500	15.8	7.000	22.0		

Storage Structures for 210902 COAST.SWS

Cellular Storage Manhole: G5HB, DS/PN: 1.004

Invert Level (m) 90.914 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	0.0	0.0	2.221	232.0	0.0
0.620	0.0	0.0	2.222	0.0	0.0
0.621	232.0	0.0			

Cellular Storage Manhole: S14 HB, DS/PN: 1.008

Invert Level (m) 88.209 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	0.0	0.0	1.100	108.0	0.0
0.299	0.0	0.0	1.101	0.0	0.0
0.300	108.0	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.259
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	16.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360
Return Period(s) (years)	100
Climate Change (%)	40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	G1	15 Winter	100	+40%	100/15 Summer				93.521
2.000	G8	15 Winter	100	+40%	100/15 Summer				93.873
3.000	G11	15 Winter	100	+40%	100/15 Summer				93.894
2.001	G9	15 Winter	100	+40%	100/15 Summer				93.841
2.002	G10	15 Winter	100	+40%	100/15 Summer				93.770
1.001	G2	15 Winter	100	+40%	100/15 Summer				93.203
1.002	G3	15 Winter	100	+40%	100/15 Summer				92.797
4.000	G6	360 Winter	100	+40%	100/30 Summer				92.696
4.001	G7	360 Winter	100	+40%	100/30 Summer				92.696
1.003	G4	360 Winter	100	+40%	100/30 Summer				92.696
1.004	G5HB	360 Winter	100	+40%	100/15 Summer				92.696
1.005	S8	360 Winter	100	+40%					90.822
1.006	S9	15 Summer	100	+40%					90.214

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	G1	0.184	0.000	0.77			54.2	SURCHARGED	
2.000	G8	0.545	0.000	0.43			16.4	SURCHARGED	
3.000	G11	0.469	0.000	0.47			21.5	SURCHARGED	
2.001	G9	0.667	0.000	1.21			41.0	SURCHARGED	
2.002	G10	0.662	0.000	1.24			64.1	SURCHARGED	
1.001	G2	0.458	0.000	1.97			126.8	SURCHARGED	
1.002	G3	0.157	0.000	1.09			145.0	SURCHARGED	
4.000	G6	0.771	0.000	0.01			3.5	SURCHARGED	
4.001	G7	0.804	0.000	0.01			4.8	SURCHARGED	
1.003	G4	0.837	0.000	0.09			46.4	SURCHARGED	
1.004	G5HB	1.482	0.000	0.06			4.9	SURCHARGED	
1.005	S8	-0.267	0.000	0.03			4.9	OK	
1.006	S9	-0.186	0.000	0.30			34.0	OK	

Summary of Critical Results by Maximum Level (Rank 1) for 210902 COAST.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.007	S10	360 Winter	100	+40%	100/360 Winter			
1.008	S14 HB	360 Winter	100	+40%	100/15 Summer	100/360 Winter		
5.000	S1	15 Winter	100	+40%	100/15 Summer	100/15 Winter		
6.000	S6	15 Winter	100	+40%	100/15 Summer			
6.001	S7	15 Winter	100	+40%	100/15 Summer			
5.001	S2	15 Winter	100	+40%	100/15 Winter			
1.009	S3	15 Winter	100	+40%				
7.000	S11	15 Winter	100	+40%	100/15 Summer			
7.001	S12	15 Winter	100	+40%	100/15 Summer			
1.010	S4	15 Winter	100	+40%				
1.011	S15	15 Winter	100	+40%				
1.012	SBD	360 Winter	100	+40%	100/360 Winter			
1.013	S17A	360 Winter	100	+40%	100/15 Summer			
1.014	S25 H-B	360 Winter	100	+40%	100/15 Summer			
1.015	S18	360 Winter	100	+40%				
1.016	S19	360 Winter	100	+40%				
1.017	S20	360 Winter	100	+40%				
1.018	35	360 Winter	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	S10	89.671	0.116	0.000	0.06			15.9	SURCHARGED	
1.008	S14 HB	89.664	1.355	2.478	0.02			6.2	FLOOD	1
5.000	S1	92.778	1.304	0.160	1.69			58.7	FLOOD	1
6.000	S6	92.530	0.883	0.000	1.12			25.2	FLOOD RISK	
6.001	S7	92.016	0.776	0.000	1.63			37.1	SURCHARGED	
5.001	S2	90.799	0.017	0.000	1.00			121.3	SURCHARGED	
1.009	S3	87.239	-0.083	0.000	0.86			161.3	OK	
7.000	S11	87.903	0.419	0.000	0.92			24.7	SURCHARGED	
7.001	S12	87.625	0.532	0.000	1.58			71.7	SURCHARGED	
1.010	S4	86.577	-0.178	0.000	0.54			232.0	OK	
1.011	S15	83.564	-0.212	0.000	0.39			232.1	OK	
1.012	SBD	81.393	0.379	0.000	0.00			63.3	SURCHARGED	
1.013	S17A	81.393	2.690	0.000	0.07			21.9	FLOOD RISK	
1.014	S25 H-B	81.391	3.195	0.000	0.23			15.6	FLOOD RISK	
1.015	S18	77.283	-0.161	0.000	0.18			15.6	OK	
1.016	S19	74.458	-0.169	0.000	0.14			15.6	OK	
1.017	S20	70.000	-0.133	0.000	0.36			15.6	OK	
1.018	35	69.905	-0.131	0.000	0.37			15.6	OK	

APPENDIX G

PROPOSED DRAINAGE LAYOUT PLAN

DO NOT SCALE THIS DRAWING | A1

GENERAL NOTES:

1. Before construction commences, the setting out Engineer shall ensure that all setting out information is mutually compatible with all the drawings and documents provided by the designers. Where information is apparently contradictory or ambiguous, the design Engineer and/or the Architect is to be informed immediately. Thomas Consulting will accept no liability for setting out errors where work is constructed to incorrect information.

2. All drawings and documents are to be read in conjunction with one another, are mutually compatible and shall be read as such. All documents shall be checked to ensure that they are compatible by the contractor before construction commences. In the event of apparent ambiguity or contradiction the engineer and/or architect shall be notified immediately. Thomas Consulting accept no liability in the event of not being so notified and where construction work has commenced.

3. In accordance with CDM regulations 2015 this drawing has been prepared with due attention to identifying any unusual design hazards that may exist. Unusual design hazards are hazards that a reasonably competent contractor, experienced in this type of work may not be expected to identify. In dealing with unusual design hazards we have adopted the "ERIC" principle and where possible eliminated (E) the hazard at design stage, if it has not been possible to eliminate the hazard we have endeavoured to reduce (R) it. Where it has not been possible to eliminate these hazards, the hazard is noted on the drawing with appropriate information (I) in order that the hazard can be controlled (C) during construction. It is the contractor's responsibility to fully acquaint themselves with all construction drawings before commencing construction and if in doubt about any matter to ask for clarification from the designer.

4. All drawings issued electronically for this scheme are provided for the sole purpose of assisting the design, procurement or construction of the structures for which Thomas Consulting have been appointed as Design Engineers/Consultants. They may not be used for any other purpose, nor may they be amended, copied, redistributed or issued to third parties without the written agreement of Thomas Consulting. All drawings remain under copyright to, and the intellectual property of, Thomas Consulting. Upon completion of the project, all drawings are to be deleted from your computer systems and all other electronic copies destroyed. Where electronic copies of final drawings are to be issued, these will be provided in a digital only format by Thomas Consulting (no other copies may be retained). By opening and using this drawing, it is assumed that you agree to abide by these Terms and Conditions.

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KEY

- Surface Water Drainage
- Foul Water Drainage
- Exceedance Flow Route
- Exceedance Flow Area

REVISIONS

REV	DATE	DESCRIPTION	DRAWN BY	CHECKED BY
A	30.09.20	Planning Issue	JP	MJ
B	03.03.21	Drainage amended to allow for 40% Climate Change	MJ	JP
C	20.05.21	Drainage amended to allow for Cv of 1.0. Exceedance flows added.	MJ	JP
D	29.06.21	Site Plan updated	MJ	JP
E	17.11.21	Exceedance route updated.	cf	JP
F	23.11.21	Exceedance route updated. Exceedance flow area added.	cf	JP

DRAWING STATUS: FOR BUILDING REGULATION APPROVAL

THOMAS CONSULTING
STRUCTURAL & CIVIL DESIGN ENGINEERS
*Offices in Chorley, **Lancaster** & Shrewsbury*
Tel: 01524 846022
e-mail: info@thomasconsulting.co.uk

CLIENT: gleeson

PROJECT: WATERS EDGE WHITEHEAVEN

DRAWING TITLE: DRAINAGE LAYOUT PLAN

DATE CREATED:	DRAWING SCALE:	DRAWN BY:	CHECKED BY:	QA CATEGORY:
06/03/2020	1:250	JP	MJ	1

DRAWING REF: TC / T19360 / A1 / 100 | REV: F