West Cumberland Hospital Phase 2 Development

Planning Ref: 4/21/2294 Discharge of Panning Conditions (Drainage)

Project Ref: WCHPH2-CUR-VV-XX-RP-C-92004

Revision: V01

Issue Date: 31 March 2022

Client Name: North Cumbria Integrated Care NHS Foundation Trust

Client Address: West Cumberland Hospital, Homewood Rd, Whitehaven, CA28 8JG

Site Address: West Cumberland Hospital, Homewood Rd, Whitehaven, CA28 8JG

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Rev	Description	Issued by	Checked	Date
V01	First Issue	DM	CJS	31/03/22

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Author	Signature	Date
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Reviewed	Signature	Date
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1.0 Introduction

1.1 Project Background

Curtins were instructed by North Cumbria Integrated Care NHS Foundation Trust to develop a Detailed Drainage Strategy (DS) for the development located at West Cumberland Hospital, CA28 8JG. The site is centred on NGR 298950, 516040. The purpose of the DS is to provide construction information and to deal with outstanding matters in respect to the discharge of planning conditions.

A planning application has been made to Copeland Borough Council with the reference 4/21/2294/0F1. Cumbria County Council have made comments as the Highways Authority and the Lead Local Flood Authority. Following on from these comments, conditions that relate to the drainage, as well other aspects of the works, need to be discharged in order to gain planning approval.

Condition 5, 6, 14 are related to the drainage for the scheme and will be responded to in this report.

This report is based on the currently available information, discussions, and correspondence.

Proposals contained or forming part of this report represent the design intent and maybe subject to alteration or adjustment in refining the detailed design for this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material deviation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

Where the proposed works to which this report refers are undertaken more than twelve months following the issue of this report, Curtins shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Curtins.

1.2 Scope of Assessment

The report is to be undertaken in accordance with the planning conditions set out by the Copeland Borough Council and the standing advice and requirements of Cumbria County Council.

The report will:

- Present background information on the proposed development and the drainage planning condition requirements.
- Discuss the drainage strategy and how it will address the planning condition.
- Include drawings and calculations to support the drainage strategy.

2.0 Site Details

2.1 History and Current Use

The proposed development site is located within the West Cumberland Hospital in Whitehaven, CA28 8JG.

Access to the site is made via Homewood Road to the north of the site.

The grid reference of the centre of the site is 298950, 516040 (see Figure 2.1 below).

Figure 2-1: Site Location

The site is located within a residential area with properties surrounding the site to the north, south and west and fields to the east. Within the site, the topography slopes relatively steeply from the northeast to the southwest.

2.2 Consented Development

The consented development comprises the following elements:

- Waste Compound
- Access Road
- Acute Hospital Building (Phase 2)
- Car Parking Area

2.3 Planning Conditions

This report addresses the following planning conditions:

Condition 5

No development shall commence until a surface water drainage scheme has been submitted to and approved in writing by the Local Planning Authority.

The drainage scheme must include:

1. *An investigation of the hierarchy of drainage options in the National Planning Practice Guidance (or any subsequent amendment thereof). This investigation shall include evidence of an assessment of ground conditions and the potential for infiltration of surface water;*
2. *A restricted rate of discharge of surface water agreed with the local planning authority (if it is agreed that infiltration is discounted by the investigations); and*
3. *A timetable for its implementation.*

The scheme shall also be in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards.

The points raised above are answered as follows and evidenced in the sections below where required.

1. *An investigation of the hierarchy of drainage options in the National Planning Practice Guidance (or any subsequent amendment thereof). This investigation shall include evidence of an assessment of ground conditions and the potential for infiltration of surface water;*

Infiltration testing has been carried out, the results of this are documented in Section 3.1 below and Appendix A.

2. *A restricted rate of discharge of surface water agreed with the local planning authority (if it is agreed that infiltration is discounted by the investigations); and*

The discharge rate for the site all storm events up to and including the Q100+40% climate change event is restricted to the greenfield Q100 rate, 18.66l/s/ha. This is in line with the guidance given in the *Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015)* document that is referenced in the condition. Attenuation has been provided to store the additional flows within the below ground network. Calculations have been provided in Appendix B that show the greenfield run off calculations as well as proof that the proposed system works and is designed with this rate. The proposed drainage layouts and impermeable areas plans can be found in Appendix C.

Condition 6

No development shall commence until a survey of the piped drainage systems to be retained on site and connecting to the public sewer and a scheme of mitigation measures where it is deemed the improvements are required to bring existing pipe work up to current design standards has been be submitted to and approved in writing by the local planning authority.

A CCTV survey has been undertaken to confirm the route of the drainage that currently serves the site and that the proposed works are connecting to. A layout showing this route and locations of defects as well as suggested remediation methods can be found in **Appendix D** and a brief explanation can be found in Section 3.3.

Condition 14

The development hereby approved shall not be brought into operational use until a management and maintenance plan for the surface water drainage scheme for the lifetime of the development has been submitted to and approved in writing by the local planning authority.

As a minimum the plan shall include arrangements for inspection and ongoing maintenance of all elements of the surface water drainage scheme to secure its effective operation for the lifetime of the development.

A maintenance strategy has been produced for the site that includes a schedule and methods of maintenance, the document is WCHPH2-CUR-VV-XX-RP-C-92002-DRAINAGE MAINTENANCE STRATEGY and will be included in the handover pack to ensure maintenance requirements are known by the end user and is included as a stand-alone document accompanying the application to discharge conditions.

3.0 SuDS Assessment

3.1 Discharge by Infiltration

Site investigation by means of in-situ testing was undertaken in November 2021 by Curtins.

Soakaway tests were conducted in three of the six machine excavated trial pits (SA01, SA02 and TW TP01 (SA03)). All tests were conducted in natural strata of fine to medium grained SANDSTONE. SA01 infiltration test was repeated three times. One test was completed in SA02 and SA03 due to negligible infiltration rates and as such no rate could be calculated over 1.5 hr duration of the tests.

The locations of the tests are shown in **Appendix A**.

Table 3-1: Infiltration Testing Results

Location	Design Soil Infiltration Rate *f* (m/s)
SA01 – Test 1	2.12E-04
SA01 – Test 2	1.03E-04
SA01 – Test 3	7.05E-05
SA02 – Test 1	N/A
SA03 – Test 1	N/A

The variation in infiltration rates is likely due to variability in weathering and fracture spacings in the bedrock. Infill between fractures also appeared more clayey in SA02 and SA03 which may limit infiltration. As such, based on the estimated infiltrations rates it is considered unlikely that soakaway drainage will be feasible across the site.

3.2 Discharge to Watercourse

Pow Beck lies approximately 800m to the west of the site boundary. The surface water drainage currently serving the site outfalls to the Beck via the UU public sewer.

3.3 Discharge to Surface Water Sewer

United Utility (UU) sewer maps indicate that a 225 mm diameter surface water sewer is present in Homewood Road to the northwest of the project as well as a 300mm diameter surface water sewer to the west in Homewood Drive. Utility mapping of the existing hospital indicates that the existing surface water drainage leaves the site at 3 locations along the southern and western boundaries of the site.

The existing drainage that leaves the site at the western boundary has been CCTV surveyed to the connection point with the United Utilities. The UU sewer records indicate that the drainage connects into Homewood Road, however the connection is to the drain to the west in Homewood Drive.

The line of the private drainage leading to the UU sewer is a relatively straight series of pipes and manholes, the UU sewer then continues east to Pow Beck.

A drawing has been produced showing the line of this drainage and the locations of defects found from the survey, along with potential remediation works, this can be found in **Appendix D** along with the UU sewer records.

3.4 Discharge to Combined Sewer

The surface water drainage will connect to a surface water sewer.

Table 3-2 below summarises the options for surface water disposal following site assessment.

Table 3-2: Summary of Surface Water Disposal

Surface Water Disposal Method	Potential	Description
Infiltration	✗	Infiltration testing resulted in little or no drainage from any of the test holes. Therefore, infiltration is confirmed as unsuitable.
Watercourse	✗	Pow Beck is approximately 800m to the west of the site – it is understood that the UU sewer in Homewood Drive outfalls to the Beck.
Surface Water Sewer	✓	Public surface water sewer to the west of the site that serves the existing site.
Combined Water Sewer	✗	Surface water sewer will be used.

The SuDS review concludes that the only viable means of dealing with drainage flows from site is to the existing surface water drainage that serves the site and connects to the Pow Beck via the UU surface water drainage.

4.0 Surface Water Drainage

4.1 Drainage Strategy

The surface water drainage is split across the site, firstly due to the steeply sloping nature of the development area but also because of the phasing of the works. The areas are split into:

- The Waste Compound and access road
- Phase 2
- Phase 2 Car Park and
- An allowance for the development of Sneckyeat Road Car Park

Each area has a flow control device rated to the greenfield Q100 flow rate and the required attenuation to serve the surface water runoff generated for storms up to the 1 in 100 year + 40% climate change event. The total discharge rate for all of the proposed works is 45.9l/s this can be broken down as follows for the different sites, listed from furthest upstream:

- An allowance of 21.1l/s from the Sneckyeat Road Car Park,
- 4.5l/s from the Waste Compound & Access Road
- 8l/s from the Phase 2 Car Park, and 1
- 12.3l/s from the Phase 2 Hospital Building.

There are 2 flow control devices at the outfall to ensure that the overall discharge rate is not exceeded one serving the Sneckyeat Road Car Park, the Waste Compound & Access Road and the Phase 2 Hospital Building with the other serving the Phase 2 Car Park.

The proposed surface water drainage connects to the private 300mm surface water sewer within the site boundary. This then flows west to the UU sewer in Homewood Drive.

The Surface Water Drainage Strategy Drawings and calculations are provided in **Appendix B, C and D** as: –

- Greenfield Run off Rate Estimation
- WCHPH2-CUR-VV-XX-CA-C-92000_Site Wide Surface Water Drainage
- WCHPH2-CUR-VV-XX-DR-C-04008_Existing Drainage Rehabilitation Sketch
- WCHPH2-CUR-VV-XX-DR-C-92001_Drainage Layout
- WCHPH2-CUR-VV-XX-DR-C-92002_Waste Compound & Access Road Drainage Layout
- WCHPH2-CUR-VV-XX-DR-C-92008_Impermeable Areas
- WCHPH2-CUR-VV-XX-DR-C-92009_Exceedance Flow Routes
- WCHPH2-CUR-VV-XX-DR-C-92010_Drainage Details

Specific elements of the surface water drainage design are described in the following sections.

4.2 Designing for Local Drainage System Failure

In accordance with general principles discussed in CIRIA Report C635, Designing for Exceedance in Urban Drainage the proposed surface water drainage, where practical, should be designed to ensure no increased risk of flooding to buildings on the site or elsewhere as a result of extreme rainfall, lack of maintenance, blockages or other causes.

Blockage

It is thought that the highest risk would be due to blockage of the flow control device prior to flow entering the new off-site pipeline.

Any overland flow from the site resulting from blockage or exceedance of the drainage system capacity would spill from the cover of the Hydro Brake chamber or the lowest point of the system.

The drainage model has been tested to failure to determine the locations of first flooding on the site should there be a blockage. The locations that would flood include gullies on the northern access route, the flow control chamber that serves phase 2, the waste compound & the Sneckyeat Road and the lowest point of the overall system which is the rodding eye to the southwest of the proposed car park.

The hospital building would not be at risk due to the proposed topography around the areas where flooding may occur.

Exceedance

The site drainage has been designed to attenuate the 100-yr rainfall event, including a 40% allowance for climate change. The drainage system will also provide capacity for lower probability (longer duration design storm events) which are not critical duration.

Exceedance flows will be retained on site within the drainage system as far as practical however for rainfall events of a greater return period it may be necessary to pass forward more flow or to spill flow from the system.

Model simulations have been undertaken to assess at what return period flooding might occur, exceedance flow routes and flood volume.

The locations that would flood include gullies on the northern access route, the flow control chamber that serves phase 2, the waste compound & the Sneckyeat Road and the lowest point of the overall system which is the rodding eye to the southwest of the proposed car park.

Runoff resulting from the flow control would flow to the southwest and into the drainage system serving the car park. If this area should then flood it will first occur from the rodding eye with exceedance water flowing west down the bank and onto the access road. From here the water will flow southwest and off site. Flooding from the gullies on the northern access road will flow along the eastern section of the access road, until it also leaves site to the south. While the flood water is flowing along the access road, if the system that serves these areas is not at capacity, flood water will enter these systems, via the existing gullies, rather than flowing off site.

Overland Flow Routes

- Overland flow routes as described above are indicated on drawing WCHPH2-CUR-VV-XX-DR-C-92010_Exceedance Flow Routes in **Appendix C**.

Drainage Contingency

The proposed surface water drainage system has been designed to provide adequate storage volume against flooding for the 1 in 100 year critical storm event, including a 40% allowance to account for potential climate change.

Building Layout and Detail

Much of the building will have level access and therefore, external levels have been set to fall away from the building ensuring any flood water runs away from the building.

4.3 Water Quality Treatment

Surface Water run-off from hard paved areas at risk from contamination should receive water quality treatment. Non-residential car parks and in-site access roads, typical for hospitals, are considered Medium hazard in terms of contamination. Figure 4-1 illustrates the pollution hazard indices for different land use classifications from The CIRIA SuDS Manual C753 (2015).

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Figure 4.1: Pollution Hazard indices for land use classification (Table 26.2 the CIRIA SuDS manual 2015)

Treatment could be provided using sustainable methods such as: filter strips, filter drains, swales, bio-retention systems, and/or permeable paving. Figure 4-3 illustrates the SuDS Component mitigation indices from The CIRIA SuDS Manual C753 (2015).

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

1. SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.
2. Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
3. Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
4. Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.
5. See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: http://tinyurl.com/qf7yaj7
6. SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

Figure 4.2: Indicative SuDS mitigation indices (Table 26.3 the CIRIA SuDS manual 2015)

The selection of treatment should ensure that the SuDS mitigation component index (Figure 4-1) exceeds the pollution hazard index (Figure 4-2). Where two stages of treatment are required, the second stage of treatment should account for reduced performance due to lower inflows; therefore 0.5 (mitigation index) should be used.

The type(s) of mitigation should be considered as the site design is finalised i.e. paving surfaces etc. The proposals for pollution protection should be agreed with Cumbria County Council, Lead Local Flood Authority. It is proposed that a permeable surface will be used in all parking bays as part of the phase 2 site, table 4-1 shows how the mitigation indices compare to the pollution indices.

Table 4-1: Summary of Pollution vs Mitigation Indices for a Permeable Non-Residential Car Park

Non-Residential Car Park vs Permeable Paving	TSS	Metals	Hydrocarbons
Pollution Indices	0.7	0.6	0.7
Mitigation Indices	0.7	0.6	0.7

The combination of the permeable paving, the filter drains below the car park and catchpit manholes will provide adequate mitigation for the pollution potential of the car park.

For the waste compound and access road an interceptor is being proposed due to the space constraints and heavy loading on the site.

5.0 Foul Water Disposal

A separate foul water drainage system has been designed for the site. The foul water drainage will serve a section of the Waste Compound as well as the proposed hospital building. The drainage will fall via gravity to the south where it connects into the existing 150mm foul drainage that serves the site. This existing drainage follows the same route as the surface water and eventually discharges into the UU sewer in Homewood Drive to the west.

The proposed foul water drainage layout is provided on drawing WCHPH2-CUR-VV-XX-DR-C-92001_Drainage Layout in **Appendix C**.

6.0 Drainage Construction

6.1 Timetable for Implementation

The drainage system will be constructed at an early stage of the development, prior to the roads, car parking and structures being finished. This will allow the system to be functioning at the time the site is completed.

7.0 Conclusions

7.1 Conclusions

This report has demonstrated Infiltration has been considered, following the SuDS hierarchy and presented evidence that clearly show that infiltration drainage is not viable for this site.

In doing so, it is concluded that part 1 of Planning Condition 5 has been satisfied.

A surface drainage design has been developed with restricted discharge rates in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015). Surface water drainage calculations, a drainage layout plan and component construction details have been provided to evidence.

In doing so, it is concluded that part 2 of Planning Condition 5 has been satisfied.

A statement confirming the intended timetable for the construction of the drainage in relation to the other construction elements and subsequent development completion has been stated.

In doing so, it is concluded that part 3 of Planning Condition 5 has been satisfied.

A CCTV survey has been completed to prove the connection and condition of the existing drainage to the UU sewers in Homewood Drive.

In doing so, it is concluded that Planning Condition 6 has been satisfied.

A maintenance report that includes procedures and a schedule has been provided for the proposed drainage system that will be provided in the handover pack for the end user to refer to.

In doing so, it is concluded that Condition 14 has been satisfied.

8.0 Appendices

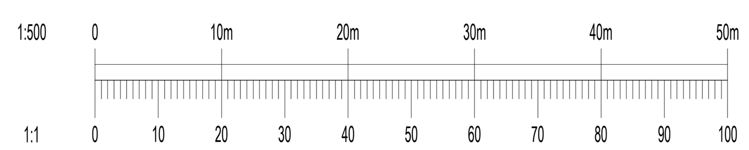
Appendix A **Site Infiltration Locations and Calculations**

Appendix B **Drainage Design Calculations**

Appendix C **Proposed Drainage Layouts**

Appendix D **Existing Drainage Layout**

Appendix A Site Infiltration Locations and Calculations



SCALEBAR
(INDICATIVE ONLY)

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

LEGEND

- SLIT TRENCH FROM BACK OF KERB
- BRE 365 SOAKAWAY TEST
- CORE EXISTING SLAB TO DETERMINE DEPTH. DCP/CBR TEST ON SUBGRADE MATERIAL WITHIN ROAD AND ADJACENT AREA
- HAND DIG TO EXISTING FOUNDATIONS
- BOREHOLE LOCATION
- TRIAL PIT LOCATION AS PER GCL TEMPORARY WORKS REQUIREMENTS

Rev:	Description:	Date:	By:	Chkd:
P01	FIRST ISSUE	16/07/21	DM	PT

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Status: ISSUED FOR INFORMATION S2

Client: GRAHAM

Project: PROCURE 22 WEST CUMBERLAND HOSPITAL PHASE 2 DEVELOPMENT

Drg Title:

SITE INVESTIGATION TEST REQUIREMENTS & LOCATIONS

Project No:	Size:	Date:	Drawn By:	Designed By:	Checked By:
072419	A1	JUL 21	DM	PT	PT
	Scale: 1:500				

Project Code:	Originator:	Zone:	Level:	Type:	Discipline:	Category / Number:	Rev:
WCHPH2	CUR	VV	XX	DR	C	04004	P01

073096-CUR-VV-XX-DR-C-04004.dwg

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CALCULATION SHEET - SOIL INFILTRATION RATE

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA01
Test Date:	03/08/2021
Test No.:	1 of 3

2.50 m	Length of trial pit
0.90 m	Width of trial pit
0.95 m	Depth (total) of trial pit
2.25 m^2	Area of trial pit base
0.53 m bgl	Water level at start of test (approximate invert level)
0.95 m bgl	Water level at end of test
0.420 m	Effective storage depth
0.635 m bgl	Effective storage depth (75% full)
0.845 m bgl	Effective storage depth (25% full)
0.473 m^3	**Effective storage volume (V_{75-25})**
3.678 m^2	**Internal surface area (50% effective depth) (a_{50})**
605 s	**Time for head to fall from 75% to 25% effective depth (t_{75-25})**

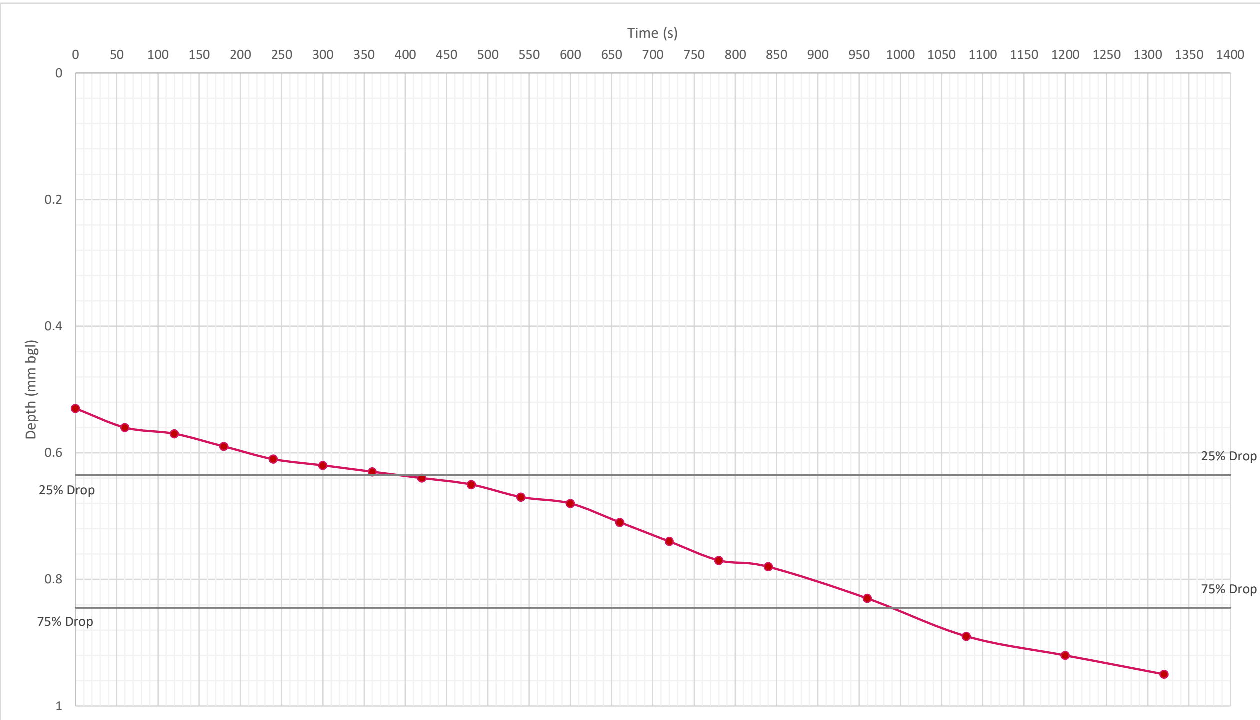
2.12E-04 m/s	**Soil infiltration rate (f)**

RAW DATA

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA01
Test Date:	03/08/2021
Test No.:	1 of 3

C	Time (min)	ui	Time (s)	Depth (mm bgl)	Stratum
	0		0	0.53	
	1		60	0.56	
	2		120	0.57	
	3		180	0.59	
	4		240	0.61	
	5		300	0.62	
	6		360	0.63	
	7		420	0.64	
	8		480	0.65	Grey and brown slightly weathered SANDSTONE with clay infill between fractures.
	9		540	0.67	
	10		600	0.68	
	11		660	0.71	
	12		720	0.74	
	13		780	0.77	
	14		840	0.78	
	16		960	0.83	
	18		1080	0.89	
	20		1200	0.92	
	22		1320	0.95	



Note 1: Pit backfilled with arisings.

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CALCULATION SHEET - SOIL INFILTRATION RATE

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA01
Test Date:	03/08/2021
Test No.:	2 of 3

2.50	m	Length of trial pit
0.90	m	Width of trial pit
0.95	m	Depth (total) of trial pit
2.25	m^2	Area of trial pit base
0.53	m bgl	Water level at start of test (approximate invert level)
0.90	m bgl	Water level at end of test
0.420	m	Effective storage depth
0.635	m bgl	Effective storage depth (75% full)
0.845	m bgl	Effective storage depth (25% full)
0.473	**m^3**	**Effective storage volume (V_{75-25})**
3.678	**m^2**	**Internal surface area (50% effective depth) (a_{50})**
1250	**s**	**Time for head to fall from 75% to 25% effective depth (t_{75-25})**

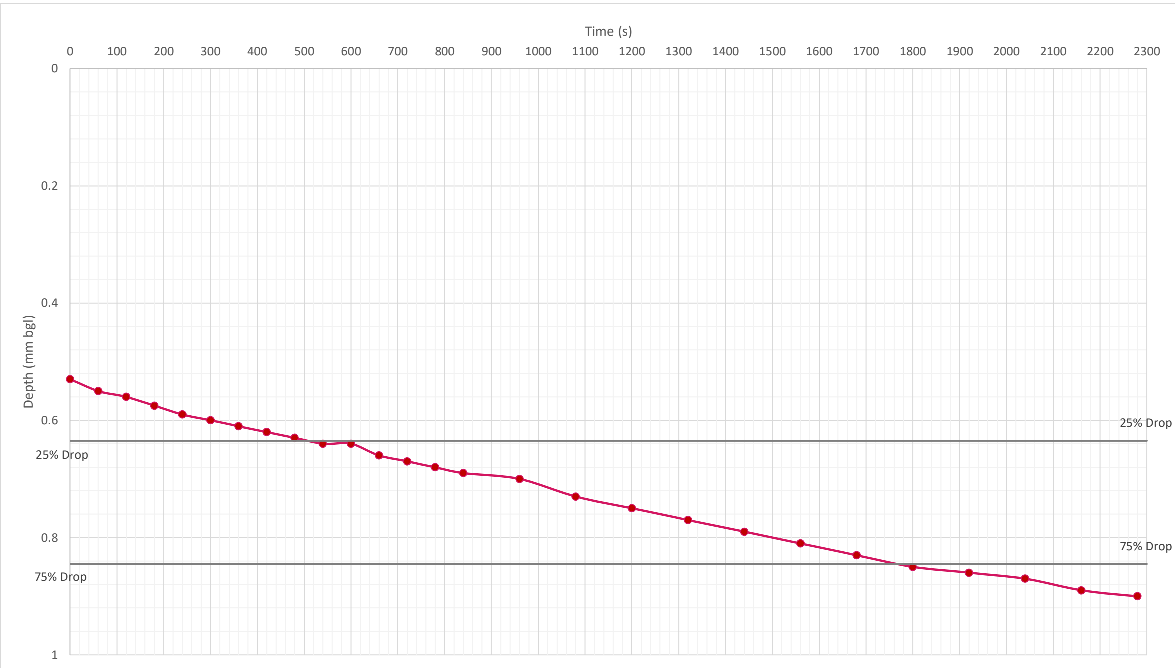
1.03E-04 m/s	**Soil infiltration rate (f)**

RAW DATA

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA01
Test Date:	03/08/2021
Test No.:	2 of 3

C	Time (min)	ui	Time (s)	Depth (mm bgl)	Stratum
	0		0	0.53	
	1		60	0.55	
	2		120	0.56	
	3		180	0.575	
	4		240	0.59	
	5		300	0.6	
	6		360	0.61	
	7		420	0.62	
	8		480	0.63	
	9		540	0.64	
	10		600	0.64	
	11		660	0.66	
	12		720	0.67	Grey medium to coarse graind crystalline SANDSTONE
	13		780	0.68	
	14		840	0.69	
	16		960	0.7	
	18		1080	0.73	
	20		1200	0.75	
	22		1320	0.77	
	24		1440	0.79	
	26		1560	0.81	
	28		1680	0.83	
	30		1800	0.85	
	32		1920	0.86	
	34		2040	0.87	
	36		2160	0.89	
	38		2280	0.9	



Note 1: Pit backfilled with arisings.

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Tel: 0121 643 4694

CALCULATION SHEET - SOIL INFILTRATION RATE

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA01
Test Date:	03/08/2021
Test No.:	3 of 3

2.50 m	Length of trial pit
0.90 m	Width of trial pit
0.95 m	Depth (total) of trial pit
2.25 m^2	Area of trial pit base
0.50 m bgl	Water level at start of test (approximate invert level)
0.90 m bgl	Water level at end of test
0.450 m	Effective storage depth
0.613 m bgl	Effective storage depth (75% full)
0.838 m bgl	Effective storage depth (25% full)
0.506 m^3	**Effective storage volume (V_{75-25})**
3.780 m^2	**Internal surface area (50% effective depth) (a_{50})**
1900 s	**Time for head to fall from 75% to 25% effective depth (t_{75-25})**

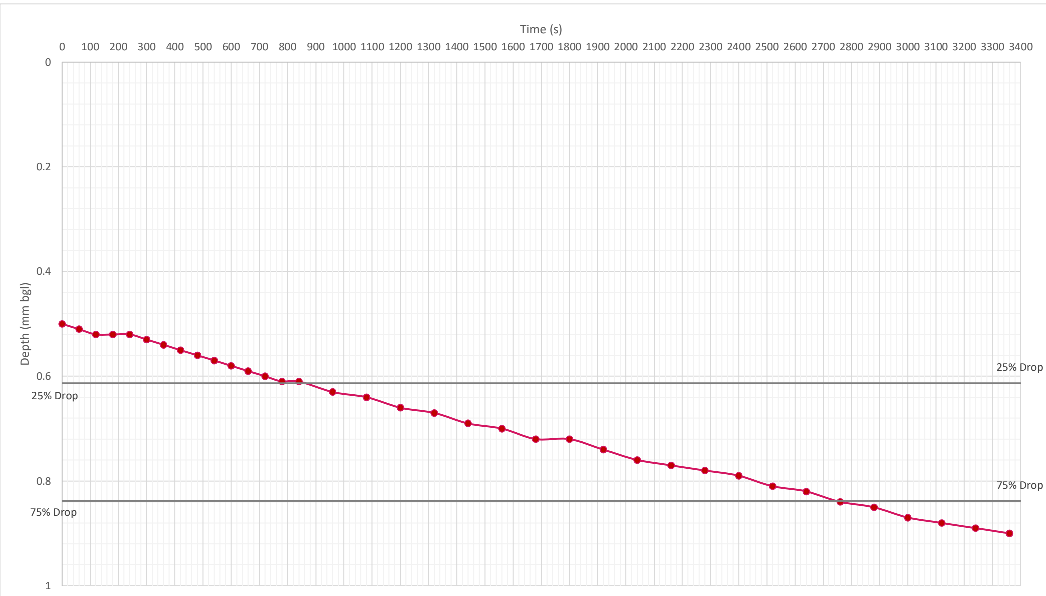
7.05E-05 m/s	**Soil infiltration rate (f)**

RAW DATA

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA01
Test Date:	03/08/2021
Test No.:	3 of 3

C	Time (min)	ui	Time (s)	Depth (mm bgl)	Stratum
	0		0	0.5	
	1		60	0.51	
	2		120	0.52	
	3		180	0.52	
	4		240	0.52	
	5		300	0.53	
	6		360	0.54	
	7		420	0.55	
	8		480	0.56	
	9		540	0.57	
	10		600	0.58	
	11		660	0.59	
	12		720	0.6	
	13		780	0.61	
	14		840	0.61	
	16		960	0.63	
	18		1080	0.64	Grey medium to coarse graind crystalline SANDSTONE
	20		1200	0.66	
	22		1320	0.67	
	24		1440	0.69	
	26		1560	0.7	
	28		1680	0.72	
	30		1800	0.72	
	32		1920	0.74	
	34		2040	0.76	
	36		2160	0.77	
	38		2280	0.78	
	40		2400	0.79	
	42		2520	0.81	
	44		2640	0.82	
	46		2760	0.84	
	48		2880	0.85	
	50		3000	0.87	
	52		3120	0.88	
	54		3240	0.89	
	56		3360	0.9	



Note 1: Pit backfilled with arisings.

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CALCULATION SHEET - SOIL INFILTRATION RATE

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA02
Test Date:	03/08/2021
Test No.:	1 of 1

2.20	m	Length of trial pit
0.90	m	Width of trial pit
1.65	m	Depth (total) of trial pit
1.98	m^2	Area of trial pit base
1.16	m bgl	Water level at start of test (approximate invert level)
1.16	m bgl	Water level at end of test
0.490	m	Effective storage depth
1.283	m bgl	Effective storage depth (75% full)
1.528	m bgl	Effective storage depth (25% full)
0.485	**m^3**	**Effective storage volume ($V_{75\text{-}25}$)**
3.499	**m^2**	**Internal surface area (50% effective depth) (a_{50})**
N/A	**s**	**Time for head to fall from 75% to 25% effective depth ($t_{75\text{-}25}$)**

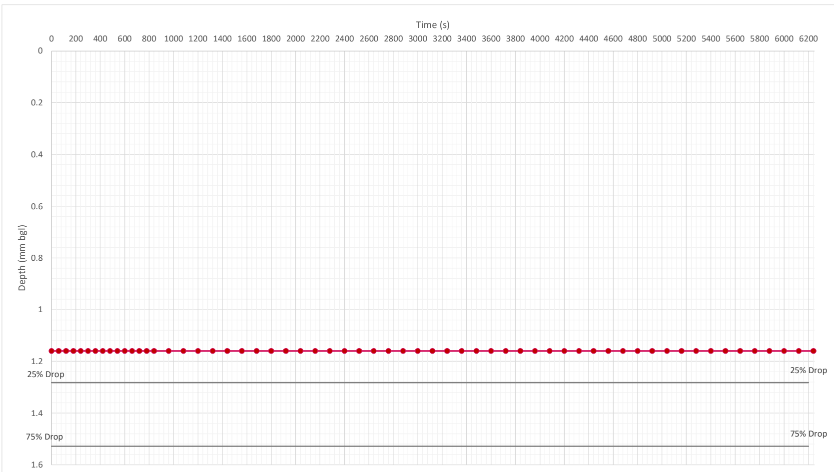
N/A	**m/s**	**Soil infiltration rate (f)**

RAW DATA

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA02
Test Date:	03/08/2021
Test No.:	1 of 1

C	Time (min)	u	Time (s)	Depth (mm bgl)	Stratum
	0		0	1.16	Light brown and grey weathered SANDSTONE, recovered as a sandy slightly clayey gravel of angular to subrounded sandstone.
	1		60	1.16	
	2		120	1.16	
	3		180	1.16	
	4		240	1.16	
	5		300	1.16	
	6		360	1.16	
	7		420	1.16	
	8		480	1.16	
	9		540	1.16	
	10		600	1.16	
	11		660	1.16	
	12		720	1.16	
	13		780	1.16	
	14		840	1.16	
	16		960	1.16	
	18		1080	1.16	
	20		1200	1.16	
	22		1320	1.16	
	24		1440	1.16	
	26		1560	1.16	
	28		1680	1.16	
	30		1800	1.16	
	32		1920	1.16	
	34		2040	1.16	
	36		2160	1.16	
	38		2280	1.16	
	40		2400	1.16	
	42		2520	1.16	
	44		2640	1.16	
	46		2760	1.16	
	48		2880	1.16	
	50		3000	1.16	
	52		3120	1.16	
	54		3240	1.16	
	56		3360	1.16	
	58		3480	1.16	
	60		3600	1.16	
	62		3720	1.16	
	64		3840	1.16	
	66		3960	1.16	
	68		4080	1.16	
	70		4200	1.16	
	72		4320	1.16	
	74		4440	1.16	
	76		4560	1.16	
	78		4680	1.16	
	80		4800	1.16	
	82		4920	1.16	
	84		5040	1.16	
	86		5160	1.16	
	88		5280	1.16	
	90		5400	1.16	
	92		5520	1.16	
	94		5640	1.16	
	96		5760	1.16	
	98		5880	1.16	
	100		6000	1.16	
	102		6120	1.16	
	104		6240	1.16	



Note 1: Negligble infiltration, infiltration rate could not be calculated. Pit backfilled with arisings.

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CALCULATION SHEET - SOIL INFILTRATION RATE

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA03
Test Date:	03/08/2021
Test No.:	1 of 1

2.80	m	Length of trial pit
1.00	m	Width of trial pit
1.40	m	Depth (total) of trial pit
2.80	m^2	Area of trial pit base
1.07	m bgl	Water level at start of test (approximate invert level)
1.11	m bgl	Water level at end of test
0.330	m	Effective storage depth
1.153	m bgl	Effective storage depth (75% full)
1.318	m bgl	Effective storage depth (25% full)
0.462	**m^3**	**Effective storage volume (V_{75-25})**
4.054	**m^2**	**Internal surface area (50% effective depth) (a_{50})**
N/A	**s**	**Time for head to fall from 75% to 25% effective depth (t_{75-25})**

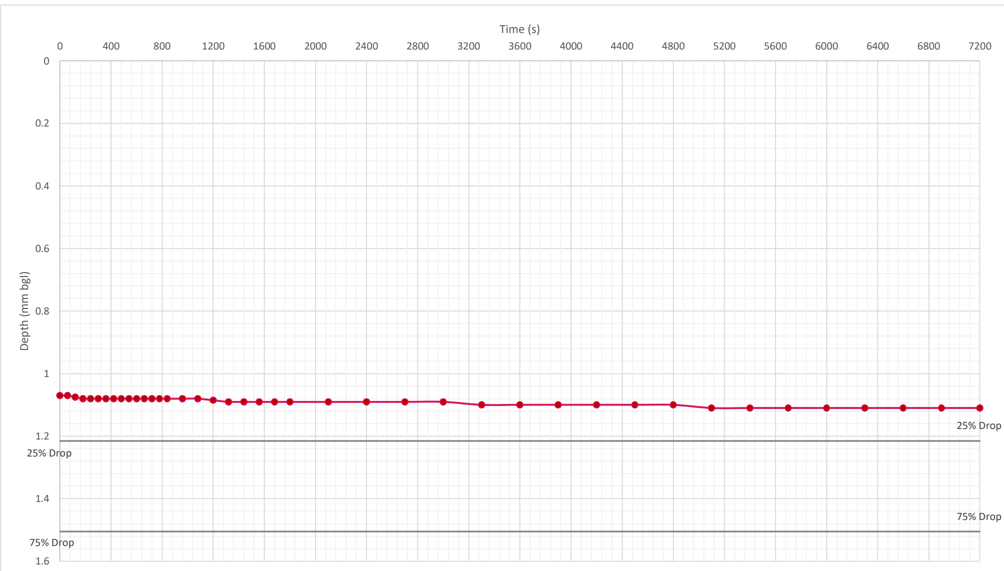
N/A	**m/s**	**Soil infiltration rate (f)**

RAW DATA

Project:	West Cumberland Hospital
Job Number:	73039
Author:	ZH

Hole Ref.:	SA03
Test Date:	03/08/2021
Test No.:	1 of 1

C	Time (min)	ui	Time (s)	Depth (mm bgl)	Stratum
	0		0	1.07	Light brown and grey weathered SANDSTONE, recovered as a sandy slightly clayey gravel of angular to subrounded sandstone.
	1		60	1.07	
	2		120	1.075	
	3		180	1.08	
	4		240	1.08	
	5		300	1.08	
	6		360	1.08	
	7		420	1.08	
	8		480	1.08	
	9		540	1.08	
	10		600	1.08	
	11		660	1.08	
	12		720	1.08	
	13		780	1.08	
	14		840	1.08	
	16		960	1.08	
	18		1080	1.08	
	20		1200	1.085	
	22		1320	1.09	
	24		1440	1.09	
	26		1560	1.09	
	28		1680	1.09	
	30		1800	1.09	
	35		2100	1.09	
	40		2400	1.09	
	45		2700	1.09	
	50		3000	1.09	
	55		3300	1.1	
	60		3600	1.1	
	65		3900	1.1	
	70		4200	1.1	
	75		4500	1.1	
	80		4800	1.1	
	85		5100	1.11	
	90		5400	1.11	
	95		5700	1.11	
	100		6000	1.11	
	105		6300	1.11	
	110		6600	1.11	
	115		6900	1.11	
	120		7200	1.11	



Note 1: Negligble infiltration, infiltration rate could not be calculated. Pit backfilled with arisings.

Appendix B Drainage Design Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Dan Moore
Site name:	P22
Site location:	WEST CUMBERLAND HOSPITAL

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:	54.52043° N
Longitude:	3.55227° W
Reference:	2477628765
Date:	May 07 2021 15:36

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	1

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):	1189	1189
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):	8.97	8.97
1 in 1 year (l/s):	7.81	7.81
1 in 30 years (l/s):	15.25	15.25
1 in 100 year (l/s):	18.66	18.66
1 in 200 years (l/s):	21.27	21.27

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	1.000
Ratio-R	0.300	Preferred Cover Depth (m)	0.900
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SNECK1	1.131	5.00	96.500	1350	299085.894	516124.461	2.500
SNECK2			96.500	1800	299085.894	516114.461	2.700
SAR1	0.129	5.00	95.212	1350	299075.086	516095.205	1.632
G1	0.018	5.00	94.500	350	299070.602	516070.128	0.600
SAR2	0.035	5.00	94.664	1800	299061.379	516083.924	1.714
SAR3		5.00	95.180	1350	299042.581	516126.876	2.360
SAR4	0.084	5.00	95.282	1800	299014.510	516140.627	2.462
SAR5			94.869	1800	299032.774	516118.444	2.109
SAR6			95.086	1800	299030.243	516116.414	2.340
CP1			91.050	600	299013.742	516102.830	1.220
S1	0.076	5.00	91.074	1200	298995.213	516081.956	1.076
S2	0.069	5.00	91.324	1350	299012.566	516101.991	1.566
S3	0.059	5.00	92.104	1350	298970.597	516151.899	2.626
s3a			91.095	1350	298945.924	516136.236	1.837
S4	0.197	5.00	90.964	1200	298968.071	516075.148	1.116
S5			90.883	1350	298926.853	516121.105	1.875
RE1	0.039	5.00	90.810	1200	298937.847	516084.501	1.050
S6			90.294	1350	298915.382	516111.185	1.323
RE2	0.121	5.00	92.433	1200	298953.531	516165.422	1.125
S7	0.102	5.00	90.213	1800	298903.483	516125.018	1.441
RE3	0.106	5.00	89.763	1200	298892.239	516043.469	1.125
RE4	0.070	5.00	88.253	1200	298857.711	516083.320	0.712
S8			88.733	1350	298869.774	516070.153	1.542
RE5	0.087	5.00	90.404	1200	298905.309	516055.152	1.047
RE6	0.142	5.00	88.418	1200	298867.542	516098.518	1.027
S9			89.306	1350	298882.844	516081.836	2.214
RE7	0.042	5.00	90.823	1200	298928.234	516072.034	1.048
S10			89.809	1350	298904.035	516100.778	2.859
S11			89.481	1350	298890.457	516116.805	2.821
EXSMH2			87.721	1200	298866.027	516107.452	2.021

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	SNECK1	SNECK2	10.000	0.600	94.000	93.800	0.200	50.0	450	5.08	50.0
1.001	SNECK2	SAR1	22.082	0.600	93.800	93.580	0.220	100.4	225	5.39	50.0
1.002	SAR1	SAR2	17.752	0.600	93.580	93.475	0.105	169.1	225	5.30	50.0
3.000	G1	SAR2	16.595	0.600	93.900	93.550	0.350	47.4	150	5.13	50.0
1.003	SAR2	SAR5	44.832	0.600	92.950	92.760	0.190	236.0	750	6.27	50.0
2.000	SAR3	SAR5	12.934	0.600	92.820	92.760	0.060	215.6	300	5.28	50.0
1.004	SAR4	SAR5	28.734	0.600	92.820	92.760	0.060	478.9	750	6.38	50.0
1.005	SAR5	SAR6	3.245	0.600	92.760	92.746	0.014	231.8	300	6.53	50.0
1.005_1	SAR6	CP1	21.373	0.600	92.746	89.905	2.841	7.5	225	6.84	50.0
1.006_1	CP1	S2	1.445	0.600	89.830	89.758	0.072	20.1	300	6.85	50.0
5.000	S1	S2	26.505	0.600	89.998	89.833	0.165	160.6	225	5.47	50.0
1.006	S2	S3	65.209	0.600	89.758	89.478	0.280	232.9	300	7.97	50.0
1.007_1	S3	s3a	29.225	0.600	89.478	89.258	0.220	132.8	300	8.86	50.0
1.009_1	s3a	S5	24.344	0.600	89.258	89.158	0.100	243.4	300	9.26	50.0
6.000_1	S4	S5	61.733	0.600	89.848	89.158	0.690	89.5	300	5.85	50.0
1.007	S5	S6	15.165	0.600	89.008	88.971	0.037	409.9	450	9.11	50.0
6.000	RE1	S6	34.881	0.600	89.760	89.271	0.489	71.3	150	5.47	50.0
1.008	S6	S7	18.247	0.600	88.971	88.772	0.199	91.7	450	9.26	50.0
7.000	RE2	S7	64.322	0.600	91.308	88.847	2.461	26.1	225	5.42	50.0
1.009	S7	S11	15.399	0.600	88.772	88.281	0.491	31.4	300	9.35	50.0
8.000	RE3	S8	34.881	0.600	88.638	88.038	0.600	58.1	225	5.34	50.0
9.000	RE4	S8	17.857	0.600	87.541	87.416	0.125	142.9	225	5.28	50.0
8.001	S8	S9	17.530	0.600	87.191	87.092	0.099	177.1	450	5.63	50.0
10.000	RE5	S9	34.881	0.600	89.357	88.194	1.163	30.0	150	5.32	50.0

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	2.880	458.1	214.6	2.050	2.250	1.131	0.0	217	2.836
1.001	1.305	51.9	214.6	2.475	1.407	1.131	0.0	225	1.329
1.002	1.002	39.9	239.1	1.407	0.964	1.260	0.0	225	1.021
3.000	1.465	25.9	3.4	0.450	0.964	0.018	0.0	37	1.016
1.003	1.817	802.8	249.1	0.964	1.359	1.313	0.0	285	1.612
2.000	1.067	75.4	0.0	2.060	1.809	0.000	0.0	0	0.000
1.004	1.272	561.8	15.9	1.712	1.359	0.084	0.0	85	0.574
1.005	1.028	72.7	265.1	1.809	2.040	1.397	0.0	300	1.042
1.005_1	4.800	190.8	265.1	2.115	0.920	1.397	0.0	225	4.888
1.006_1	3.525	249.2	265.1	0.920	1.266	1.397	0.0	273	3.928
5.000	1.029	40.9	14.4	0.851	1.266	0.076	0.0	92	0.940
1.006	1.026	72.5	292.6	1.266	2.326	1.542	0.0	300	1.039
1.007_1	1.362	96.3	303.8	2.326	1.537	1.601	0.0	300	1.380
1.009_1	1.003	70.9	303.8	1.537	1.425	1.601	0.0	300	1.016
6.000_1	1.663	117.5	37.4	0.816	1.425	0.197	0.0	116	1.480
1.007	0.998	158.7	341.1	1.425	0.873	1.798	0.0	450	1.010
6.000	1.192	21.1	7.4	0.900	0.873	0.039	0.0	61	1.088
1.008	2.123	337.7	348.5	0.873	0.991	1.837	0.0	387	2.394
7.000	2.569	102.1	23.0	0.900	1.141	0.121	0.0	73	2.087
1.009	2.817	199.1	390.9	1.141	0.900	2.060	0.0	300	2.853
8.000	1.718	68.3	20.1	0.900	0.470	0.106	0.0	83	1.496
9.000	1.092	43.4	13.3	0.487	1.092	0.070	0.0	85	0.960
8.001	1.524	242.4	33.4	1.092	1.764	0.176	0.0	112	1.083
10.000	1.845	32.6	16.5	0.897	0.962	0.087	0.0	75	1.848

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)
11.000	RE6	S9	22.637	0.600	87.391	87.242	0.149	151.9	300	5.38	50.0
8.002	S9	S10	28.423	0.600	87.092	86.950	0.142	200.2	450	6.10	50.0
12.000	RE7	S10	37.574	0.600	89.775	88.755	1.020	36.8	150	5.38	50.0
8.003	S10	S11	21.005	0.600	86.950	86.810	0.140	150.0	150	6.53	50.0
1.010	S11	EXSMH2	26.159	0.600	86.660	85.700	0.960	27.2	300	9.48	50.0

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)
11.000	1.273	90.0	26.9	0.727	1.764	0.142	0.0	112	1.116
8.002	1.433	227.9	76.8	1.764	2.409	0.405	0.0	180	1.299
12.000	1.663	29.4	8.0	0.898	0.904	0.042	0.0	53	1.414
8.003	0.818	14.5	84.8	2.709	2.521	0.447	0.0	150	0.833
1.010	3.023	213.7	475.7	2.521	1.721	2.507	0.0	300	3.062

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	10.000	50.0	450	1 STANDARD	96.500	94.000	2.050	96.500	93.800	2.250
1.001	22.082	100.4	225	1 STANDARD	96.500	93.800	2.475	95.212	93.580	1.407
1.002	17.752	169.1	225	1 STANDARD	95.212	93.580	1.407	94.664	93.475	0.964
3.000	16.595	47.4	150	1 STANDARD	94.500	93.900	0.450	94.664	93.550	0.964
1.003	44.832	236.0	750	1 STANDARD	94.664	92.950	0.964	94.869	92.760	1.359
2.000	12.934	215.6	300	1 STANDARD	95.180	92.820	2.060	94.869	92.760	1.809
1.004	28.734	478.9	750	1 STANDARD	95.282	92.820	1.712	94.869	92.760	1.359
1.005	3.245	231.8	300	1 STANDARD	94.869	92.760	1.809	95.086	92.746	2.040
1.005_1	21.373	7.5	225	1 STANDARD	95.086	92.746	2.115	91.050	89.905	0.920
1.006_1	1.445	20.1	300	1 STANDARD	91.050	89.830	0.920	91.324	89.758	1.266
5.000	26.505	160.6	225	1 STANDARD	91.074	89.998	0.851	91.324	89.833	1.266
1.006	65.209	232.9	300	1 STANDARD	91.324	89.758	1.266	92.104	89.478	2.326
1.007_1	29.225	132.8	300	1 STANDARD	92.104	89.478	2.326	91.095	89.258	1.537
1.009_1	24.344	243.4	300	1 STANDARD	91.095	89.258	1.537	90.883	89.158	1.425
6.000_1	61.733	89.5	300	1 STANDARD	90.964	89.848	0.816	90.883	89.158	1.425

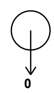
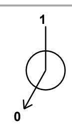
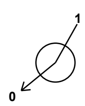
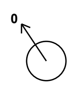
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SNECK1	1350	Manhole	1 STANDARD	SNECK2	1800	Manhole	1 STANDARD
1.001	SNECK2	1800	Manhole	1 STANDARD	SAR1	1350	Manhole	1 STANDARD
1.002	SAR1	1350	Manhole	1 STANDARD	SAR2	1800	Manhole	1 STANDARD
3.000	G1	350	Manhole	1 STANDARD	SAR2	1800	Manhole	1 STANDARD
1.003	SAR2	1800	Manhole	1 STANDARD	SAR5	1800	Manhole	1 STANDARD
2.000	SAR3	1350	Manhole	1 STANDARD	SAR5	1800	Manhole	1 STANDARD
1.004	SAR4	1800	Manhole	1 STANDARD	SAR5	1800	Manhole	1 STANDARD
1.005	SAR5	1800	Manhole	1 STANDARD	SAR6	1800	Manhole	1 STANDARD
1.005_1	SAR6	1800	Manhole	1 STANDARD	CP1	600	Manhole	1 STANDARD
1.006_1	CP1	600	Manhole	1 STANDARD	S2	1350	Manhole	1 STANDARD
5.000	S1	1200	Manhole	1 STANDARD	S2	1350	Manhole	1 STANDARD
1.006	S2	1350	Manhole	1 STANDARD	S3	1350	Manhole	1 STANDARD
1.007_1	S3	1350	Manhole	1 STANDARD	s3a	1350	Manhole	1 STANDARD
1.009_1	s3a	1350	Manhole	1 STANDARD	S5	1350	Manhole	1 STANDARD
6.000_1	S4	1200	Manhole	1 STANDARD	S5	1350	Manhole	1 STANDARD

Pipeline Schedule

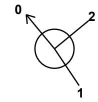
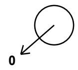
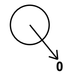
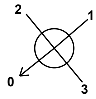
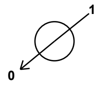
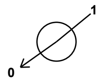
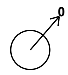
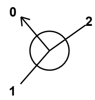
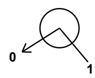
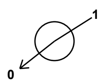
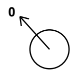
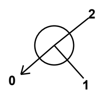
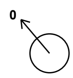
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.007	15.165	409.9	450	1 STANDARD	90.883	89.008	1.425	90.294	88.971	0.873
6.000	34.881	71.3	150	1 STANDARD	90.810	89.760	0.900	90.294	89.271	0.873
1.008	18.247	91.7	450	1 STANDARD	90.294	88.971	0.873	90.213	88.772	0.991
7.000	64.322	26.1	225	1 STANDARD	92.433	91.308	0.900	90.213	88.847	1.141
1.009	15.399	31.4	300	1 STANDARD	90.213	88.772	1.141	89.481	88.281	0.900
8.000	34.881	58.1	225	1 STANDARD	89.763	88.638	0.900	88.733	88.038	0.470
9.000	17.857	142.9	225	1 STANDARD	88.253	87.541	0.487	88.733	87.416	1.092
8.001	17.530	177.1	450	1 STANDARD	88.733	87.191	1.092	89.306	87.092	1.764
10.000	34.881	30.0	150	1 STANDARD	90.404	89.357	0.897	89.306	88.194	0.962
11.000	22.637	151.9	300	1 STANDARD	88.418	87.391	0.727	89.306	87.242	1.764
8.002	28.423	200.2	450	1 STANDARD	89.306	87.092	1.764	89.809	86.950	2.409
12.000	37.574	36.8	150	1 STANDARD	90.823	89.775	0.898	89.809	88.755	0.904
8.003	21.005	150.0	150	1 STANDARD	89.809	86.950	2.709	89.481	86.810	2.521
1.010	26.159	27.2	300	1 STANDARD	89.481	86.660	2.521	87.721	85.700	1.721

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.007	S5	1350	Manhole	1 STANDARD	S6	1350	Manhole	1 STANDARD
6.000	RE1	1200	Manhole	1 STANDARD	S6	1350	Manhole	1 STANDARD
1.008	S6	1350	Manhole	1 STANDARD	S7	1800	Manhole	1 STANDARD
7.000	RE2	1200	Manhole	1 STANDARD	S7	1800	Manhole	1 STANDARD
1.009	S7	1800	Manhole	1 STANDARD	S11	1350	Manhole	1 STANDARD
8.000	RE3	1200	Manhole	1 STANDARD	S8	1350	Manhole	1 STANDARD
9.000	RE4	1200	Manhole	1 STANDARD	S8	1350	Manhole	1 STANDARD
8.001	S8	1350	Manhole	1 STANDARD	S9	1350	Manhole	1 STANDARD
10.000	RE5	1200	Manhole	1 STANDARD	S9	1350	Manhole	1 STANDARD
11.000	RE6	1200	Manhole	1 STANDARD	S9	1350	Manhole	1 STANDARD
8.002	S9	1350	Manhole	1 STANDARD	S10	1350	Manhole	1 STANDARD
12.000	RE7	1200	Manhole	1 STANDARD	S10	1350	Manhole	1 STANDARD
8.003	S10	1350	Manhole	1 STANDARD	S11	1350	Manhole	1 STANDARD
1.010	S11	1350	Manhole	1 STANDARD	EXSMH2	1200	Manhole	1 STANDARD

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SNECK1	299085.894	516124.461	96.500	2.500	1350		0	1.000	94.000	450
SNECK2	299085.894	516114.461	96.500	2.700	1800		1	1.000	93.800	450
							0	1.001	93.800	225
SAR1	299075.086	516095.205	95.212	1.632	1350		1	1.001	93.580	225
							0	1.002	93.580	225
G1	299070.602	516070.128	94.500	0.600	350		0	3.000	93.900	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SAR2	299061.379	516083.924	94.664	1.714	1800		1	3.000	93.550	150
							2	1.002	93.475	225
							0	1.003	92.950	750
SAR3	299042.581	516126.876	95.180	2.360	1350					
							0	2.000	92.820	300
SAR4	299014.510	516140.627	95.282	2.462	1800					
							0	1.004	92.820	750
SAR5	299032.774	516118.444	94.869	2.109	1800		1	2.000	92.760	300
							2	1.004	92.760	750
							3	1.003	92.760	750
							0	1.005	92.760	300
SAR6	299030.243	516116.414	95.086	2.340	1800		1	1.005	92.746	300
							0	1.005_1	92.746	225
CP1	299013.742	516102.830	91.050	1.220	600		1	1.005_1	89.905	225
							0	1.006_1	89.830	300
S1	298995.213	516081.956	91.074	1.076	1200					
							0	5.000	89.998	225
S2	299012.566	516101.991	91.324	1.566	1350		1	5.000	89.833	225
							2	1.006_1	89.758	300
							0	1.006	89.758	300
S3	298970.597	516151.899	92.104	2.626	1350		1	1.006	89.478	300
							0	1.007_1	89.478	300
s3a	298945.924	516136.236	91.095	1.837	1350		1	1.007_1	89.258	300
							0	1.009_1	89.258	300
S4	298968.071	516075.148	90.964	1.116	1200					
							0	6.000_1	89.848	300
S5	298926.853	516121.105	90.883	1.875	1350		1	6.000_1	89.158	300
							2	1.009_1	89.158	300
							0	1.007	89.008	450
RE1	298937.847	516084.501	90.810	1.050	1200					
							0	6.000	89.760	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S6	298915.382	516111.185	90.294	1.323	1350	1	6.000	89.271	150
						2	1.007	88.971	450
						0	1.008	88.971	450
RE2	298953.531	516165.422	92.433	1.125	1200	0	7.000	91.308	225
S7	298903.483	516125.018	90.213	1.441	1800	1	7.000	88.847	225
						2	1.008	88.772	450
						0	1.009	88.772	300
RE3	298892.239	516043.469	89.763	1.125	1200	0	8.000	88.638	225
RE4	298857.711	516083.320	88.253	0.712	1200	0	9.000	87.541	225
S8	298869.774	516070.153	88.733	1.542	1350	1	9.000	87.416	225
						2	8.000	88.038	225
						0	8.001	87.191	450
RE5	298905.309	516055.152	90.404	1.047	1200	0	10.000	89.357	150
RE6	298867.542	516098.518	88.418	1.027	1200	0	11.000	87.391	300
S9	298882.844	516081.836	89.306	2.214	1350	1	11.000	87.242	300
						2	10.000	88.194	150
						3	8.001	87.092	450
						0	8.002	87.092	450
RE7	298928.234	516072.034	90.823	1.048	1200	0	12.000	89.775	150
S10	298904.035	516100.778	89.809	2.859	1350	1	12.000	88.755	150
						2	8.002	86.950	450
						0	8.003	86.950	150
S11	298890.457	516116.805	89.481	2.821	1350	1	8.003	86.810	150
						2	1.009	88.281	300
						0	1.010	86.660	300
EXSMH2	298866.027	516107.452	87.721	2.021	1200	1	1.010	85.700	300

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	17.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.300	Check Discharge Rate(s)	✓
Summer CV	0.750	100 year (l/s)	50.0
Winter CV	0.840	Check Discharge Volume	x
Analysis Speed	Normal		

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 %)
1	0	0	0
30	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node SAR6 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	92.746	Product Number	CTL-SHE-0208-2560-1900-2560
Design Depth (m)	1.900	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	25.6	Min Node Diameter (mm)	1800

Node SNECK2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	93.800	Product Number	CTL-SHE-0189-2110-2000-2110
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	21.1	Min Node Diameter (mm)	1800

Node S10 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	86.950	Product Number	CTL-SHE-0124-8000-1500-8000
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.0	Min Node Diameter (mm)	1200

Node S7 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	88.772	Product Number	CTL-SHE-0256-3790-1450-3790
Design Depth (m)	1.450	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	37.9	Min Node Diameter (mm)	1800

Node SNECK2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	93.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	212

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	600.0	0.0	1.000	600.0	0.0	1.001	0.0	0.0

Node SAR3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	92.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.97	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	85.5	0.0	0.500	85.5	0.0	0.501	0.0	0.0

Node S6 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	88.971
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	228

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	247.5	0.0	1.000	247.5	0.0	1.001	0.0	0.0

Node S9 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	87.092
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	244

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	180.0	0.0	1.000	180.0	0.0	1.001	0.0	0.0

Node RE4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	87.850
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.33	Time to half empty (mins)	104

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	120.0	0.0	0.300	120.0	0.0	0.301	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SNECK1	8	94.685	0.685	122.7	7.1760	0.0000	SURCHARGED
240 minute winter	SNECK2	164	93.969	0.169	30.2	96.5630	0.0000	OK
240 minute winter	SAR1	156	93.685	0.105	16.4	0.3174	0.0000	OK
15 minute winter	G1	10	93.928	0.028	2.0	0.0197	0.0000	OK
15 minute winter	SAR2	11	93.031	0.081	20.9	0.2399	0.0000	OK
240 minute winter	SAR3	164	92.930	0.110	4.1	9.2317	0.0000	OK
240 minute winter	SAR4	164	92.930	0.110	2.2	0.3545	0.0000	OK
240 minute winter	SAR5	164	92.930	0.170	18.7	0.4323	0.0000	OK
240 minute winter	SAR6	164	92.925	0.179	17.7	0.4545	0.0000	OK
240 minute winter	CP1	164	89.909	0.079	17.7	0.0223	0.0000	OK
15 minute winter	S1	11	90.067	0.069	8.2	0.1744	0.0000	OK
15 minute winter	S2	11	89.891	0.133	29.1	0.3081	0.0000	OK
15 minute winter	S3	12	89.606	0.128	34.4	0.2413	0.0000	OK
15 minute winter	s3a	12	89.411	0.153	34.2	0.2183	0.0000	OK
15 minute winter	S4	11	89.934	0.086	21.4	0.3990	0.0000	OK
15 minute winter	S5	9	89.268	0.260	52.3	0.3724	0.0000	OK
15 minute winter	RE1	11	89.805	0.045	4.2	0.0848	0.0000	OK
60 minute winter	S6	43	89.065	0.094	38.9	22.2637	0.0000	OK
15 minute winter	RE2	10	91.362	0.054	13.1	0.1763	0.0000	OK
60 minute winter	S7	44	89.078	0.306	40.8	1.2131	0.0000	SURCHARGED
15 minute winter	RE3	10	88.701	0.063	11.5	0.1884	0.0000	OK
15 minute winter	RE4	10	87.606	0.065	7.6	0.1999	0.0000	OK
15 minute winter	S8	10	87.280	0.089	18.4	0.1280	0.0000	OK
15 minute winter	RE5	10	89.412	0.055	9.4	0.1549	0.0000	OK
15 minute winter	RE6	10	87.476	0.085	15.4	0.3331	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SNECK1	1.000	SNECK2	176.5	2.979	0.385	0.8026	
240 minute winter	SNECK2	Hydro-Brake®	SAR1	14.5				
240 minute winter	SAR1	1.002	SAR2	16.4	0.933	0.412	0.3123	
15 minute winter	G1	3.000	SAR2	1.9	0.852	0.074	0.0376	
15 minute winter	SAR2	1.003	SAR5	20.7	0.538	0.026	2.0062	
15 minute winter	SAR3	2.000	SAR5	-8.6	-0.362	-0.114	0.3136	
15 minute summer	SAR4	1.004	SAR5	7.7	0.356	0.014	1.2925	
240 minute winter	SAR5	1.005	SAR6	17.7	0.417	0.243	0.1377	
240 minute winter	SAR6	Hydro-Brake®	CP1	17.7				
240 minute winter	CP1	1.006_1	S2	17.7	0.959	0.071	0.0272	
15 minute winter	S1	5.000	S2	8.0	0.795	0.195	0.2660	
15 minute winter	S2	1.006	S3	28.9	0.981	0.399	1.9211	
15 minute winter	S3	1.007_1	s3a	34.2	1.066	0.355	0.9458	
15 minute winter	s3a	1.009_1	S5	33.7	0.986	0.475	0.8322	
15 minute winter	S4	6.000_1	S5	20.6	1.258	0.175	1.1864	
15 minute winter	S5	1.007	S6	52.9	1.783	0.333	0.7280	
15 minute winter	RE1	6.000	S6	4.1	0.919	0.193	0.1545	
60 minute winter	S6	1.008	S7	33.4	0.564	0.099	1.2637	
15 minute winter	RE2	7.000	S7	12.8	1.419	0.126	0.9368	
60 minute winter	S7	Hydro-Brake®	S11	36.7				
15 minute winter	RE3	8.000	S8	11.1	1.261	0.163	0.3081	
15 minute winter	RE4	9.000	S8	7.3	0.804	0.169	0.1631	
15 minute winter	S8	8.001	S9	18.7	1.323	0.077	0.2991	
15 minute winter	RE5	10.000	S9	9.2	1.569	0.281	0.2035	
15 minute winter	RE6	11.000	S9	14.9	0.935	0.166	0.3625	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	S9	47	87.219	0.127	24.8	21.8497	0.0000	OK
15 minute winter	RE7	10	89.815	0.040	4.6	0.0769	0.0000	OK
60 minute winter	S10	57	87.248	0.298	20.3	0.4259	0.0000	SURCHARGED
60 minute winter	S11	44	86.757	0.097	44.5	0.1382	0.0000	OK
60 minute winter	EXSMH2	44	85.792	0.092	44.5	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	S9	8.002	S10	21.5	0.379	0.094	1.8872	
15 minute winter	RE7	12.000	S10	4.4	1.194	0.150	0.1391	
60 minute winter	S10	Hydro-Brake®	S11	7.8				
60 minute winter	S11	1.010	EXSMH2	44.5	2.346	0.208	0.4960	192.9

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SNECK1	7	94.990	0.990	298.5	10.3693	0.0000	SURCHARGED
240 minute winter	SNECK2	176	94.214	0.414	108.1	236.9148	0.0000	SURCHARGED
30 minute summer	SAR1	19	93.800	0.220	42.9	0.6623	0.0000	OK
15 minute winter	G1	10	93.945	0.045	4.8	0.0311	0.0000	OK
240 minute winter	SAR2	180	93.165	0.215	30.3	0.6360	0.0000	OK
240 minute winter	SAR3	180	93.165	0.345	7.7	29.0878	0.0000	SURCHARGED
240 minute winter	SAR4	180	93.165	0.345	5.1	1.1141	0.0000	OK
240 minute winter	SAR5	180	93.165	0.405	34.3	1.0313	0.0000	SURCHARGED
240 minute winter	SAR6	180	93.160	0.414	25.2	1.0542	0.0000	SURCHARGED
15 minute winter	CP1	11	89.963	0.133	23.8	0.0376	0.0000	OK
15 minute winter	S1	10	90.112	0.114	20.1	0.2901	0.0000	OK
15 minute winter	S2	11	89.973	0.215	59.8	0.4969	0.0000	OK
15 minute winter	S3	11	89.692	0.214	74.9	0.4024	0.0000	OK
15 minute winter	s3a	12	89.524	0.266	73.7	0.3803	0.0000	OK
15 minute winter	S4	10	89.988	0.140	52.0	0.6512	0.0000	OK
120 minute winter	S5	100	89.374	0.366	61.6	0.5238	0.0000	OK
15 minute winter	RE1	10	89.834	0.074	10.3	0.1393	0.0000	OK
120 minute winter	S6	100	89.372	0.401	92.4	94.8021	0.0000	OK
15 minute winter	RE2	10	91.393	0.085	31.9	0.2798	0.0000	OK
120 minute winter	S7	100	89.369	0.597	88.8	2.3646	0.0000	SURCHARGED
15 minute winter	RE3	10	88.740	0.102	28.0	0.3083	0.0000	OK
15 minute winter	RE4	10	87.648	0.107	18.5	0.3303	0.0000	OK
120 minute winter	S8	102	87.509	0.318	17.1	0.4557	0.0000	OK
15 minute winter	RE5	10	89.452	0.095	23.0	0.2650	0.0000	OK
15 minute winter	RE6	10	87.532	0.141	37.5	0.5496	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SNECK1	1.000	SNECK2	320.7	3.492	0.700	0.8832	
240 minute winter	SNECK2	Hydro-Brake®	SAR1	20.6				
30 minute summer	SAR1	1.002	SAR2	42.4	1.157	1.064	0.6406	
15 minute winter	G1	3.000	SAR2	4.7	1.097	0.182	0.0714	
15 minute winter	SAR2	1.003	SAR5	54.9	0.657	0.068	4.4310	
15 minute winter	SAR3	2.000	SAR5	-40.0	-0.732	-0.531	0.6777	
15 minute winter	SAR4	1.004	SAR5	15.8	0.427	0.028	3.7155	
240 minute winter	SAR5	1.005	SAR6	25.2	0.421	0.346	0.2285	
240 minute winter	SAR6	Hydro-Brake®	CP1	25.2				
240 minute winter	CP1	1.006_1	S2	25.2	1.054	0.101	0.0391	
15 minute winter	S1	5.000	S2	19.9	0.916	0.486	0.5988	
15 minute winter	S2	1.006	S3	60.2	1.117	0.830	3.5130	
15 minute winter	S3	1.007_1	s3a	73.7	1.241	0.766	1.7347	
15 minute winter	s3a	1.009_1	S5	73.5	1.223	1.037	1.4501	
15 minute winter	S4	6.000_1	S5	50.4	1.598	0.429	1.9464	
15 minute winter	S5	1.007	S6	120.6	2.131	0.760	1.1939	
15 minute winter	RE1	6.000	S6	9.9	1.166	0.472	0.2981	
600 minute winter	S6	1.008	S7	101.4	0.918	0.300	2.1212	
15 minute winter	RE2	7.000	S7	31.4	1.437	0.308	1.7138	
60 minute summer	S7	Hydro-Brake®	S11	37.9				
15 minute winter	RE3	8.000	S8	27.3	1.599	0.400	0.5960	
15 minute winter	RE4	9.000	S8	18.0	1.016	0.415	0.3178	
15 minute winter	S8	8.001	S9	44.8	1.494	0.185	1.1872	
15 minute winter	RE5	10.000	S9	22.4	1.952	0.688	0.4008	
15 minute winter	RE6	11.000	S9	36.6	1.180	0.407	0.7048	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	S9	104	87.509	0.417	44.2	71.9272	0.0000	OK
15 minute winter	RE7	10	89.839	0.064	11.1	0.1241	0.0000	OK
120 minute winter	S10	94	87.521	0.571	20.6	0.8177	0.0000	SURCHARGED
480 minute winter	S11	368	86.758	0.098	45.9	0.1406	0.0000	OK
480 minute winter	EXSMH2	376	85.794	0.094	45.9	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	S9	8.002	S10	21.7	0.334	0.095	2.2251	
15 minute winter	RE7	12.000	S10	10.8	1.519	0.367	0.2665	
30 minute winter	S10	Hydro-Brake®	S11	8.0				
480 minute winter	S11	1.010	EXSMH2	45.9	2.365	0.215	0.5076	1038.9

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SNECK1	6	95.306	1.306	536.9	13.6840	0.0000	SURCHARGED
240 minute winter	SNECK2	228	94.722	0.922	123.8	527.9542	0.0000	SURCHARGED
240 minute winter	SAR1	176	94.509	0.929	35.4	2.7977	0.0000	SURCHARGED
240 minute winter	G1	172	94.478	0.578	2.0	0.4024	0.0000	FLOOD RISK
240 minute winter	SAR2	172	94.478	1.528	41.2	4.5118	0.0000	FLOOD RISK
240 minute winter	SAR3	172	94.478	1.658	14.2	42.1821	0.0000	SURCHARGED
240 minute winter	SAR4	172	94.478	1.658	14.1	5.3490	0.0000	SURCHARGED
240 minute winter	SAR5	172	94.478	1.718	45.0	4.3715	0.0000	SURCHARGED
240 minute winter	SAR6	172	94.473	1.727	27.2	4.3951	0.0000	SURCHARGED
15 minute winter	CP1	12	90.408	0.578	25.1	0.1637	0.0000	SURCHARGED
15 minute winter	S1	12	90.508	0.510	36.1	1.2969	0.0000	SURCHARGED
15 minute winter	S2	12	90.404	0.646	85.2	1.4947	0.0000	SURCHARGED
240 minute winter	S3	224	90.141	0.663	48.3	1.2473	0.0000	SURCHARGED
240 minute winter	s3a	224	90.118	0.860	48.4	1.2307	0.0000	SURCHARGED
240 minute winter	S4	224	90.099	0.251	22.0	1.1687	0.0000	OK
240 minute winter	S5	224	90.098	1.090	69.0	1.5600	0.0000	SURCHARGED
240 minute winter	RE1	224	90.096	0.336	4.4	0.6301	0.0000	SURCHARGED
240 minute winter	S6	224	90.096	1.125	90.0	236.8520	0.0000	FLOOD RISK
15 minute winter	RE2	10	91.427	0.119	57.5	0.3911	0.0000	OK
240 minute winter	S7	224	90.093	1.321	67.8	5.2304	0.0000	FLOOD RISK
15 minute winter	RE3	10	88.787	0.149	50.3	0.4490	0.0000	OK
240 minute winter	RE4	232	88.076	0.535	7.8	10.6143	0.0000	FLOOD RISK
240 minute winter	S8	232	88.076	0.885	19.6	1.2658	0.0000	SURCHARGED
15 minute winter	RE5	12	89.816	0.459	41.3	1.2825	0.0000	SURCHARGED
240 minute winter	RE6	232	88.076	0.685	15.9	2.6673	0.0000	SURCHARGED

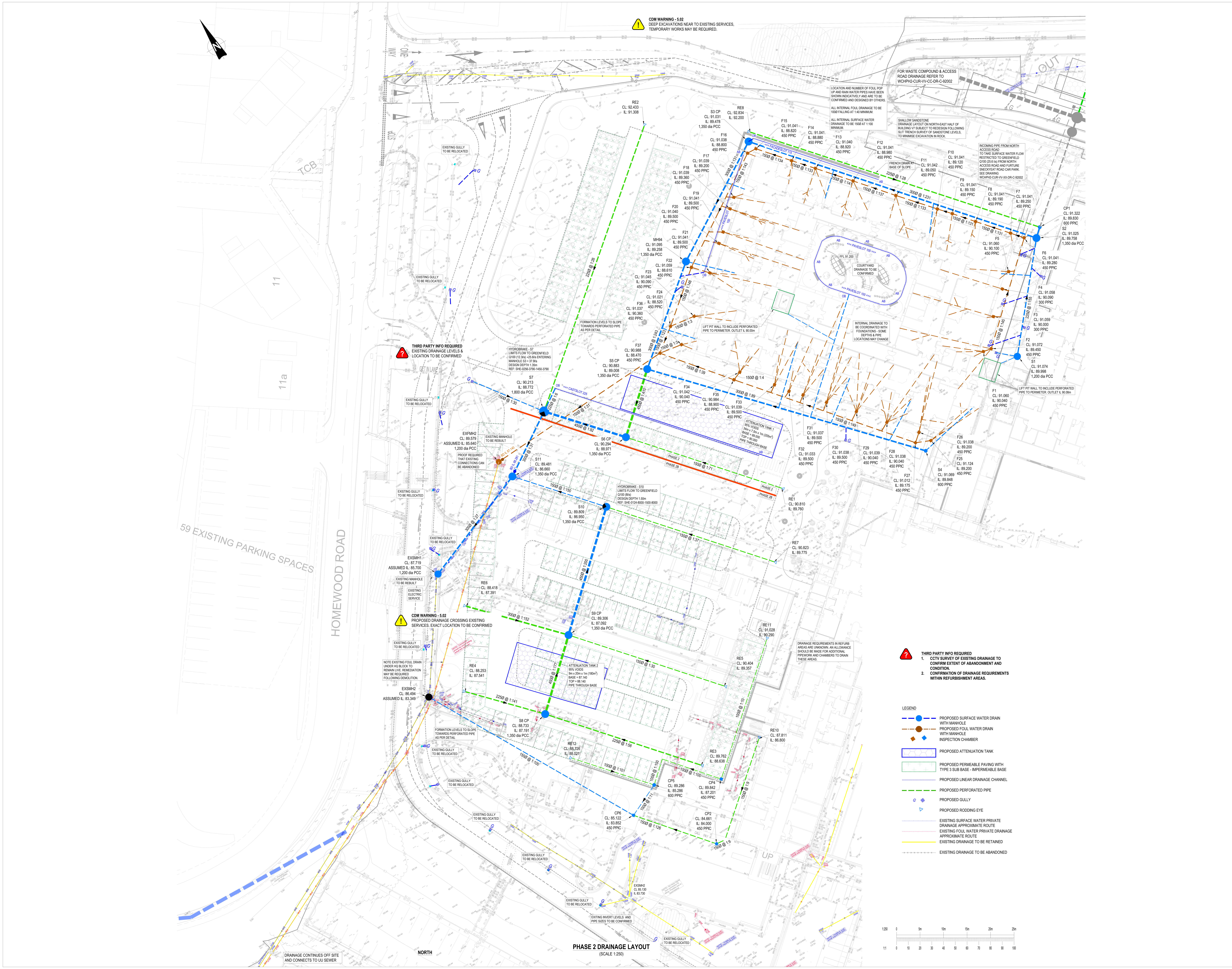
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SNECK1	1.000	SNECK2	544.1	4.233	1.188	1.3624	
60 minute summer	SNECK2	Hydro-Brake®	SAR1	21.0				
30 minute summer	SAR1	1.002	SAR2	61.5	1.547	1.542	0.6861	
15 minute winter	G1	3.000	SAR2	8.4	1.278	0.324	0.1088	
15 minute winter	SAR2	1.003	SAR5	82.8	0.717	0.103	7.5116	
15 minute winter	SAR3	2.000	SAR5	-76.2	-1.121	-1.011	0.9108	
15 minute winter	SAR4	1.004	SAR5	33.4	0.486	0.059	6.1611	
60 minute winter	SAR5	1.005	SAR6	31.8	0.553	0.438	0.2285	
60 minute summer	SAR6	Hydro-Brake®	CP1	25.6				
60 minute winter	CP1	1.006_1	S2	33.6	1.097	0.135	0.0687	
15 minute winter	S1	5.000	S2	32.2	0.958	0.787	1.0541	
15 minute winter	S2	1.006	S3	81.7	1.161	1.127	4.5920	
15 minute winter	S3	1.007_1	s3a	104.4	1.482	1.084	2.0580	
15 minute winter	s3a	1.009_1	S5	104.6	1.501	1.476	1.6873	
15 minute winter	S4	6.000_1	S5	90.8	1.823	0.772	3.1278	
15 minute winter	S5	1.007	S6	189.9	2.259	1.197	2.3981	
15 minute winter	RE1	6.000	S6	17.9	1.319	0.848	0.4733	
960 minute winter	S6	1.008	S7	95.6	0.839	0.283	2.8911	
15 minute winter	RE2	7.000	S7	56.8	1.637	0.556	1.9652	
30 minute summer	S7	Hydro-Brake®	S11	37.9				
15 minute winter	RE3	8.000	S8	49.2	1.830	0.720	0.9395	
15 minute winter	RE4	9.000	S8	32.4	1.160	0.747	0.5004	
15 minute winter	S8	8.001	S9	80.4	1.590	0.332	2.5936	
15 minute winter	RE5	10.000	S9	35.1	2.021	1.076	0.6140	
15 minute winter	RE6	11.000	S9	65.9	1.349	0.732	1.2605	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	S9	232	88.076	0.984	48.0	169.5991	0.0000	SURCHARGED
15 minute winter	RE7	10	89.867	0.092	19.9	0.1779	0.0000	OK
240 minute winter	S10	232	88.075	1.125	20.7	1.6105	0.0000	SURCHARGED
120 minute summer	S11	60	86.758	0.098	45.9	0.1406	0.0000	OK
120 minute summer	EXSMH2	60	85.794	0.094	45.9	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	S9	8.002	S10	26.4	0.268	0.116	4.5034	
15 minute winter	RE7	12.000	S10	19.4	1.750	0.661	0.4173	
15 minute summer	S10	Hydro-Brake®	S11	8.0				
120 minute summer	S11	1.010	EXSMH2	45.9	2.365	0.215	0.5075	864.2

Appendix C Proposed Drainage Layouts



PHASE 2 DRAINAGE LAYOUT
(SCALE 1:250)

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

PRIVATE DRAINAGE NOTES:

1. ALL DRAINAGE WORK TO BE IN ACCORDANCE WITH THE BUILDING REGULATIONS, BS EN 752 AND TO THE SATISFACTION OF THE BUILDING INSPECTOR.
2. ALL PROPRIETARY ITEMS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH MANUFACTURER'S DETAILS, INSTRUCTIONS & SPECIFICATIONS.
3. ALL EXISTING DRAINS AND SERVICES (LINE AND LEVELS) TO BE CHECKED BY THE CONTRACTOR ON SITE PRIOR TO FINALISING NEW DRAINAGE LINES AND LEVELS.
4. ALL COVER LEVELS ARE APPROXIMATE. EXACT LEVELS TO BE DETERMINED FROM THE EXTERNAL WORKS LAYOUT.
5. INVERT LEVELS QUOTED AT MANHOLES AND INSPECTION CHAMBERS ARE THOSE OF THE LARGEST CONNECTED PIPE DIAMETER. PIPES AT CHAMBERS TO BE LAID WITH SOFFITS LEVEL UNLESS NOTED OTHERWISE.
6. PIPE GRADIENTS WHERE STATED ARE APPROXIMATE.
7. REFER TO ARCHITECT'S DRAWINGS FOR PRECISE LOCATION OF ALL RAINWATER PIPES, INTERNAL CONNECTIONS ETC.
8. ALL INTERNAL CONNECTIONS ARE TO HAVE AN ABOVE-FLOOR ACCESS POINT TO ENABLE FUTURE ACCESS FOR MAINTENANCE.
9. PIPES AND FITTINGS TO BE:
   - CONCRETE PIPES AND ANCILLARY PRODUCTS TO BS 5911-1:2002+AR:2010 AND BS EN 1916:2002.
   - VITRIFIED CLAY PIPES AND FITTINGS TO BS EN 295:2013 (ALL PARTS).
   - DUCTILE IRON TO BS EN 598:2007 & BS ISO 4179:2005.
   - PLASTIC PIPES FOR LAND DRAINAGE TO BS 4962:1982.
   - PLASTIC PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWAGE TO BS EN 1401 & BS 4660 – SOLID WALL ONLY, STRUCTURED WALL PIPES ARE NOT ACCEPTABLE FOR USE IN DRAINAGE SYSTEMS UNLESS AGREED.
   - PRECAST CONCRETE MANHOLE UNITS TO BS EN 1917:2002.
   - PLASTIC INSPECTION CHAMBERS FOR DRAINS AND SEWERS TO BS EN 13598-1:2010.
   - GULLY AND MANHOLE TOPS FOR VEHICULAR AND PEDESTRIAN AREAS TO BS EN 124:1994.
   - DRAINAGE CHANNELS FOR VEHICULAR AND PEDESTRIAN AREAS TO BS EN 1433:2002.
10. ALL MANHOLE COVERS, ROAD GULLY COVERS AND FRAMES TO COMPLY WITH BS EN124 NON ROCKING TYPE.

    UNLESS NOTED OTHERWISE USE:

    CLASS A15 AREAS INACCESSIBLE TO VEHICLES, ACCESSED ONLY BY PEDESTRIANS AND PEDAL CYCLISTS.

    CLASS B125 FOOTPATHS, FOOTWAYS, PEDESTRIAN AREAS WITH ONLY OCCASIONAL LIGHT VEHICULAR ACCESS INCLUDING DOMESTIC DRIVEWAYS & SMALL CAR PARKS.

    CLASS C250 GULLY TOPS IN CARRIAGEWAY WITHIN 500mm OF KERB AND UP TO 200mm INTO THE FOOTWAY.

    CLASS D400 CARRIAGEWAYS, HARD SHOULDERS, PARKING AREAS AND PEDESTRIAN AREAS ACCESSED BY ALL TYPES OF VEHICLES.

    CLASS E600 AREAS IMPOSING HIGH WHEEL LOADS SUCH AS INDUSTRIAL ESTATES AND SERVICE YARDS.
11. MANHOLES IN INTERNAL AREAS REQUIRE DOUBLE SEALED COVERS WITH LOCKING SCREWS, RECESSED WHERE REQUIRED TO ACCOMMODATE FLOOR FINISHES TO ARCHITECT'S SPECIFICATION.
12. PIPE BEDDING

    USE CLASS S BEDDING UNLESS NOTED OTHERWISE. NB PROTECT AGAINST CONSTRUCTION TRAFFIC AS NECESSARY

    USE CLASS Z CONCRETE BED & SURROUND OR CONCRETE SLAB PROTECTION AS FOLLOWS:
    - 100 - 600Ø PIPES (CLASS 120 CLAYWARE OR CLASS M CONCRETE)

      FIELDS AND GARDENS - LESS THAN 600mm COVER TO CROWN.

      ROADS - LESS THAN 1200mm COVER TO CROWN
    - 100 - 300Ø PIPES (PLASTIC)

      FIELDS AND GARDENS - LESS THAN 600mm COVER TO CROWN.

      ROADS - LESS THAN 900mm COVER TO CROWN
13. PIPES BELOW CONCRETE GROUND FLOOR SLABS

    WHERE THE CROWN OF THE PIPE IS WITHIN 300mm OF THE UNDERSIDE OF SLAB, SPECIAL PROTECTION TO BE PROVIDED IN ACCORDANCE WITH BUILDING REGULATIONS H1 2.44 OR 150mm GEN3 CONCRETE BED AND SURROUND CAST INTEGRALLY WITH SLAB.

    OTHERWISE USE CLASS S BEDDING
14. MAIN BACKFILL TO BE WELL COMPACTED IN 150mm LAYERS OF:

    SELECTED BACKFILL MATERIAL IN ALL SOFT LANDSCAPED AREAS

    TYPE 1 GRANULAR MATERIAL IN ALL HARDSTANDING AREAS & PUBLIC HIGHWAYS
15. BACKFILL TO DRAINS NEAR FOUNDATIONS IS TO BE IN ACCORDANCE WITH BUILDING REGULATIONS H1 DIAGRAMS 8 & 12.
16. SURFACE WATER MANHOLE SIZE TO BE MAXIMUM PIPE SIZE +900mm (ASSUME 1350Ø).
17. ALL CHAMBERS DOWNSTREAM OF PERFORATED PIPES TO BE A SILT TRAP

Rev:	Description:	Date:	By:	Chkd:
P06	CONNECTION POINT OF WASTE COMPOUND UPDATED, DRAINAGE AMENDED AROUND PROPOSED BUILDING, FRENCH DRAIN AMENDED AND SLOT DRAINS ADDED	31/03/22	DM	AMB
P05	DRAFT RIBA STAGE 4 ISSUE.	03/03/22	DM/ AMB	AMB/ PT
P04	ADDED INFLOW AT MH S3 AND INCREASED FLOW CONTROL AT MH S8 ACCORDINGLY.	01/10/21	AMB	PT
P03	EXISTING DRAINAGE RELOCATION ADDED	24/06/21	DM	PT
P02	LAYOUT AND PHASING ALLOWANCES UPDATED, IMPERMEABLE AREAS ADDED	18/06/21	DM	PT
P01	FIRST ISSUE	28/05/21	DM	PT

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Status: PARTIALLY SIGNED-OFF - STAGE 4 B4

Client: GRAHAM

Project: PROCURE 22 WEST CUMBERLAND HOSPITAL PHASE 2 DEVELOPMENT

Drg Title: DRAINAGE LAYOUT

Project No:	Size:	Date:	Drawn By:	Designed By:	Checked By:
072419	A0, Scale: 1:250	MAY 21	DM	DM	PT

Project Code:	Originator:	Zone:	Level:	Type:	Discipline:	Category / Number:	Rev:
WCHPH2	CUR	VV	XX	DR	C	92001	P06

WCHPH2-CUR-VV-XX-DR-C-92001-P06- Drainage Layout.dwg

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.
5. ALL DRAINAGE WORK TO BE IN ACCORDANCE WITH CURTINS' DRAINAGE SPECIFICATION, BS EN 752, THE BUILDING REGULATIONS AND TO THE SATISFACTION OF THE BUILDING INSPECTOR.
6. ALL PROPRIETARY ITEMS ARE TO BE INSTALLED STRICTLY IN ACCORDANCE WITH MANUFACTURER'S DETAILS, INSTRUCTIONS & SPECIFICATIONS.
7. ALL EXISTING DRAINS AND SERVICES (LINE AND LEVELS) TO BE CHECKED BY THE CONTRACTOR ON SITE PRIOR TO FINALISING NEW DRAINAGE LINES AND LEVELS.
8. ALL COVER LEVELS ARE APPROXIMATE. EXACT LEVELS TO BE DETERMINED FROM THE EXTERNAL WORKS LAYOUT.
9. INVERT LEVELS QUOTED AT MANHOLES AND INSPECTION CHAMBERS ARE THOSE OF THE LARGEST CONNECTED PIPE DIAMETER. PIPES AT CHAMBERS TO BE LAID WITH SOFFITS LEVEL UNLESS NOTED OTHERWISE.
10. PIPE GRADIENTS WHERE STATED ARE APPROXIMATE.
11. PIPES AND FITTINGS TO BE:
    - CONCRETE PIPES AND ANCILLARY PRODUCTS TO BS 5911-1:2002+AR:2010 AND BS EN 1916:2002.
    - VITRIFIED CLAY PIPES AND FITTINGS TO BS EN 295:2013 (ALL PARTS).
    - PLASTIC PIPES FOR LAND DRAINAGE TO BS 4962:1982.
    - PLASTIC PIPING SYSTEMS FOR NON-PRESSURE UNDERGROUND DRAINAGE AND SEWAGE TO BS EN 1401 & BS 4660 – SOLID WALL ONLY, STRUCTURED WALL PIPES ARE NOT ACCEPTABLE FOR USE IN DRAINAGE SYSTEMS UNLESS AGREED.
    - PRECAST CONCRETE MANHOLE UNITS TO BS EN 1917:2002.
    - PLASTIC INSPECTION CHAMBERS FOR DRAINS AND SEWERS TO BS EN 13598-1:2010.
    - GULLY AND MANHOLE TOPS FOR VEHICULAR AND PEDESTRIAN AREAS TO BS EN 124:1994.
    - DRAINAGE CHANNELS FOR VEHICULAR AND PEDESTRIAN AREAS TO BS EN 1433:2002.

10. ALL MANHOLE COVERS, ROAD GULLY COVERS AND FRAMES TO COMPLY WITH BS EN124 NON-ROCKING TYPE.

    UNLESS NOTED OTHERWISE USE:

    CLASS A15 AREAS INACCESSIBLE TO VEHICLES, ACCESSED ONLY BY PEDESTRIANS AND PEDAL CYCLISTS.

    CLASS B125 FOOTPATHS, FOOTWAYS, PEDESTRIAN AREAS WITH ONLY OCCASIONAL LIGHT VEHICULAR ACCESS INCLUDING DOMESTIC DRIVEWAYS & SMALL CAR PARKS.

    CLASS C250 GULLY TOPS IN CARRIAGEWAY WITHIN 500mm OF KERB AND UP TO 200mm INTO THE FOOTWAY.

    CLASS D400 CARRIAGEWAYS, HARD SHOULDERS, PARKING AREAS AND PEDESTRIAN AREAS ACCESSED BY ALL TYPES OF VEHICLES.

    CLASS E600 AREAS IMPOSING HIGH WHEEL LOADS SUCH AS INDUSTRIAL ESTATES AND SERVICE YARDS.

11. PIPE BEDDING

    USE CLASS S BEDDING UNLESS NOTED OTHERWISE. NB PROTECT AGAINST CONSTRUCTION TRAFFIC AS NECESSARY

    USE CLASS Z CONCRETE BED & SURROUND OR CONCRETE SLAB PROTECTION AS FOLLOWS:
    - 100 - 300Ø PIPES (PLASTIC)
    - FIELDS AND GARDENS - LESS THAN 600mm COVER TO CROWN.
    - ROADS - LESS THAN 900mm COVER TO CROWN

12. MAIN BACKFILL TO BE WELL COMPACTED IN 150mm LAYERS OF:

    SELECTED BACKFILL MATERIAL IN ALL SOFT LANDSCAPED AREAS

    TYPE 1 GRANULAR MATERIAL IN ALL HARDSTANDING AREAS & PUBLIC HIGHWAYS.

13. PIPE SIZES ARE INDICATIVE, TO BE CONFIRMED AT DETAILED DESIGN.
14. DISCHARGE RATE TO CONFIRMED.
15. INVERT LEVELS TO BE CONFIRMED UPON RECEIPT OF LEVELS OF EXISTING SEWER IN ROAD.
16. ALL LEVELS & DRAINAGE TO BE CONFIRMED FOLLOWING RECEIPT OF APPROVED COORDINATED LAYOUT.

SCALEBAR
(INDICATIVE ONLY)

LEGEND:

- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED OIL INTERCEPTOR
- PROPOSED ATTENUATION TANK
- PROPOSED LINEAR DRAINAGE CHANNEL
- PROPOSED GULLY
- EXISTING PRIVATE DRAINAGE
- PROPOSED FOUL WATER DRAINAGE
- CAPPED PIPE
- PERFORATED PIPE IN TANK

Rev:	Description:	Date:	By:	Chkd:
P07	CONNECTION POINT TO PHASE 2 DRAINAGE UPDATED - WASTE COMPOUND DRAINAGE LOCATIONS AMENDED	31/03/22	DM	AMB
P06	MANHOLE SCHEDULE ADDED, LEVELS AMENDED	03/03/22	DM	AMB
P05	ADDED FOUL DRAIN FOR CLINICAL WASTE COMPOUND. REVISED SITE LAYOUT. DRAFT STAGE 4 ISSUE.	18/02/22	AMB	DM
P04	REVISED SURFACE WATER OUTFALL.	01/10/21	AMB	PT
P03	SITE ACCESS AND EXISTING GULLIES ADDED	24/06/21	DM	PT
P02	DRAWING TITLE UPDATED, IMPERMEABLE AREAS ADDED & DRAINAGE AMENDED TO ALLOW FOR PHASING OF WORKS	18/06/21	DM	PT
P01	FIRST ISSUE	28/05/21	DM	PT

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Status: PARTIALLY SIGNED-OFF - STAGE 4 | B4

Client: GRAHAM

Project: WEST CUMBERLAND HOSPITAL PHASE 2 DEVELOPMENT

Drg Title: WASTE COMPOUND & ACCESS ROAD DRAINAGE LAYOUT

Project No:	Size:	Date:	Drawn By:	Designed By:	Checked By:
072419	A0, Scale: 1:200	MAY 21	DM	DM	PT

Project Code:	Originator:	Zone:	Level:	Type:	Discipline:	Category / Number:	Rev:
WCHPH2	CUR	VV	XX	DR	C	92002	P07

WCHPH2-CUR-VV-XX-DR-C-92002-P07 - Waste Compound and Access Road Drainage Layout.dwg