



Kirkby BESS

Surface Water Drainage Assessment

For Axis

KRS.0653.006.R.001.B

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Kirkby BESS

Project	Surface Water Drainage Assessment
Client	Axis
Status	Final
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Date	February 2024

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EXECUTIVE SUMMARY

The purpose of this report is to assess the potential for disposing of surface water. This Surface Water Drainage Assessment demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the National Planning Policy Framework (NPPF).

The development should not therefore be precluded on the grounds of flood risk or drainage.

1.0 INTRODUCTION

1.1 Background

This Surface Water Drainage Assessment has been prepared by KRS Enviro at the request of Pelagic Energy Ltd to support a planning application for the proposed development on Coopers Lane, Kirkby.

It is recognised that developments that are designed without regards to the surface water runoff are likely to result in increased impact on existing off-site service provision and may lead to an increase in flood risk.

1.2 Purpose

This Surface Water Drainage Assessment complies with the principles of SuDS presented in the new Defra non-statutory technical standards for SuDS¹, and the National Planning Policy Framework (NPPF)². A Surface Water Drainage Assessment is presented with reference to the hydrological and hydrogeological context of the development.

The report findings are based upon professional judgement and are summarised below with detailed recommendations provided at the end of the report. The report includes baseline data on flood risk from the Environment Agency, rainfall data from the Flood Estimation Handbook (FEH) and hydrogeological information from the British Geological Survey (BGS). The assessment will summarise and refer to these datasets in the text.

1.3 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

A SuDS Strategy for the site proposals has been developed to manage and reduce the flood risk posed by the surface water runoff from the site. An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the development compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development unless specific off-site arrangements are made and result in the same net effect.

¹ Department for Environment, Food and Rural Affairs (2015) Non-statutory technical standards for SuDS (March 2015).

² Ministry of Housing, Communities and Local Government (2023). National Planning Policy Framework (NPPF).

1.4 What are SuDS?

A Sustainable Drainage System (SuDS) is designed to replicate, as closely as possible, the natural drainage from the site (before development) to ensure that the flood risk downstream of the site does not increase as a result of the land being developed. SuDS can also significantly improve the quality of water leaving the site and can enhance the amenity and biodiversity that a site has to offer.

There are a range of SuDS options available to provide effective surface water management that intercept and store excess runoff. The standards set out appropriate design criteria based on four main parameters:

- 1) Runoff Destination (in order of preference)
 - a. To ground;
 - b. To surface water body;
 - c. To road drain or surface water sewer;
 - d. To combined sewer
- 2) Peak flow rate and volume (pre-and post-development)
- 3) Water Quality (based on potential hazards arising from development and sensitivity of the runoff destination)
- 4) Function (design; flood risk; operation and maintenance)

These parameters are then used to develop a drainage strategy based on the following six principles;

- 1) Manage surface runoff at source
- 2) Manage on the surface
- 3) Utilise public space and integrate into the drainage design
- 4) Effective operation and maintenance
- 5) Account for climate change and changes in impermeable area
- 6) Affordability

This report aims identify the most practicable runoff destination and drainage parameters for the site and is presented with reference to the hydrological and hydrogeological context of the development.

1.5 Report Structure

This Surface Water Drainage Assessment has the following report structure:

- Section 2 details the location and the existing and proposed development;
- Section 3 details the possible surface water discharge destinations
- Section 4 outlines the surface water peak flow;
- Section 5 outlines the surface water drainage strategy; and

- Section 6 presents conclusions.

2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The site is situated off Coopers Lane (A5208) in Kirkby, on a plot of land measuring approximately 0.4028 hectares (ha). The site is centred on approximate National Grid Reference (NGR) 343641, 397142.

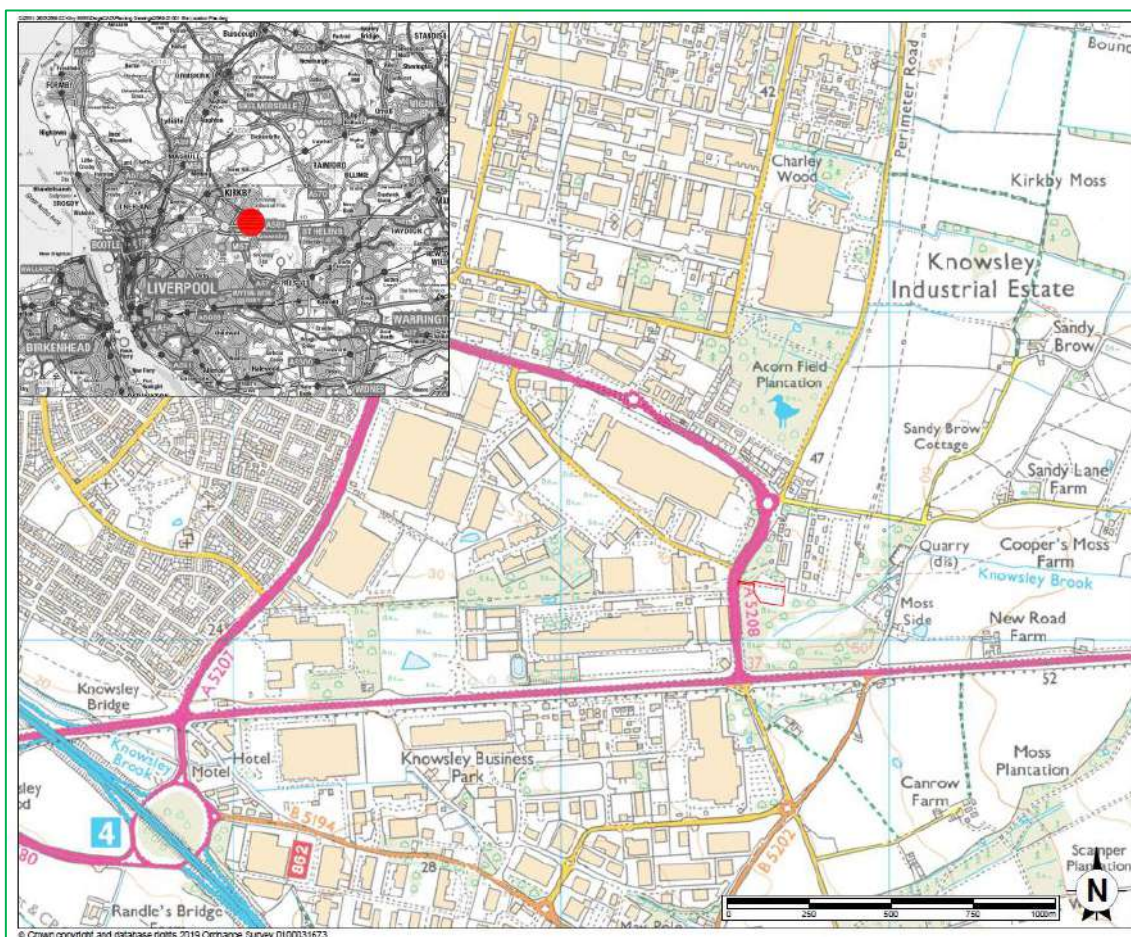


Figure 1 - Site Location

2.2 Existing Development

The site is currently a disused parcel of land that was formerly farmland.

2.3 Proposed Development

The proposed development is for a Battery Energy Storage System (BESS) on land adjacent to the Coopers Lane National Grid Substation (see Appendix 1). Further details with regard to the Proposed Development can be found in the accompanying information submitted with the planning application.

2.4 Ground Levels

A topographical survey of the site has recently been completed (see Appendix 2). The site falls from north to south, with ground levels of between 42.92 metres Above Ordnance Datum (mAOD) and 40.68mAOD.

2.5 Catchment Hydrology / Drainage

The Knowsley Brook is located approximately 40m to the south of the site and a drainage ditch is located approximately 35m to the north west of the site. The Knowsley Brook flows in a south westerly direction and is culverted to the south of the site beyond the East Lancashire Road. There are no other watercourses evident either on, or within the vicinity of the site.

2.6 Ground Conditions

The British Geological Survey (BGS) map shows that the superficial deposits consist of Till, Devensian - diamicton. Superficial deposits formed between 116 and 11.80 thousand years ago in the Quaternary Period in a local environment previously dominated by ice age conditions. The bedrock deposits consist of the Chester Formation - sandstone. Sedimentary bedrock formed approximately 247 to 250 million years ago in the Triassic Period in a local environment previously dominated by rivers.

The superficial Till is classified as a Secondary (undifferentiated) aquifer. A Secondary (undifferentiated) aquifer 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. The underlying bedrock is described as a Principal Aquifer. 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.

Information from the National Soil Resources Institute details the site area as being situated on naturally wet very acid sandy and loamy soils. The Wallingford Winter Rain Acceptance Potential (WRAP) map indicates that the site lies within WRAP Class 4: clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

2.7 Source Protection Zone

The site is located within a Source Protection Zone (SPZ) Zone II - Outer Protection Zone. SPZ's have been defined by the Environment Agency around major public water supplies with the intent to show the risk of contamination from any activities that might cause pollution in the area. Three zones are defined: SPZ 1 is the Inner Zone (highest risk); SPZ 2 is the Outer Zone (average risk); and SPZ 3 is the Total Catchment (least risk).

3.0 SURFACE WATER RUNOFF DESTINATION

3.1 Opportunities for Runoff of Surface Water

Possible receptors for surface water runoff generated onsite have been assessed in line with the prioritisation set onsite out in the Defra non-statutory technical standards for SuDS. There are four possible options to discharge the surface water. The Runoff Destination is (in order of preference):

- a) To ground;
- b) To surface water body;
- c) To road drain or surface water sewer;
- d) To combined sewer

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

3.2 Discharge to Ground

In determining the future surface runoff from the site, the potential of using infiltration devices has been considered. An overview of the general ground conditions may be used to gauge if there is potential for their application.

BRE 365 soakaway tests were carried out by a third party on 25th April 2022, two trial pits were excavated at the site. However, the tests were abandoned after 4 hours due to very low rates of infiltration. The results are shown in Appendix 3. Therefore, the ground conditions suggest infiltration would not provide a suitable option at the site for surface water discharge.

3.3 Discharge to surface Water Body

Should infiltration be found to be unsuitable, the next option is discharge to a surface water body. The Knowsley Brook is located approximately 40m to the south of the site and a drainage ditch is located approximately 35m to the north west of the site.

The surface water runoff from the site would be attenuated on-site before being discharged to the Knowsley Brook at a restricted runoff rate. Any attenuated and controlled surface water discharge would have minimal effect on the water levels within the watercourse. Therefore, it would be possible to discharge surface water runoff from the site into a watercourse.

3.4 Discharge to Road Drain or Surface Water Sewer

This option is not required.

3.5 Discharge to a Combined Sewer

This option is not required.

3.6 Summary

For the purposes of this assessment the most likely scenario of discharging surface water runoff to the Knowsley Brook at restricted rate has been considered. The option of discharge to the Knowsley Brook is the preferred option for the discharge of surface water runoff from the site.

4.0 SURFACE WATER PEAK FLOW

4.1 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into assessments. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the flood risk assessments: climate change allowances guidance³. Therefore, the proposals will take into account a 40% increase in rainfall intensity due to climate change.

4.2 Surface Water Runoff Rates

Currently the majority of rainfall infiltrates into the soil substrate and/or runoff from the site. It is proposed that the proposed access track would be surfaced with compacted stone to provide an even surface for vehicle movements and to provide a stable base for installation and maintenance (when required). The transformer compound and control building would be located on concrete foundations. All these areas would have a low permeability and have been treated as impermeable. Therefore the impermeable areas of the site will be 2,300m².

An estimation of surface water runoff is required to permit effective site surface water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the Greenfield runoff from the site has been calculated using the Institute of Hydrology (IoH124) method. Table 1 shows the IoH 124 method Greenfield runoff rates calculated for the proposed impermeable area of 2,300m². The mean annual maximum flow rate from a Greenfield site (QBAR: approximately a 2.30 year return period) has been calculated to be 0.50 litres/second (l/s) (see Appendix 4).

Table 1 - IoH124 method Greenfield Runoff Rates

Rainfall Event	Runoff Rate (l/s)
1	0.50
QBAR (rural)	0.50
30	0.90
100	1.10

The method used for calculating the runoff complies with the NPPF, as well as the new Defra non-statutory technical standards for SuDS and assumes that the excess runoff associated with the proposed development (plus an allowance for future climate change) will need to be managed by the proposed SuDS scheme.

³ <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances>

5.0 SURFACE WATER DRAINAGE SYSTEMS

5.1 SuDS Strategy

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

The objective of this SuDS Strategy is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SuDS Strategy takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The Outline SuDS Strategy will take the form of:

- Permeable surfaces - crushed stone (lined).
- Filter trenches (lined).
- Underground attenuation crate storage with a restricted discharge into the Knowsley Brook.

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

The principle applied in the design of storage is to limit the discharge rate of surface water runoff from the developed site for events of similar frequency of occurrence to the same peak rate of runoff as that which takes place from a Greenfield site prior to development. It would not be practical to include a pond, or lagoon within the site it would also not be sustainable to install a green roof on the buildings/structures.

The SuDS Strategy will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site. The adoption of a SuDS Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the Site is uncontrolled, untreated, unmanaged and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

The equipment will sit on concrete rafts, the apron in front of the equipment will be constructed from compacted impermeable surfaces. The free draining stone will have a sufficient void ratio of 30% and permeability of granular fill to allow adequate percolation and to control the risk of blockage (examples include coarse aggregate 4-40mm (4/40), 4-20mm (4/20) as defined in BS 753313:2009 or Type 3 sub-base 0-40mm (0/40)). A permeable/open-graded (reduced fines) sub-base layer (i.e. Type 3 with a void ratio of 30%) will be used as a drainage layer below the permeable surfaces which will be sufficiently permeable to allow water to drain through and to store water temporarily. The selected gravel fill and bedding would be clean, free-draining, angular shaped material in the specified size range. These permeable areas will be lined with an impermeable geotextile.

Infiltration capacities of free draining stone are significantly greater than the design rainfall intensities and are not a limiting factor. A minimum value of 2500mm/hr is considered reasonable within The SuDS Manual (see Section 20.5.1 of the SuDS Manual). These are SuDS source control compliant and will as a minimum provide storage for the first 5mm (interception storage). Permeable surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. These systems encourage biological treatment of flow and extraction of oils and heavy metals from the run-off. Treatment processes that occur within the surface structure and the geotextile layers include:

- Filtration
- Absorption
- Biodegradation
- Sedimentation

It will also assist in reducing the flood profile of the Site by significantly attenuating the runoff from the Proposed Development within the sub-base material. The greenfield runoff rate has been calculated to be 0.50l/s. Using a control device and practical minimum pipe sizes it is not practical to control the discharge rate to below 5.00l/s. Therefore, a value of 5.00l/s has been used as the limiting discharge rate before discharge into the watercourse.

The SuDS design is shown in Appendix 5 and Appendix 6 shows the supporting MicroDrainage Calculations for the 1 in 100 year event, with a 40% allowance for climate change (increase in peak rainfall) with 5.00l/s used as the limiting discharge rate before discharge to the watercourse.

At this stage, it is proposed that underground crate storage tanks and oversized drainage networks will be used to provide the required attenuation storage volume. Additional storage would be provided within the manholes, pipes and drainage gullies which will provide betterment over and above the 1 in 100 year (+40%) event.

5.2 Intercepting and Collecting Fire Water

Given the nature of the energy storage within the proposed development, there is a potential risk of fire which may negatively affect upon the local water environment by mobilising pollution within surface water runoff, ultimately discharging to the nearby watercourses or infiltrating to ground.

The National Fire Chiefs Council (NFCC) guidance states “as a minimum, it is recommended that hydrant supplies for boundary cooling purpose.....should be capable of delivering no less

than 1,900 litres per minute for at least 2 hours.” Therefore, management systems to deal with contaminated water in the event of fire-fighting operations at the site have been included within the SuDS design. It is proposed that in the event of a fire at the site, the runoff from the energy storage area will be contained by a 3.90m high brick firewall to the south, east and west boundaries and attenuated within the site prior to being passed forward to discharge from the site. The natural slope of the site to the south would be worked into the finished site levels so that surface waters would run south and therefore the firewater could be retained by this wall.

In the event of a fire, an automated penstock pollution containment device will be activated to isolate the system drainage. The firewater should then be tested and either treated and released or tankered off-site as necessary. Further details are shown in Appendix 5. The permeable areas will be lined with an impermeable geotextile.

5.3 Designing for Local Drainage System Failure

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system. The SuDS Strategy applies a safe and sustainable approach to discharging rainfall runoff from the site and this reduces the risk of flooding however, it is not possible to completely remove the risk.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground.

The design of the site layout provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur. There will not be an extensive sewerage network on the proposed development site and therefore any potential exceedance flooding would be from the sewers and lateral drains connecting the buildings to the underground storage areas. It is very unlikely that a catastrophic failure would occur. An exceedance or blockage event of the sewers would not affect the proposed buildings/structures because the finished floor level will be raised above surrounding ground levels, ensuring any exceedance flooding would not affect the buildings/structures.

Exceedance flows would be contained within the highways adjacent to the site and within the site and would flow to the lower ground levels where the public open space is located. It is not considered that there is an increased risk to the properties on the site or located adjacent to the site.

In particular, the landscaped areas will include preferential flow paths that convey water away from structures. Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the structures and through contouring of the hardstanding areas.

When considering the impacts of a storm event that exceeds the design event, there is safety factor, even under the design event conditions. Consequently, if this event were to be exceeded there is additional capacity with the system to accommodate this (i.e. within the manholes, pipes etc.). If this freeboard was to be exceeded the consequences would be similar, if not less than for the local drainage system failure. Consequently, the impact of an exceedance event is not considered to represent any significant flood hazard.

The above manages and mitigates the flood risk from surface water runoff to the proposed properties from surface water runoff generated by the site development and to offsite locations as well the risk from surface water runoff generated offsite.

6.0 SUMMARY AND CONCLUSIONS

6.1 Conclusion

This Surface Water Drainage Assessment demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The proposed development will considerably reduce the flood risk posed to the site and to off-site locations due to the adoption of a SuDS Strategy.

The proposed development should not therefore be precluded on the grounds of flood risk or drainage.

APPENDICES

APPENDIX 1 – Proposed Site Layout



Application Boundary

Existing Hardstanding

0344 8700 007
axis.co.uk



Client

Pelagic Energy

Project

Kirkby BESS

Drawing Title

General Arrangement

Scale

1:500 @A3

Date

November 2023

Dwg no

2569-02-003

Status

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Drawn

SK

Checked

JMg

Rev

F

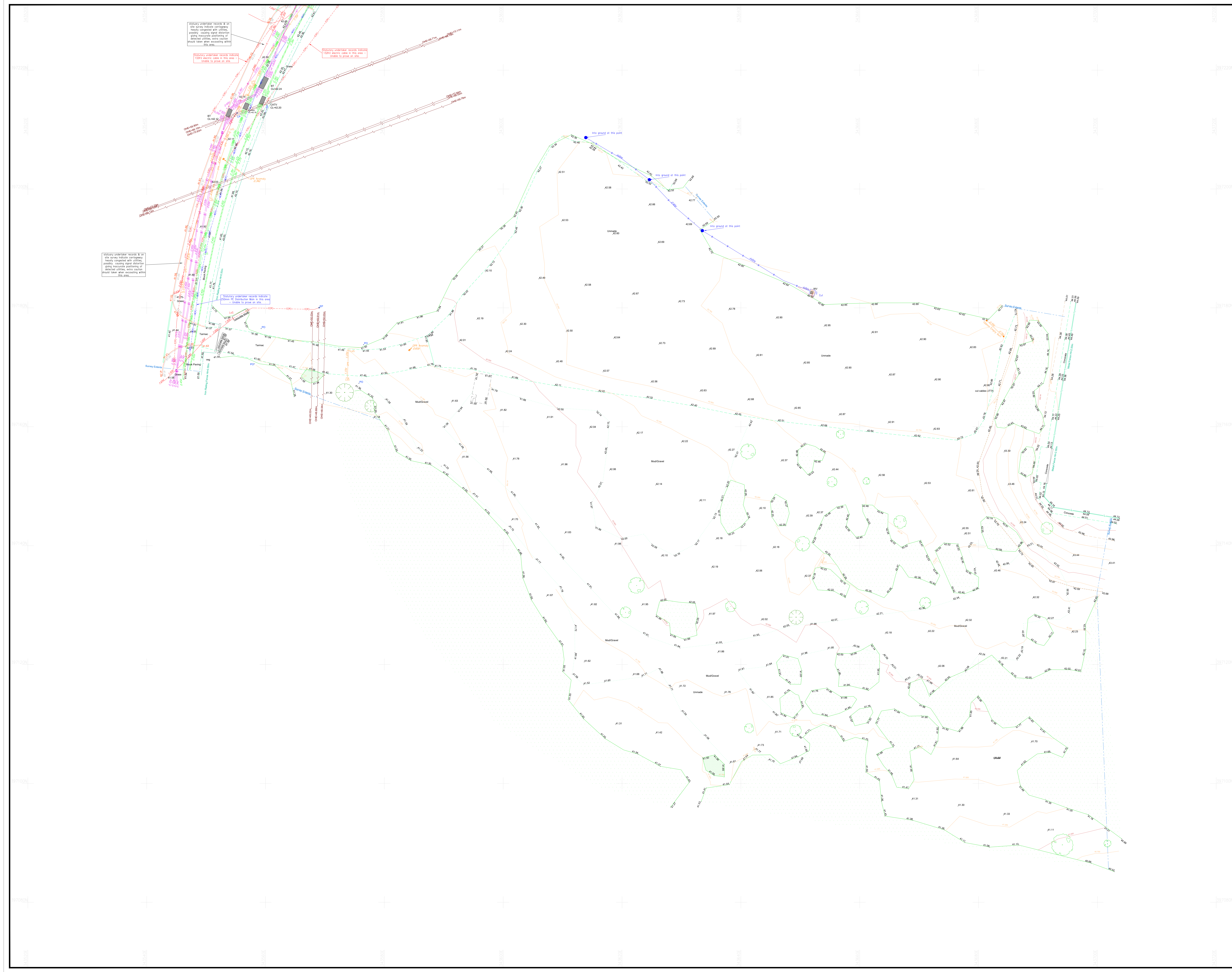


revision: **F** desc: **Layout Amendment**

date: **20-11-23**



APPENDIX 2 – Topographical Survey



N

GRID: OS NATIONAL GRID
Using the OS GPS Network and applying OSTN15 Transformation
and then removing the scale factor for true distances with a one-step
transformation centred on: 4801
DATUM: OS LEVEL DATUM
Using the OS GPS Network and applying OSGM15 National Grid
Model to obtain local area corrections

Topographic Legend

Bottom of Bank

Top of Banking

Building

Building Canopy

Concrete Base

Contour Major

Contour Minor

Fences

General

Kerb Bottom

Kerb Top

Kerb Drop

Walls

OH Comms

OH Electric

Railway Line

Road Centre

Road Markings

SC Hard/Hard

SC Hard/Soft

SC Soft/Soft

Steps

Tree Canopy

Vegetation

Visible Trench

Water Edge

Topographic Abbreviations

AV

BH

BO(L)

BS

Cab

CL

COL

Conc

DC

DFBin

DP

EP

ER

FFL

FH

FP

GP

GV

Gully

IC

KO

LP

MH

Mk

MP

Air Valve

Bottle

Bollard (Illuminated)

Bus Stop

Cabinet

Cover Level

Column

Concrete

Drainage Channel

Dog Foul Bin

Down Pipe

Electricity Pole

Earth Rod

Finished Floor Level

Fire Hydrant

Flag Pole

Gate Post

Gas Valve

Gully

Inspection Cover

Kerb Outlet

Lamp Post

Manhole

Marker

Marker Post

PB

PBX

PGR

PM

PO

RE

RSL(L)

RWP

Sign Post (Illuminated)

SPCam

ST

Stop Tap

SV

Sluice Valve

SVP

Soil Vent Pipe

TL

Traffic Light

TOF

Top of Fence Level

TOW

Top of Wall Level

TP

Telecoms Pole

VP

Vent Pipe

WB

Waste Bin

WBM

Window Bottom Level

WM

Water Meter

WO

Wash Out

WTT

Window Top Level

WV

Water Valve

WV

Water Valve

MW

Monitoring Well

Utility Legend

Air Line

Alarm Cable

BT Cable

CATV Cable

Chamber Extent

Comms Cable

CWD Sewer

Earth Wire/Tape

Electric Cable

Fibre Optic Cable

Fuel Line

FWD Sewer

Gas Pipe

Band of Cables

Empty Service Duct

SWD Sewer

Survey Extents

Heating Pipes

HV Electric Cable

Kingston Comms

OS Pipe

Rising Main

Traffic Control

Unknown Utility

Vent Pipe

Water

GPR Detection

Assumed Route

Records Route

Drainage

Backdrop

Cable Riser

Utility Abbreviations

CP

Cut

Di

DoB

DoC

ED

EoT

PE

HDPE

Cathodic Protection

Disconnected Utility

Discrete Iron

Depth of Bottom

Depth of Cover

Empty Duct

End of Trace

Polyethylene

High Density PE

VC

LoS

MDPE

SI

TLC

UDI

Unreliable Depth Info

Unidentified

UPVC

UTR

Unreliable to Trace

Unreliable to Trace

Manufacturer Stated Depths

Detected Using Electromagnetic Location Methods

e.g. Any metallic pipe/cable. Accuracy $\pm 2.5\%$ of depth reading.

Detected Using Electromagnetic Location Methods

e.g. Using a Sonde to locate drainage pipework. Accuracy $\pm 2.5\%$ of depth reading.

Detected Using Ground Penetrating Radar

e.g. A plastic pipe or service not located by other means. Accuracy depends on ground conditions.

CAUTION LIVE SERVICES PRESENT - EXTREME CARE SHOULD BE TAKEN WHEN EXCAVATING

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Notes

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ALL HATCHING IS FOR PRESENTATIONAL PURPOSES ONLY.

Rev.	Date	Comments

Client

PELAGIC ENERGY

Site Location:

LAND AT KIRKBY SUBSTATION
COOPERS LANE
KIRKBY
LIVERPOOL
L33 7TT

Purpose of Drawing

UTILITY SURVEY
PRESENTED ON A
TOPOGRAPHICAL SURVEY

Surveyed:

JB JM

Drawn:

DH

Checked:

Authorised:

NB

Date:

27-30/04/23

Scale:

1:200@A0

Scale 1:200

0

5

10

15

Centara

Office 10, Ripley Drive,
Normanton Business Park,
Wakefield,
WF6 1QT.
info@centara-ltd.com

Project No

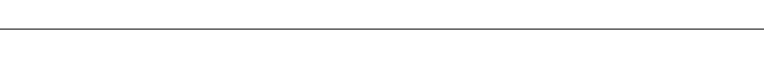
108675

Revision Status

00

Sheet Number:

1 of 4



APPENDIX 3 – Soakaway Test Results

SP ASSOCIATES SOAKAWAY TEST

1 Market Place, Warwick, CV34 4SA
Tel: 01926 494271

Site: Coopers Lane, Kirby

Job No: S1650

Test Date: 25/04/2022 Report date: 28/04/22

Test Method: BRE 365 (2007)

Trial Pit Number: TPA

Depth: 1.8m, Length 1.0m Width 0.4m

Start Water Depth for Analysis – Datum (mbgl): **0.92**

75% Effective Depth (mbgl): -

Elapsed Time (Mins):

50% Effective Depth (mbgl): -

25% Effective Depth (mbgl): -

Elapsed Time (Mins):

Base of Soakage Zone (mbgl): **1.8**

Volume outflow between 75% and 25% effective depth (m3):

Mean surface area of outflow (m²):

Time for outflow between 75% and 25% effective depth (mins):

Elapsed Time (minutes)	Water Depth (m below datum)	Elapsed Time (minutes)	Water Depth (m below datum)
0	0.92	90	1.01
1	0.92	100	1.01
2	0.92	110	1.02
3	0.92	120	1.03
4	0.92	130	1.04
5	0.92	140	1.04
6	0.92	150	1.04
7	0.92	160	1.05
8	0.92	170	1.05
9	0.92	180	1.06
10	0.93	190	1.07
15	0.93	200	1.07
20	0.94	210	1.07
25	0.95	220	1.07
30	0.95	230	1.07
40	0.96	240	1.07
50	0.97	250	1.07
60	0.99	260	1.07
70	1.00	270	1.07
80	1.00	280	1.07

Soil Infiltration Rate (m/s): Test abandoned due to very low rate of infiltration.

SP ASSOCIATES SOAKAWAY TEST

1 Market Place, Warwick, CV34 4SA
Tel: 01926 494271

Site: Coopers Lane, Kirby

Job No: S1650

Test Date: 25/04/2022 Report date: 28/04/22

Test Method: BRE 365 (2007)

Trial Pit Number: TPB

Depth: 1.9m, Length 1.0m Width 0.4m

Start Water Depth for Analysis – Datum (mbgl): **0.98**

75% Effective Depth (mbgl): - Elapsed Time (Mins):

50% Effective Depth (mbgl): -

25% Effective Depth (mbgl): - Elapsed Time (Mins):

Base of Soakage Zone (mbgl): **1.9**

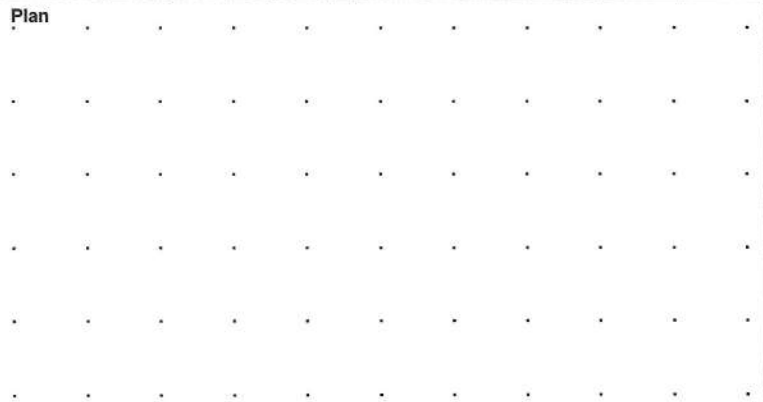
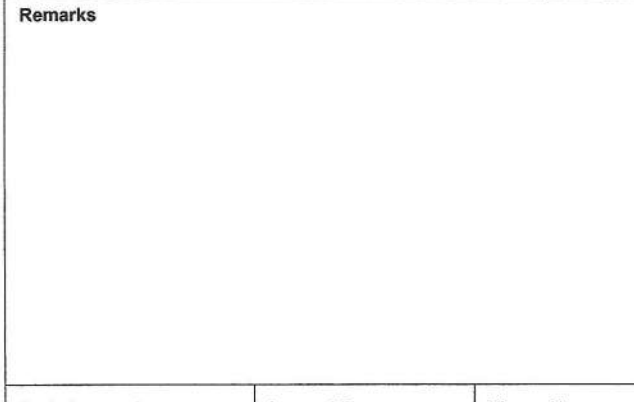
Volume outflow between 75% and 25% effective depth (m3):

Mean surface area of outflow (m²):

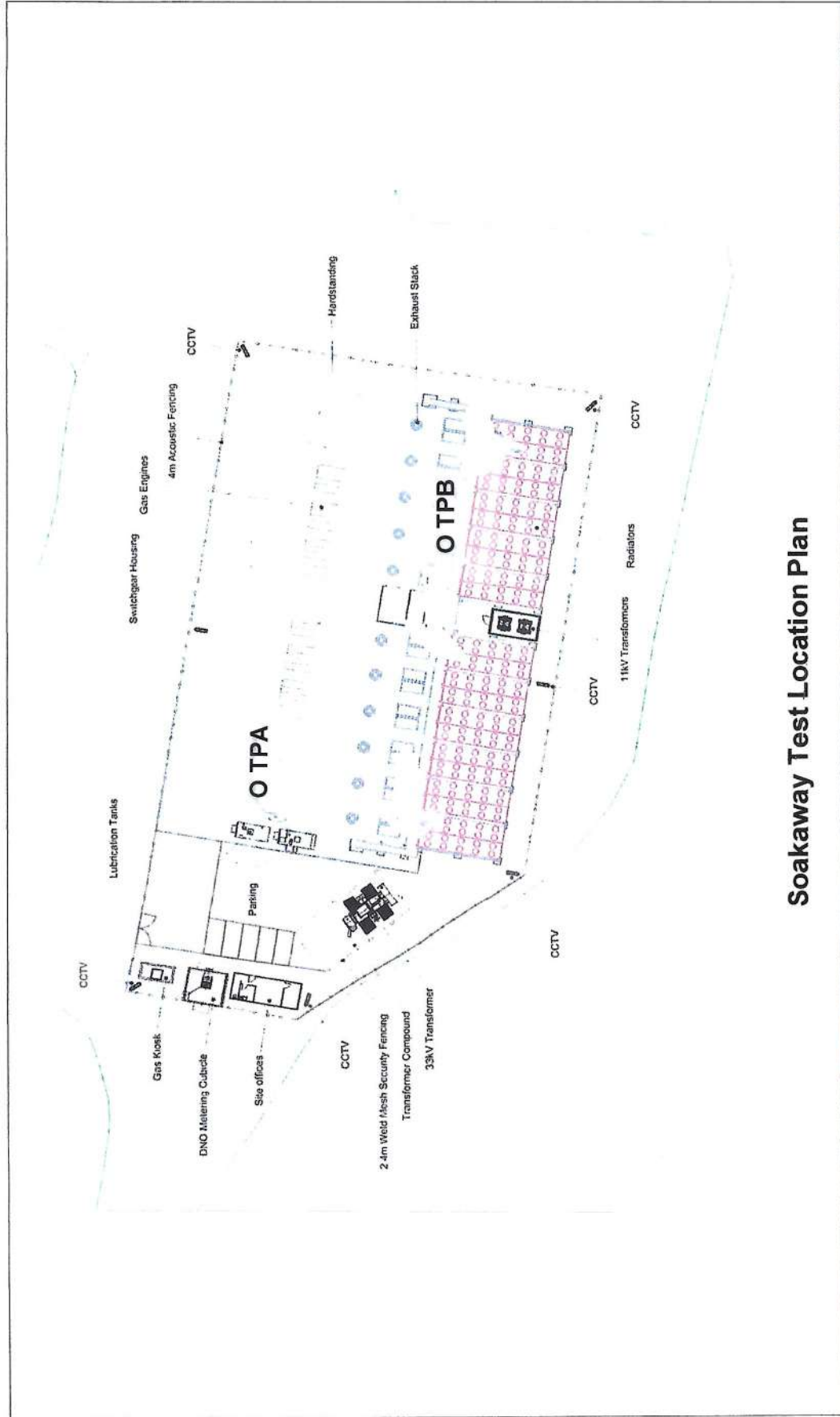
Time for outflow between 75% and 25% effective depth (mins):

Elapsed Time (minutes)	Water Depth (m below datum)	Elapsed Time (minutes)	Water Depth (m below datum)
0	0.98	90	0.99
1	0.98	100	0.99
2	0.98	110	0.99
3	0.98	120	0.99
4	0.98	130	0.99
5	0.98	140	0.99
6	0.98	150	0.99
7	0.98	160	0.99
8	0.98	170	0.99
9	0.98	180	0.99
10	0.98	190	0.99
15	0.98	200	0.99
20	0.98	210	0.99
25	0.98	220	0.99
30	0.98	230	0.99
40	0.98	240	0.99
50	0.98	250	-
60	0.98	260	-
70	0.99	270	-
80	0.99	280	-

Soil Infiltration Rate (m/s): Test abandoned due to very low rate of infiltration.

 SP ASSOCIATES Geoenvironmental & Geotechnical Services 1 Market Place, Warwick, CV34 4SA tel: 01926 494271 email: spassociates@hotmail.co.uk					Site Kirby Substation, Coopers Lane		Trial Pit Number TPA		
Excavation Method Trial Pit		Dimensions 1 x 0.4 x 1.8		Ground Level (mOD)		Client Pelagic Energy Ltd		Job Number S1650	
		Location		Dates 25/04/2022		Engineer SMP		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water
					(0.30) 0.30 (0.30) 0.60 (1.20) 1.80	Soft, brown CLAY with occasional fine to medium, angular gravel and occasional roots (Made Ground - reworked Topsoil) Loose, fine to medium, angular GRAVEL with some fine gravel of brick, concrete and clinker (Made Ground) Soft to firm, brown CLAY (Glacial Till)		                         	
Plan						Remarks			
									
Scale (approx) 1:50						Logged By PVC		Figure No. S1650 TPA	

SP ASSOCIATES Geoenvironmental & Geotechnical Services 1 Market Place, Warwick, CV34 4SA tel: 01926 494271 email: spassociates@hotmail.co.uk					Site Kirby Substation, Coopers Lane		Trial Pit Number TPB		
Excavation Method Trial Pit		Dimensions 1 x 0.4 x 1.9		Ground Level (mOD)		Client Pelagic Energy Ltd		Job Number S1650	
		Location		Dates 01/05/2022		Engineer SMP		Sheet 1/1	
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water
					(0.30) 0.30 (0.70) 1.00 (0.90) 1.90	Soft, brown CLAY with occasional fine to medium, angular gravel and occasional roots (Topsoil) Firm, red brown, sandy CLAY with occasional fine to coarse, angular gravel (Glacial Till) Firm, red brown, mottled grey, sandy CLAY (Glacial Till) Complete at 1.90m		    	
Plan					Remarks				
. .					Scale (approx) 1:50				
					Logged By PVC		Figure No. S1650 TPB		



Soakaway Test Location Plan

SP ASSOCIATES	Report No. S1650	Project: Coopers Lane, Kirby	Figure: 1
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PHOTOS

Trial Pit A



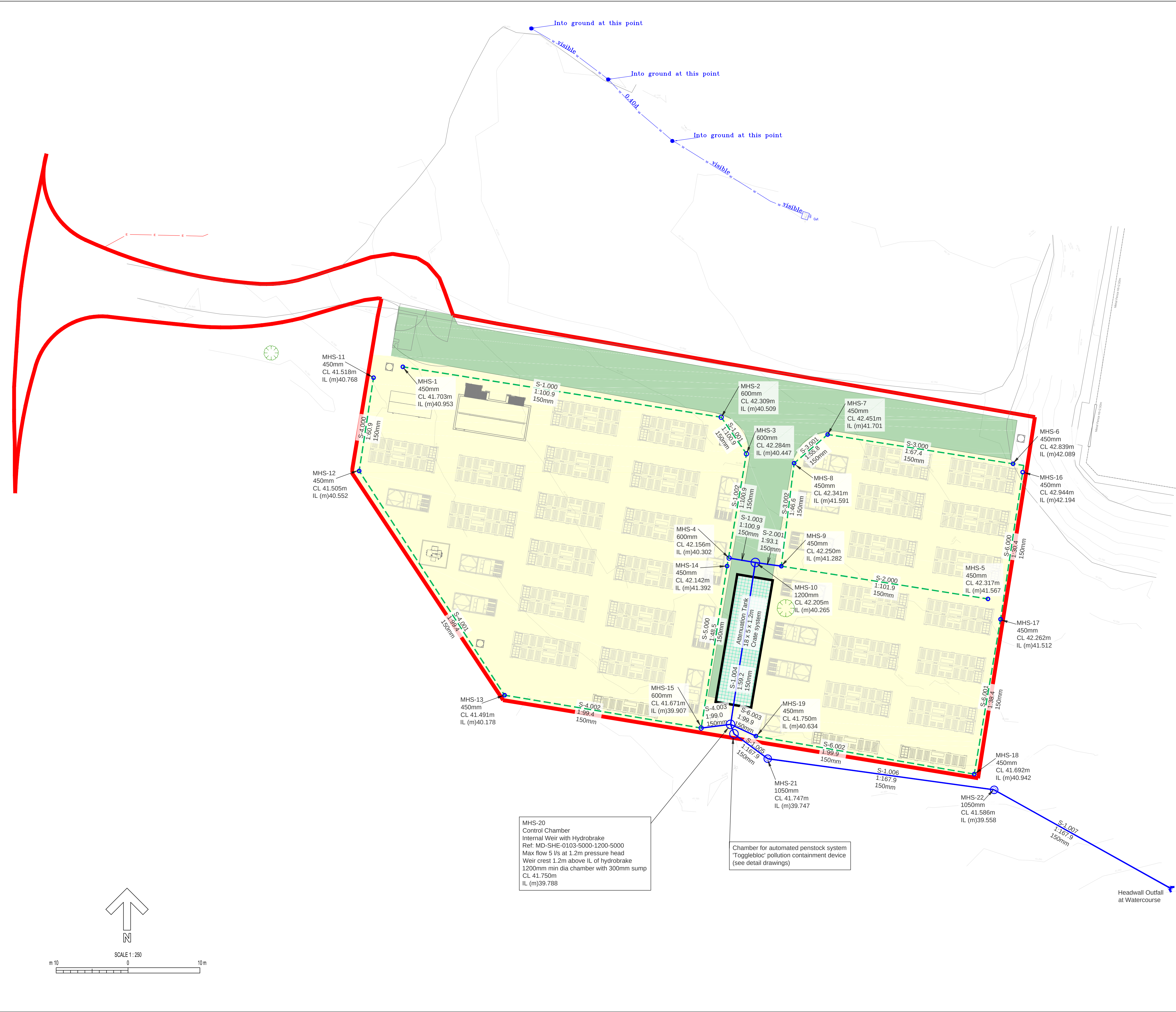
Trial Pit B



APPENDIX 4 – IoH Method Greenfield Runoff Rates

KRS Environmental Ltd		Page 1																								
3 Princes Square, Princes St... Montgomery SY15 6PZ																										
Date 18/02/2024 20:44 File	Designed by Emma Checked by																									
Innovyze	Source Control 2020.1.3																									
<u>ICP SUDS Mean Annual Flood</u> Input <table><tr><td>Return Period (years)</td><td>100</td><td>Soil</td><td>0.300</td></tr><tr><td>Area (ha)</td><td>0.230</td><td>Urban</td><td>0.000</td></tr><tr><td>SAAR (mm)</td><td>869</td><td>Region Number</td><td>Region 10</td></tr></table> Results 1/s <table><tr><td>QBAR Rural</td><td>0.5</td></tr><tr><td>QBAR Urban</td><td>0.5</td></tr><tr><td>Q100 years</td><td>1.1</td></tr><tr><td>Q1 year</td><td>0.5</td></tr><tr><td>Q30 years</td><td>0.9</td></tr><tr><td>Q100 years</td><td>1.1</td></tr></table>			Return Period (years)	100	Soil	0.300	Area (ha)	0.230	Urban	0.000	SAAR (mm)	869	Region Number	Region 10	QBAR Rural	0.5	QBAR Urban	0.5	Q100 years	1.1	Q1 year	0.5	Q30 years	0.9	Q100 years	1.1
Return Period (years)	100	Soil	0.300																							
Area (ha)	0.230	Urban	0.000																							
SAAR (mm)	869	Region Number	Region 10																							
QBAR Rural	0.5																									
QBAR Urban	0.5																									
Q100 years	1.1																									
Q1 year	0.5																									
Q30 years	0.9																									
Q100 years	1.1																									
©1982-2020 Innovyze																										

APPENDIX 5 – SuDS Design



Notes

To be constructed in accordance with local authority drainage design guidelines or to latest version of sewers for adoption in the absence of any local authority guidelines'

Contractor is to confirm, on site, all information given relating to existing services and drainage connections etc. Prior to commencing the works and any discrepancies reported immediately to the engineer.

Allow for hand dig around existing services where necessary.

Existing flows in watercourses, sewers and land drainage shall be maintained at all times during the works or handled accordingly.

Any gradients of drains are indicative only and the contractor shall install drains to the invert levels shown for each manhole, or check with the engineer if any doubt.

All covers and gratings to be class B where in access or can be class A where away from access and any vehicle paths

Cover levels of the manholes are provisional and subject to adjustment to suit the finished ground levels.

Unless noted otherwise, all manhole invert levels are to the lowest (outgoing) pipe. All incoming pipework to be laid soffits level.

Ground levels shown are existing topographic survey and will not apply to the design but probably to much of the surrounding area. On drawing for guide purposes only

All external levels to be checked against latest architects drawings.

All drainage outlet positions, (rainwater pipes and soil stacks), to be checked against latest architects drawings.

KEY

SITE BOUNDARY

PROPOSED SURFACE WATER DRAIN

PROPOSED FILTER DRAIN
(Filter drains are for catching SW run off and
excedance flows rather than infiltration)

ATTENUATION TANK

MH

CATCHMENT - 70% RUN OFF

CATCHMENT - 50% RUN OFF

- NOTES:
- All works and materials to conform to standards in latest edition of Sewers for Adoption or any relevant design guides by the overseeing Local Authorities
 - All covers and gratings to be class C in Highway, Class B where in access or can be class A where away from access and any vehicle paths
 - Outfall to be headwall at watercourse (see details)
 - For automated water pollution containment device see detail drawing

KRS
enviro

www.krsenviro.com

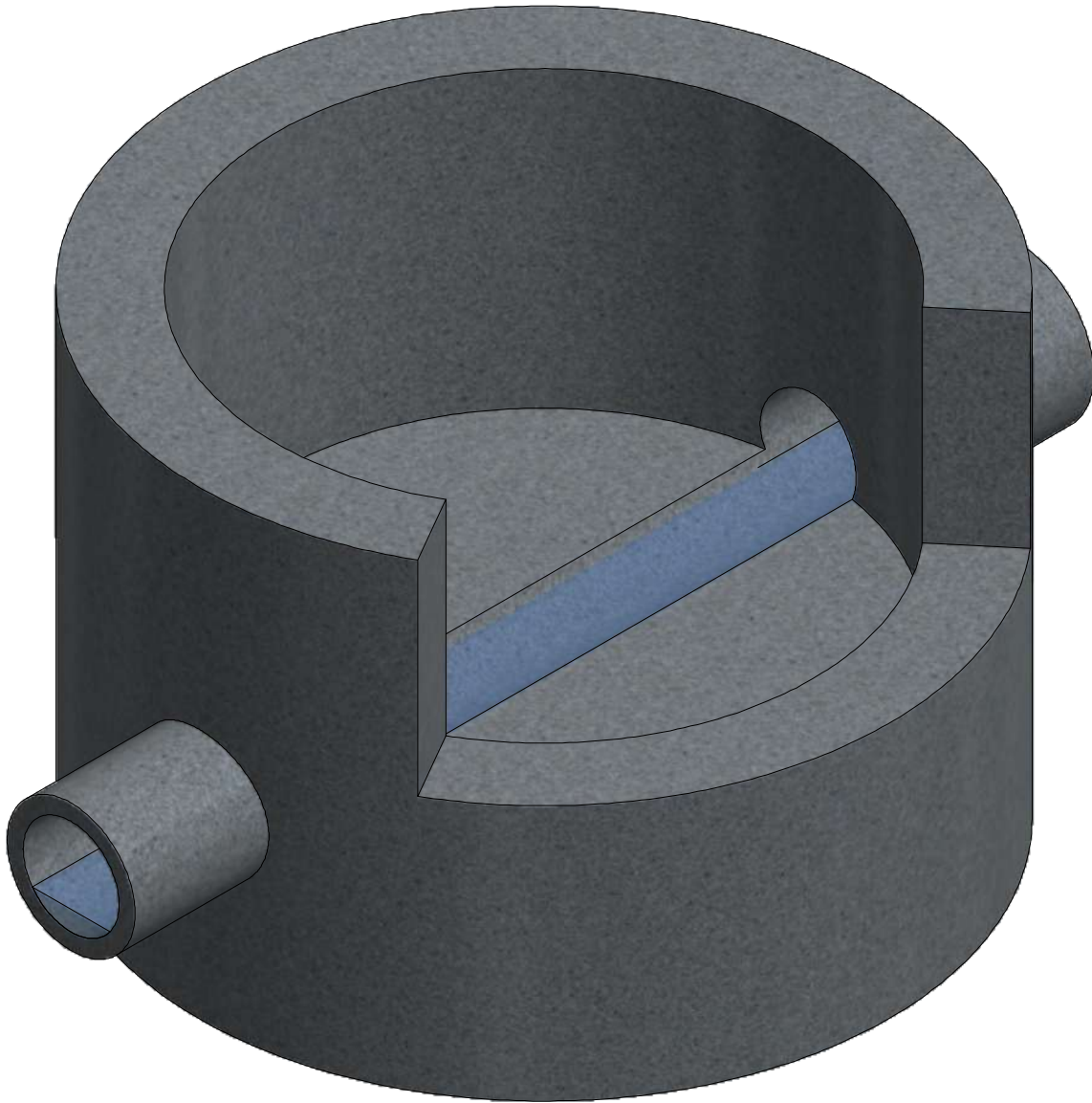
Registered Office: 3 Princes Square, Princes Street, Montgomery, Powys, SY15 6PZ.
Tel: 01686 668957 · Mobile - 07711 257466 · Email: info@krsenviro.com

Job:	Kirkby BESS		
Client:	Axis		
Drawing Title:	Proposed Surface Water Drainage		
Date:	February 2024		
Drawing No:	KRS.0653.006	revision:	Status:
Scale:	1:250 @ A1	Drawn:	PM

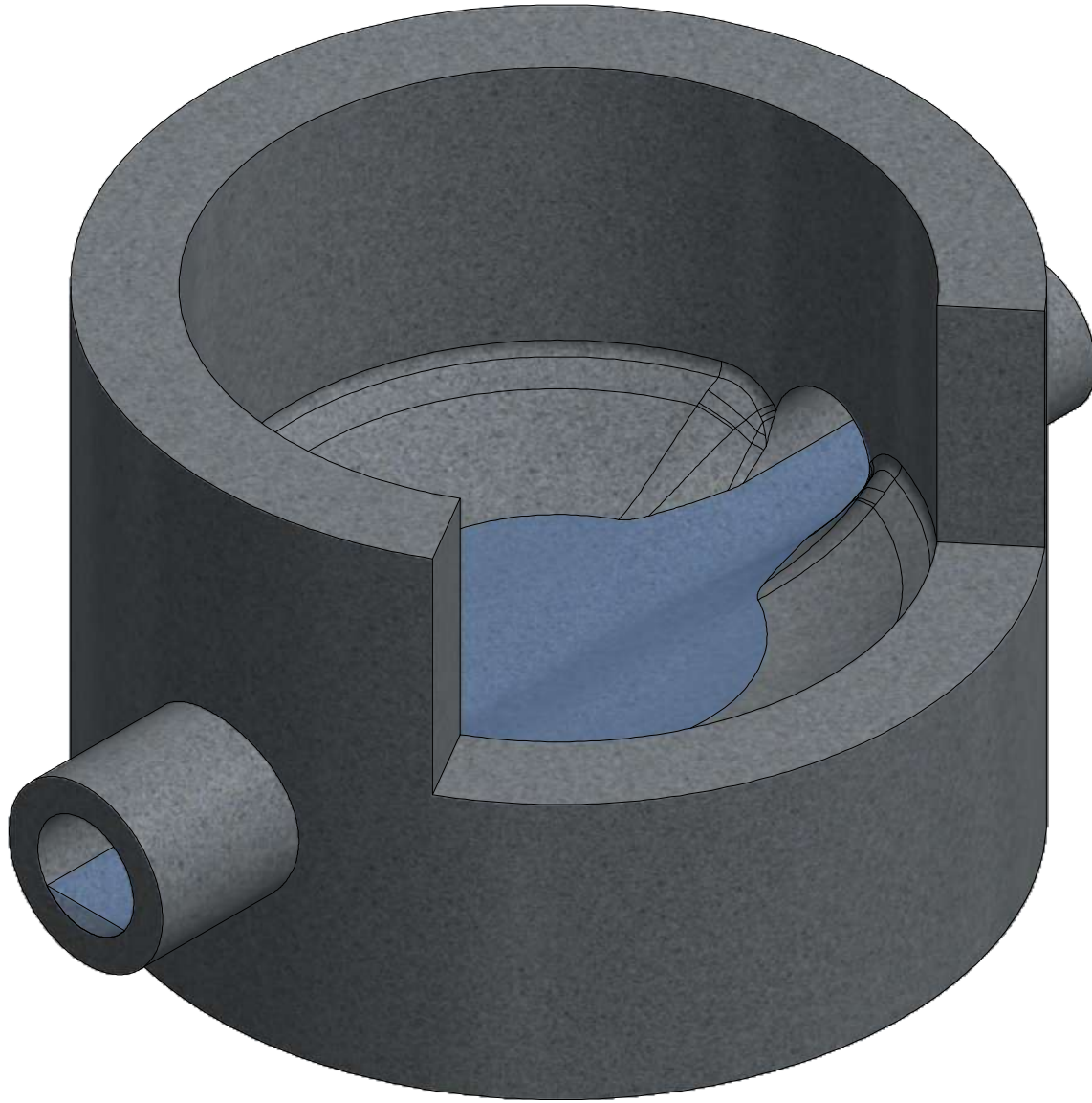
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Population (millions)	7.7	7.9	8.1	8.3	8.5	8.7	8.9	9.1	9.3	9.5	9.7	9.9	10.1	10.3	10.5	10.7	10.9	11.1	11.3	11.5	11.7
GDP (trillion USD)	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0
Urban population (millions)	4.5	4.7	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.1	8.3	8.5
Life expectancy (years)	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
Renewable energy share (%)	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
CO2 emissions (Gt)	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0

EXAMPLES OF CHAMBER TYPE AND MODIFICATIONS REQUIRED TO FIT VALVES

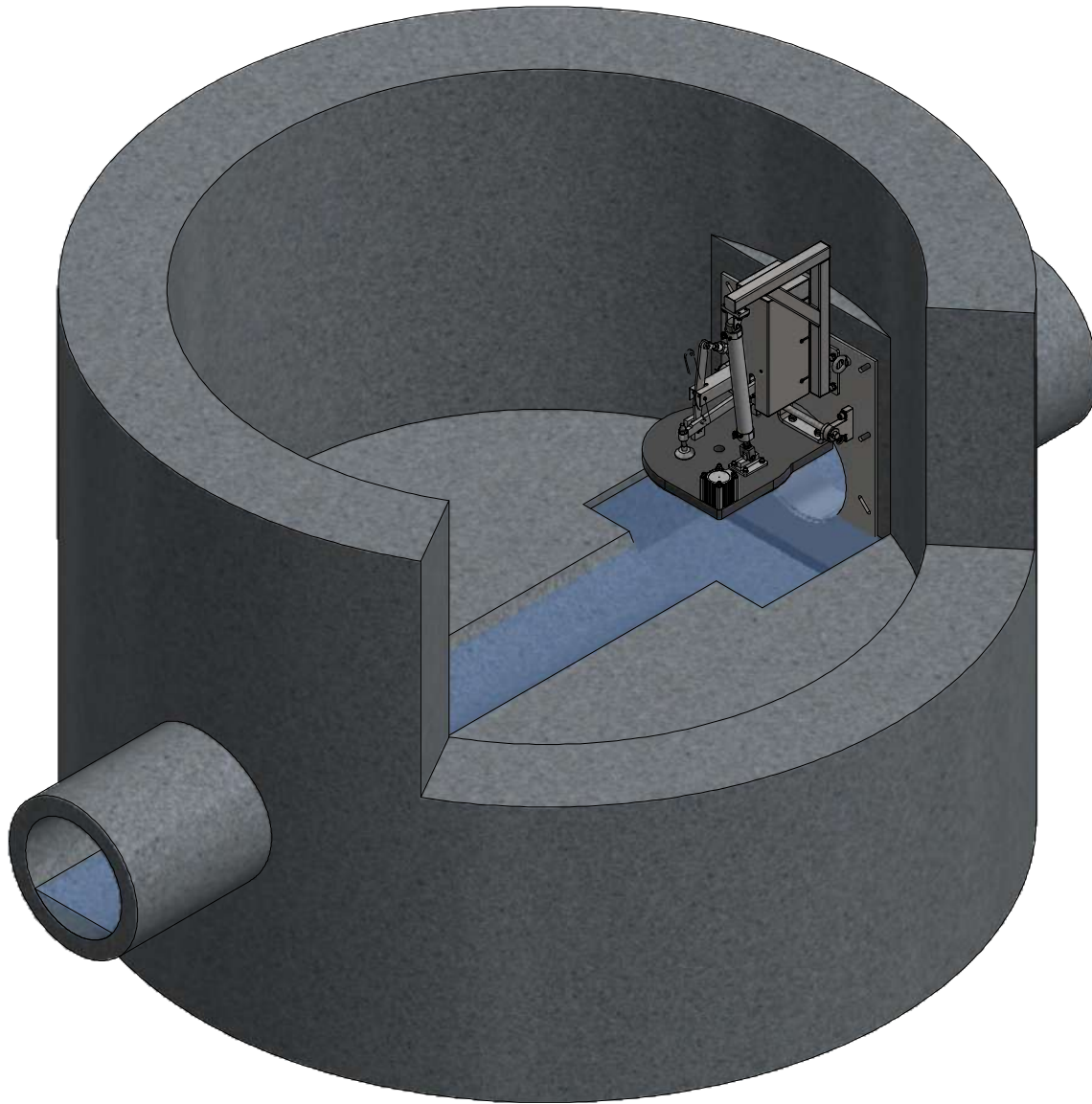
TYPICAL FLAT FLOOR CHAMBER (1 : 20)
(PART OF CHAMBER WALL REMOVED FOR CLARITY)



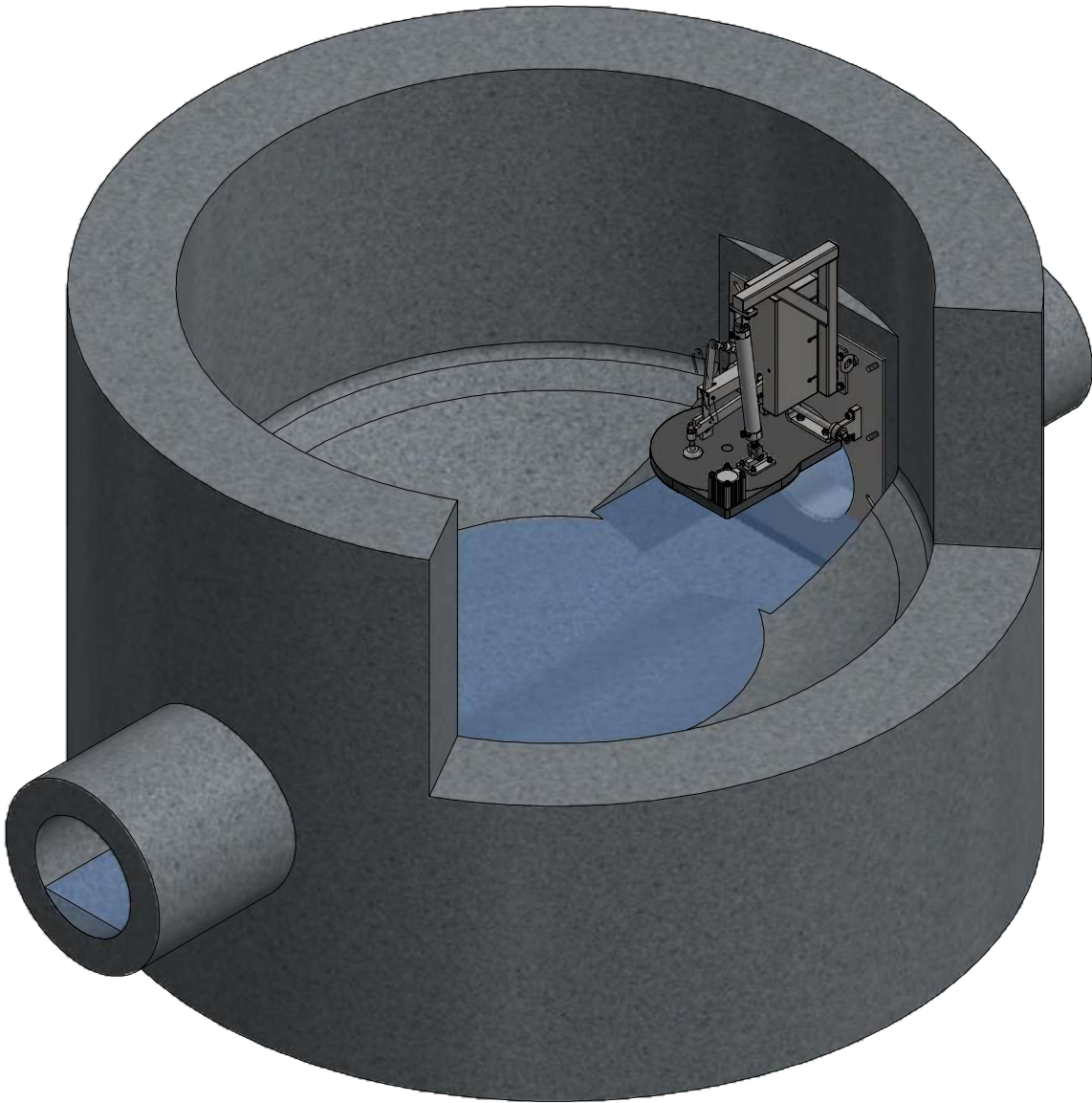
TYPICAL BANKED FLOOR CHAMBER (1 : 20)
(PART OF CHAMBER WALL REMOVED FOR CLARITY)



VALVE FITTED TO A MODIFIED FLAT FLOOR CHAMBER (1 : 20)

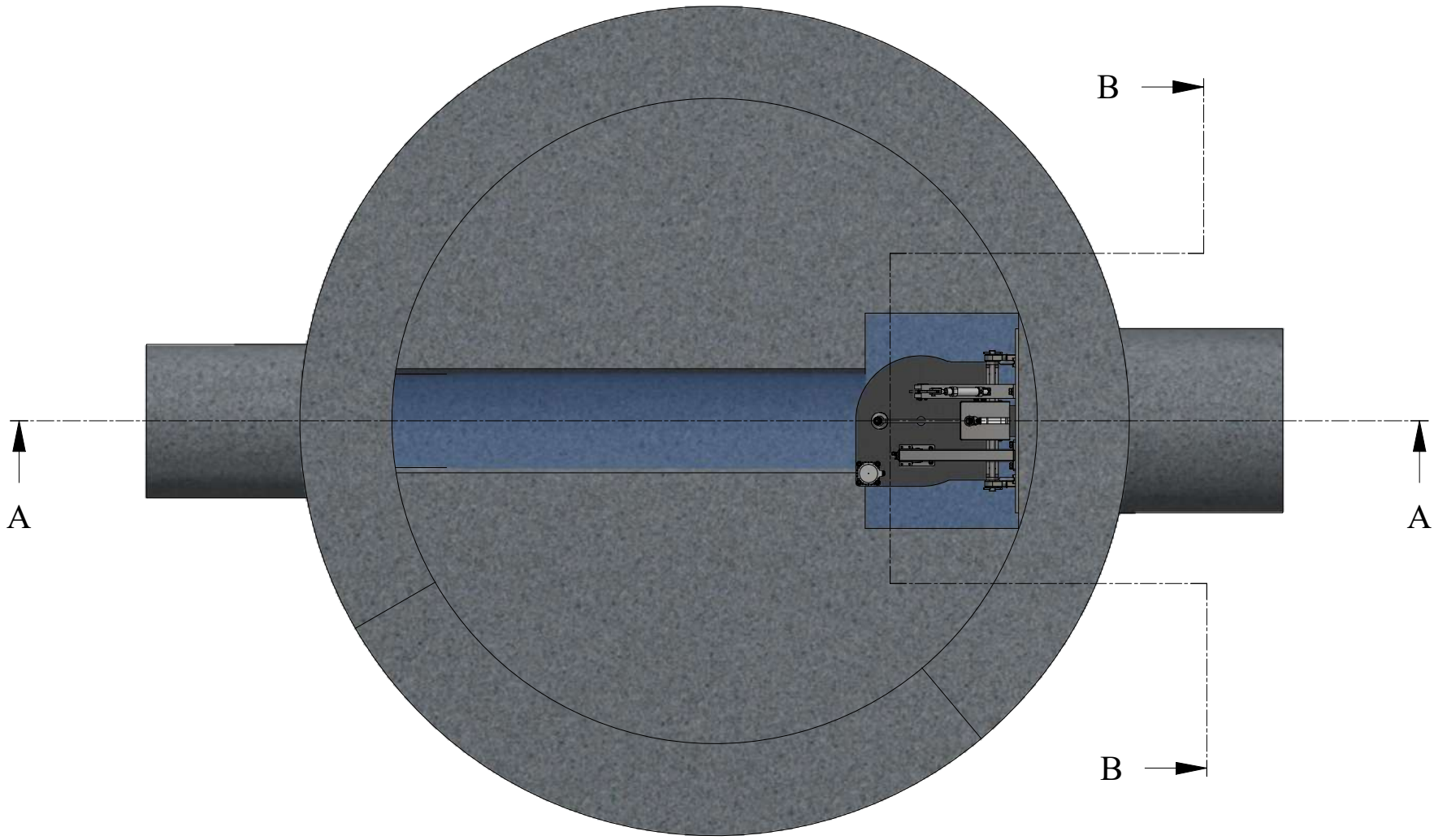


VALVE FITTED TO A MODIFIED BANKED FLOOR CHAMBER (1 : 20)

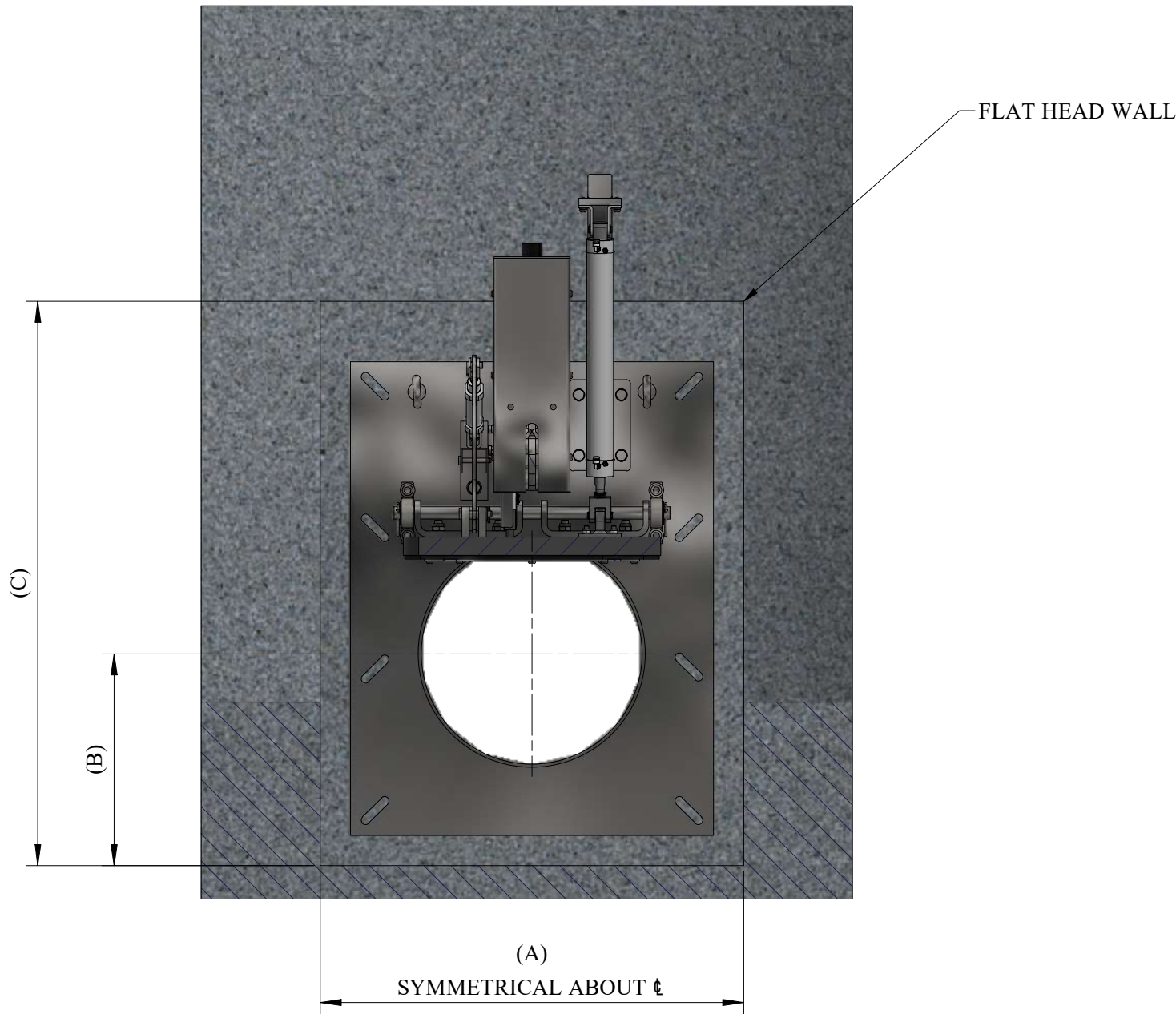


TITLE	
DWG NO.	
CHAMBER CIVILS	
DRAWING	
PROJECT	
SHEET	
1	
MATERIAL	
FINISH	
PART NUMBER	
TBV375 IN CHAMBER	
ALTERNATIVE	
ARRANGMENT	
DRAWN	RWilson
CHECKED	
DATE	25/08/2023
SCALE	1 : 20
	TOLERANCES
	0. ±0.1
	0.0 AS STATED
ENSURE ALL BURRS & SHARP EDGES ARE REMOVED	
	SHEET SIZE
	A2
SANDFIELD ENGINEERING CO. LTD	
TEL: 01299 823158	
FAX: 01299 827011	

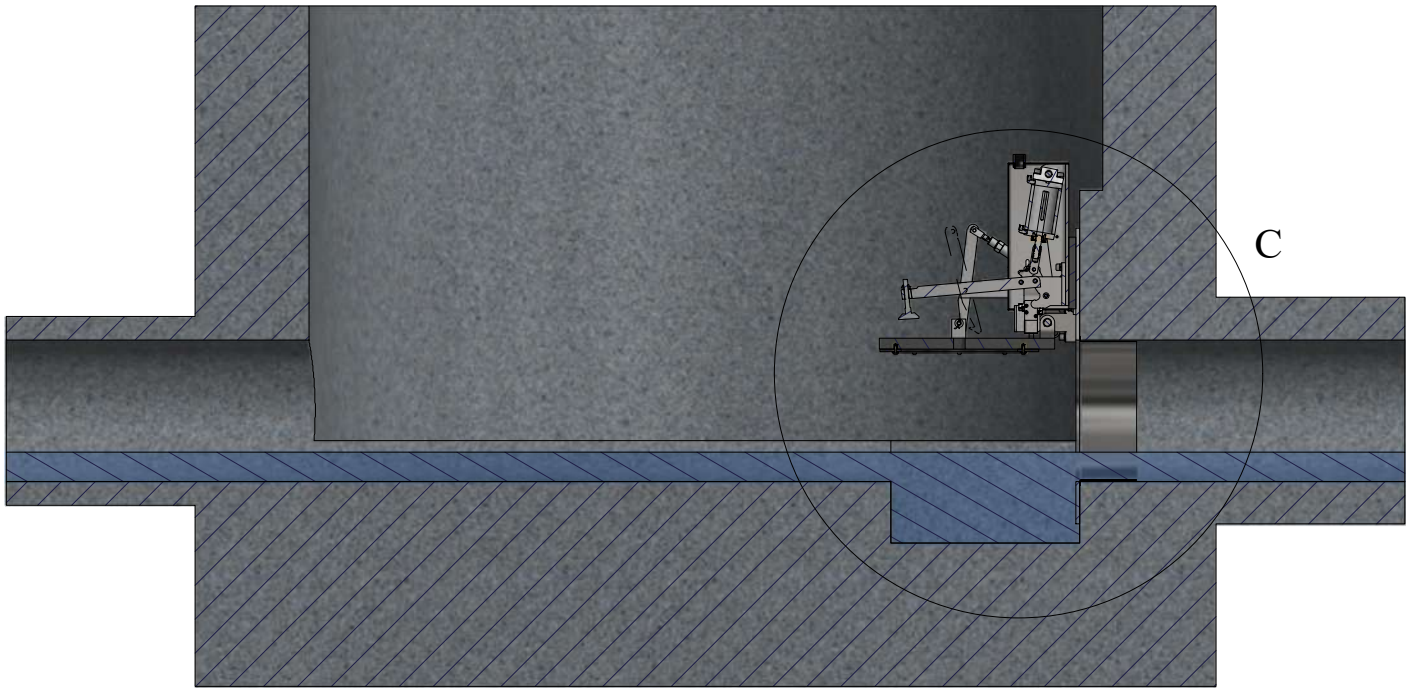
MODIFICATIONS TO INSTALL TOGGLEBLOK VALVE INTO A FLAT FLOOR CHAMBER



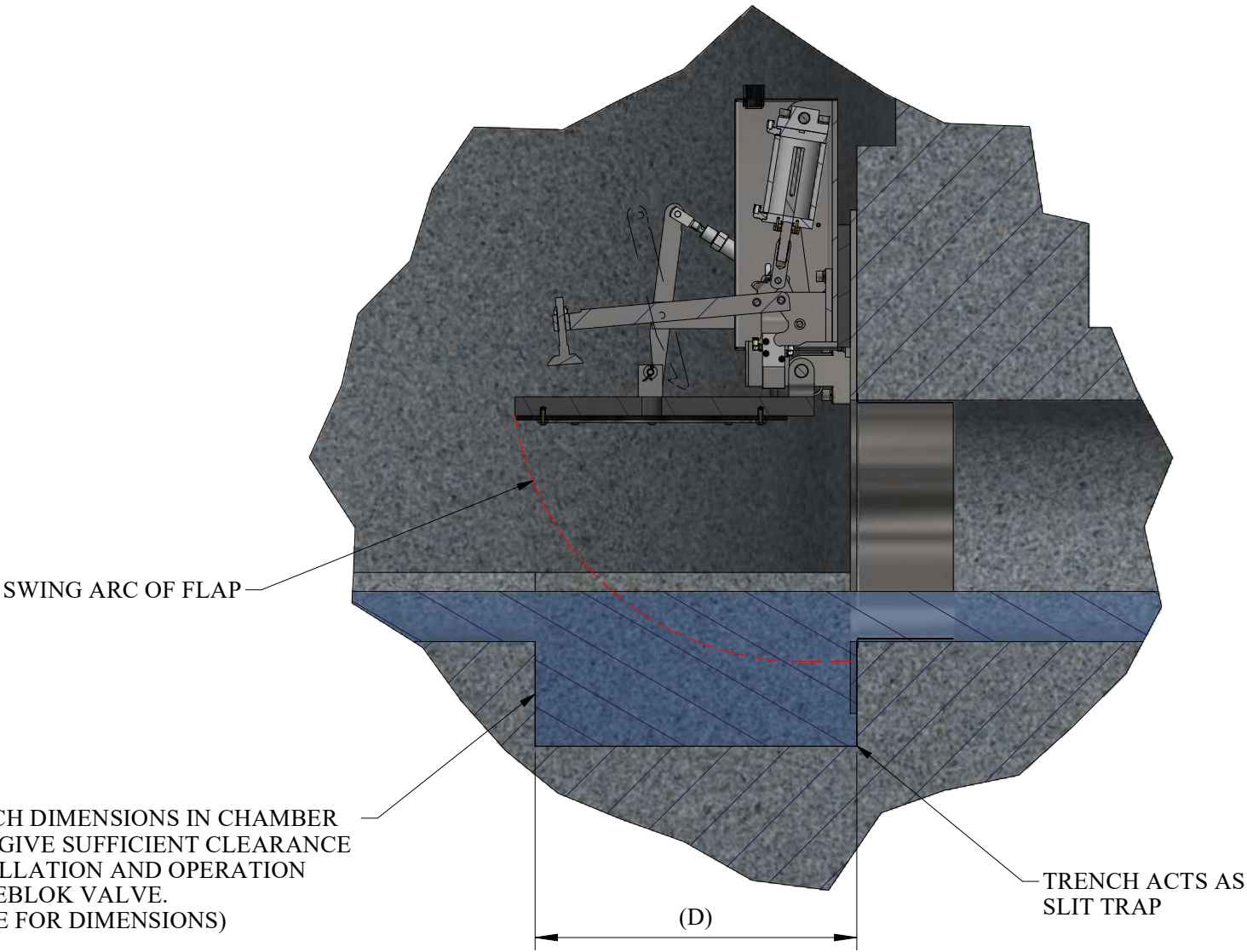
B-B (1 : 10)



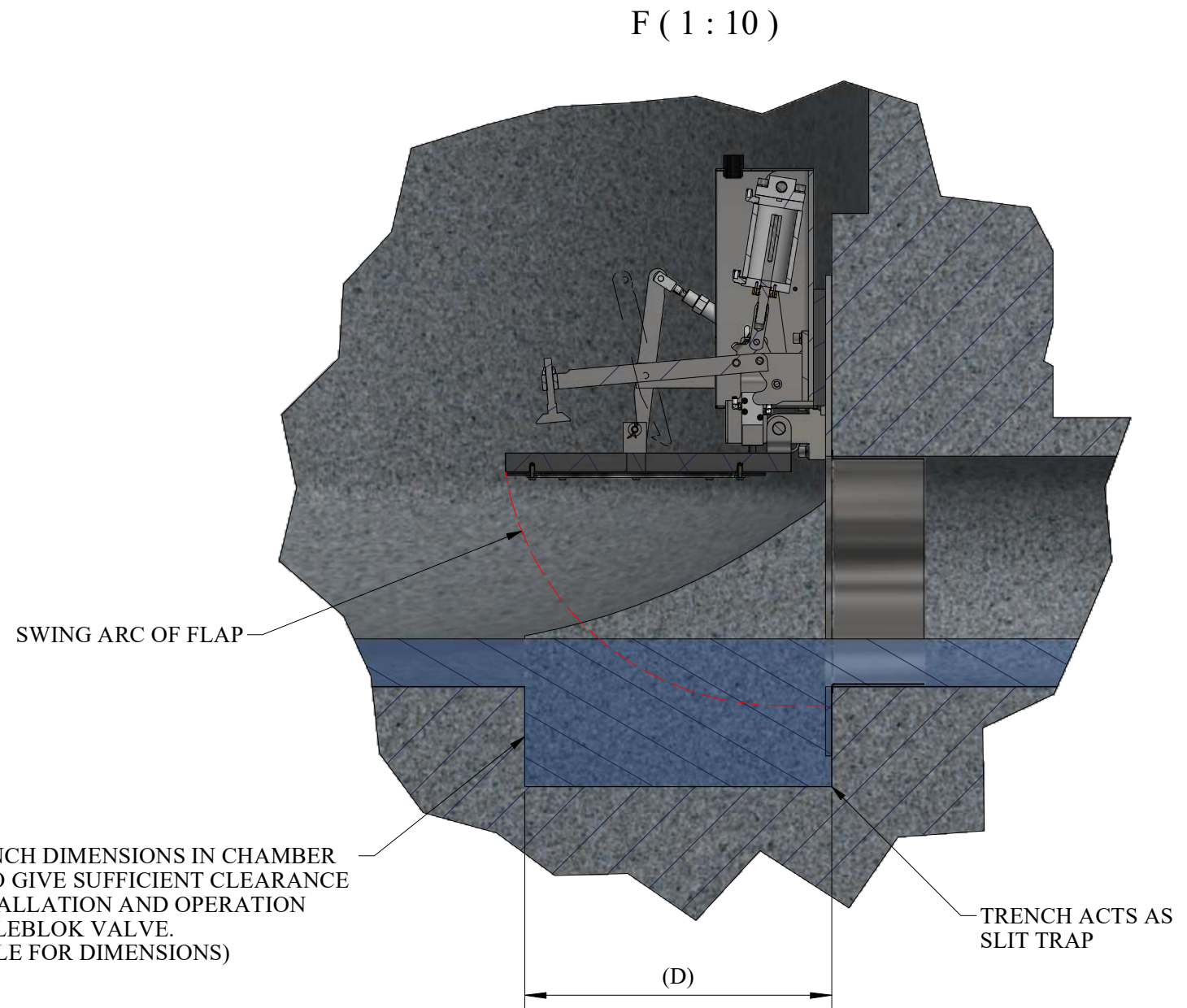
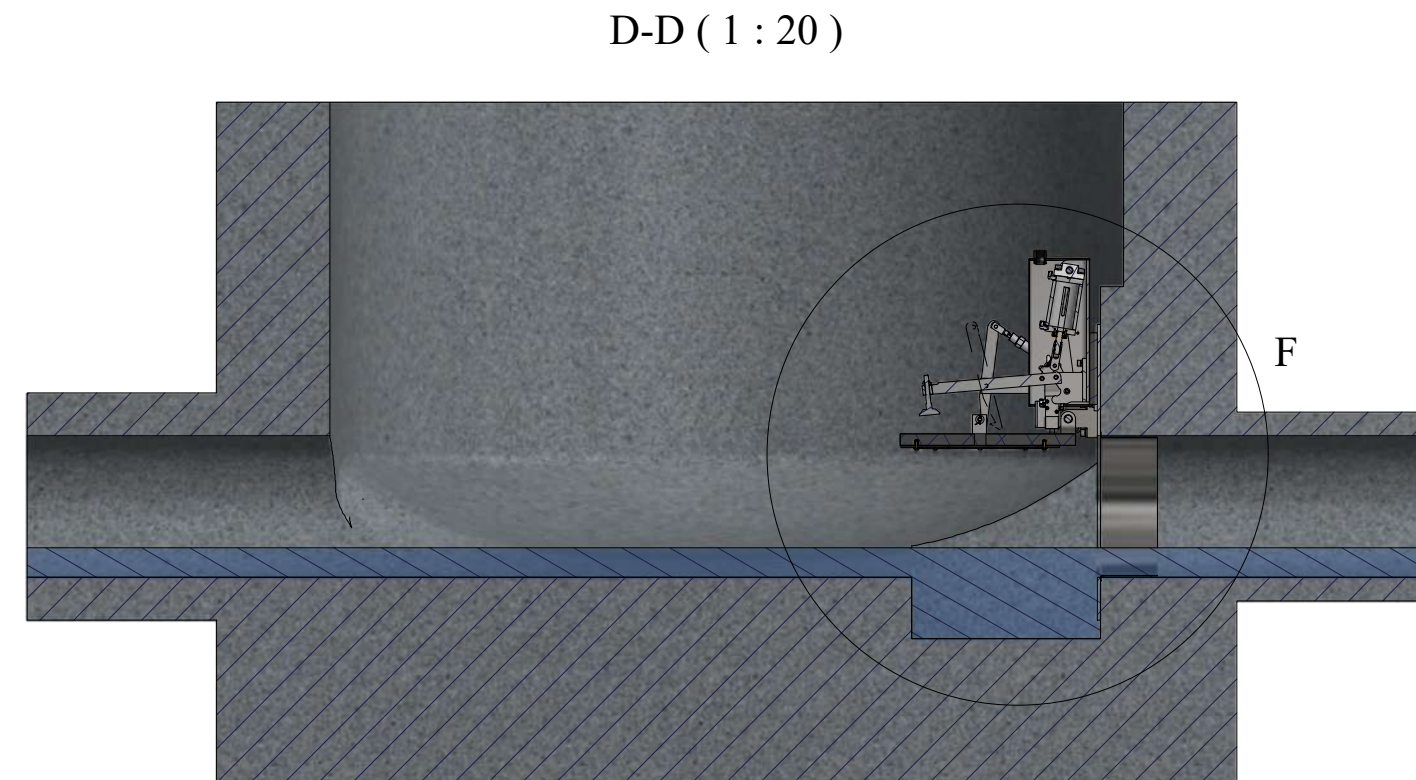
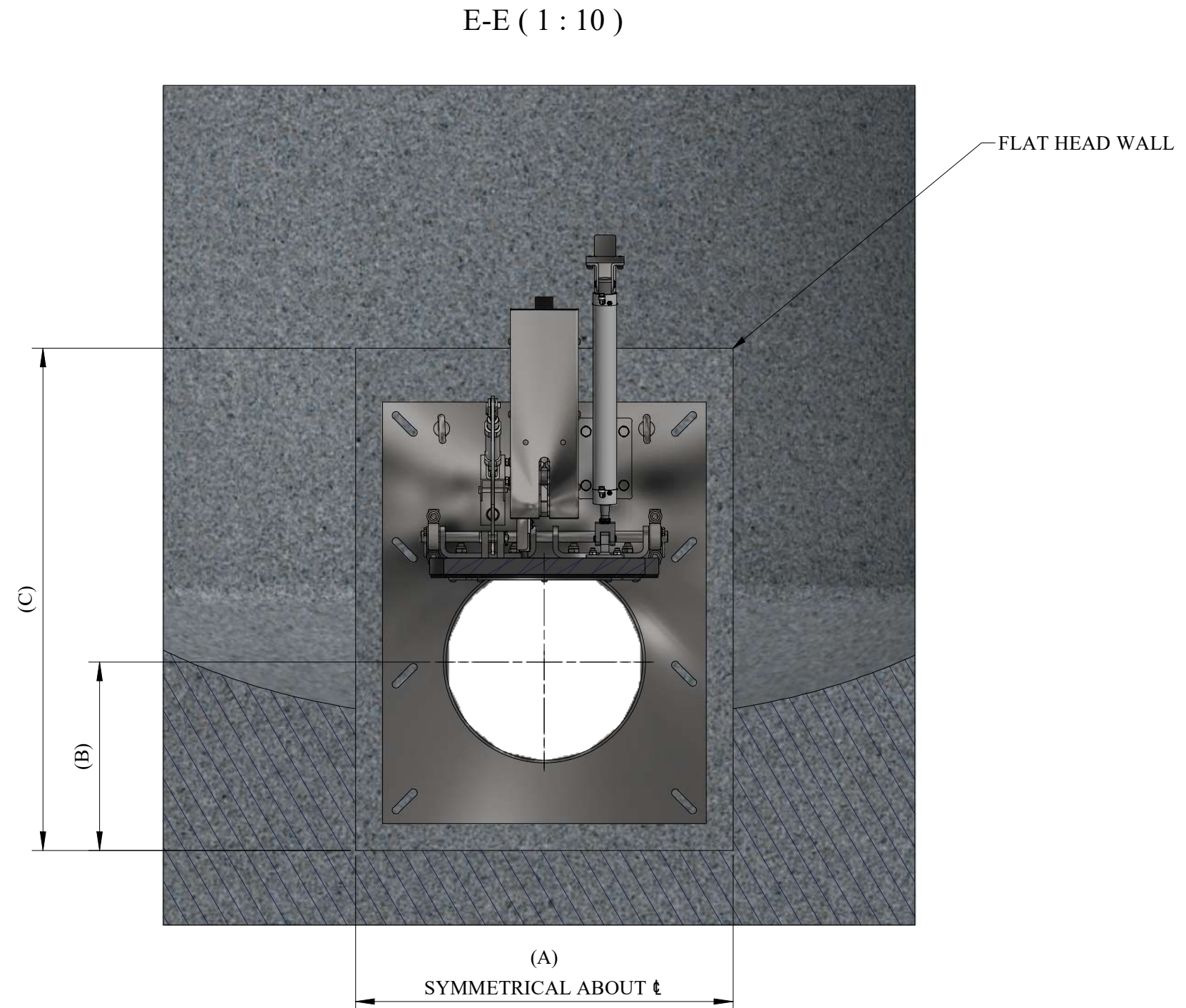
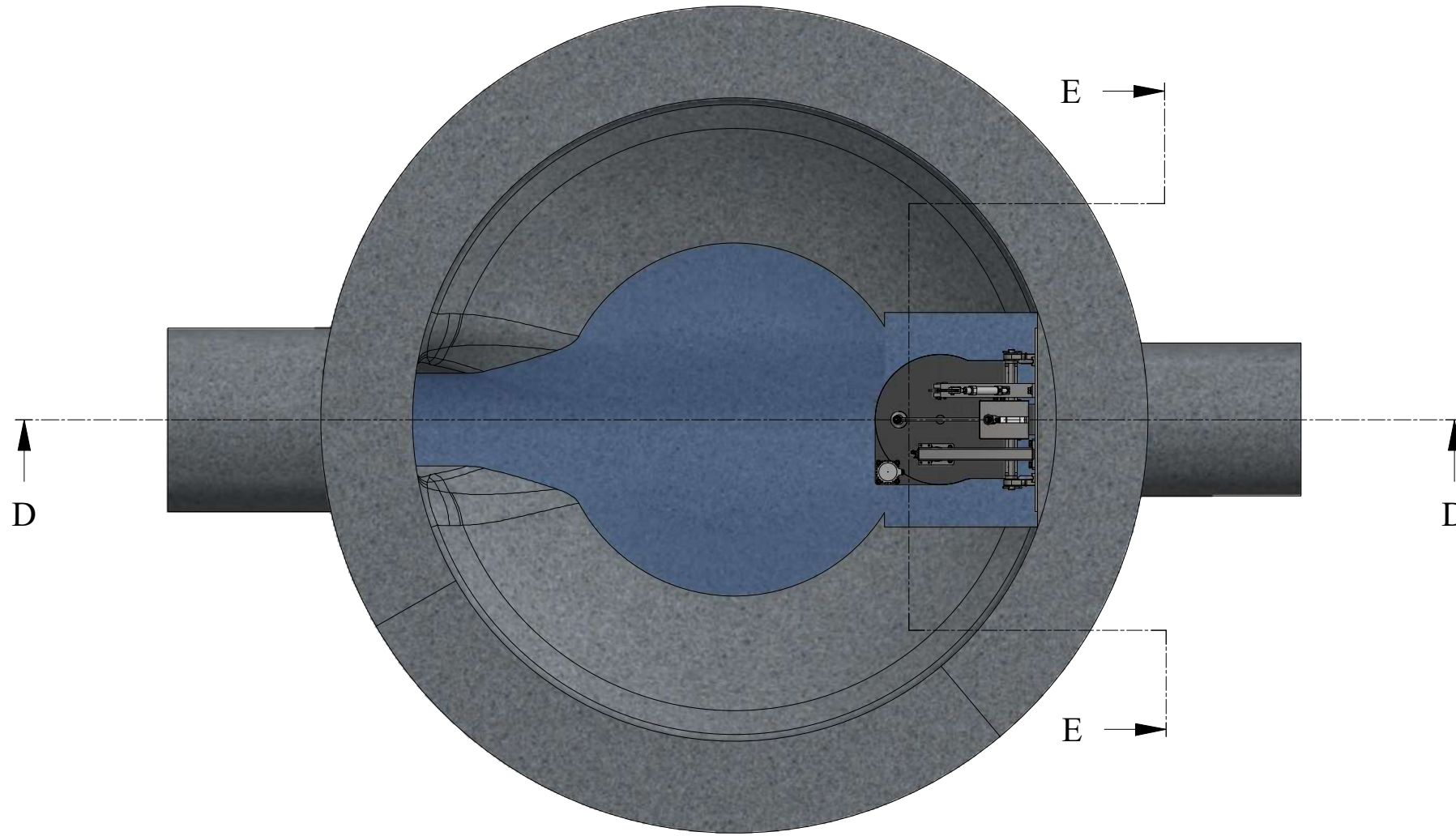
A-A (1 : 20)



C (1 : 10)



MODIFICATIONS TO INSTALL TOGGLEBLOK VALVE INTO A BANKED FLOOR CHAMBER



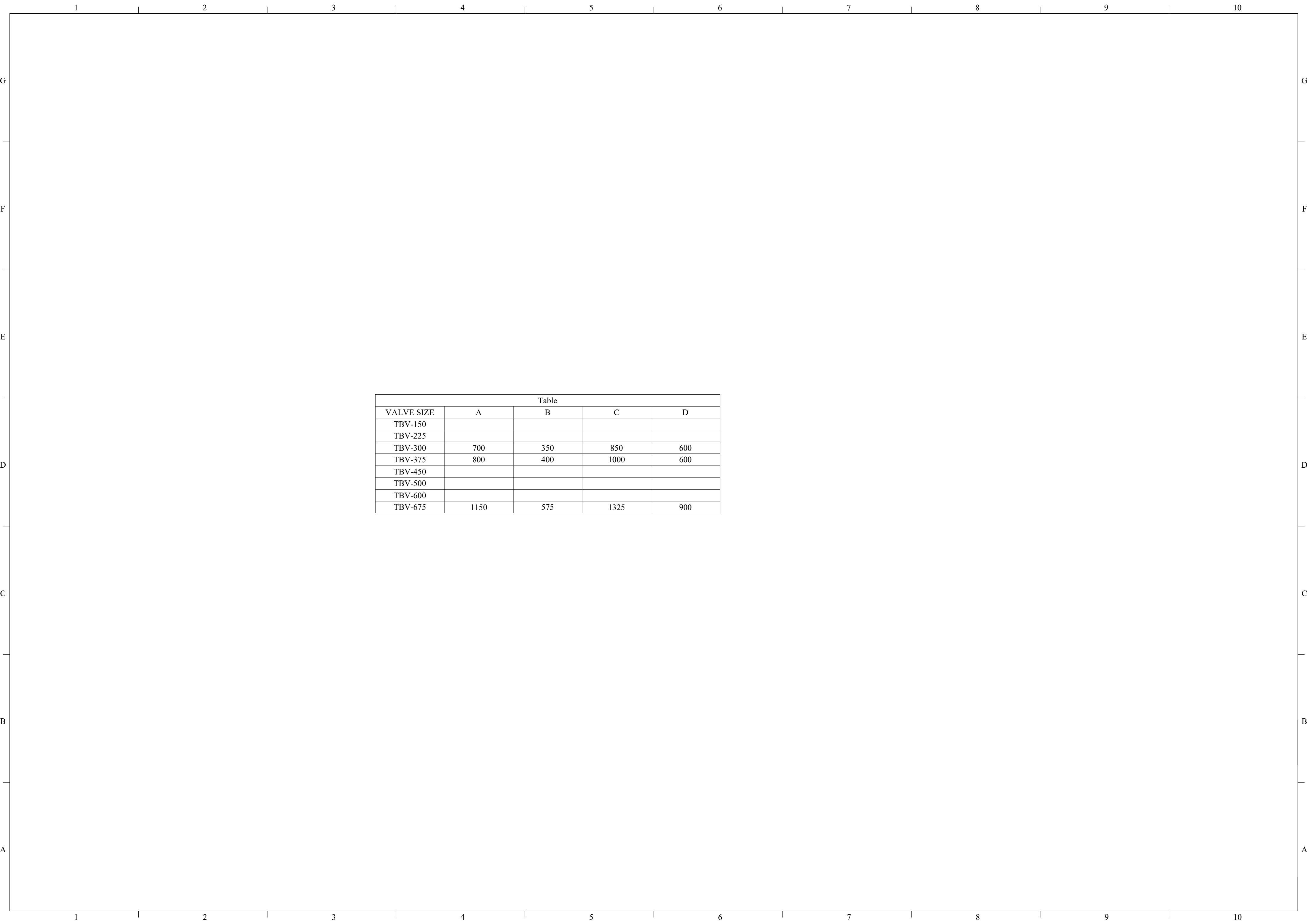
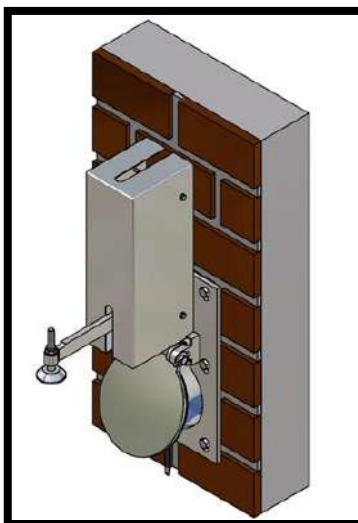


Table				
VALVE SIZE	A	B	C	D
TBV-150				
TBV-225				
TBV-300	700	350	850	600
TBV-375	800	400	1000	600
TBV-450				
TBV-500				
TBV-600				
TBV-675	1150	575	1325	900

Toggleblok™

Operation & Maintenance Manual

TBV-F-225-spring open



Sandfield Engineering Services.

Sandy Lane Industrial Estate, Sandy Lane, Stourport-on-Severn DY13 9QB
t. 01299 823158 f. 01299 827011 e. sales@sandfieldengineering.com
www.sandfieldengineering.com

Document Control

Customer

Author:
David Cole

Revision	Detail	Issue Date	Author	Approved By
4	Revision 4	12/05/2023	David Cole	Dawn Tebbett

Item No	Size	Type	Power / charger
1	225MM	FIRE VALVE WITH SPRING OPEN SW	12V battery / MAINS



TOGGLEBLOK™ OVERVIEW

The system has been designed for emergency containment; to be used as part of the sites Emergency Management System EMS.

You must read & follow the operation guide before operating the Toggleblok™ system.

The Toggleblok™ uses compressed air to operate a Toggle clamp. Once it is mechanically locked in position there is no need to maintain air pressure to keep the valve closed. When the valve is open the valve, flap is held open on the springs.

The control operation is battery with a trickle charged 20W solar panel or mains power supply. The power supply maintains a healthy battery; it will not recover a discharged or low voltage battery.

Toggleblok is designed for emergency drainage isolation only, it is not a flow control valve. Only test valve during zero rainfall. If you close a valve during rain fall you may require a pump to remove flow to allow the valve to open.

On activation the latch releases to allow the valve flap to drop into the flow. The Toggle clamps will then push the valve flap against the valve plate to seal off flow. When opening the valve, the Toggle clamps will release to open a drain hole in the flap. The drain hole will allow flow through the valve and the springs will lift the flap open. In the spill position (off seating valve) the contained water is pushing the flap open. In the fire position (on seating valve) the backed-up water pressure is forcing the flap shut.

To meet CIRIA736 fire water runoff and industry guidance for containment of flow for up to 8 days section 4.3.3, the Toggleblok™ valve will lock and seal permanently until opened again. It is essential to maintain the site drainage and valve. We cannot warrant changes in the drainage condition and the Toggleblok™ should be maintained to suit the potential conditions on the site. If materials other than surface water are allowed to enter the drains the reliability of the system can be compromised. Toggleblok is design for on seating position. It can work as off-seating with reduced head pressure.

GUIDE TO TOGGLEBLOK™ OPERATION

The system has been designed for emergency containment; used as part of the sites Emergency Management System EMS. Do not adjust the system as it has been set at our factory.

BEFORE ENTERING THE TOGGLEBLOK MANHOLE YOU MUST DICONNECT BATTERY AND ALL POWER



Toggleblok front view



1. Initial Set up & start up

When initially installing or replacing the battery the system needs to be operated to allow the processor to identify the valve position. On initial power up or signal fault no LED will be seen. To set the position carry out an OPEN TOGGLEBLOK action. This will set the **GREEN** LED, Open position.

2. CLOSE TOGGLEBLOK Locally at panel.

1. Press **RED** button >1< and hold for >5 seconds or until you hear the compressor start. The internal sounder will now sound continuously. The compressor will run, release button >1<. The valve close cycle has started.
2. Once the valve has closed the LED >3< will turn from **GREEN** to **RED**. Sounder will stop once the internal processor has confirmed valve closed
3. If the Toggleblok™ valve fails to close an AMBER or flashing LED will be seen. Sounder will sound to indicate FAULT

NB system is Battery / solar charge if the unit is left active without a charge the battery will drain and the system will fail.

3. OPEN Toggleblok™ valve locally at panel Stage.

NB Before opening the valve allow the full close cycle to finish and log the operation, sounder stopped.

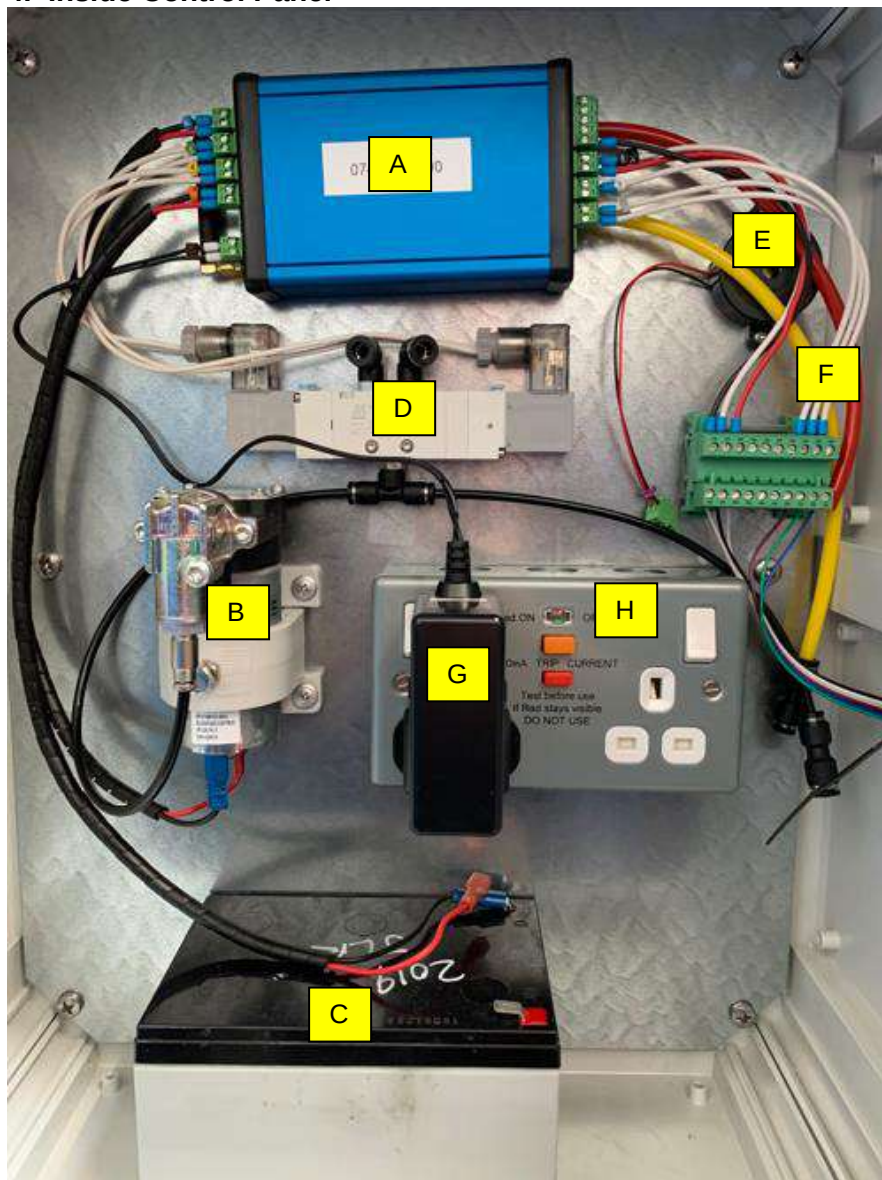
1. Press **GREEN** button >2< and hold for >5 seconds or until the compressor starts, the sounder will sound. Release button >2<. The valve open cycle has started.
2. Initially the Toggle clamp opens to releases pressure on the valve flap. 1 x 25MM port open to allow flow through the valve flap. The valve flap is then lifted back into the fully open position by the springs. The plunger valve will then indicate valve fully open. LED >3< will turn **GREEN** to indicate valve is fully open.
3. If the valve flap fails to fully open in the initial open sequence an AMBER or flashing LED will flash, Sounder will also sound to indicate fault. *Failed to fully open*. The system now waits 10 minutes to allow a further drain down. The open sequence will repeat.
4. The Toggleblok™ may be unable to open due to backed up water pressure. It is vital that valve testing is never done during heavy rainfall. Only test when inlet flow is at a minimum.

NB system is Battery / Solar charge, if the unit is left active without a charge the battery will drain and the system will fail.

5. If the clamp fails it is not possible to lift the flap as the mechanical lock is holding.
The open function is there to identify if the valve open sequence has been fully completed.

Failure to check a valve is open can result in flooding.

4. Inside Control Panel



- A= CONTROLLER
- B= 12VDC COMPRESSOR
- C= 12V 12AH BATTERY
- D= 12V 2/5 SOL VALVE
- E= 12V SOUNDER
- F= 6MM RED TUBE CLOSE VALVE
6MM YELLOW TUBE OPEN VALVE
- G= POWER SUPPLY INTERNAL 18VDC
- H= RCD / POWER EXTERNAL 230VAC

5. FAULT FINDING

Toggleblok™ Valve does not close on activation of button

- Make sure button is held for >5 seconds
- Check valve is not already closed
- Check battery voltage >12volts
- Has the system finished previous cycle

Toggleblok™ Valve indicating close alarm but does not close

- Check valve flap is free to close
- Check airline

No Panel LED

- Carry out an open function to activate LED
- Check power and battery condition

**No system power**

Check battery voltage >12v

Check solar or mains charge circuit is on, Bench charge solar battery

Has initial set up & start up being done

Toggleblok™ Valve will not open after close operation,

Make sure the button was held for >5 seconds.

Make sure E STOP is reset

Is the LED indicator flashing?

Make sure clamp has released.

Check open cylinders

Check system for air leaks

Is the chamber full of water? Repeat open cycle or allow repeat cycle every 10 minutes.

NB: Before opening any valve after a close function the operator should check that the contained liquid is ok for release. It is essential that the contained material is released by an authorised person.

Never enter the Toggleblok™ chamber unless the battery has been disconnected.

6. MAINTENANCE

NB. Isolate power and pneumatics prior to removing the Toggleblok™ valve guard or working on this equipment.

The valve uses a mechanical locking flap valve which is controlled by a complete self-powering control panel. The system provides verification that the valve has been operated and closed. Once operated valves will stay mechanically locked without air pressure.

The Toggleblok™ system is designed to deliver final tertiary containment as a final protection and should be used in conjunction with the sites Environmental Management system (EMS).

7. Routine Maintenance

We recommend that all pollution containment systems are serviced every 6/12 months by competent person(s) or sooner dependent on the environment they work in.

Monthly PM / test the valve operation and log

- Clear any debris from valve to allow clear movement.
- Check Battery and charge supply
- Clean solar panel if applicable, Bench charge battery 3 monthly if poor daylight charging
- Send SMS List message to each controller number

6 monthly / Annual

- Check all panel terminals
- Bench charge battery
- Full Valve clean



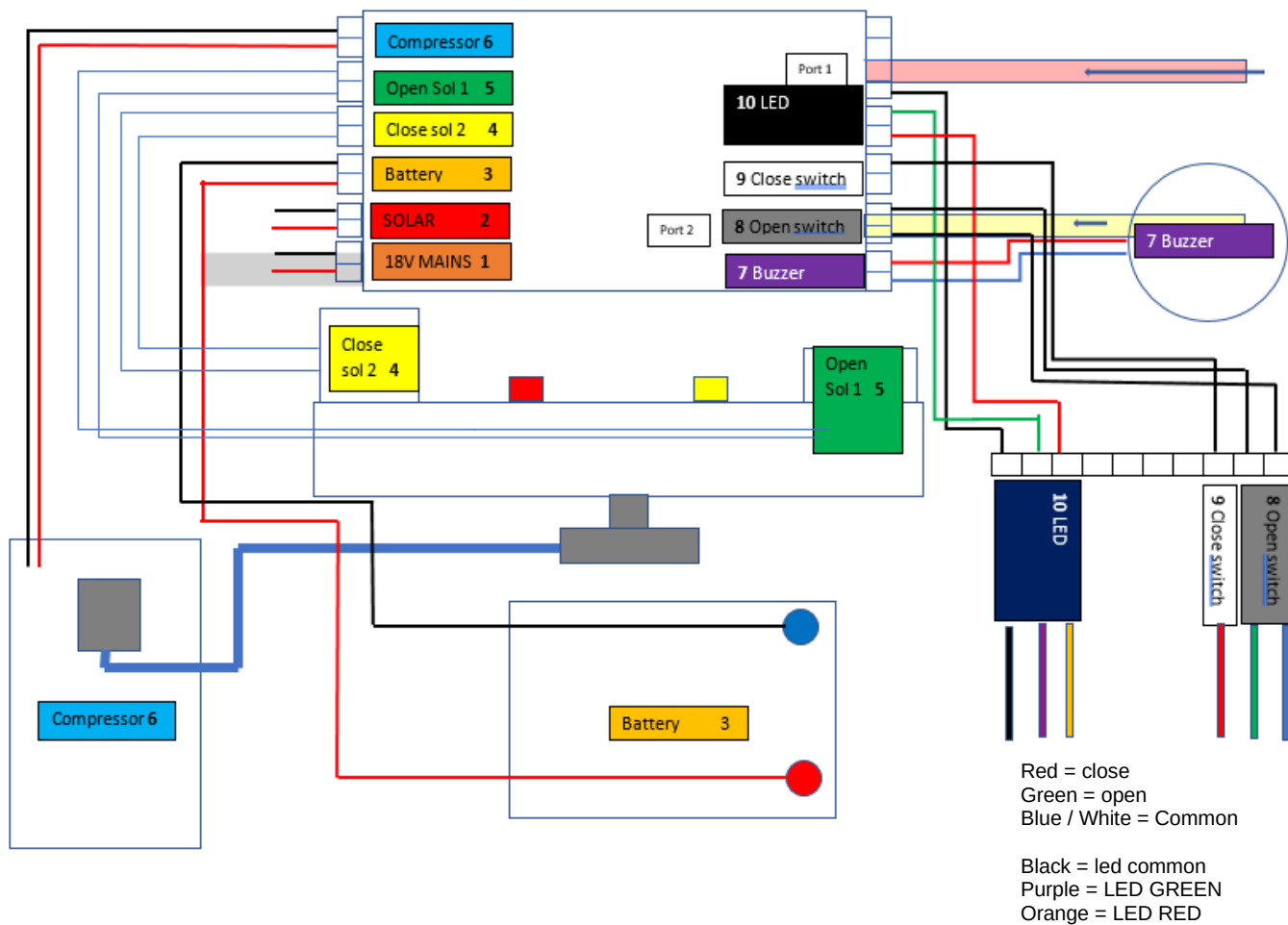
- Inspect / replace seal as required
- Check fixings and airlines

Battery has a 3yr life span. Though batteries can function longer a replacement should be supplied after 3 yrs. For systems that the battery drains down without battery charge; battery life will be greatly reduced.

NB: If the system is operated for any other reason than routine inspections, we recommend a thorough inspection is undertaken prior to resetting the unit into service.

DO NOT try to lift valve if the clamp is closed. This is a mechanical lock and it is impossible to pull the valve open.

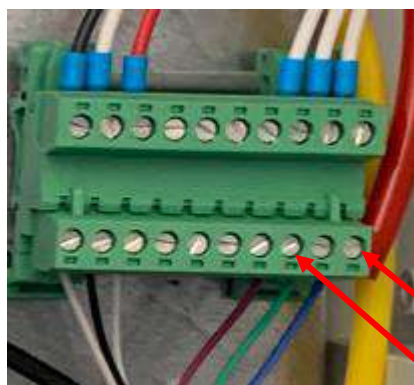
WE RECOMMEND ALL VALVES SHOULD BE TESTED MONTHLY. FULL CONFINED SPACE SERVICE EVERY 6-12 MONTHS.



Auxiliary controls.

If the system is to be connected to an oil separator alarm, flood alarm or fire alarm volt free N/O contact or relay.

Close on alarm = Common (Blue or white) + RED link.



Common

Close



Sandfield Penstock Solutions



Declaration of Conformity

Sandfield Penstock Solutions
Sandy Lane
Stourport-on-Severn
Worcestershire
DY13 9QB

Equipment ToggleBlok

This machine conforms to the standards:

EN 60204-1 Safety of machinery - Electrical equipment for machines

This is to declare that the above equipment conforms to the requirements of the Low Voltage Directive 2014/35/EU and its amendments, plus any standards mentioned above.

Assessed by P G Chambers, BSc, CMIOSH, Strategic Safety Systems Ltd.

Signed



Signed for Sandfield Penstock Solutions

SERVICING

6 monthly service due	Engineers sign off	Date

Serviceable items.

* indicates recommended serviceable life. Condition and usage will reduce the serviceability of equipment.

ITEM No	DESCRIPTION	Supplier	Service life
1	12V 12Ah lead acid battery or equivalent	General supply	3yrs
2	Valve flap seal TBV-225	Penstock Solutions	1yrs*
3	Main clamp actuator TBV-225	Penstock Solutions	3yrs*
4	Open limit plunger	SMC	2yrs*
5	2 x tension springs	Penstock Solutions	2yrs*

APPENDIX 6 – MicroDrainage Calculations



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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes SLS-1 Manhole Sizes 600mm +

FSR Rainfall Model - England and Wales

Return Period (years)	2	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	19.200	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	0.600
Ratio R	0.395	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.500		

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
S-1.000	44.844	0.444	100.9	0.021	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.001	6.181	0.061	100.9	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.002	14.710	0.146	100.9	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.003	3.697	0.037	100.9	0.000	0.00	0.0	0.600	o	150	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)
S-1.000	50.00	5.75	40.953	0.021	0.0	0.0	0.0	1.00	17.7	2.8
S-1.001	50.00	5.85	40.509	0.026	0.0	0.0	0.0	1.00	17.7	3.5
S-1.002	50.00	6.10	40.447	0.035	0.0	0.0	0.0	1.00	17.7	4.8
S-1.003	50.00	6.16	40.302	0.035	0.0	0.0	0.0	1.00	17.7	4.8



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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
S-2.000	29.107	0.286	101.9	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-3.000	26.118	0.387	67.4	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-3.001	6.138	0.110	55.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-3.002	14.442	0.310	46.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-2.001	3.644	0.039	93.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.004	23.790	0.402	59.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-4.000	13.135	0.216	60.9	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-4.001	37.187	0.374	99.4	0.051	0.00	0.0	0.600	o	150	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)
S-2.000	50.00	5.49	41.567	0.030	0.0	0.0	0.0	1.00	17.6	4.1
S-3.000	50.00	5.35	42.089	0.010	0.0	0.0	0.0	1.23	21.7	1.3
S-3.001	50.00	5.43	41.701	0.010	0.0	0.0	0.0	1.35	23.9	1.3
S-3.002	50.00	5.59	41.591	0.010	0.0	0.0	0.0	1.48	26.1	1.3
S-2.001	50.00	5.65	41.282	0.040	0.0	0.0	0.0	1.04	18.4	5.4
S-1.004	50.00	6.46	40.265	0.075	0.0	0.0	0.0	1.31	23.1	10.2
S-4.000	50.00	5.17	40.768	0.010	0.0	0.0	0.0	1.29	22.8	1.4
S-4.001	50.00	5.78	40.552	0.061	0.0	0.0	0.0	1.01	17.8	8.3



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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
S-4.002	26.911	0.271	99.4	0.041	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-5.000	22.817	0.471	48.5	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-4.003	4.387	0.044	99.0	0.001	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.000	20.702	0.682	30.4	0.003	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.001	21.863	0.569	38.4	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.002	30.819	0.309	99.9	0.028	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.003	4.131	0.041	99.9	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.005	6.886	0.041	167.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
S-1.006	31.796	0.189	167.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		

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)
S-4.002	50.00	6.23	40.178	0.102	0.0	0.0	0.0	1.01	17.8	13.8
S-5.000	50.00	5.26	41.392	0.009	0.0	0.0	0.0	1.45	25.6	1.2
S-4.003	50.00	6.30	39.907	0.112	0.0	0.0	0.0	1.01	17.8	15.2
S-6.000	50.00	5.19	42.194	0.003	0.0	0.0	0.0	1.83	32.4	0.5
S-6.001	50.00	5.41	41.512	0.007	0.0	0.0	0.0	1.63	28.8	1.0
S-6.002	50.00	5.92	40.942	0.035	0.0	0.0	0.0	1.01	17.8	4.7
S-6.003	50.00	5.99	40.634	0.042	0.0	0.0	0.0	1.01	17.8	5.7
S-1.005	50.00	6.57	39.788	0.230	0.0	0.0	0.0	1.01	40.0	31.1
S-1.006	50.00	7.10	39.747	0.230	0.0	0.0	0.0	1.01	40.0	31.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-1.007	28.050	0.167	167.9	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)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-1.007	50.00	7.57	39.558	0.230	0.0	0.0	0.0	1.01	40.0	31.1



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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
MHS-1	41.703	0.750	Open Manhole	450	S-1.000	40.953	150				
MHS-2	42.309	1.801	Open Manhole	600	S-1.001	40.509	150	S-1.000	40.509	150	
MHS-3	42.284	1.836	Open Manhole	600	S-1.002	40.447	150	S-1.001	40.447	150	
MHS-4	42.156	1.854	Open Manhole	600	S-1.003	40.302	150	S-1.002	40.302	150	
MHS-5	42.317	0.750	Open Manhole	450	S-2.000	41.567	150				
MHS-6	42.839	0.750	Open Manhole	450	S-3.000	42.089	150				
MHS-7	42.451	0.750	Open Manhole	450	S-3.001	41.701	150	S-3.000	41.701	150	
MHS-8	42.341	0.750	Open Manhole	450	S-3.002	41.591	150	S-3.001	41.591	150	
MHS-9	42.250	0.968	Open Manhole	450	S-2.001	41.282	150	S-2.000	41.282	150	
								S-3.002	41.282	150	
MHS-10	42.205	1.940	Open Manhole	1200	S-1.004	40.265	150	S-1.003	40.265	150	977
								S-2.001	41.242	150	
MHS-11	41.518	0.750	Open Manhole	450	S-4.000	40.768	150				
MHS-12	41.505	0.953	Open Manhole	450	S-4.001	40.552	150	S-4.000	40.552	150	
MHS-13	41.491	1.313	Open Manhole	450	S-4.002	40.178	150	S-4.001	40.178	150	
MHS-14	42.142	0.750	Open Manhole	450	S-5.000	41.392	150				
MHS-15	41.671	1.764	Open Manhole	600	S-4.003	39.907	150	S-4.002	39.907	150	1014
								S-5.000	40.921	150	
MHS-16	42.944	0.750	Open Manhole	450	S-6.000	42.194	150				
MHS-17	42.262	0.750	Open Manhole	450	S-6.001	41.512	150	S-6.000	41.512	150	
MHS-18	41.692	0.750	Open Manhole	450	S-6.002	40.942	150	S-6.001	40.942	150	
MHS-19	41.750	1.116	Open Manhole	450	S-6.003	40.634	150	S-6.002	40.634	150	
MHS-20	41.750	1.962	Open Manhole	1200	S-1.005	39.788	225	S-1.004	39.863	150	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
								S-4.003	39.863	150	
								S-6.003	40.592	150	729
MHS-21	41.747	2.000	Open Manhole	1050	S-1.006	39.747	225	S-1.005	39.747	225	
MHS-22	41.586	2.028	Open Manhole	1050	S-1.007	39.558	225	S-1.006	39.558	225	
MHS-	40.780	1.389	Open Manhole	1050		OUTFALL		S-1.007	39.391	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-1	343596.024	397161.551	343596.024	397161.551	Required	
MHS-2	343640.317	397154.536	343640.317	397154.536	Required	
MHS-3	343643.824	397149.446	343643.824	397149.446	Required	
MHS-4	343641.417	397134.934	343641.417	397134.934	Required	
MHS-5	343677.419	397129.248	343677.419	397129.248	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-6	343680.914	397148.055	343680.914	397148.055	Required	
MHS-7	343655.116	397152.133	343655.116	397152.133	Required	
MHS-8	343650.455	397148.139	343650.455	397148.139	Required	
MHS-9	343648.671	397133.807	343648.671	397133.807	Required	
MHS-10	343645.062	397134.315	343645.062	397134.315	Required	
MHS-11	343591.952	397160.039	343591.952	397160.039	Required	
MHS-12	343589.955	397147.057	343589.955	397147.057	Required	
MHS-13	343610.177	397115.849	343610.177	397115.849	Required	
MHS-14	343641.135	397133.825	343641.135	397133.825	Required	
MHS-15	343636.724	397111.439	343636.724	397111.439	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-16	343682.245	397146.890	343682.245	397146.890	Required	
MHS-17	343679.166	397126.418	343679.166	397126.418	Required	
MHS-18	343675.505	397104.864	343675.505	397104.864	Required	
MHS-19	343645.143	397110.156	343645.143	397110.156	Required	
MHS-20	343641.073	397110.862	343641.073	397110.862	Required	
MHS-21	343646.782	397107.011	343646.782	397107.011	Required	
MHS-22	343678.281	397102.678	343678.281	397102.678	Required	
MHS-	343702.766	397088.991			No Entry	



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.000	o	150	MHS-1	41.703	40.953	0.600	Open Manhole		450
S-1.001	o	150	MHS-2	42.309	40.509	1.651	Open Manhole		600
S-1.002	o	150	MHS-3	42.284	40.447	1.686	Open Manhole		600
S-1.003	o	150	MHS-4	42.156	40.302	1.704	Open Manhole		600
S-2.000	o	150	MHS-5	42.317	41.567	0.600	Open Manhole		450
S-3.000	o	150	MHS-6	42.839	42.089	0.600	Open Manhole		450
S-3.001	o	150	MHS-7	42.451	41.701	0.600	Open Manhole		450
S-3.002	o	150	MHS-8	42.341	41.591	0.600	Open Manhole		450
S-2.001	o	150	MHS-9	42.250	41.282	0.818	Open Manhole		450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.000	44.844	100.9	MHS-2	42.309	40.509	1.651	Open Manhole		600
S-1.001	6.181	100.9	MHS-3	42.284	40.447	1.686	Open Manhole		600
S-1.002	14.710	100.9	MHS-4	42.156	40.302	1.704	Open Manhole		600
S-1.003	3.697	100.9	MHS-10	42.205	40.265	1.790	Open Manhole		1200
S-2.000	29.107	101.9	MHS-9	42.250	41.282	0.818	Open Manhole		450
S-3.000	26.118	67.4	MHS-7	42.451	41.701	0.600	Open Manhole		450
S-3.001	6.138	55.8	MHS-8	42.341	41.591	0.600	Open Manhole		450
S-3.002	14.442	46.6	MHS-9	42.250	41.282	0.818	Open Manhole		450
S-2.001	3.644	93.1	MHS-10	42.205	41.242	0.813	Open Manhole		1200



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S-1.004	o	150	MHS-10	42.205	40.265	1.790	Open Manhole		1200
S-4.000	o	150	MHS-11	41.518	40.768	0.600	Open Manhole		450
S-4.001	o	150	MHS-12	41.505	40.552	0.803	Open Manhole		450
S-4.002	o	150	MHS-13	41.491	40.178	1.163	Open Manhole		450
S-5.000	o	150	MHS-14	42.142	41.392	0.600	Open Manhole		450
S-4.003	o	150	MHS-15	41.671	39.907	1.614	Open Manhole		600
S-6.000	o	150	MHS-16	42.944	42.194	0.600	Open Manhole		450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.004	23.790	59.2	MHS-20	41.750	39.863	1.737	Open Manhole		1200
S-4.000	13.135	60.9	MHS-12	41.505	40.552	0.803	Open Manhole		450
S-4.001	37.187	99.4	MHS-13	41.491	40.178	1.163	Open Manhole		450
S-4.002	26.911	99.4	MHS-15	41.671	39.907	1.614	Open Manhole		600
S-5.000	22.817	48.5	MHS-15	41.671	40.921	0.600	Open Manhole		600
S-4.003	4.387	99.0	MHS-20	41.750	39.863	1.737	Open Manhole		1200
S-6.000	20.702	30.4	MHS-17	42.262	41.512	0.600	Open Manhole		450



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S-6.001	o	150	MHS-17	42.262	41.512	0.600	Open Manhole		450
S-6.002	o	150	MHS-18	41.692	40.942	0.600	Open Manhole		450
S-6.003	o	150	MHS-19	41.750	40.634	0.966	Open Manhole		450
S-1.005	o	225	MHS-20	41.750	39.788	1.737	Open Manhole		1200
S-1.006	o	225	MHS-21	41.747	39.747	1.775	Open Manhole		1050
S-1.007	o	225	MHS-22	41.586	39.558	1.803	Open Manhole		1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-6.001	21.863	38.4	MHS-18	41.692	40.942	0.600	Open Manhole		450
S-6.002	30.819	99.9	MHS-19	41.750	40.634	0.966	Open Manhole		450
S-6.003	4.131	99.9	MHS-20	41.750	40.592	1.008	Open Manhole		1200
S-1.005	6.886	167.9	MHS-21	41.747	39.747	1.775	Open Manhole		1050
S-1.006	31.796	167.9	MHS-22	41.586	39.558	1.803	Open Manhole		1050
S-1.007	28.050	167.9	MHS-	40.780	39.391	1.164	Open Manhole		1050



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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	70	0.030	0.021	0.021
1.001	User	-	70	0.008	0.005	0.005
1.002	User	-	70	0.013	0.009	0.009
1.003	-	-	100	0.000	0.000	0.000
2.000	User	-	50	0.060	0.030	0.030
3.000	User	-	70	0.014	0.010	0.010
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
2.001	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
4.000	User	-	50	0.021	0.010	0.010
4.001	User	-	50	0.102	0.051	0.051
4.002	User	-	50	0.081	0.041	0.041
5.000	User	-	70	0.013	0.009	0.009
4.003	User	-	50	0.003	0.001	0.001
6.000	User	-	50	0.007	0.003	0.003
6.001	User	-	50	0.008	0.004	0.004
6.002	User	-	50	0.055	0.028	0.028
6.003	User	-	50	0.015	0.007	0.007
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.428	0.230	0.230

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Simulation Criteria for Storm

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

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	19.200	Cv (Summer)	0.750
Return Period (years)	2	Ratio R	0.395	Cv (Winter)	0.840
Region England and Wales Profile Type Summer Storm			Duration (mins)	30	

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: MHS-20, DS/PN: S-1.005, Volume (m³): 2.7

Unit Reference	MD-SHE-0103-5000-1200-5000	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	103
Design Flow (l/s)	5.0	Invert Level (m)	39.788
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	0.600	4.7	1.600	5.7	2.600	7.2	5.000	9.8	7.500	11.8
0.200	4.7	0.800	4.1	1.800	6.0	3.000	7.7	5.500	10.2	8.000	12.2
0.300	5.0	1.000	4.6	2.000	6.3	3.500	8.3	6.000	10.7	8.500	12.6
0.400	5.0	1.200	5.0	2.200	6.6	4.000	8.8	6.500	11.1	9.000	12.9
0.500	4.9	1.400	5.4	2.400	6.9	4.500	9.3	7.000	11.5	9.500	13.3

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Micro Drainage	Network 2020.1	
<u>Offline Controls for Storm</u> <u>Weir Manhole: MHS-20, DS/PN: S-1.005, Loop to PN: S-1.006</u> Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 40.988		
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Storage Structures for Storm

Cellular Storage Manhole: MHS-20, DS/PN: S-1.005

Invert Level (m) 39.788 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	90.0	90.0	1.200	90.0	145.2	1.300	0.0	145.2

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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	0.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs	0	Number of Offline Controls	1	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.200	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.395	Cv (Winter)

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Margin for Flood Risk Warning (mm) 300.0 DTS Status   ON Inertia Status OFF
Analysis Timestep   Fine DVD Status OFF
```

Profile(s)	Summer and Winter														
Duration(s) (mins)	15,	30,	60,	120,	180,	240,	360,	480,	600,	720,	960,	1440,	2160,	2880,	4320,
												5760,	7200,	8640,	10080
n Period(s) (years)	1														
Climate Change (%)	25														

										Water	Surcharged	Flooded			Half Drain	Pipe
PN	US/MH	Storm	Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow	Status
	Name		Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	
S-1.000	MHS-1	15	Winter	1	+25%				40.999	-0.104	0.000	0.19			3.3	OK
S-1.001	MHS-2	15	Winter	1	+25%				40.562	-0.096	0.000	0.28			4.1	OK
S-1.002	MHS-3	15	Winter	1	+25%				40.507	-0.091	0.000	0.33			5.4	OK
S-1.003	MHS-4	15	Winter	1	+25%				40.372	-0.080	0.000	0.45			5.4	OK
S-2.000	MHS-5	15	Winter	1	+25%				41.623	-0.094	0.000	0.29			4.9	OK
S-3.000	MHS-6	15	Winter	1	+25%				42.117	-0.122	0.000	0.08			1.6	OK
S-3.001	MHS-7	15	Winter	1	+25%				41.730	-0.121	0.000	0.08			1.6	OK
S-3.002	MHS-8	15	Winter	1	+25%				41.617	-0.124	0.000	0.07			1.6	OK

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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>		



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

									Water	Surcharged	Flooded			Half Drain	Pipe	
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow	
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status
S-2.001	MHS-9	15	Winter	1	+25%				41.360	-0.072	0.000	0.53			6.6	OK
S-1.004	MHS-10	15	Winter	1	+25%				40.344	-0.071	0.000	0.54			11.9	OK
S-4.000	MHS-11	15	Winter	1	+25%				40.797	-0.121	0.000	0.08			1.7	OK
S-4.001	MHS-12	15	Winter	1	+25%				40.629	-0.073	0.000	0.51			8.8	OK
S-4.002	MHS-13	15	Winter	1	+25%				40.285	-0.043	0.000	0.84			14.4	OK
S-5.000	MHS-14	15	Winter	1	+25%				41.416	-0.126	0.000	0.06			1.5	OK
S-4.003	MHS-15	15	Winter	1	+25%	1/15	Summer		40.071	0.013	0.000	1.20			15.9	SURCHARGED
S-6.000	MHS-16	15	Winter	1	+25%				42.207	-0.137	0.000	0.02			0.6	OK
S-6.001	MHS-17	15	Winter	1	+25%				41.531	-0.130	0.000	0.04			1.1	OK
S-6.002	MHS-18	15	Winter	1	+25%				40.998	-0.094	0.000	0.29			5.0	OK
S-6.003	MHS-19	15	Winter	1	+25%				40.706	-0.077	0.000	0.47			6.0	OK
S-1.005	MHS-20	60	Winter	1	+25%	1/60	Winter	0	40.018	0.005	0.000	0.16	0.0	54	4.8	SURCHARGED
S-1.006	MHS-21	60	Winter	1	+25%				39.800	-0.172	0.000	0.13			4.8	OK
S-1.007	MHS-22	60	Winter	1	+25%				39.611	-0.172	0.000	0.13			4.8	OK

	US/MH	Level
PN	Name	Exceeded
S-2.001	MHS-9	
S-1.004	MHS-10	
S-4.000	MHS-11	
S-4.001	MHS-12	
S-4.002	MHS-13	
S-5.000	MHS-14	
S-4.003	MHS-15	
S-6.000	MHS-16	
S-6.001	MHS-17	
S-6.002	MHS-18	

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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>																				
<table><tr><td></td><td>US/MH</td><td>Level</td></tr><tr><td>PN</td><td>Name</td><td>Exceeded</td></tr><tr><td>S-6.003</td><td>MHS-19</td><td></td></tr><tr><td>S-1.005</td><td>MHS-20</td><td></td></tr><tr><td>S-1.006</td><td>MHS-21</td><td></td></tr><tr><td>S-1.007</td><td>MHS-22</td><td></td></tr></table>				US/MH	Level	PN	Name	Exceeded	S-6.003	MHS-19		S-1.005	MHS-20		S-1.006	MHS-21		S-1.007	MHS-22	
	US/MH	Level																		
PN	Name	Exceeded																		
S-6.003	MHS-19																			
S-1.005	MHS-20																			
S-1.006	MHS-21																			
S-1.007	MHS-22																			
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes SLS-1 Manhole Sizes 600mm +

FSR Rainfall Model - England and Wales

Return Period (years)	2	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	19.200	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	0.600
Ratio R	0.395	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.500		

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
S-1.000	44.844	0.444	100.9	0.021	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.001	6.181	0.061	100.9	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.002	14.710	0.146	100.9	0.009	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.003	3.697	0.037	100.9	0.000	0.00	0.0	0.600	o	150	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)
S-1.000	50.00	5.75	40.953	0.021	0.0	0.0	0.0	1.00	17.7	2.8
S-1.001	50.00	5.85	40.509	0.026	0.0	0.0	0.0	1.00	17.7	3.5
S-1.002	50.00	6.10	40.447	0.035	0.0	0.0	0.0	1.00	17.7	4.8
S-1.003	50.00	6.16	40.302	0.035	0.0	0.0	0.0	1.00	17.7	4.8



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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
S-2.000	29.107	0.286	101.9	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-3.000	26.118	0.387	67.4	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-3.001	6.138	0.110	55.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-3.002	14.442	0.310	46.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-2.001	3.644	0.039	93.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.004	23.790	0.402	59.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-4.000	13.135	0.216	60.9	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-4.001	37.187	0.374	99.4	0.051	0.00	0.0	0.600	o	150	Pipe/Conduit		

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)
S-2.000	50.00	5.49	41.567	0.030	0.0	0.0	0.0	1.00	17.6	4.1
S-3.000	50.00	5.35	42.089	0.010	0.0	0.0	0.0	1.23	21.7	1.3
S-3.001	50.00	5.43	41.701	0.010	0.0	0.0	0.0	1.35	23.9	1.3
S-3.002	50.00	5.59	41.591	0.010	0.0	0.0	0.0	1.48	26.1	1.3
S-2.001	50.00	5.65	41.282	0.040	0.0	0.0	0.0	1.04	18.4	5.4
S-1.004	50.00	6.46	40.265	0.075	0.0	0.0	0.0	1.31	23.1	10.2
S-4.000	50.00	5.17	40.768	0.010	0.0	0.0	0.0	1.29	22.8	1.4
S-4.001	50.00	5.78	40.552	0.061	0.0	0.0	0.0	1.01	17.8	8.3



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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
S-4.002	26.911	0.271	99.4	0.041	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-5.000	22.817	0.471	48.5	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-4.003	4.387	0.044	99.0	0.001	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.000	20.702	0.682	30.4	0.003	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.001	21.863	0.569	38.4	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.002	30.819	0.309	99.9	0.028	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.003	4.131	0.041	99.9	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.005	6.886	0.041	167.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
S-1.006	31.796	0.189	167.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		

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)
S-4.002	50.00	6.23	40.178	0.102	0.0	0.0	0.0	1.01	17.8	13.8
S-5.000	50.00	5.26	41.392	0.009	0.0	0.0	0.0	1.45	25.6	1.2
S-4.003	50.00	6.30	39.907	0.112	0.0	0.0	0.0	1.01	17.8	15.2
S-6.000	50.00	5.19	42.194	0.003	0.0	0.0	0.0	1.83	32.4	0.5
S-6.001	50.00	5.41	41.512	0.007	0.0	0.0	0.0	1.63	28.8	1.0
S-6.002	50.00	5.92	40.942	0.035	0.0	0.0	0.0	1.01	17.8	4.7
S-6.003	50.00	5.99	40.634	0.042	0.0	0.0	0.0	1.01	17.8	5.7
S-1.005	50.00	6.57	39.788	0.230	0.0	0.0	0.0	1.01	40.0	31.1
S-1.006	50.00	7.10	39.747	0.230	0.0	0.0	0.0	1.01	40.0	31.1

Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design	
S-1.007	28.050	0.167	167.9	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)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
S-1.007	50.00	7.57	39.558	0.230	0.0	0.0	0.0	1.01	40.0	31.1		



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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam. ,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
MHS-1	41.703	0.750	Open Manhole	450	S-1.000	40.953	150				
MHS-2	42.309	1.801	Open Manhole	600	S-1.001	40.509	150	S-1.000	40.509	150	
MHS-3	42.284	1.836	Open Manhole	600	S-1.002	40.447	150	S-1.001	40.447	150	
MHS-4	42.156	1.854	Open Manhole	600	S-1.003	40.302	150	S-1.002	40.302	150	
MHS-5	42.317	0.750	Open Manhole	450	S-2.000	41.567	150				
MHS-6	42.839	0.750	Open Manhole	450	S-3.000	42.089	150				
MHS-7	42.451	0.750	Open Manhole	450	S-3.001	41.701	150	S-3.000	41.701	150	
MHS-8	42.341	0.750	Open Manhole	450	S-3.002	41.591	150	S-3.001	41.591	150	
MHS-9	42.250	0.968	Open Manhole	450	S-2.001	41.282	150	S-2.000	41.282	150	
								S-3.002	41.282	150	
MHS-10	42.205	1.940	Open Manhole	1200	S-1.004	40.265	150	S-1.003	40.265	150	977
								S-2.001	41.242	150	
MHS-11	41.518	0.750	Open Manhole	450	S-4.000	40.768	150				
MHS-12	41.505	0.953	Open Manhole	450	S-4.001	40.552	150	S-4.000	40.552	150	
MHS-13	41.491	1.313	Open Manhole	450	S-4.002	40.178	150	S-4.001	40.178	150	
MHS-14	42.142	0.750	Open Manhole	450	S-5.000	41.392	150				
MHS-15	41.671	1.764	Open Manhole	600	S-4.003	39.907	150	S-4.002	39.907	150	1014
								S-5.000	40.921	150	
MHS-16	42.944	0.750	Open Manhole	450	S-6.000	42.194	150				
MHS-17	42.262	0.750	Open Manhole	450	S-6.001	41.512	150	S-6.000	41.512	150	
MHS-18	41.692	0.750	Open Manhole	450	S-6.002	40.942	150	S-6.001	40.942	150	
MHS-19	41.750	1.116	Open Manhole	450	S-6.003	40.634	150	S-6.002	40.634	150	
MHS-20	41.750	1.962	Open Manhole	1200	S-1.005	39.788	225	S-1.004	39.863	150	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
								S-4.003	39.863	150	
								S-6.003	40.592	150	729
MHS-21	41.747	2.000	Open Manhole	1050	S-1.006	39.747	225	S-1.005	39.747	225	
MHS-22	41.586	2.028	Open Manhole	1050	S-1.007	39.558	225	S-1.006	39.558	225	
MHS-	40.780	1.389	Open Manhole	1050		OUTFALL		S-1.007	39.391	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-1	343596.024	397161.551	343596.024	397161.551	Required	
MHS-2	343640.317	397154.536	343640.317	397154.536	Required	
MHS-3	343643.824	397149.446	343643.824	397149.446	Required	
MHS-4	343641.417	397134.934	343641.417	397134.934	Required	
MHS-5	343677.419	397129.248	343677.419	397129.248	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-6	343680.914	397148.055	343680.914	397148.055	Required	
MHS-7	343655.116	397152.133	343655.116	397152.133	Required	
MHS-8	343650.455	397148.139	343650.455	397148.139	Required	
MHS-9	343648.671	397133.807	343648.671	397133.807	Required	
MHS-10	343645.062	397134.315	343645.062	397134.315	Required	
MHS-11	343591.952	397160.039	343591.952	397160.039	Required	
MHS-12	343589.955	397147.057	343589.955	397147.057	Required	
MHS-13	343610.177	397115.849	343610.177	397115.849	Required	
MHS-14	343641.135	397133.825	343641.135	397133.825	Required	
MHS-15	343636.724	397111.439	343636.724	397111.439	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-16	343682.245	397146.890	343682.245	397146.890	Required	
MHS-17	343679.166	397126.418	343679.166	397126.418	Required	
MHS-18	343675.505	397104.864	343675.505	397104.864	Required	
MHS-19	343645.143	397110.156	343645.143	397110.156	Required	
MHS-20	343641.073	397110.862	343641.073	397110.862	Required	
MHS-21	343646.782	397107.011	343646.782	397107.011	Required	
MHS-22	343678.281	397102.678	343678.281	397102.678	Required	
MHS-	343702.766	397088.991			No Entry	



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.000	o	150	MHS-1	41.703	40.953	0.600	Open Manhole		450
S-1.001	o	150	MHS-2	42.309	40.509	1.651	Open Manhole		600
S-1.002	o	150	MHS-3	42.284	40.447	1.686	Open Manhole		600
S-1.003	o	150	MHS-4	42.156	40.302	1.704	Open Manhole		600
S-2.000	o	150	MHS-5	42.317	41.567	0.600	Open Manhole		450
S-3.000	o	150	MHS-6	42.839	42.089	0.600	Open Manhole		450
S-3.001	o	150	MHS-7	42.451	41.701	0.600	Open Manhole		450
S-3.002	o	150	MHS-8	42.341	41.591	0.600	Open Manhole		450
S-2.001	o	150	MHS-9	42.250	41.282	0.818	Open Manhole		450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.000	44.844	100.9	MHS-2	42.309	40.509	1.651	Open Manhole		600
S-1.001	6.181	100.9	MHS-3	42.284	40.447	1.686	Open Manhole		600
S-1.002	14.710	100.9	MHS-4	42.156	40.302	1.704	Open Manhole		600
S-1.003	3.697	100.9	MHS-10	42.205	40.265	1.790	Open Manhole		1200
S-2.000	29.107	101.9	MHS-9	42.250	41.282	0.818	Open Manhole		450
S-3.000	26.118	67.4	MHS-7	42.451	41.701	0.600	Open Manhole		450
S-3.001	6.138	55.8	MHS-8	42.341	41.591	0.600	Open Manhole		450
S-3.002	14.442	46.6	MHS-9	42.250	41.282	0.818	Open Manhole		450
S-2.001	3.644	93.1	MHS-10	42.205	41.242	0.813	Open Manhole		1200



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S-1.004	o	150	MHS-10	42.205	40.265	1.790	Open Manhole		1200
S-4.000	o	150	MHS-11	41.518	40.768	0.600	Open Manhole		450
S-4.001	o	150	MHS-12	41.505	40.552	0.803	Open Manhole		450
S-4.002	o	150	MHS-13	41.491	40.178	1.163	Open Manhole		450
S-5.000	o	150	MHS-14	42.142	41.392	0.600	Open Manhole		450
S-4.003	o	150	MHS-15	41.671	39.907	1.614	Open Manhole		600
S-6.000	o	150	MHS-16	42.944	42.194	0.600	Open Manhole		450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.004	23.790	59.2	MHS-20	41.750	39.863	1.737	Open Manhole		1200
S-4.000	13.135	60.9	MHS-12	41.505	40.552	0.803	Open Manhole		450
S-4.001	37.187	99.4	MHS-13	41.491	40.178	1.163	Open Manhole		450
S-4.002	26.911	99.4	MHS-15	41.671	39.907	1.614	Open Manhole		600
S-5.000	22.817	48.5	MHS-15	41.671	40.921	0.600	Open Manhole		600
S-4.003	4.387	99.0	MHS-20	41.750	39.863	1.737	Open Manhole		1200
S-6.000	20.702	30.4	MHS-17	42.262	41.512	0.600	Open Manhole		450



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S-6.001	o	150	MHS-17	42.262	41.512	0.600	Open Manhole		450
S-6.002	o	150	MHS-18	41.692	40.942	0.600	Open Manhole		450
S-6.003	o	150	MHS-19	41.750	40.634	0.966	Open Manhole		450
S-1.005	o	225	MHS-20	41.750	39.788	1.737	Open Manhole		1200
S-1.006	o	225	MHS-21	41.747	39.747	1.775	Open Manhole		1050
S-1.007	o	225	MHS-22	41.586	39.558	1.803	Open Manhole		1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-6.001	21.863	38.4	MHS-18	41.692	40.942	0.600	Open Manhole		450
S-6.002	30.819	99.9	MHS-19	41.750	40.634	0.966	Open Manhole		450
S-6.003	4.131	99.9	MHS-20	41.750	40.592	1.008	Open Manhole		1200
S-1.005	6.886	167.9	MHS-21	41.747	39.747	1.775	Open Manhole		1050
S-1.006	31.796	167.9	MHS-22	41.586	39.558	1.803	Open Manhole		1050
S-1.007	28.050	167.9	MHS-	40.780	39.391	1.164	Open Manhole		1050



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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	70	0.030	0.021	0.021
1.001	User	-	70	0.008	0.005	0.005
1.002	User	-	70	0.013	0.009	0.009
1.003	-	-	100	0.000	0.000	0.000
2.000	User	-	50	0.060	0.030	0.030
3.000	User	-	70	0.014	0.010	0.010
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
2.001	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
4.000	User	-	50	0.021	0.010	0.010
4.001	User	-	50	0.102	0.051	0.051
4.002	User	-	50	0.081	0.041	0.041
5.000	User	-	70	0.013	0.009	0.009
4.003	User	-	50	0.003	0.001	0.001
6.000	User	-	50	0.007	0.003	0.003
6.001	User	-	50	0.008	0.004	0.004
6.002	User	-	50	0.055	0.028	0.028
6.003	User	-	50	0.015	0.007	0.007
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.428	0.230	0.230

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<u>Simulation Criteria for Storm</u> Volumetric Runoff Coeff 0.750 Manhole Headloss Coeff (Global) 0.500 Inlet Coeffiecient 0.800 Areal Reduction Factor 1.000 Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000 Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 60 Hot Start Level (mm) 0 MADD Factor * 10m³/ha Storage 0.000 Output Interval (mins) 1 Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FSR M5-60 (mm) 19.200 Cv (Summer) 0.750 Return Period (years) 2 Ratio R 0.395 Cv (Winter) 0.840 Region England and Wales Profile Type Summer Storm Duration (mins) 30		
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: MHS-20, DS/PN: S-1.005, Volume (m³): 2.7

Unit Reference	MD-SHE-0103-5000-1200-5000	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	103
Design Flow (l/s)	5.0	Invert Level (m)	39.788
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	0.600	4.7	1.600	5.7	2.600	7.2	5.000	9.8	7.500	11.8
0.200	4.7	0.800	4.1	1.800	6.0	3.000	7.7	5.500	10.2	8.000	12.2
0.300	5.0	1.000	4.6	2.000	6.3	3.500	8.3	6.000	10.7	8.500	12.6
0.400	5.0	1.200	5.0	2.200	6.6	4.000	8.8	6.500	11.1	9.000	12.9
0.500	4.9	1.400	5.4	2.400	6.9	4.500	9.3	7.000	11.5	9.500	13.3

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<u>Offline Controls for Storm</u> <u>Weir Manhole: MHS-20, DS/PN: S-1.005, Loop to PN: S-1.006</u> Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 40.988		
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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	0.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs	0	Number of Offline Controls	1	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.200	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.395	Cv (Winter)

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

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Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
n Period(s) (years)	30
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	Flood				Water	Surcharged	Flooded	Half Drain		Pipe	Status	
					First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)		Flow (l/s)
S-1.000	MHS-1	15 Winter	30	+40%					41.033	-0.070	0.000	0.53			9.2	OK
S-1.001	MHS-2	15 Winter	30	+40%	30/15 Summer				40.855	0.196	0.000	0.66			9.7	SURCHARGED
S-1.002	MHS-3	15 Winter	30	+40%	30/15 Summer				40.833	0.236	0.000	0.82			13.4	SURCHARGED
S-1.003	MHS-4	15 Winter	30	+40%	30/15 Summer				40.759	0.308	0.000	0.96			11.5	SURCHARGED
S-2.000	MHS-5	15 Winter	30	+40%					41.671	-0.046	0.000	0.80			13.4	OK
S-3.000	MHS-6	15 Winter	30	+40%					42.136	-0.102	0.000	0.22			4.5	OK
S-3.001	MHS-7	15 Winter	30	+40%					41.750	-0.102	0.000	0.22			4.4	OK

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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>		



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

									Water	Surcharged	Flooded	Half Drain			Pipe
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)
S-3.002	MHS-8	15 Winter	30	+40%					41.635	-0.106	0.000	0.19			4.5
S-2.001	MHS-9	15 Winter	30	+40%	30/15 Summer				41.470	0.038	0.000	1.46			18.1
S-1.004	MHS-10	15 Winter	30	+40%	30/15 Summer				40.726	0.311	0.000	1.26			27.7
S-4.000	MHS-11	15 Winter	30	+40%	30/15 Summer	30/15 Summer			41.518	0.600	0.280	0.17			3.5
S-4.001	MHS-12	15 Winter	30	+40%	30/15 Summer	30/15 Summer			41.506	0.804	0.732	1.22			21.1
S-4.002	MHS-13	15 Summer	30	+40%	30/15 Summer				41.373	1.045	0.000	1.90			32.3
S-5.000	MHS-14	15 Winter	30	+40%					41.434	-0.109	0.000	0.17			4.1
S-4.003	MHS-15	120 Winter	30	+40%	30/15 Summer				40.585	0.527	0.000	1.17			15.4
S-6.000	MHS-16	15 Winter	30	+40%					42.215	-0.128	0.000	0.05			1.5
S-6.001	MHS-17	15 Winter	30	+40%					41.547	-0.114	0.000	0.13			3.5
S-6.002	MHS-18	15 Winter	30	+40%	30/15 Summer				41.137	0.044	0.000	0.95			16.3
S-6.003	MHS-19	15 Winter	30	+40%	30/15 Summer				40.838	0.054	0.000	1.55			19.7
S-1.005	MHS-20	120 Winter	30	+40%	30/15 Summer			0	40.581	0.568	0.000	0.17	0.0	132	5.0
S-1.006	MHS-21	600 Summer	30	+40%					39.801	-0.171	0.000	0.13			5.0
S-1.007	MHS-22	720 Winter	30	+40%					39.612	-0.171	0.000	0.13			5.0

PN	US/MH Name	Status	Level Exceeded
S-3.002	MHS-8	OK	
S-2.001	MHS-9	SURCHARGED	
S-1.004	MHS-10	SURCHARGED	
S-4.000	MHS-11	FLOOD	4
S-4.001	MHS-12	FLOOD	2
S-4.002	MHS-13	FLOOD RISK	
S-5.000	MHS-14	OK	
S-4.003	MHS-15	SURCHARGED	
S-6.000	MHS-16	OK	

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

PN	US/MH Name	Status	Level Exceeded
S-6.001	MHS-17	OK	
S-6.002	MHS-18	SURCHARGED	
S-6.003	MHS-19	SURCHARGED	
S-1.005	MHS-20	SURCHARGED	
S-1.006	MHS-21	OK	
S-1.007	MHS-22	OK	

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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
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S-2.000	29.107	0.286	101.9	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
S-3.000	26.118	0.387	67.4	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S-3.001	6.138	0.110	55.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-3.002	14.442	0.310	46.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-2.001	3.644	0.039	93.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-1.004	23.790	0.402	59.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S-4.000	13.135	0.216	60.9	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
S-4.001	37.187	0.374	99.4	0.051	0.00	0.0	0.600	o	150	Pipe/Conduit	

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)
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S-2.000	50.00	5.49	41.567	0.030	0.0	0.0	0.0	1.00	17.6	4.1
S-3.000	50.00	5.35	42.089	0.010	0.0	0.0	0.0	1.23	21.7	1.3
S-3.001	50.00	5.43	41.701	0.010	0.0	0.0	0.0	1.35	23.9	1.3
S-3.002	50.00	5.59	41.591	0.010	0.0	0.0	0.0	1.48	26.1	1.3
S-2.001	50.00	5.65	41.282	0.040	0.0	0.0	0.0	1.04	18.4	5.4
S-1.004	50.00	6.46	40.265	0.075	0.0	0.0	0.0	1.31	23.1	10.2
S-4.000	50.00	5.17	40.768	0.010	0.0	0.0	0.0	1.29	22.8	1.4
S-4.001	50.00	5.78	40.552	0.061	0.0	0.0	0.0	1.01	17.8	8.3



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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
S-4.002	26.911	0.271	99.4	0.041	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-5.000	22.817	0.471	48.5	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-4.003	4.387	0.044	99.0	0.001	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.000	20.702	0.682	30.4	0.003	5.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.001	21.863	0.569	38.4	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.002	30.819	0.309	99.9	0.028	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-6.003	4.131	0.041	99.9	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit		
S-1.005	6.886	0.041	167.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		
S-1.006	31.796	0.189	167.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit		

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)
S-4.002	50.00	6.23	40.178	0.102	0.0	0.0	0.0	1.01	17.8	13.8
S-5.000	50.00	5.26	41.392	0.009	0.0	0.0	0.0	1.45	25.6	1.2
S-4.003	50.00	6.30	39.907	0.112	0.0	0.0	0.0	1.01	17.8	15.2
S-6.000	50.00	5.19	42.194	0.003	0.0	0.0	0.0	1.83	32.4	0.5
S-6.001	50.00	5.41	41.512	0.007	0.0	0.0	0.0	1.63	28.8	1.0
S-6.002	50.00	5.92	40.942	0.035	0.0	0.0	0.0	1.01	17.8	4.7
S-6.003	50.00	5.99	40.634	0.042	0.0	0.0	0.0	1.01	17.8	5.7
S-1.005	50.00	6.57	39.788	0.230	0.0	0.0	0.0	1.01	40.0	31.1
S-1.006	50.00	7.10	39.747	0.230	0.0	0.0	0.0	1.01	40.0	31.1

Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
S-1.007	28.050	0.167	167.9	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)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
S-1.007	50.00	7.57	39.558	0.230	0.0	0.0	0.0	1.01	40.0	31.1		



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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
MHS-1	41.703	0.750	Open Manhole	450	S-1.000	40.953	150				
MHS-2	42.309	1.801	Open Manhole	600	S-1.001	40.509	150	S-1.000	40.509	150	
MHS-3	42.284	1.836	Open Manhole	600	S-1.002	40.447	150	S-1.001	40.447	150	
MHS-4	42.156	1.854	Open Manhole	600	S-1.003	40.302	150	S-1.002	40.302	150	
MHS-5	42.317	0.750	Open Manhole	450	S-2.000	41.567	150				
MHS-6	42.839	0.750	Open Manhole	450	S-3.000	42.089	150				
MHS-7	42.451	0.750	Open Manhole	450	S-3.001	41.701	150	S-3.000	41.701	150	
MHS-8	42.341	0.750	Open Manhole	450	S-3.002	41.591	150	S-3.001	41.591	150	
MHS-9	42.250	0.968	Open Manhole	450	S-2.001	41.282	150	S-2.000	41.282	150	
								S-3.002	41.282	150	
MHS-10	42.205	1.940	Open Manhole	1200	S-1.004	40.265	150	S-1.003	40.265	150	977
								S-2.001	41.242	150	
MHS-11	41.518	0.750	Open Manhole	450	S-4.000	40.768	150				
MHS-12	41.505	0.953	Open Manhole	450	S-4.001	40.552	150	S-4.000	40.552	150	
MHS-13	41.491	1.313	Open Manhole	450	S-4.002	40.178	150	S-4.001	40.178	150	
MHS-14	42.142	0.750	Open Manhole	450	S-5.000	41.392	150				
MHS-15	41.671	1.764	Open Manhole	600	S-4.003	39.907	150	S-4.002	39.907	150	1014
								S-5.000	40.921	150	
MHS-16	42.944	0.750	Open Manhole	450	S-6.000	42.194	150				
MHS-17	42.262	0.750	Open Manhole	450	S-6.001	41.512	150	S-6.000	41.512	150	
MHS-18	41.692	0.750	Open Manhole	450	S-6.002	40.942	150	S-6.001	40.942	150	
MHS-19	41.750	1.116	Open Manhole	450	S-6.003	40.634	150	S-6.002	40.634	150	
MHS-20	41.750	1.962	Open Manhole	1200	S-1.005	39.788	225	S-1.004	39.863	150	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
								S-4.003	39.863	150	
								S-6.003	40.592	150	729
MHS-21	41.747	2.000	Open Manhole	1050	S-1.006	39.747	225	S-1.005	39.747	225	
MHS-22	41.586	2.028	Open Manhole	1050	S-1.007	39.558	225	S-1.006	39.558	225	
MHS-	40.780	1.389	Open Manhole	1050		OUTFALL		S-1.007	39.391	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-1	343596.024	397161.551	343596.024	397161.551	Required	
MHS-2	343640.317	397154.536	343640.317	397154.536	Required	
MHS-3	343643.824	397149.446	343643.824	397149.446	Required	
MHS-4	343641.417	397134.934	343641.417	397134.934	Required	
MHS-5	343677.419	397129.248	343677.419	397129.248	Required	

Manhole Schedules for Storm						
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-6	343680.914	397148.055	343680.914	397148.055	Required	
MHS-7	343655.116	397152.133	343655.116	397152.133	Required	
MHS-8	343650.455	397148.139	343650.455	397148.139	Required	
MHS-9	343648.671	397133.807	343648.671	397133.807	Required	
MHS-10	343645.062	397134.315	343645.062	397134.315	Required	
MHS-11	343591.952	397160.039	343591.952	397160.039	Required	
MHS-12	343589.955	397147.057	343589.955	397147.057	Required	
MHS-13	343610.177	397115.849	343610.177	397115.849	Required	
MHS-14	343641.135	397133.825	343641.135	397133.825	Required	
MHS-15	343636.724	397111.439	343636.724	397111.439	Required	

Manhole Schedules for Storm						
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
MHS-16	343682.245	397146.890	343682.245	397146.890	Required	
MHS-17	343679.166	397126.418	343679.166	397126.418	Required	
MHS-18	343675.505	397104.864	343675.505	397104.864	Required	
MHS-19	343645.143	397110.156	343645.143	397110.156	Required	
MHS-20	343641.073	397110.862	343641.073	397110.862	Required	
MHS-21	343646.782	397107.011	343646.782	397107.011	Required	
MHS-22	343678.281	397102.678	343678.281	397102.678	Required	
MHS-	343702.766	397088.991			No Entry	



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.000	o	150	MHS-1	41.703	40.953	0.600	Open Manhole		450
S-1.001	o	150	MHS-2	42.309	40.509	1.651	Open Manhole		600
S-1.002	o	150	MHS-3	42.284	40.447	1.686	Open Manhole		600
S-1.003	o	150	MHS-4	42.156	40.302	1.704	Open Manhole		600
S-2.000	o	150	MHS-5	42.317	41.567	0.600	Open Manhole		450
S-3.000	o	150	MHS-6	42.839	42.089	0.600	Open Manhole		450
S-3.001	o	150	MHS-7	42.451	41.701	0.600	Open Manhole		450
S-3.002	o	150	MHS-8	42.341	41.591	0.600	Open Manhole		450
S-2.001	o	150	MHS-9	42.250	41.282	0.818	Open Manhole		450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.000	44.844	100.9	MHS-2	42.309	40.509	1.651	Open Manhole		600
S-1.001	6.181	100.9	MHS-3	42.284	40.447	1.686	Open Manhole		600
S-1.002	14.710	100.9	MHS-4	42.156	40.302	1.704	Open Manhole		600
S-1.003	3.697	100.9	MHS-10	42.205	40.265	1.790	Open Manhole		1200
S-2.000	29.107	101.9	MHS-9	42.250	41.282	0.818	Open Manhole		450
S-3.000	26.118	67.4	MHS-7	42.451	41.701	0.600	Open Manhole		450
S-3.001	6.138	55.8	MHS-8	42.341	41.591	0.600	Open Manhole		450
S-3.002	14.442	46.6	MHS-9	42.250	41.282	0.818	Open Manhole		450
S-2.001	3.644	93.1	MHS-10	42.205	41.242	0.813	Open Manhole		1200



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S-1.004	o	150	MHS-10	42.205	40.265	1.790	Open Manhole		1200
S-4.000	o	150	MHS-11	41.518	40.768	0.600	Open Manhole		450
S-4.001	o	150	MHS-12	41.505	40.552	0.803	Open Manhole		450
S-4.002	o	150	MHS-13	41.491	40.178	1.163	Open Manhole		450
S-5.000	o	150	MHS-14	42.142	41.392	0.600	Open Manhole		450
S-4.003	o	150	MHS-15	41.671	39.907	1.614	Open Manhole		600
S-6.000	o	150	MHS-16	42.944	42.194	0.600	Open Manhole		450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-1.004	23.790	59.2	MHS-20	41.750	39.863	1.737	Open Manhole		1200
S-4.000	13.135	60.9	MHS-12	41.505	40.552	0.803	Open Manhole		450
S-4.001	37.187	99.4	MHS-13	41.491	40.178	1.163	Open Manhole		450
S-4.002	26.911	99.4	MHS-15	41.671	39.907	1.614	Open Manhole		600
S-5.000	22.817	48.5	MHS-15	41.671	40.921	0.600	Open Manhole		600
S-4.003	4.387	99.0	MHS-20	41.750	39.863	1.737	Open Manhole		1200
S-6.000	20.702	30.4	MHS-17	42.262	41.512	0.600	Open Manhole		450



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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
S-6.001	o	150	MHS-17	42.262	41.512	0.600	Open Manhole		450
S-6.002	o	150	MHS-18	41.692	40.942	0.600	Open Manhole		450
S-6.003	o	150	MHS-19	41.750	40.634	0.966	Open Manhole		450
S-1.005	o	225	MHS-20	41.750	39.788	1.737	Open Manhole		1200
S-1.006	o	225	MHS-21	41.747	39.747	1.775	Open Manhole		1050
S-1.007	o	225	MHS-22	41.586	39.558	1.803	Open Manhole		1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	I*W
S-6.001	21.863	38.4	MHS-18	41.692	40.942	0.600	Open Manhole		450
S-6.002	30.819	99.9	MHS-19	41.750	40.634	0.966	Open Manhole		450
S-6.003	4.131	99.9	MHS-20	41.750	40.592	1.008	Open Manhole		1200
S-1.005	6.886	167.9	MHS-21	41.747	39.747	1.775	Open Manhole		1050
S-1.006	31.796	167.9	MHS-22	41.586	39.558	1.803	Open Manhole		1050
S-1.007	28.050	167.9	MHS-	40.780	39.391	1.164	Open Manhole		1050



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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	70	0.030	0.021	0.021
1.001	User	-	70	0.008	0.005	0.005
1.002	User	-	70	0.013	0.009	0.009
1.003	-	-	100	0.000	0.000	0.000
2.000	User	-	50	0.060	0.030	0.030
3.000	User	-	70	0.014	0.010	0.010
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
2.001	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
4.000	User	-	50	0.021	0.010	0.010
4.001	User	-	50	0.102	0.051	0.051
4.002	User	-	50	0.081	0.041	0.041
5.000	User	-	70	0.013	0.009	0.009
4.003	User	-	50	0.003	0.001	0.001
6.000	User	-	50	0.007	0.003	0.003
6.001	User	-	50	0.008	0.004	0.004
6.002	User	-	50	0.055	0.028	0.028
6.003	User	-	50	0.015	0.007	0.007
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.428	0.230	0.230

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Micro Drainage		Network 2020.1
<u>Simulation Criteria for Storm</u> Volumetric Runoff Coeff 0.750 Manhole Headloss Coeff (Global) 0.500 Inlet Coeffiecient 0.800 Areal Reduction Factor 1.000 Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000 Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 60 Hot Start Level (mm) 0 MADD Factor * 10m³/ha Storage 0.000 Output Interval (mins) 1 Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FSR M5-60 (mm) 19.200 Cv (Summer) 0.750 Return Period (years) 2 Ratio R 0.395 Cv (Winter) 0.840 Region England and Wales Profile Type Summer Storm Duration (mins) 30		
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: MHS-20, DS/PN: S-1.005, Volume (m³): 2.7

Unit Reference	MD-SHE-0103-5000-1200-5000	Sump Available	Yes
Design Head (m)	1.200	Diameter (mm)	103
Design Flow (l/s)	5.0	Invert Level (m)	39.788
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	0.600	4.7	1.600	5.7	2.600	7.2	5.000	9.8	7.500	11.8
0.200	4.7	0.800	4.1	1.800	6.0	3.000	7.7	5.500	10.2	8.000	12.2
0.300	5.0	1.000	4.6	2.000	6.3	3.500	8.3	6.000	10.7	8.500	12.6
0.400	5.0	1.200	5.0	2.200	6.6	4.000	8.8	6.500	11.1	9.000	12.9
0.500	4.9	1.400	5.4	2.400	6.9	4.500	9.3	7.000	11.5	9.500	13.3

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<u>Offline Controls for Storm</u> <u>Weir Manhole: MHS-20, DS/PN: S-1.005, Loop to PN: S-1.006</u> Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 40.988		
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Storage Structures for Storm

Cellular Storage Manhole: MHS-20, DS/PN: S-1.005

Invert Level (m)	39.788	Infiltration Coefficient Side (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	90.0	90.0	1.200	90.0	145.2	1.300	0.0	145.2



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

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m ³ /ha Storage	0.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs	0	Number of Offline Controls	1	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	19.200	Cv (Summer)	0.750	
Region	England and Wales	Ratio R	0.395	Cv (Winter)	0.840

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

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Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
n Period(s) (years)	100
Climate Change (%)	40

									Water	Surcharged	Flooded			Half Drain	Pipe
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Time	Flow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)
S-1.000	MHS-1	15 Winter	100	+40%	100/15	Summer			41.497	0.394	0.000	0.66			11.4
S-1.001	MHS-2	15 Winter	100	+40%	100/15	Summer			41.370	0.712	0.000	0.80			11.8
S-1.002	MHS-3	15 Winter	100	+40%	100/15	Summer			41.336	0.739	0.000	0.93			15.1
S-1.003	MHS-4	15 Winter	100	+40%	100/15	Summer			41.222	0.770	0.000	1.20			14.4
S-2.000	MHS-5	15 Winter	100	+40%	100/15	Summer			41.842	0.125	0.000	1.03			17.4
S-3.000	MHS-6	15 Winter	100	+40%					42.143	-0.095	0.000	0.28			5.8
S-3.001	MHS-7	15 Winter	100	+40%					41.757	-0.094	0.000	0.29			5.8

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

US/MH		Level
PN	Name	Status Exceeded
S-1.000	MHS-1	FLOOD RISK
S-1.001	MHS-2	SURCHARGED
S-1.002	MHS-3	SURCHARGED
S-1.003	MHS-4	SURCHARGED
S-2.000	MHS-5	SURCHARGED
S-3.000	MHS-6	OK
S-3.001	MHS-7	OK



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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Overflow (l/s)	Half Drain	Pipe	
									Level (m)	Depth (m)	Volume (m³)		Flow Cap.	Time (mins)	Flow (l/s)
S-3.002	MHS-8	15 Winter	100	+40%					41.641	-0.100	0.000	0.24		5.8	
S-2.001	MHS-9	15 Winter	100	+40%	100/15 Summer				41.521	0.090	0.000	1.86		23.0	
S-1.004	MHS-10	15 Winter	100	+40%	100/15 Summer				41.171	0.756	0.000	1.57		34.5	
S-4.000	MHS-11	15 Winter	100	+40%	100/15 Summer	100/15 Summer			41.519	0.601	0.943	0.24		5.1	
S-4.001	MHS-12	15 Winter	100	+40%	100/15 Summer	100/15 Summer			41.511	0.808	5.571	1.23		21.1	
S-4.002	MHS-13	15 Summer	100	+40%	100/15 Summer	100/15 Summer			41.478	1.150	0.050	1.94		33.0	
S-5.000	MHS-14	15 Winter	100	+40%					41.440	-0.102	0.000	0.22		5.3	
S-4.003	MHS-15	120 Winter	100	+40%	100/15 Summer				40.887	0.830	0.000	1.58		20.8	
S-6.000	MHS-16	15 Winter	100	+40%					42.219	-0.125	0.000	0.07		2.0	
S-6.001	MHS-17	15 Winter	100	+40%					41.553	-0.109	0.000	0.17		4.5	
S-6.002	MHS-18	15 Winter	100	+40%	100/15 Summer				41.380	0.288	0.000	1.22		20.8	
S-6.003	MHS-19	15 Winter	100	+40%	100/15 Summer				40.897	0.113	0.000	1.96		25.0	
S-1.005	MHS-20	120 Winter	100	+40%	100/15 Summer			0	40.883	0.870	0.000	0.17	0.0	189	5.0
S-1.006	MHS-21	1440 Summer	100	+40%					39.801	-0.171	0.000	0.13		5.0	
S-1.007	MHS-22	1440 Summer	100	+40%					39.612	-0.171	0.000	0.13		5.0	

PN	US/MH Name	Status	Level Exceeded
S-3.002	MHS-8	OK	
S-2.001	MHS-9	SURCHARGED	
S-1.004	MHS-10	SURCHARGED	
S-4.000	MHS-11	FLOOD	5
S-4.001	MHS-12	FLOOD	5
S-4.002	MHS-13	FLOOD	
S-5.000	MHS-14	OK	
S-4.003	MHS-15	SURCHARGED	
S-6.000	MHS-16	OK	

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Micro Drainage	Network 2020.1	
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