

Rivertrees, Henley

Surface Water Drainage Strategy - Condition Discharge

Prepared by:
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Job Number:

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Date
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Revision
01

Notes/Amendments/Issue/Purpose
Planning

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Acronyms	
AOD	Above Ordnance Datum
CIRIA	Construction Industry Research and Information Association
EA	Environment Agency
FFL	Finished Floor Level
LLFA	Lead Local Flood Authority
SuDS	Sustainable Drainage Systems

1 Introduction

Price & Myers have been commissioned to produce a Surface Water Drainage Strategy for the proposed development at Rivertrees, Henley.

This report provides supplementary information to discharge Condition 6 of the approved planning application, reference number 232716.

“Condition 6:

Drainage Strategy - Prior to the commencement of the development, a detailed surface water Drainage Strategy has been submitted to and approved in writing by the Local Planning Authority. The Strategy should be supported by modelling of the scheme to demonstrate it is technically feasible, along with a timetable for implementation and completion. The development shall thereafter be carried out and maintained in accordance with the approved details for as long as the development remains on the site.”

This report has been undertaken in accordance with the Wokingham Borough Council Strategic Flood Risk Assessment (SFRA May 2023), Wokingham Sustainable Drainage Systems (SuDS) Strategy (Jan 2017), the Environment Agency (EA) advice and CIRIA documents guidelines.

2 Site Description & Location

The site which is situated directly between the River Thames and the A321 Wargrave Road. The development covers an area of approximately 0.235 ha. The site is located within an urban area and surrounded by residential, recreational and commercial units. The site postcode is RG9 3JD and the Grid Reference is OS 476694, 182306.

A topographic survey was undertaken by Gryphon Survey in March 2023 and indicates the levels on the site range from 31.08 mAOD to 32.48 mAOD. Showing that the ground generally falls from northeast to southwest, towards the River Thames. The topographical survey can be found in Appendix A.

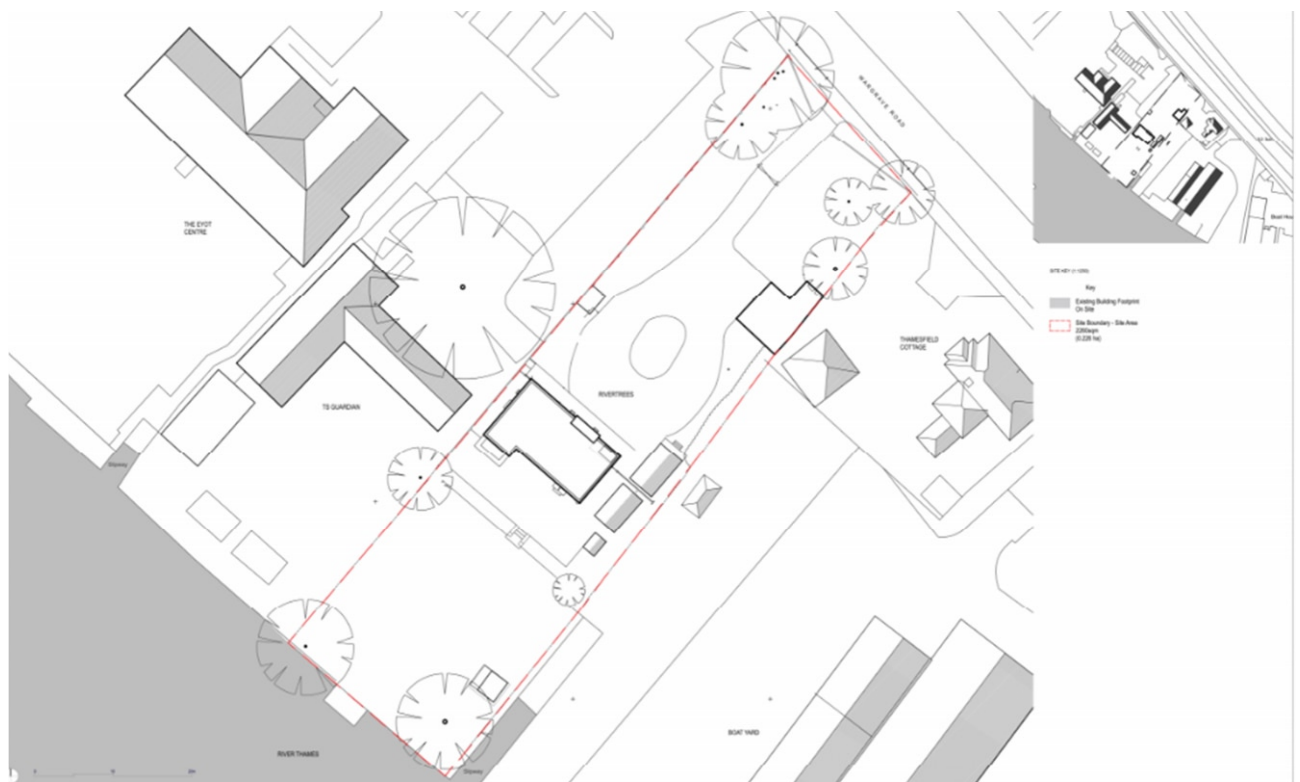


Figure 2.1: Site Outline (Baca Architects)

2.1 Existing Drainage

The Thames Water asset plans show that there are no surface, foul or combined water public sewers in any proximity to the site. The closest sewer shown on the records is a foul water sewer >605m away from the site, located over Henley Bridge. The sewer records are available in Appendix B.

The topographic survey located an existing foul water network draining the site connecting to an existing septic tank. No surface water network was located, it is assumed the rainwater pipes connect to below ground soakaways or to the below ground foul water network.

3 Development Proposals

The proposed development involves the erection of a new 3 storey house with a basement level and associated landscaping. The house has been designed to float when river water floods the site. In its typical state, the house will sit within the Dry-Dock. This is a concrete box fixed within the ground; river flood water will enter this box during extreme flood events. The house is designed to float within the Dry-Dock above the flood level.

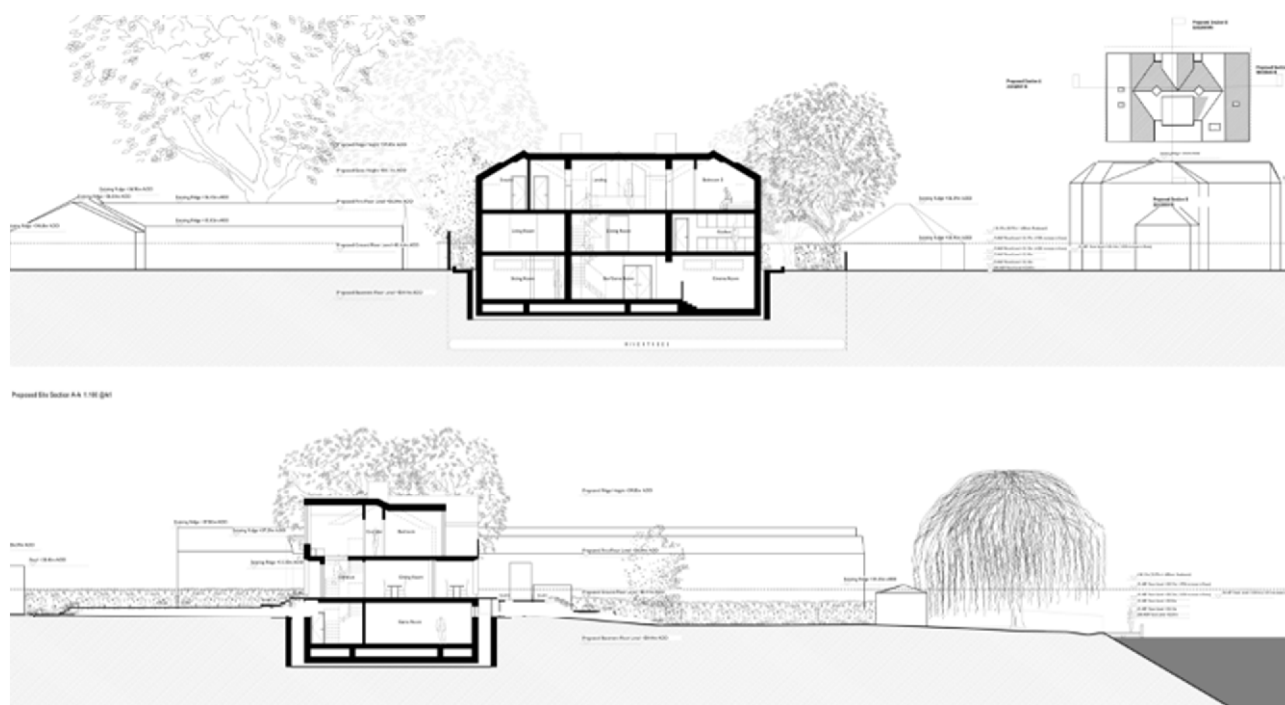


Figure 3.1: Proposed Site Section (Baca Architects)

4 Surface Water Run-off Assessment

4.1 Existing Run-off

The total site area is approximately 0.235 ha of which approximately 0.090 ha is impermeable.

Using FEH-22 data the existing peak run-off rates for the design storm events were calculated using the modified rational method as shown below:

$$Q_x = 2.78 \times A \times i$$

Where 'x' is the return period in years, 'A' is the catchment area in ha and 'i' is the rainfall intensity in mm/hr as estimated from Causeway FLOW software.

$$Q_{1_{ex}} = 2.78 \times 0.090 \times 16.80 = 4.20 \text{ l/s}$$

$$Q_{30_{ex}} = 2.78 \times 0.090 \times 84.62 = 21.17 \text{ l/s}$$

$$Q_{100_{ex}} = 2.78 \times 0.090 \times 152.54 = 38.17 \text{ l/s}$$

4.2 Post Development Run-off

The proposed development with consist of 0.055 ha of hard landscaped areas including driveways, pathways, roof areas and terraces. Approximately 0.023 ha is proposed to be of permeable construction. This consists of the driveway and pathway area that are to be constructed of permeable resin bound gravel and permeable block paving respectively.

The remaining 0.032 ha is proposed to be impermeable. The peak run-off rates for the design storm events were calculated using the modified rational method as shown below:

$$Q_1 = 2.78 \times 0.032 \times 16.80 = 1.49 \text{ l/s}$$

$$Q_{30} = 2.78 \times 0.032 \times 84.62 = 7.53 \text{ l/s}$$

$$Q_{100} = 2.78 \times 0.032 \times 152.54 = 13.57 \text{ l/s}$$

4.3 Climate Change

The EA's "climate change allowances for peak rainfall in England" map shows that the site is within the 'Thames and South Chilterns' Management area and that a 40% allowance for climate should be considered in the drainage design.

4.4 Proposed Surface Water Drainage

In accordance with the EA guidelines, Wokingham Sustainable Drainage Systems (SuDS) Strategy (Jan 2017), design guidelines for surface water drainage systems and CIRIA documents, surface water run-off should be managed as close to its source as possible.

The LLFA's SuDS Policy 1 states that:

1. *"The way that rainfall leaves a development should follow the preferred hierarchy:*
 - *re-use on site*
 - *infiltration into the ground*
 - *a natural watercourse*
 - *surface water sewer*
 - *combined sewer."*

4.4.1 Re-use on Site

There is an opportunity to reuse rainwater that falls on the roof. This will provide some form of surface water attenuation, also reducing the proposed developments' water demand. However, the capacity of any rainwater harvesting systems to attenuate rainwater depends on the water use within the building. If there is no activity in the building or other water use and the harvester is full, no attenuation will be provided during a subsequent storm event. In the worst-case scenario, any rainwater harvester will provide no attenuation. Therefore, the reduction in run-off rates due to any rainwater harvesting system will be excluded from the drainage calculations to allow for the worst-case scenario.

4.4.2 Infiltration Into the Ground

Borehole data was recorded by the A2 Site Investigation team in report No. 61225-A2SI-XX-XX-RP-X-0002-00 (April 2025). The findings show that the site is covered with a depth of approximately 0.5m of made ground. The made ground is underlaid by strata of Kempton Park Gravel approximately 4.9m thick. Below this is a Chalk bedrock layer.

As part of the site investigation groundwater levels and infiltration testing were undertaken at the location of proposed infiltration features. Testing was undertaken between the 2nd and 5th of March 2025 when water levels were still high from the winter rainfall. Borehole, groundwater and infiltration testing data can be found in Appendix C.

Infiltration testing was undertaken to BRE 365 standards on site. The tests were undertaken in the gravel layer at a shallow depth of 31.72 mAOD (0.5m BGL). An infiltration rate of 2.10×10^{-4} m/s was achieved. The groundwater level was found to be at 30.82 mAOD. Further groundwater monitoring from the 5th of March 2025 to the 4th of April 2025 found groundwater to fluctuate between 30.82 mAOD and 30.93 mAOD.

It is proposed that all surface water is collected within the Dry-Dock. It is proposed to discharge surface water from the Dry-Dock via a surface water pumping station, at a maximum of 12 l/s. The station pumps water to a shallow soakaway located within the Kempton Park Gravel layer, above the groundwater level.

Calculations show that a 11.4m³ soakaway will be able to manage the run-off from the proposed development in storm events with a return period of up to the 1 in 100 year plus 40% (climate change allowance). Refer to Appendix D for the calculations and Appendix E for an indicative layout.

The soakaway has been designed with minimum cover and a shallow unit depth of 0.375m. This is to ensure the soakaway is as high above the groundwater level as possible. In the event that the soakaway experiences ineffective infiltration due to river flooding causing groundwater levels greater than those observed as part of the SI, the soakaway is fitted with an overflow set above the top of the tank. The overflow pipework follows the natural ground falls and discharges to the River Thames.

4.4.3 Water Pollution

SuDS have the potential to provide water quality benefits to runoff entering the environment. The SuDS Manual states that SuDS should be designed to treat runoff to reduce the risk of environmental pollution. Chapter 26 of The SuDS Manual sets out the 'simple index approach' to water quality risk management. This approach has been used to quantify the benefits of the proposed SuDS scheme on water quality.

Step 1 of the simple index approach is to identify the pollution hazard indices for the proposed land use. The proposed residential development is considered to have a 'Very Low/Low' pollution hazard level as Table 4.1 shows.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change	Low	0.5	0.4	0.4

Table 4.1: Pollution Hazard Indices, taken from Table 26.2 of The SuDS Manual (CIRIA, 2015)

Step 2 of the simple index approach is to select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.

As the destination of the runoff is to the groundwater, the groundwater pollution mitigation indices should be used as shown in Table 4.2. The indicative surface water pollution mitigation indices for permeable paving are shown in Table 4.2 below:

Type of SuDS Component	TSS	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7

Table 4.2 Surface Water Pollution Mitigation Indices, taken from Table 26.3 of The SuDS Manual

Provided that the mitigation indices of the treatment techniques are greater than or equal to the hazard indices for the proposed development then there should be no reduction in the overall water quality within the receiving watercourse or groundwater body.

5 Surface Water Maintenance Strategy

The successful implementation and operation of a SuDS depends on a robust and clear maintenance strategy being implemented. The following measures should form part of the site's proposed management plan. The drainage system will be maintained by a private management company and will form part of the overall maintenance regime for the site.

The drainage layout drawing shows that SuDS are provided for all vehicular trafficked areas.

Maintenance and cleaning of gullies, gutters, rainwater pipes and stormwater manholes will ensure adequate performance. This maintenance program is outlined below;

Regular maintenance should include:

1. Inspect channel drains, gutters and gully inlet grates and remove any debris every 3 months or as determined to be reasonable based on experience with the installed systems to ensure that all drainage components are working in their intended fashion and that they are free of debris; quarterly, inspect gully sumps and bottom of drain manholes; if the depth of sediment in sumps exceeds 50% capacity, the sediment must be removed. Excessive sediment shall be removed and properly disposed of by a licensed drainage cleaning company.
2. Inspect all vegetated areas and remove litter and debris as necessary. Replant bare areas or areas with sparse growth.
3. Inspection of external the Dry-Dock, bin stores and M&E enclosure for spillage and scattered litter must be performed on a regular basis to prevent the spread of pollutants into the stormwater management system.

Winter Maintenance Program:

Ensure that drainage structures are not blocked by ice, snow, debris, or rubbish during the winter months.

Fertiliser Use

Only slow-release organic low-phosphorous fertilisers will be used in any landscaped areas in order to limit the amount of nutrients that could enter the stormwater system.

SuDS Element	Maintenance		
	Activity	Required Action	Typical Frequency
Soakaways	Monitoring / Inspections	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
		Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Regular Maintenance	Cleaning of gutters and any filters on downpipes	Annually or as required based on inspections
		Trimming any roots that may be causing blockages	Annually or as required
	Occasional Maintenance	Remove sediment and debris from pre-treatment components, silt traps and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
	Remedial Actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
		Replacement of clogged geotextile (will require reconstruction of soakaway)	
Permeable Paving	Monitoring / Inspections	Initial inspection	Monthly for three months after installation
		Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 hours after large storms in first six months
		Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
		Monitor inspection chambers	Annually
	Regular Maintenance	Brushing and vacuuming -standard cosmetic sweep over whole surface	Once a year after autumn leaf fall
		Rubbish and litter removal	As required
	Remedial Actions	Remediate any landscaping which through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
		Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	
		Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required

Table 5.1 SuDS Maintenance Strategy as taken from the CIRIA SUDS Manual

Effective SuDS design must assess all foreseeable risks during construction and maintenance. These must be mitigated during the detailed design stages where effective design will aim to avoid, reduce and mitigate risks. This process will also require input from the principal contractor who will ensure the construction of SuDS components is carried out in a safe and sustainable manner.

6 Exceedance Routes and Overland Flows

Surface water exceedance and overland flows occur when intense rainfall is unable to either soak into the ground or enter a drainage system; due to blockages or the capacity of the system being exceeded. Although drainage systems are currently designed for extreme storm events, it is not economical or sustainable to build large, oversized drainage networks for all types of extreme rainfall or scenarios. As a result, there will be occasions when surface water runoff will exceed the capacity of drains as outlined in CIRA 635 document 'Designing for exceedance in urban drainage – good practice':

"It is inevitable that as a result of extreme rainfall the capacities of sewers, covered watercourses and other drainage systems will be exceeded on occasion. Periods of exceedance occur when the rate of surface runoff exceeds the drainage system inlet capacity, when the pipe system becomes overloaded, or when the outfall becomes restricted due to flood levels in the receiving water."

Designing for exceedance aims to divert and control flood flows along routes where the risk of property flooding and the risk to health and safety is minimised and can be managed.

The following sections assess the overland flow routes for the developed site and proposed mitigation measures, where required. These will route water away from vulnerable areas, avoid creating hazards to end users and also not increase flood risk on or off site.

6.1 Proposed Exceedance and Overland Flow Routes and Mitigation Measures

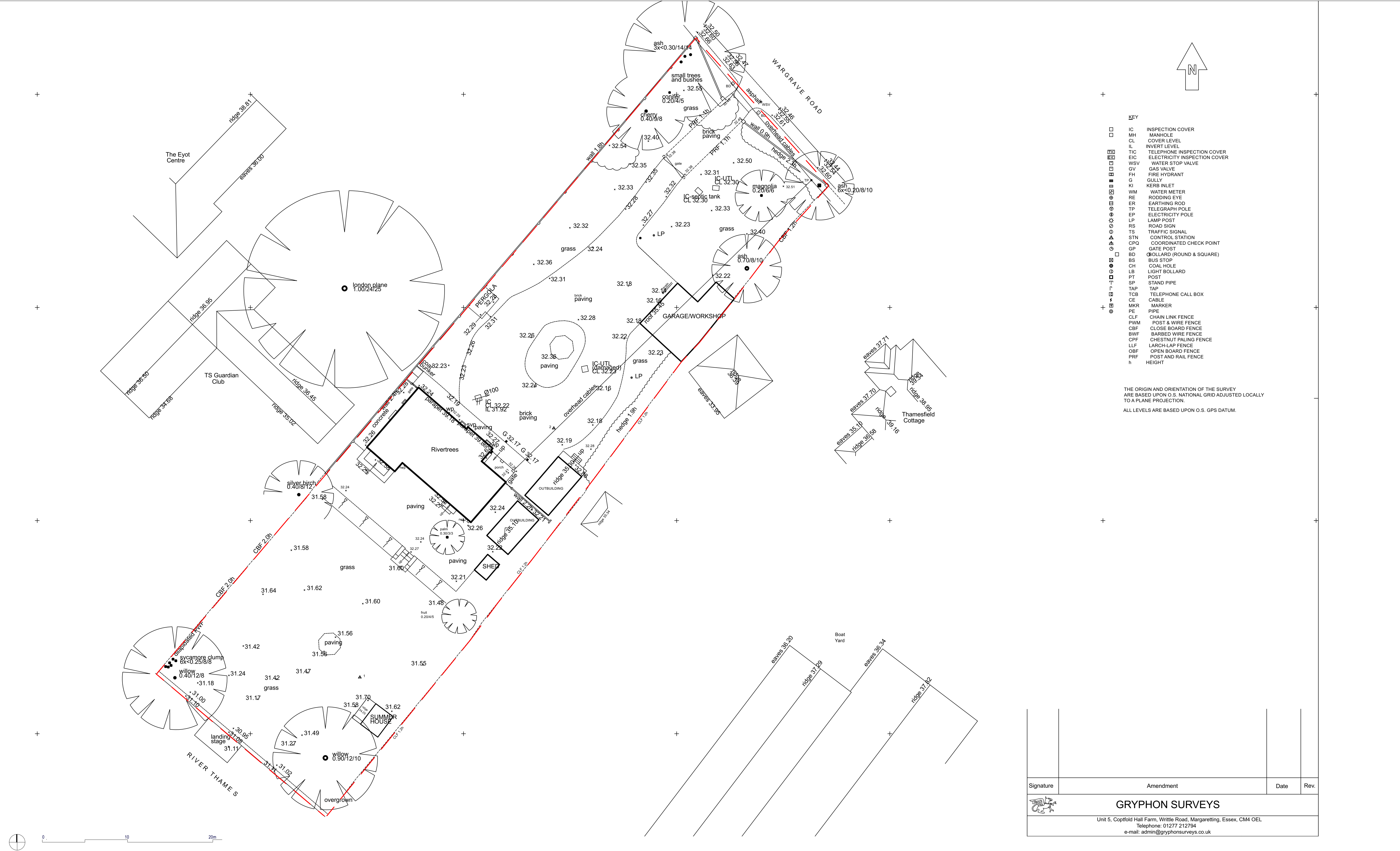
The 1 in 30 years storm event is the design storm event for the proposed development however, the proposed SuDS have been designed so that there is no flooding within the site for the 1 in 100-year + 40% climate change rainfall event. The drainage system exceedance flows have been assessed for events that exceed the critical storm event (100 year + 40% climate change) and in the event that the drainage system fails. The Finished Floor Levels (FFLs) of the proposed building will be set higher than the surrounding ground levels in order to prevent flooding during an exceedance event. The exceedance flow plan, included within Appendix F, shows that surface water from the site would flow offsite towards the River Thames, or towards the Dry-Dock, where it will be pumped to the soakaway, overflowing to the River Thames. Therefore, the proposed building is at low risk of flooding during an exceedance event.

7 Conclusions

- The proposed development involves the erection of a new 2 storey house with a basement level and associated landscaping. The house has been designed to float in the event of the river flooding.
- The proposed development will decrease the impermeable areas on site and therefore the run-off rates.
- Site investigation works show that infiltration systems can be utilised for surface water disposal.
- A 11.4m³ soakaway has been proposed to discharge surface water from all impermeable areas of the site.
- The proposed SuDS features will provide suitable prevention from pollution to groundwater.
- A suitable surface water maintenance strategy has been provided. It has detailed the required maintenance procedures and expected frequencies.
- Exceedance events will be directed toward the River Thames via the fall of ground level and overflow pipework from the soakaway.

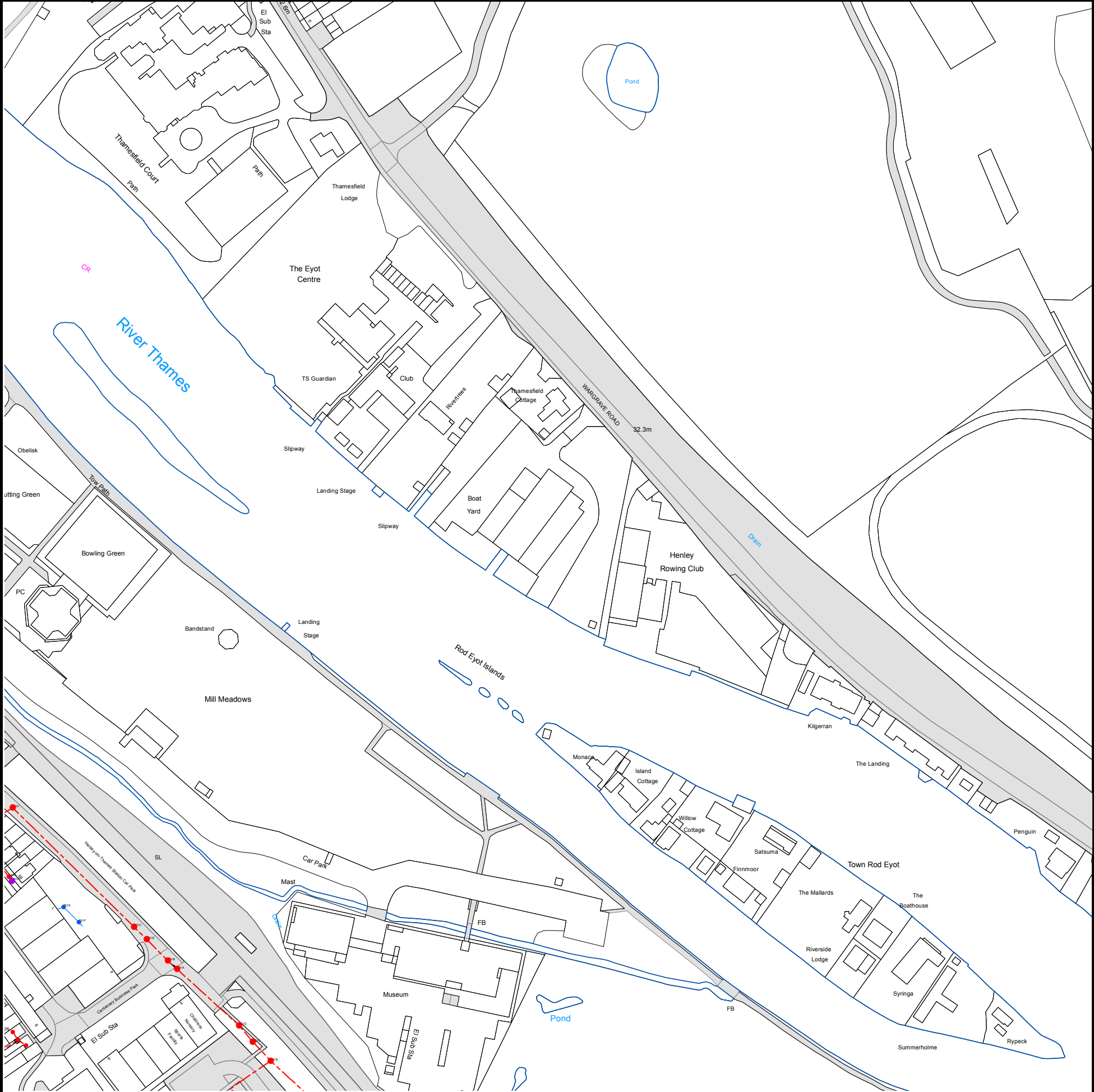
Appendix A

Topographical Survey Drawing



Appendix B

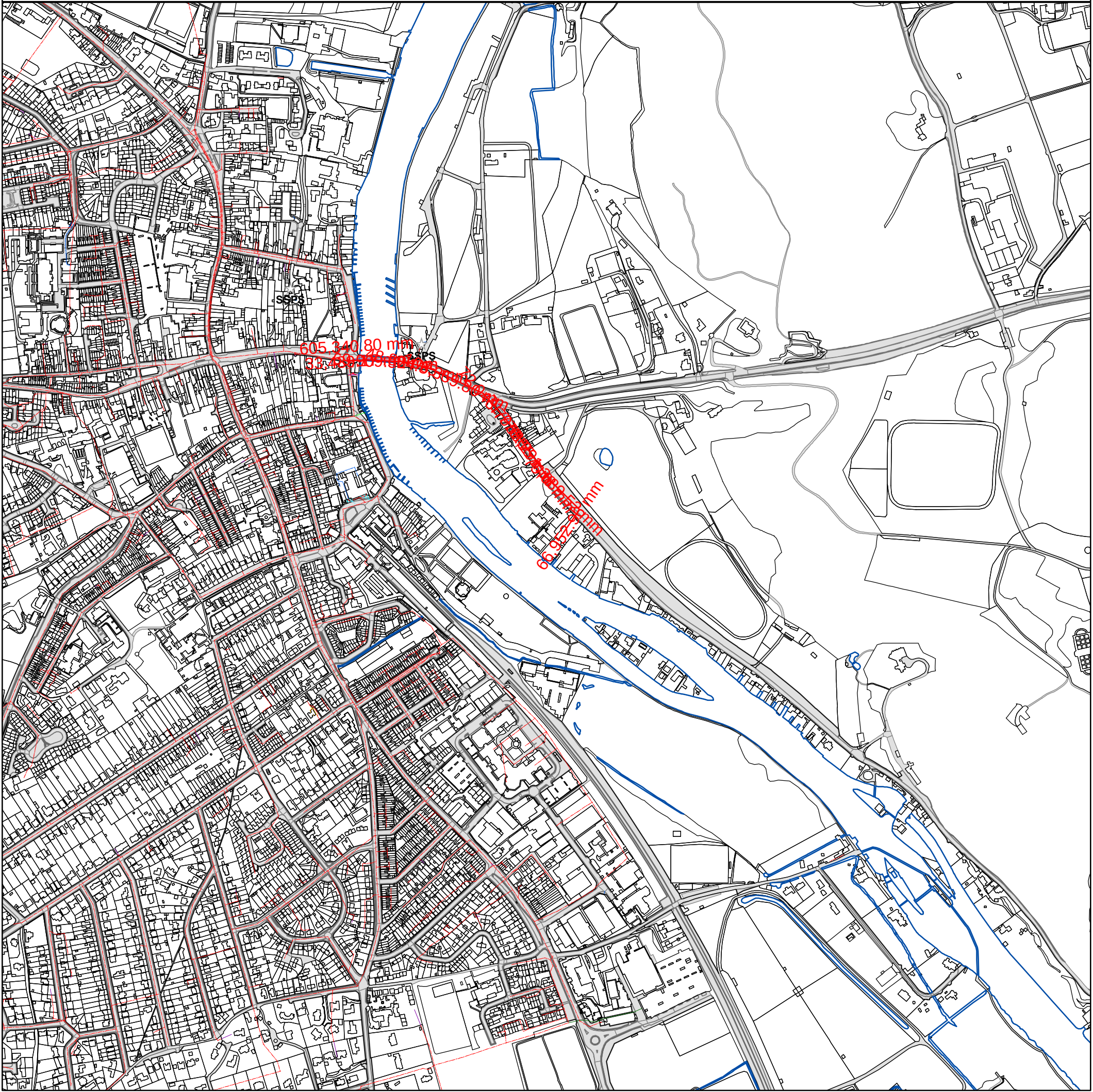
Sewer Record



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 476750,182250

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.



The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified before any works are undertaken. Crown copyright Reserved

Scale: 1:7161
Width: 2000m
Printed By: BArumuga
Print Date: 11/12/2024
Map Centre: 476677,182299
Grid Reference: SU7682SE

Comments:

Appendix C

Site Investigation Information





A2 Site Investigation

Borehole Log

Project Rivertrees				Borehole No BH01	
Job No 61225	Start 03/03/2025 End 05/03/2025	Ground Level (mOD) 32.22	Co-Ordinates (Local Grid) E 476705.00 N 182313.00		Depth (m) 20.50
Client Jo Turner / Matthew Turner			SPT Energy Ratio % 68	Sheet Sheet 1 of 3	Status FINAL

SAMPLES & TESTS				Stratum Description	Depth (thickness)	Reduced Level	Water	Legend	Instrument / Backfill
Depth (m)	TCR SCR RQD	If	Test Result/ Samples						
0.50 0.50 - 1.00			B 1 ES 2	Cobblestone pavement. [MADE GROUND - DRIVEWAY SURFACE] Loose yellowish brown fine and medium SAND. [MADE GROUND - SUB BASE] Loose to medium dense sandy clayey angular to subangular fine to coarse GRAVEL of flint, brick and concrete. Sand is fine to coarse.	0.00 (0.06) 0.06 (0.09) 0.15 (0.45) 0.60	32.16 32.07 31.62			
1.00			ES 3	[MADE GROUND] Medium dense sandy clayey angular to subrounded fine to coarse GRAVEL of flint and chalk. Sand is fine to coarse. [KEMPTON PARK GRAVEL MEMBER]	(0.70)				
1.50 - 2.00 1.50			N=23 (2,2/4,6,6,7) B 4	Medium dense yellowish brown sandy slightly clayey angular to subrounded fine to coarse flint GRAVEL. Sand is fine to coarse. [KEMPTON PARK GRAVEL MEMBER]	1.30	30.92	▼		
1.50 - 2.50	90 0 0								
2.50			N=30 (4,6/7,7,8,8)	<u>2.50 to 2.50m - ...becoming dense</u>					
3.00 - 3.50 2.50 - 3.50	100 0 0		B 5	<u>3.00 to 4.50m - ...becoming very sandy.</u>					
3.50			N=23 (5,4/4,7,6,6)		(4.90)				
4.00 - 4.50 3.50 - 4.50	70 0 0		B 6						
4.50 - 5.00 4.50			N=30 (4,7/8,8,6,8) B 7	<u>4.50 to 4.50m - ...becoming dense</u>					
4.50 - 5.50	30 0 0								
5.50 - 6.00 5.50			N=27 (4,4/7,7,6,7) B 8						
6.00 - 6.20			B 9	Structureless CHALK composed of firm white gravelly sandy SILT with low cobble content. Sand is fine to coarse chalk. Gravel is angular to subrounded fine to coarse of chalk and flint. Cobbles are angular to subrounded, clasts are weak medium density white chalk. (CIRIA Chalk Grade A)	6.20	26.02			
6.20 - 6.50 5.50 - 7.00	50 0 0		B 10	[HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]	(0.30)				
6.50			N=15 (2,3/4,3,4,4)	Structureless CHALK composed of medium strength white slightly sandy silty subangular to subrounded fine to coarse GRAVEL and COBBLES. Clasts are strong high density with occasional green specks. (CIRIA Chalk Grade B)	6.50	25.72			
7.00 - 8.50			C 11	[HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]					

	All dimensions in metres Scale 1:50	Contractor A2 Site Investigation	Method Rotary Drilling	Logged By FA	Approved by JE
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A2 Site Investigation

Borehole Log

Project Rivertrees				Borehole No BH01	
Job No 61225	Start 03/03/2025 End 05/03/2025	Ground Level (mOD) 32.22	Co-Ordinates (Local Grid) E 476705.00 N 182313.00		Depth (m) 20.50
Client Jo Turner / Matthew Turner			SPT Energy Ratio % 68	Sheet Sheet 2 of 3	Status FINAL

SAMPLES & TESTS				Stratum Description	Depth (thickness)	Reduced Level	Water	Legend	Instrument / Backfill
Depth (m)	TCR SCR RQD	If	Test Result/ Samples						
7.00 - 8.50	100 0 0			Structureless CHALK composed of medium strength white slightly sandy silty subangular to subrounded fine to coarse GRAVEL and COBBLES. Clasts are strong high density with occasional green specks. (CIRIA Chalk Grade B) [HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]	(2.30)				
8.50 - 10.00 8.50			N=17 (2,2/4,4,4,5) C 12						
9.10 - 9.30 8.50 - 10.00	80 20 10		C 13	Weak high density white unstained CHALK. Fractures are closely spaced, clean, unstained. (CIRIA Chalk Grade D) [HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]	8.80 (0.60)	23.42			
10.00 - 11.50 10.00			N=50 (13,8/50 for 230mm) C 14	Structureless CHALK composed of firm white gravelly sandy SILT with low cobble content. Sand is fine to coarse chalk. Gravel is angular to subrounded fine to coarse of chalk and flint. Cobbles are angular to subrounded, clasts are weak medium density white chalk. (CIRIA Chalk Grade A) [HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]	9.40 (1.00)	22.82			
10.00 - 11.50	100 10 0			White CHALK recovered as: medium strength dense white slightly sandy silty subangular to subrounded fine to coarse GRAVEL and COBBLES. Clasts are strong very high density with occasional green specks. (CIRIA Chalk Grade D) [HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]	10.40	21.82			
11.50 - 13.00 11.50			N=50 (10,8/50 for 240mm) C 15						
11.50 - 13.00	90 10 0								
13.00 - 14.50 13.00			N=50 (5,6/50 for 270mm) C 16		(5.00)				
13.00 - 14.50									



A2 Site Investigation

Borehole Log

Project Rivertrees				Borehole No BH01	
Job No 61225	Start 03/03/2025 End 05/03/2025	Ground Level (mOD) 32.22	Co-Ordinates (Local Grid) E 476705.00 N 182313.00		Depth (m) 20.50
Client Jo Turner / Matthew Turner			SPT Energy Ratio % 68	Sheet Sheet 3 of 3	Status FINAL

SAMPLES & TESTS				Stratum Description	Depth (thickness)	Reduced Level	Water	Legend	Instrument / Backfill
Depth (m)	TCR SCR RQD	If	Test Result/ Samples						
14.50 - 16.00 14.50	90 0 0		N=50 (6,13/50 for 290mm) C 17	White CHALK recovered as: medium strength dense white slightly sandy silty subangular to subrounded fine to coarse GRAVEL and COBBLES. Clasts are strong very high density with occasional green specks. (CIRIA Chalk Grade D) [HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]	15.40	16.82			
14.50 - 16.00	100 10 0			Weak medium density white unstained CHALK. Fractures are closely spaced, infilled, unstained. (CIRIA Chalk Grade D) [HOLYWELL NODULAR CHALK FORMATION AND NEW PIT CHALK FORMATION (UNDIFFERENTIATED)]					
16.00 - 17.50 16.00			N=50 (25 for 140mm/50 for 20mm) C 18						
16.00 - 17.50	100 20 0								
17.50 - 19.00 17.50			N=50 (5,7/50 for 275mm) C 19	17.50 to 19.00m - ...with grey marly chalk with intraclasts within, with more intraclasts /nodular appearance in the lighter chalk below followed by a couple of orange stained sponge nodular beds	(5.10)				
17.50 - 19.00	100 30 0								
19.00 - 20.50 19.00 19.10 - 19.25			N=50 (7,7/50 for 220mm) C 20 C 21						
19.60 - 19.70 19.00 - 20.50	100 40 20								
20.50			N=50 (4,19/50 for 140mm)	End of Borehole at 20.50m		11.72			



A2 Site Investigation

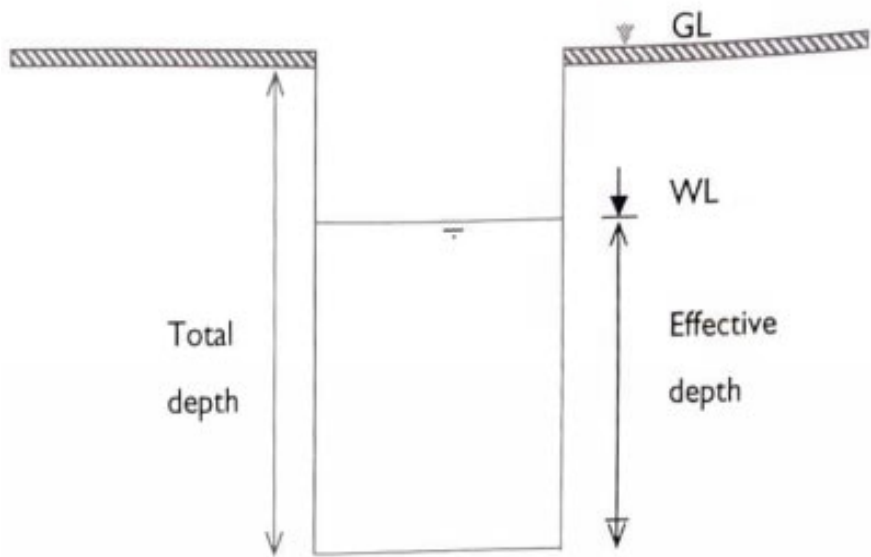
SOIL INFILTRATION TEST

In accordance with BRE Digest 365

Client: Jo Turner / Matthew Turner	Engineer: FA	INF02(BH01) - Test 1
Project: Rivertrees	Date: 03/03/2025	
Job Number: 61225	Time to fill pit:	

Pit Dimensions			
Length (m)	Width (m)	Total depth (m)	Effective depth (m)
0.3	0.3	0.5	0.2

Elapsed Time (mins)	Water Level (mbgl)	Head (m)	Head (%)
0	0.3	0.2	100.0
1	0.35	0.15	75.0
2	0.39	0.11	55.0
3	0.44	0.06	30.0
4	0.5	0	0.0



Soil Infiltration Rate: 3.25E-04 m/s
Notes:





A2 Site Investigation

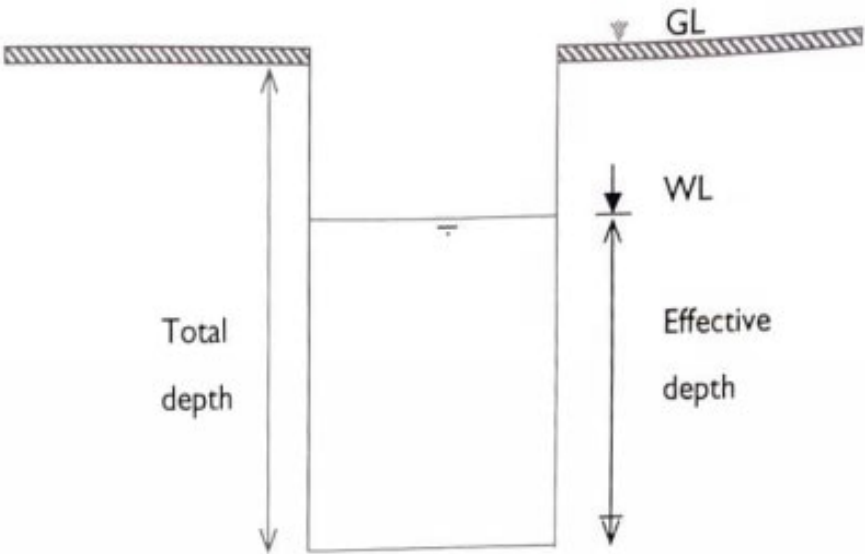
SOIL INFILTRATION TEST

In accordance with BRE Digest 365

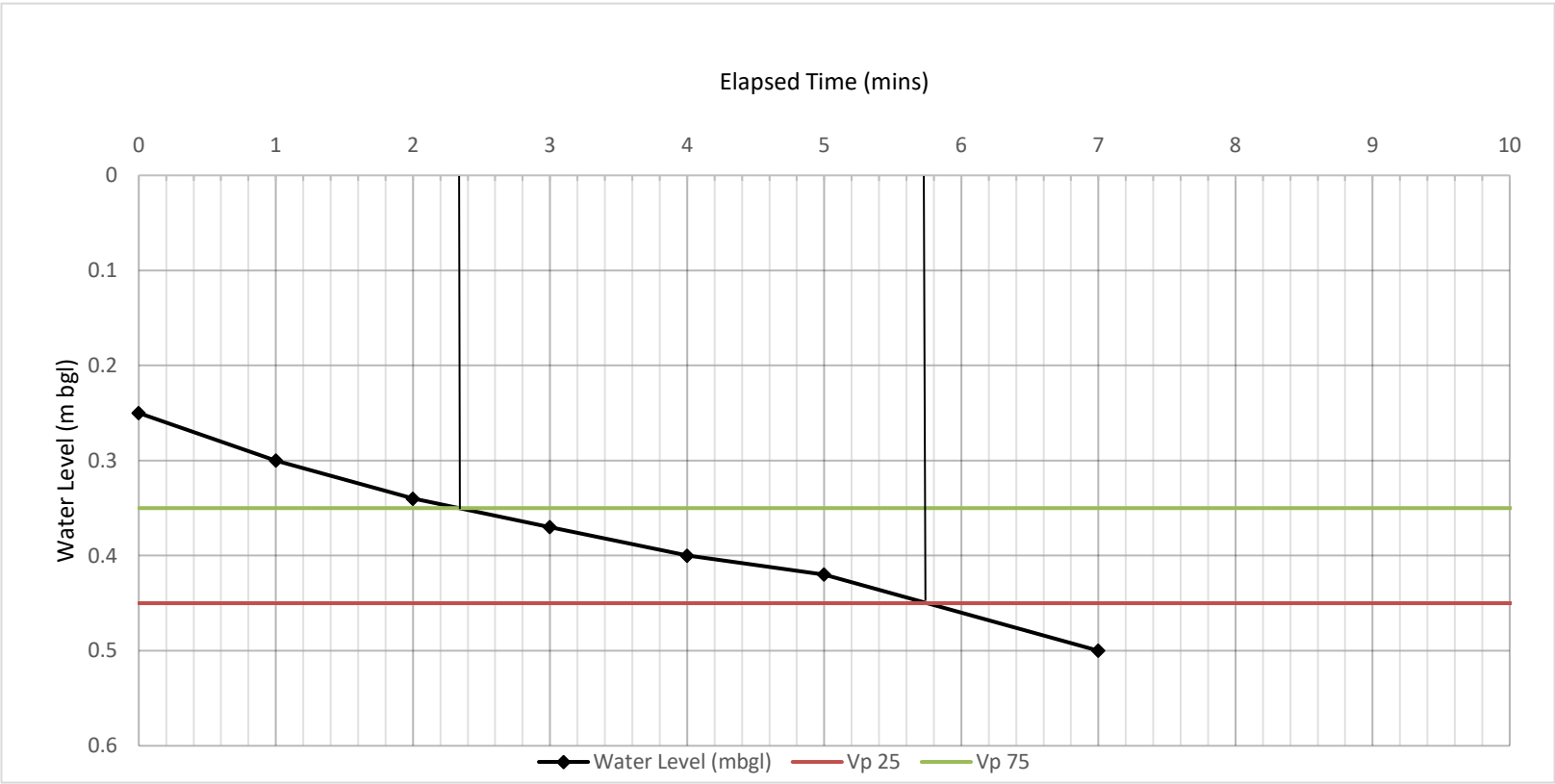
Client: Jo Turner / Matthew Turner	Engineer: FA	INF02 (BH01) - Test 2
Project: Rivertrees	Date: 03/03/2025	
Job Number: 61225	Time to fill pit:	

Pit Dimensions			
Length (m)	Width (m)	Total depth (m)	Effective depth (m)
0.3	0.3	0.5	0.2

Elapsed Time (mins)	Water Level (mbgl)	Head (m)	Head (%)
0	0.25	0.25	100.0
1	0.3	0.2	80.0
2	0.34	0.16	64.0
3	0.37	0.13	52.0
4	0.4	0.1	40.0
5	0.42	0.08	32.0
7	0.5	0	0.0



Soil Infiltration Rate: 2.10E-04 m/s



Appendix D

Hydraulic Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SWPS1			32.740	450	700.310	302.142	4.562
S2			32.440	450	696.073	296.963	0.699
S1 (CP)			32.740	600	699.284	300.582	0.975
S3			31.700	450	692.528	294.913	0.500
Dry-Dock	0.032	5.00	33.440	100	701.575	303.915	5.240

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
Dry-Dock Outfall	Dry-Dock	SWPS1	2.177	0.600	28.200	28.178	0.022	99.0	150	5.04	50.0
Rising Main	SWPS1	S1 (CP)	1.867	0.600	28.178	31.765	-3.587	-0.5	150	5.07	50.0
Soakaway Channel	S1 (CP)	S2	4.838	0.600	31.765	31.741	0.024	201.6	150	5.18	50.0
Soakaway Overflow	S2	S3	4.095	0.600	32.150	31.200	0.950	4.3	150	5.20	50.0

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	40	0	0

Node SWPS1 Online Pump Control

Flap Valve	x	Invert Level (m)	28.178	Switch off depth (m)	0.000
Replaces Downstream Link	✓	Switch on depth (m)	0.001		

Depth (m)	Flow (l/s)
0.001	12.000

Node S2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.75600	Safety Factor	2.0	Invert Level (m)	31.741
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	40

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	32.0	32.0	0.375	32.0	39.5	0.376	0.0	39.5

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	59.371	16.800	30 year 480 minute summer	27.795	7.345
1 year 15 minute winter	41.664	16.800	30 year 480 minute winter	18.467	7.345
1 year 30 minute summer	38.167	10.800	30 year 600 minute summer	22.397	6.126
1 year 30 minute winter	26.784	10.800	30 year 600 minute winter	15.303	6.126
1 year 60 minute summer	25.353	6.700	30 year 720 minute summer	19.663	5.270
1 year 60 minute winter	16.844	6.700	30 year 720 minute winter	13.214	5.270
1 year 120 minute summer	20.812	5.500	30 year 960 minute summer	15.706	4.136
1 year 120 minute winter	13.827	5.500	30 year 960 minute winter	10.404	4.136
1 year 180 minute summer	17.835	4.590	30 year 1440 minute summer	10.938	2.932
1 year 180 minute winter	11.593	4.590	30 year 1440 minute winter	7.351	2.932
1 year 240 minute summer	14.947	3.950	30 year 2160 minute summer	7.516	2.077
1 year 240 minute winter	9.930	3.950	30 year 2160 minute winter	5.179	2.077
1 year 360 minute summer	12.086	3.110	30 year 2880 minute summer	6.092	1.633
1 year 360 minute winter	7.856	3.110	30 year 2880 minute winter	4.094	1.633
1 year 480 minute summer	9.750	2.577	100 year +40% CC 15 minute summer	539.068	152.538
1 year 480 minute winter	6.478	2.577	100 year +40% CC 15 minute winter	378.293	152.538
1 year 600 minute summer	8.080	2.210	100 year +40% CC 30 minute summer	354.633	100.349
1 year 600 minute winter	5.520	2.210	100 year +40% CC 30 minute winter	248.865	100.349
1 year 720 minute summer	7.245	1.942	100 year +40% CC 60 minute summer	237.421	62.743
1 year 720 minute winter	4.869	1.942	100 year +40% CC 60 minute winter	157.737	62.743
1 year 960 minute summer	5.977	1.574	100 year +40% CC 120 minute summer	142.977	37.784
1 year 960 minute winter	3.959	1.574	100 year +40% CC 120 minute winter	94.990	37.784
1 year 1440 minute summer	4.338	1.162	100 year +40% CC 180 minute summer	108.361	27.885
1 year 1440 minute winter	2.915	1.162	100 year +40% CC 180 minute winter	70.437	27.885
1 year 2160 minute summer	3.119	0.862	100 year +40% CC 240 minute summer	84.687	22.380
1 year 2160 minute winter	2.149	0.862	100 year +40% CC 240 minute winter	56.264	22.380
1 year 2880 minute summer	2.620	0.702	100 year +40% CC 360 minute summer	63.290	16.287
1 year 2880 minute winter	1.761	0.702	100 year +40% CC 360 minute winter	41.140	16.287
30 year 15 minute summer	299.037	84.617	100 year +40% CC 480 minute summer	48.895	12.921
30 year 15 minute winter	209.851	84.617	100 year +40% CC 480 minute winter	32.485	12.921
30 year 30 minute summer	193.795	54.837	100 year +40% CC 600 minute summer	39.338	10.760
30 year 30 minute winter	135.996	54.837	100 year +40% CC 600 minute winter	26.878	10.760
30 year 60 minute summer	129.165	34.135	100 year +40% CC 720 minute summer	34.493	9.245
30 year 60 minute winter	85.814	34.135	100 year +40% CC 720 minute winter	23.182	9.245
30 year 120 minute summer	79.639	21.046	100 year +40% CC 960 minute summer	27.512	7.244
30 year 120 minute winter	52.910	21.046	100 year +40% CC 960 minute winter	18.224	7.244
30 year 180 minute summer	60.990	15.695	100 year +40% CC 1440 minute summer	19.053	5.106
30 year 180 minute winter	39.645	15.695	100 year +40% CC 1440 minute winter	12.805	5.106
30 year 240 minute summer	47.906	12.660	100 year +40% CC 2160 minute summer	12.978	3.587
30 year 240 minute winter	31.828	12.660	100 year +40% CC 2160 minute winter	8.942	3.587
30 year 360 minute summer	35.905	9.240	100 year +40% CC 2880 minute summer	10.434	2.796
30 year 360 minute winter	23.339	9.240	100 year +40% CC 2880 minute winter	7.012	2.796

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	SWPS1	3	28.179	0.001	2.0	0.0002	0.0000	OK
30 minute summer	S2	21	31.764	0.023	2.7	0.7064	0.0000	OK
15 minute summer	S1 (CP)	9	31.821	0.056	3.1	0.0159	0.0000	OK
15 minute summer	S3	1	31.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Dry-Dock	10	28.242	0.042	3.1	0.0003	0.0000	OK

US Node	Outflow (l/s)	Discharge Vol (m³)
SWPS1	2.0	
S2	0.0	0.0
S2	1.6	
S1 (CP)	3.1	
Dry-Dock	3.1	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SWPS1	12	28.784	0.606	13.8	0.0964	0.0000	SURCHARGED
30 minute summer	S2	24	31.896	0.155	12.0	4.7309	0.0000	OK
30 minute summer	S1 (CP)	23	31.923	0.158	12.0	0.0447	0.0000	SURCHARGED
15 minute summer	S3	1	31.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Dry-Dock	12	28.807	0.607	15.6	0.0049	0.0000	SURCHARGED

US Node	Outflow (l/s)	Discharge Vol (m³)
SWPS1	12.0	
S2	0.0	0.0
S2	3.4	
S1 (CP)	12.0	
Dry-Dock	13.8	

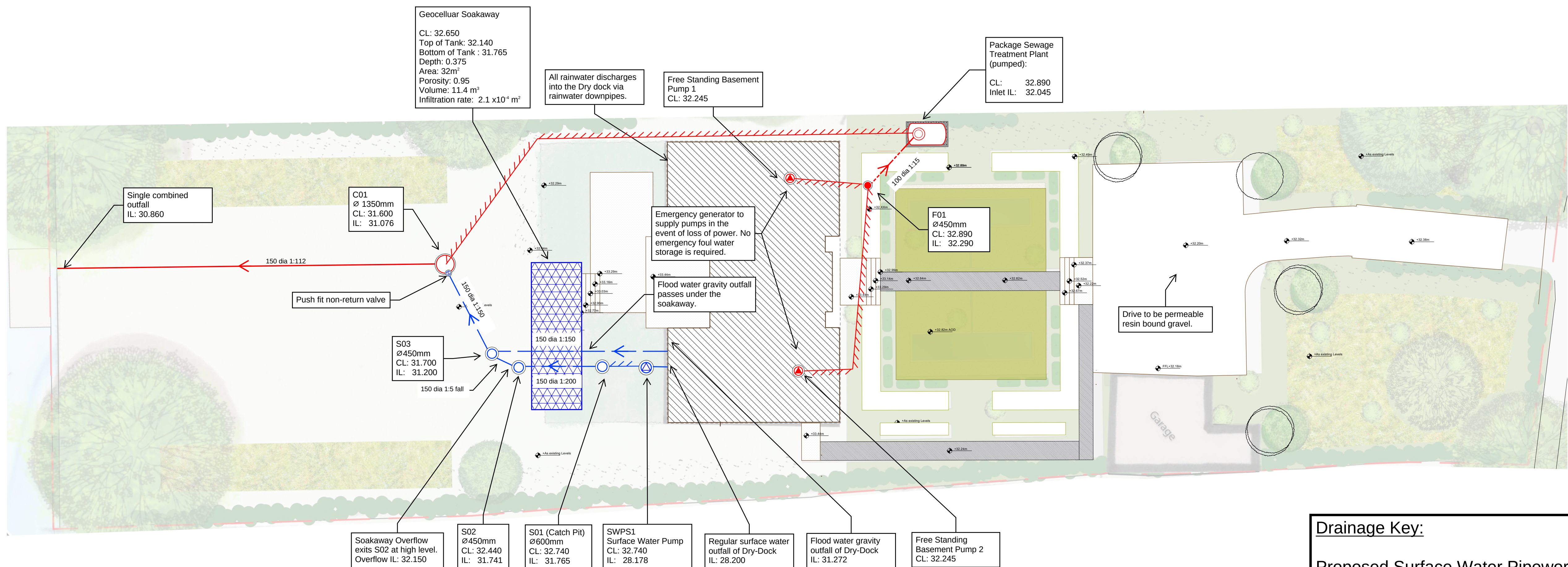
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SWPS1	13	30.519	2.341	20.1	0.3723	0.0000	SURCHARGED
60 minute summer	S2	45	32.099	0.358	12.0	10.9256	0.0000	OK
60 minute summer	S1 (CP)	44	32.123	0.358	12.0	0.1014	0.0000	SURCHARGED
15 minute summer	S3	1	31.200	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Dry-Dock	13	30.544	2.344	28.2	0.0188	0.0000	SURCHARGED

US Node	Outflow (l/s)	Discharge Vol (m³)
SWPS1	12.0	
S2	0.0	0.0
S2	3.4	
S1 (CP)	12.0	
Dry-Dock	20.1	

Appendix E

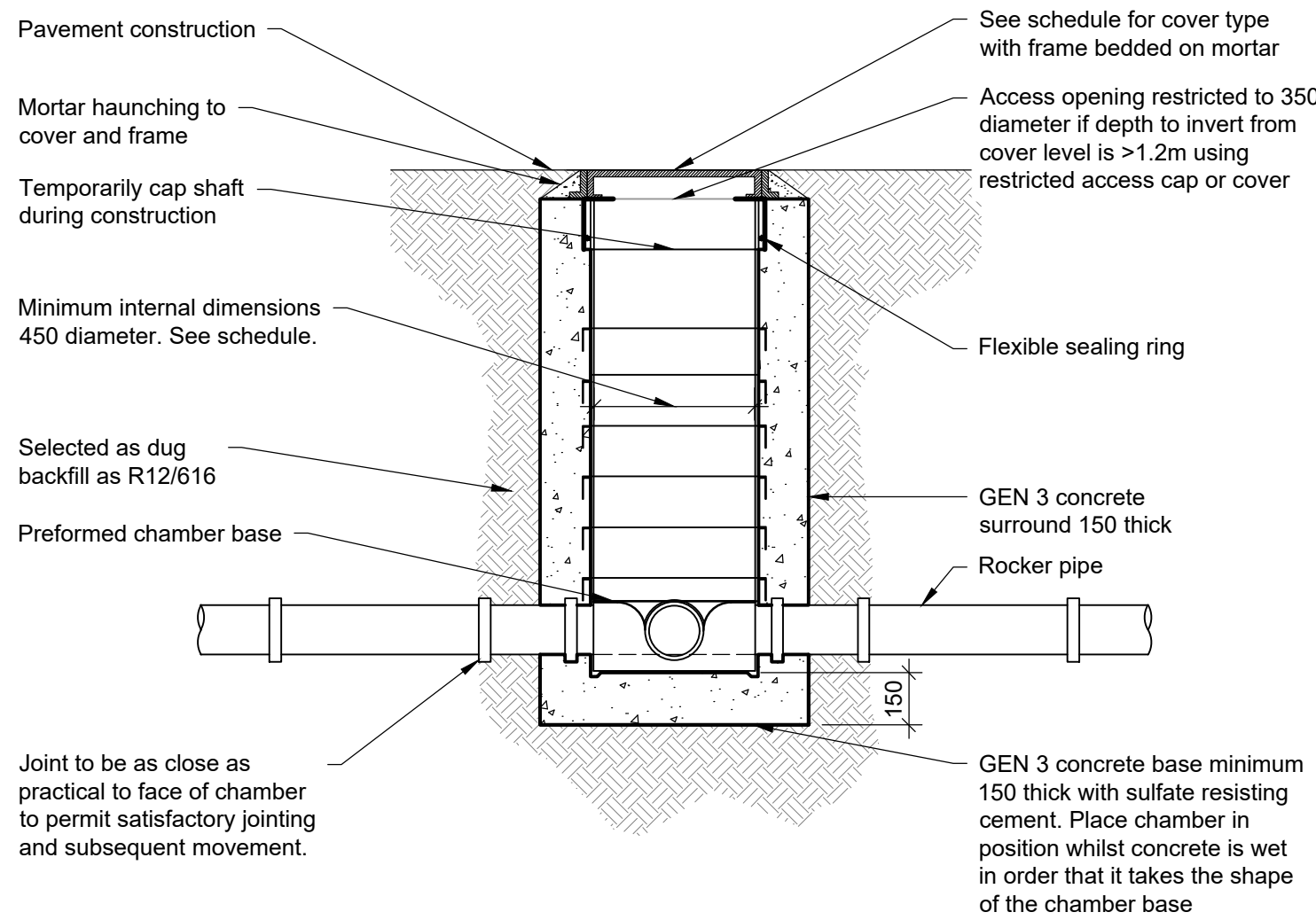
Drainage Layout & Details



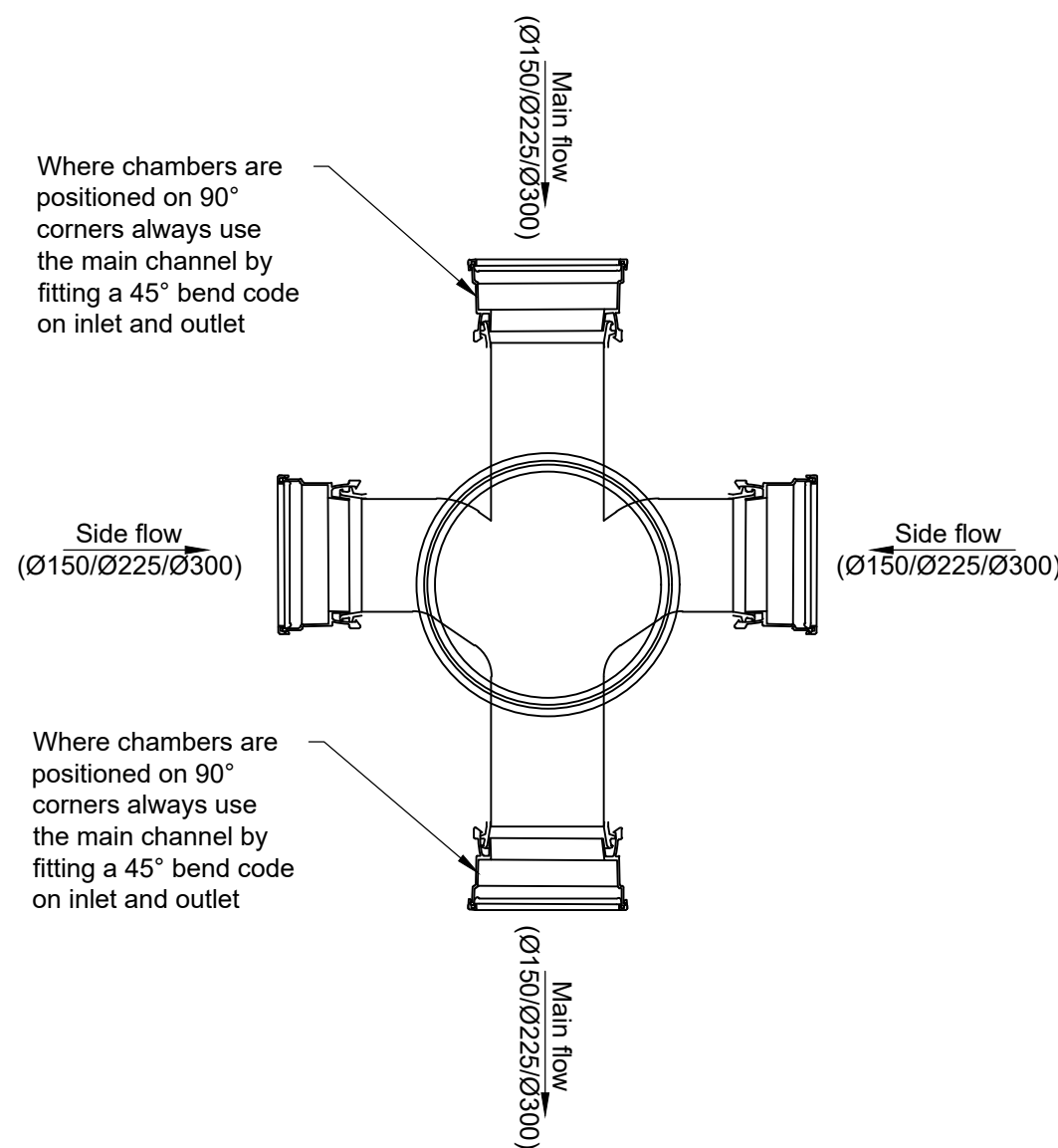
Below Ground Drainage Layout

Drainage Key:

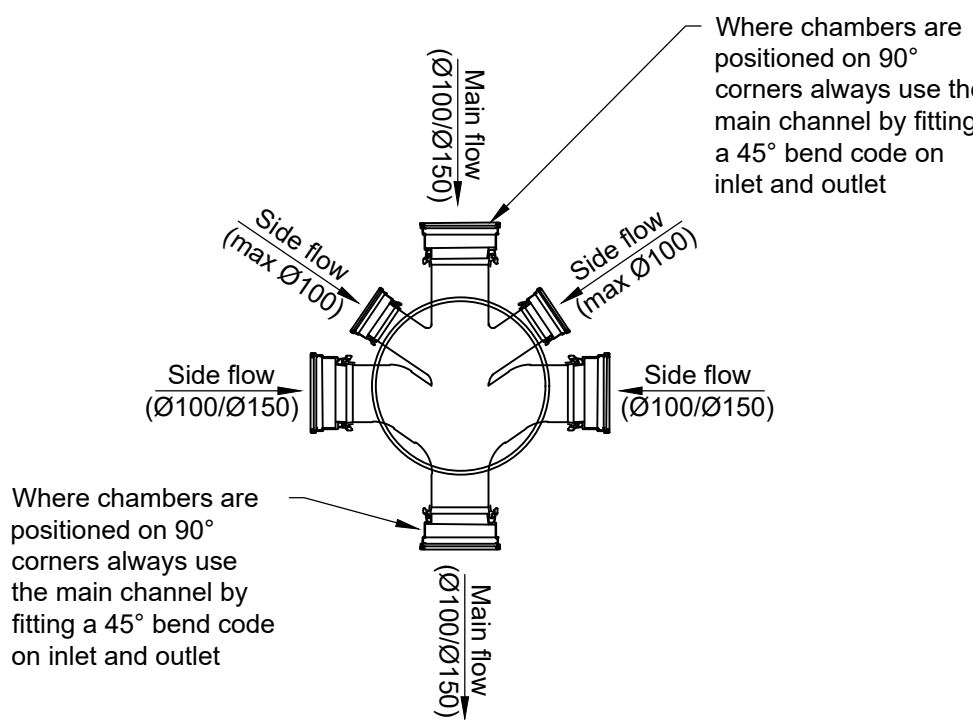
Proposed Surface Water Pipework	
Proposed Foul Water Pipework	
Proposed Combined Water Pipework	
Proposed Surface Water Rising Main	
Proposed Foul Water Rising Main	
Proposed Surface Water Inspection Chamber 450mm	
Proposed Foul Water Inspection Chamber 450mm	
Proposed Combined Water Manhole	
Proposed Surface Water Pumping Station	
Proposed Free Standing Basement Foul Water Pump	
Proposed Package Sewage Treatment Plant	
Proposed Surface Water Non-Return Valve	
Proposed Geocellular Soakaway	



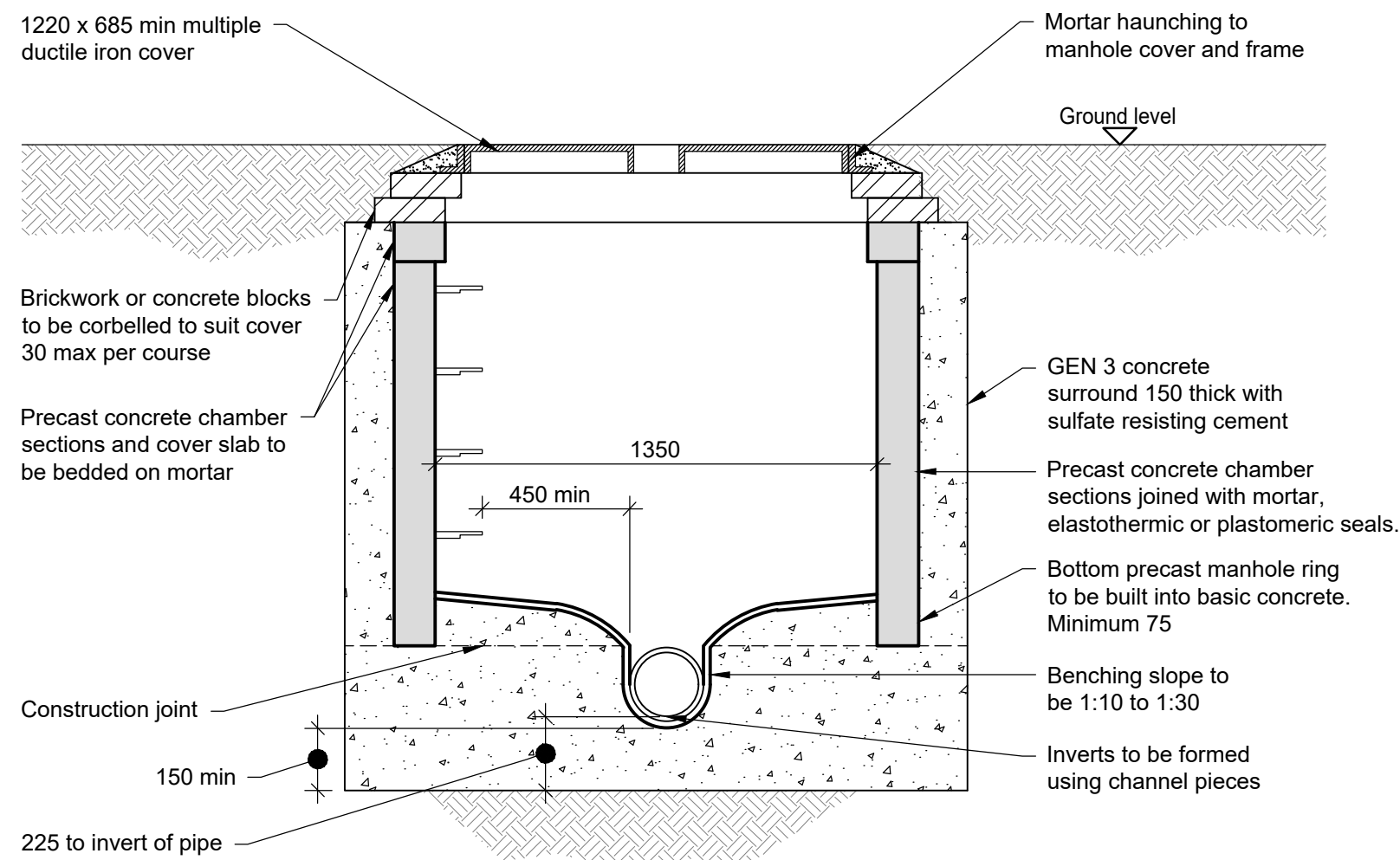
PLASTIC INSPECTION CHAMBER
FOR 450 DIAMETER CHAMBERS IN :-
SOFT LANDSCAPING, PEDESTRIAN- B125 LOADED AREAS UP TO 1.0m DEEP



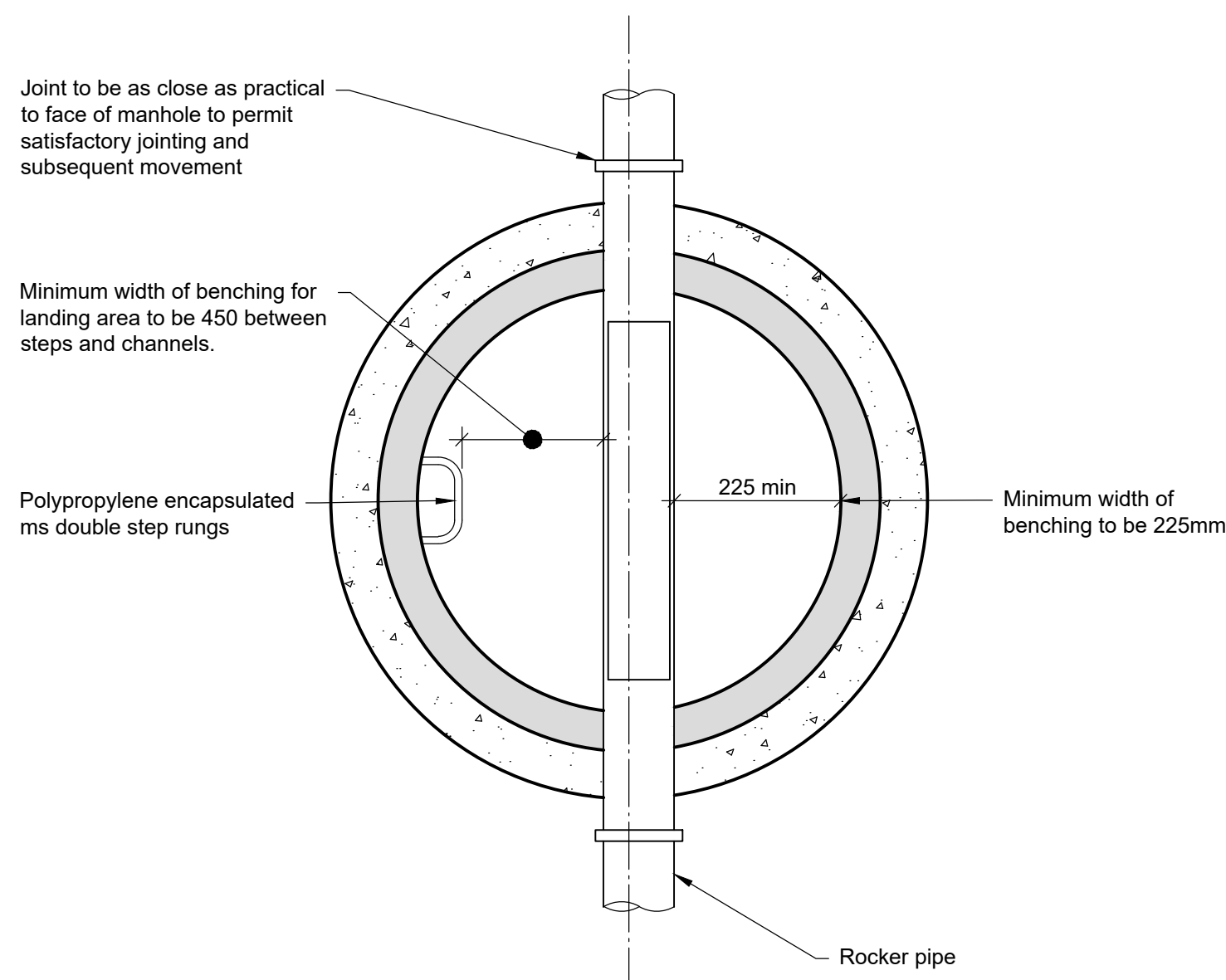
Ø600 WAVIN PPIC PLAN
Ø300 MAIN CHANNEL
MAX 1 NO. Ø300 SIDE CONNECTION ON EACH SIDE
(30mm STEP HEIGHT FOR ALL BRANCH CONNECTIONS)



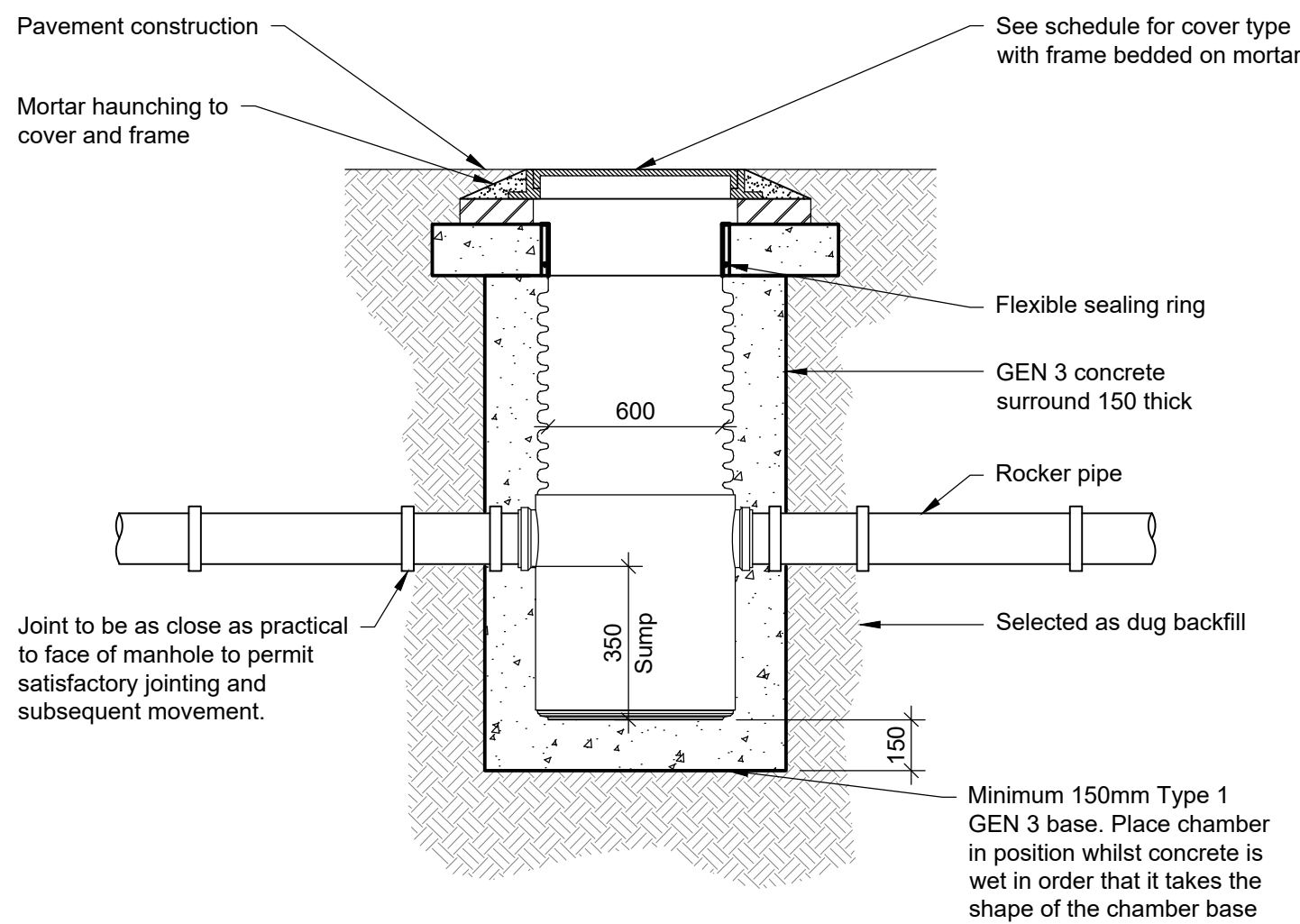
Ø450 WAVIN PPIC PLAN
Ø150 MAIN CHANNEL
MAX 2 NO. (Ø100 & Ø150) SIDE CONNECTIONS ON EACH SIDE
(50mm STEP HEIGHT FOR ALL BRANCH CONNECTIONS)



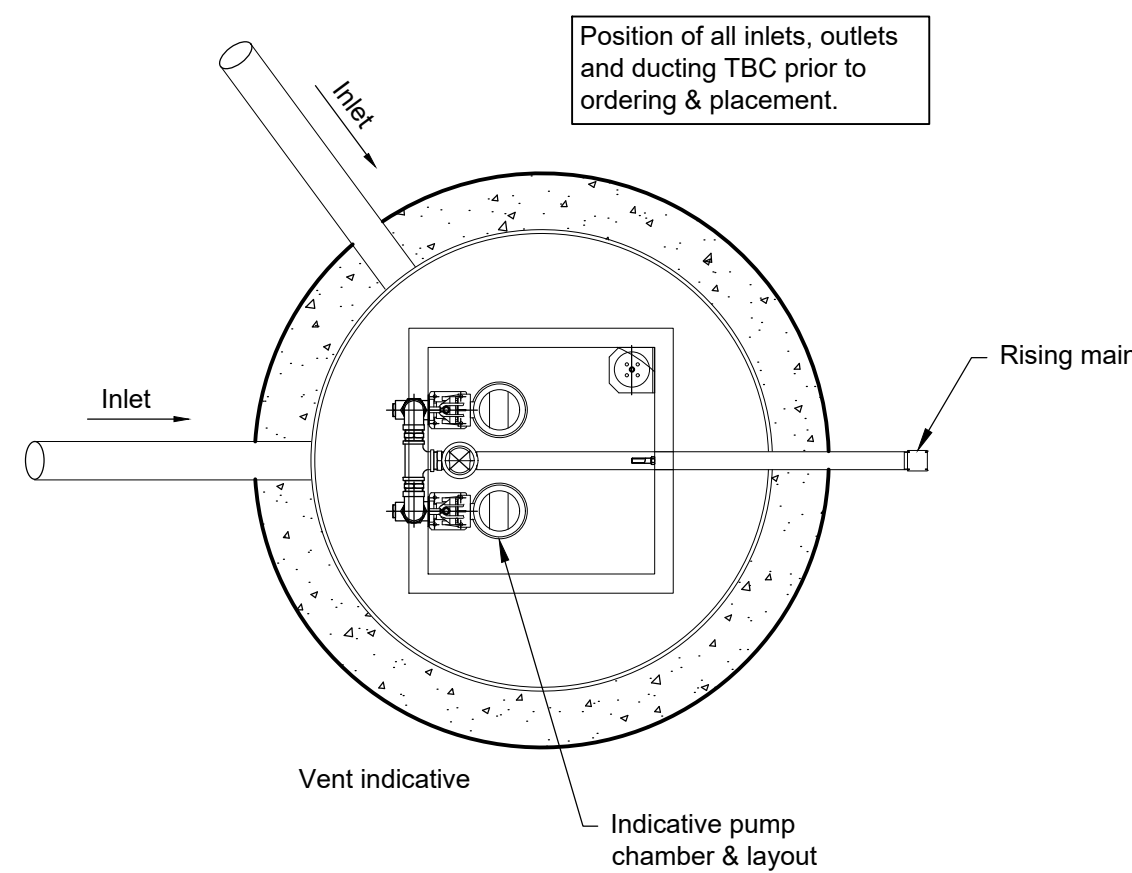
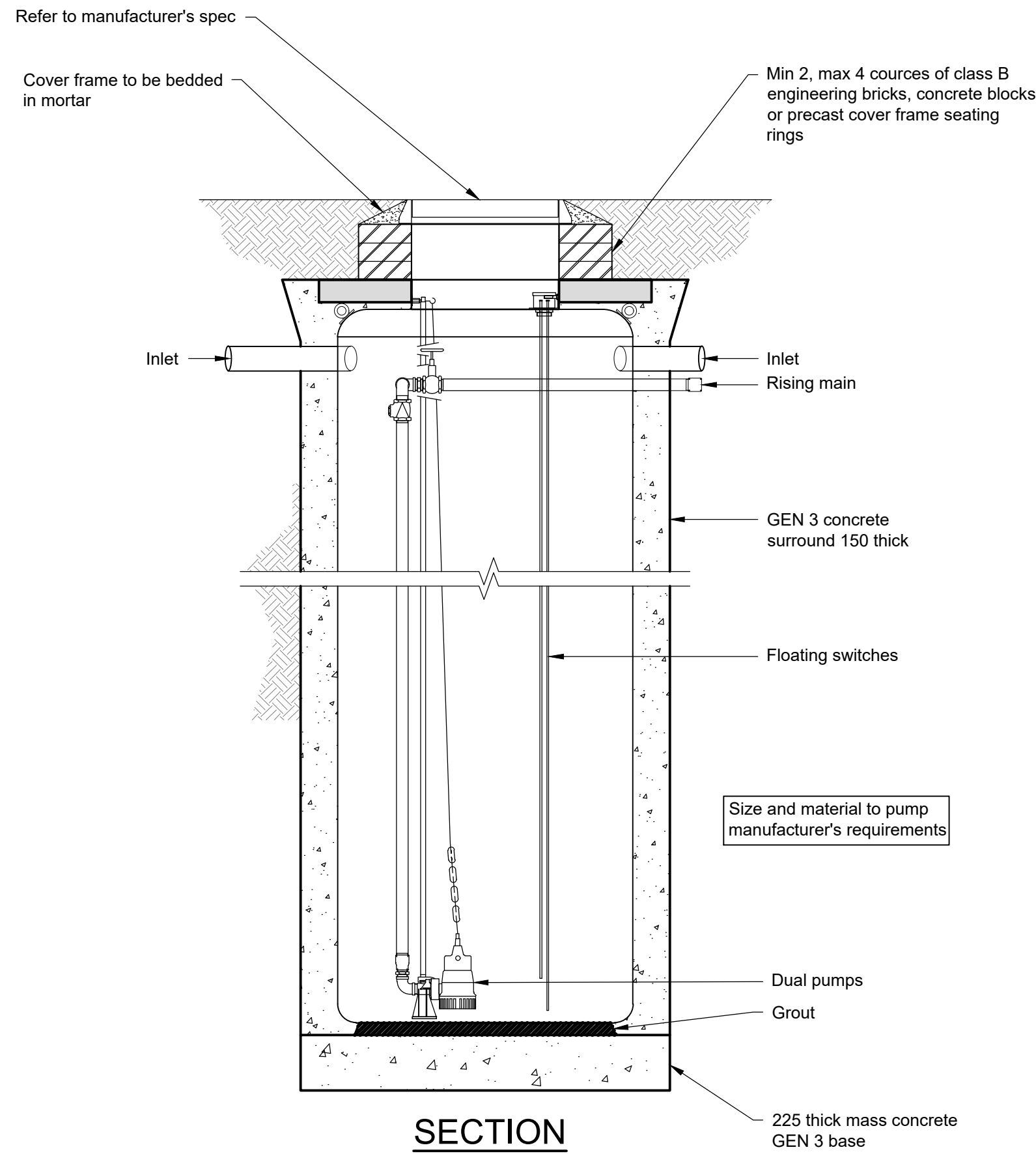
TYPE C MANHOLE DETAIL - SECTION
DEPTH TO SOFFIT LESS THAN 1.5m



TYPE C MANHOLE DETAIL - PLAN
DEPTH TO SOFFIT LESS THAN 1.5m
MAX PIPE SIZE 450MM DIAMETER



PLASTIC INSPECTION CHAMBER - CATCHPIT
FOR CHAMBERS IN :-
SOFT LANDSCAPING, PEDESTRIAN- B125 LOADED AREAS



GRP PUMP CHAMBER - PLAN VIEW

NOTES

- Co-ordination:** Read this drawing in conjunction with all relevant Architect's, Engineer's and specialist's drawings and specifications
- Scale:** Do not scale from this drawing, use written dimensions only. All dimensions are in millimetres and levels in metres. To check the drawing has been printed at the intended scale this bar should be 50mm long at A1 or 25mm long at A3.
- Health & Safety:** All specific drawing notes are to be read in conjunction with the Project Health & Safety Issues: Construction Stage document.
- General Notes:** Refer to drawing 31856-0002.

P01	15.05.25	SE	HD	Stage 3
Rev.	Date	Drm.	Eng.	Amendment

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BELOW GROUND DRAINAGE DETAILS SHEET 1

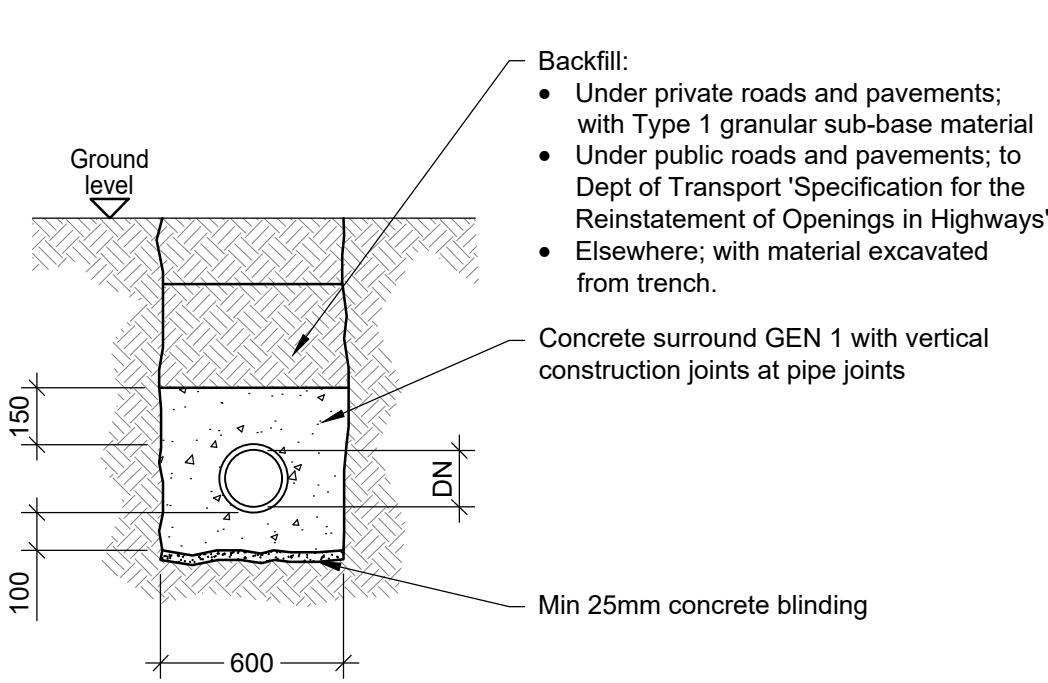
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FOR TENDER
NOT FOR CONSTRUCTION

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Drawing No.	31856 / 6100	Rev.	P01
Doc Ref.	RIV-PAM-ZZ-ZZ-DR-C-6100		

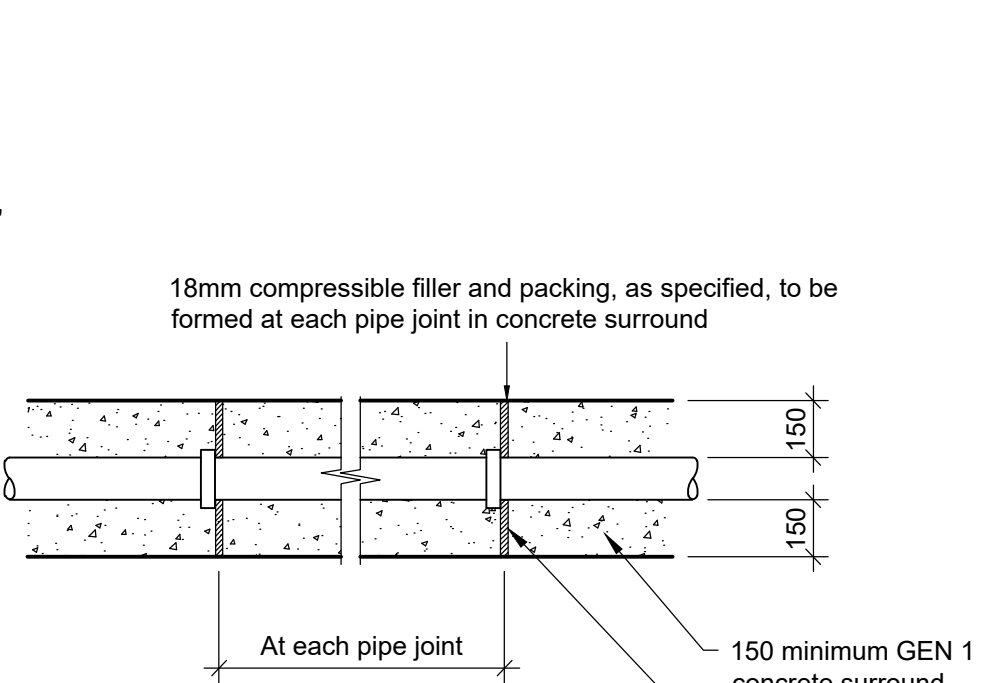
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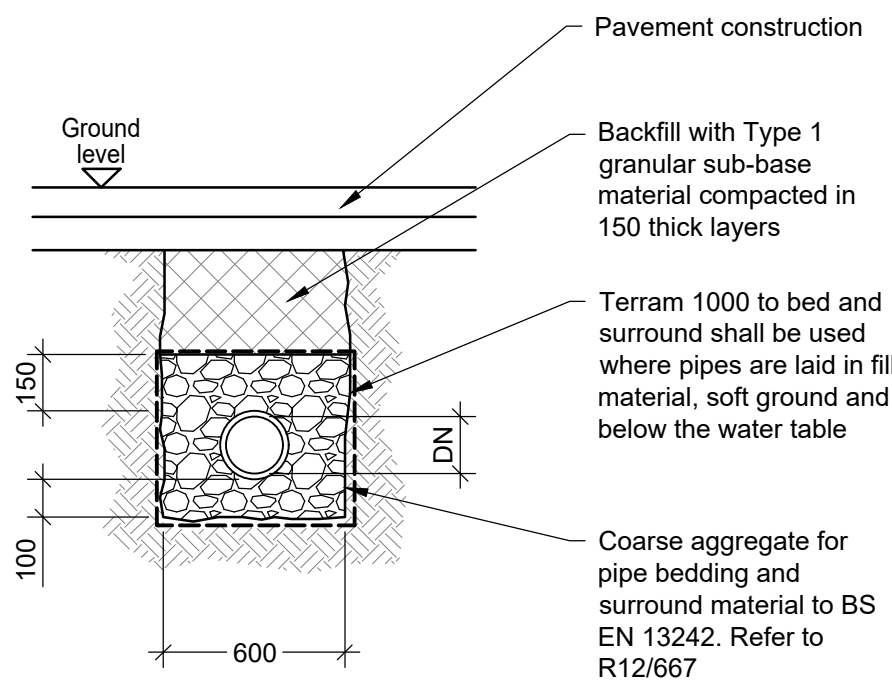


CLASS Z SURROUND

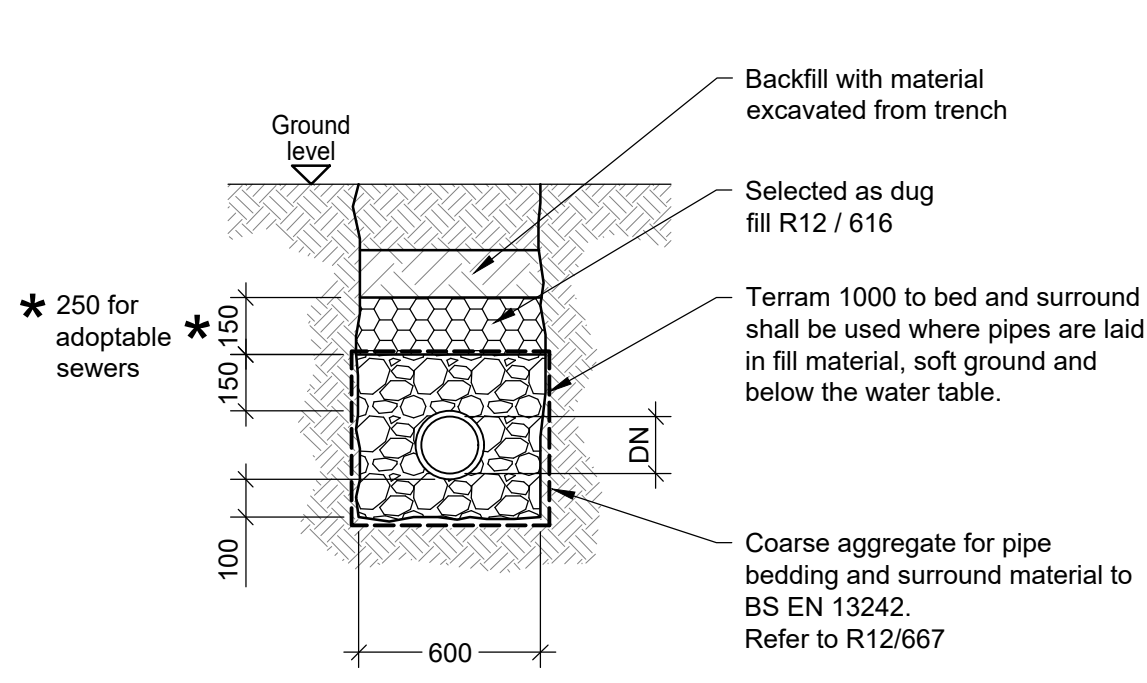


CLASS Z SURROUND
FLEXIBLE JOINTS IN
CONCRETE SURROUND

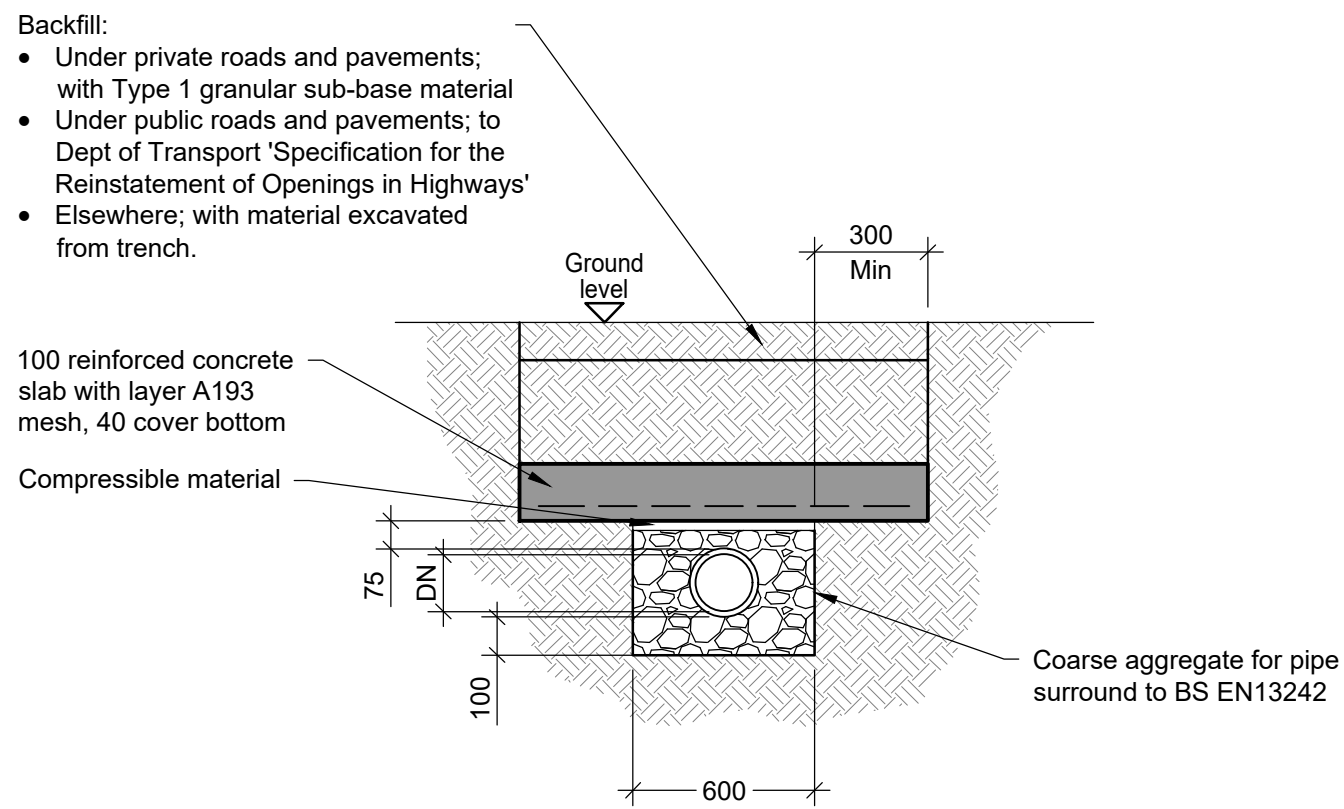
For plastic pipes care is to be taken in placing concrete to avoid deformation or displacement of pipe.



CLASS S SURROUND
GRANULAR SURROUND & BACKFILL FOR
AREAS SUBJECT TO VEHICLE LOADING

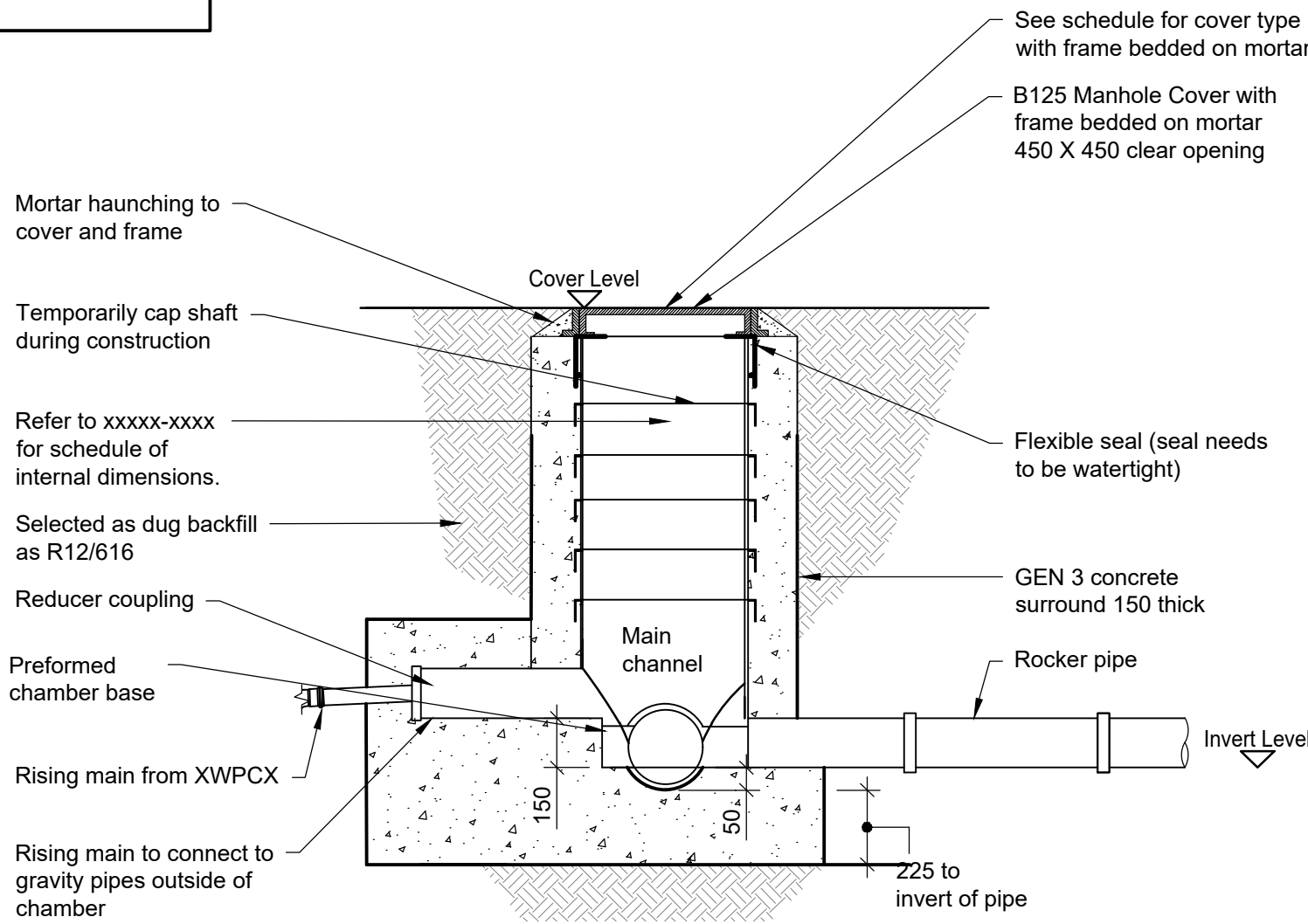


CLASS S SURROUND
GRANULAR SURROUND & BACKFILL FOR
SOFT OR HARD LANDSCAPING AREAS
NOT SUBJECT TO VEHICLE LOADING

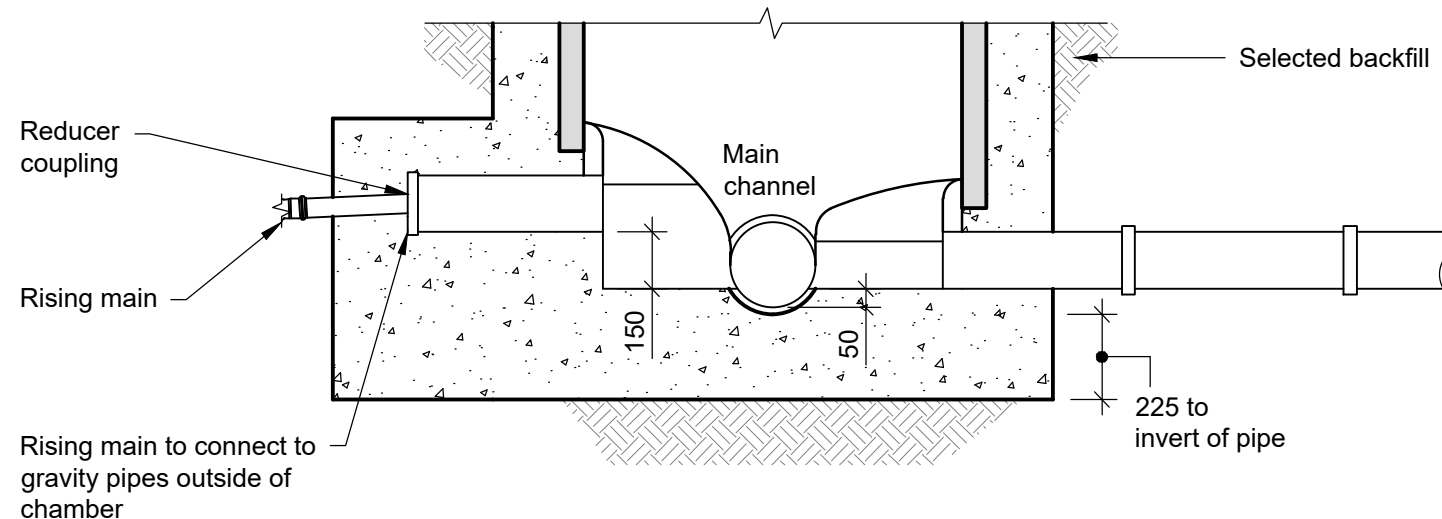


CLASS Q GRANULAR SURROUND

Provides protection in landscaped areas against driven tools. For cover < 600. Also use with plastic pipes.



RISING MAIN CONNECTION TO PPIC MANHOLE CHAMBER



RISING MAIN CONNECTION TO CHAMBER DETAIL

- NOTES**
- Co-ordination:** Read this drawing in conjunction with all relevant Architect's, Engineer's and specialist's drawings and specifications
 - Scale:** Do not scale from this drawing, use written dimensions only. All dimensions are in millimetres and levels in metres. To check the drawing has been printed at the intended scale this bar should be 50mm long at A1 or 25mm long at A3.
 - Health & Safety:** All specific drawing notes are to be read in conjunction with the Project Health & Safety Issues: Construction Stage document.
 - General Notes:** Refer to drawing 31856-0002.

P01	15.05.25	SE	HD	Stage 3
Rev.	Date	Drn.	Eng.	Amendment

RIVERTREES, HENLEY

BELOW GROUND
DRAINAGE DETAILS
SHEET 2

Status
FOR TENDER
NOT FOR CONSTRUCTION

Drawn	SE	Eng.	HD
Scales	1:20 at A1 U.N.O.	1:40 at A3	
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Doc Ref.	RIV-PAM-ZZ-ZZ-DR-C-6101		

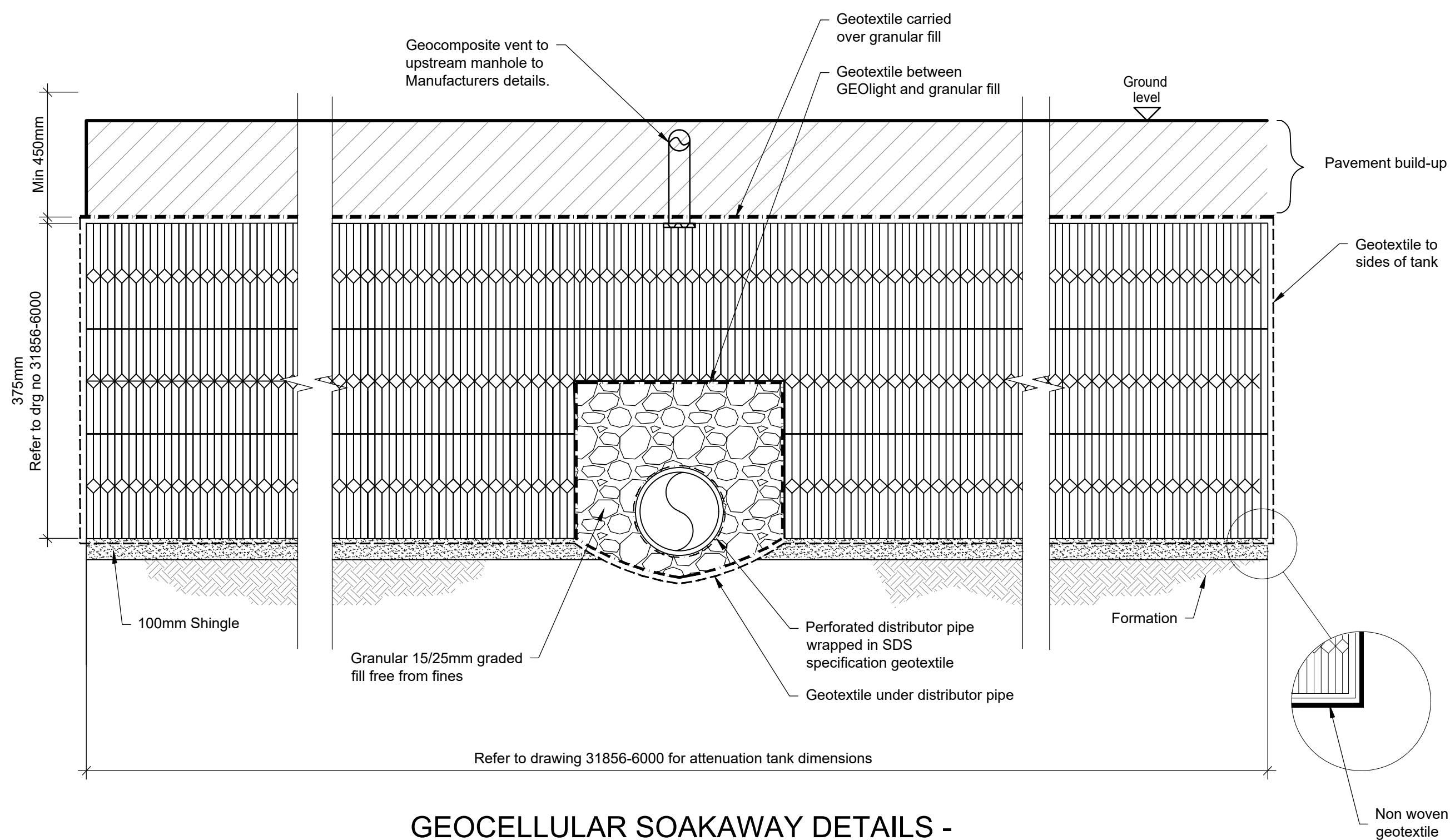
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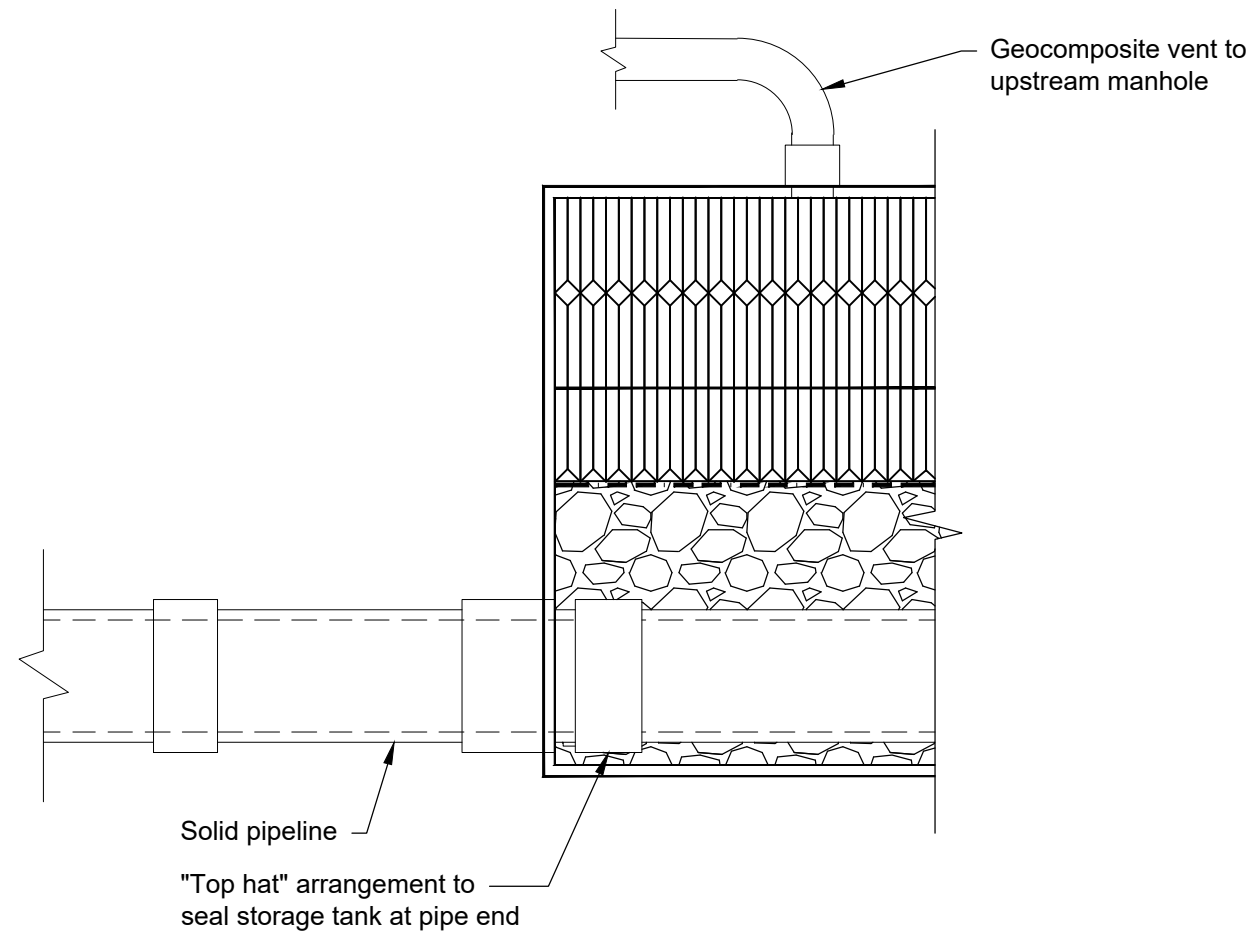
REFER TO SDS INSTALLATION
AND FORMATION PREPARATION
DETAILS FOR TANK
CONSTRUCTION DETAILS

ANY SOFT SPOTS TO BE DUG
OUT AND FILLED WITH CLEAN
COMPACTED TYPE 1 MATERIAL

FORMATION TO BE TESTED
PRIOR TO INSTALLATION OF
TANK AND BEDDING



**GEOCELLULAR SOAKAWAY DETAILS -
GEOLIGHT 400 SDS**



VENT PIPE DETAIL

NOTES

- 1. Co-ordination:** Read this drawing in conjunction with all relevant Architect's, Engineer's and specialist's drawings and specifications
- 2. Scale:** Do not scale from this drawing, use written dimensions only. All dimensions are in millimetres and levels in metres. To check the drawing has been printed at the intended scale this bar should be 50mm long at A1 or 25mm long at A3.
- 3. Health & Safety:** All specific drawing notes are to be read in conjunction with the Project Health & Safety Issues: Construction Stage document.
- 4. General Notes:** Refer to drawing 31856-0002.

P01	15.05.25	SE	HD	Stage 3
Rev.	Date	Dwn	Eng.	Amendment

RIVERTREES, HENLEY

BELOW GROUND
DRAINAGE DETAILS
SHEET 3

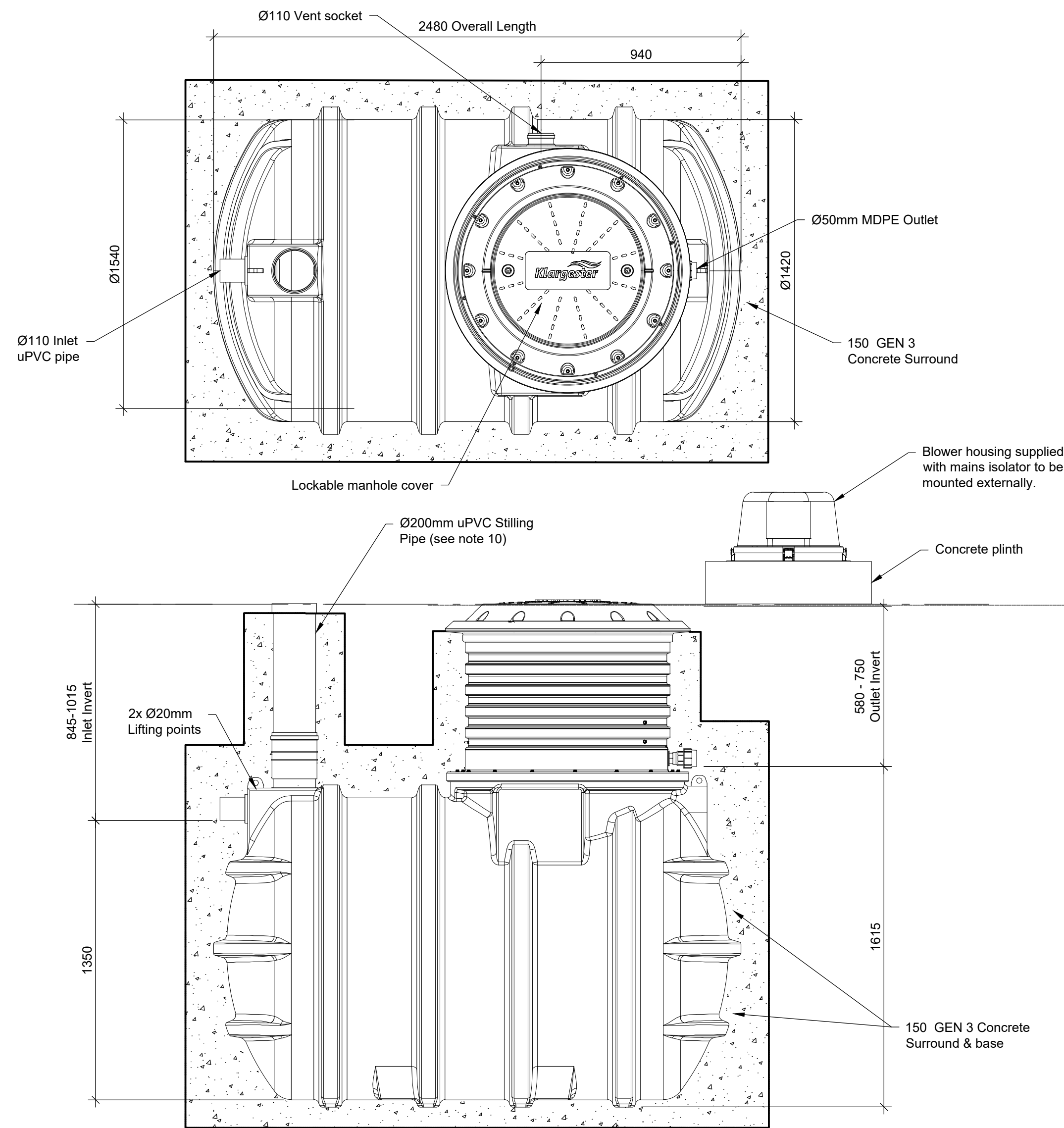
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Drawing No.	31856 / 6102	Rev.	P01
Doc Ref.	RIV-PAM-ZZ-ZZ-DR-C-6102		

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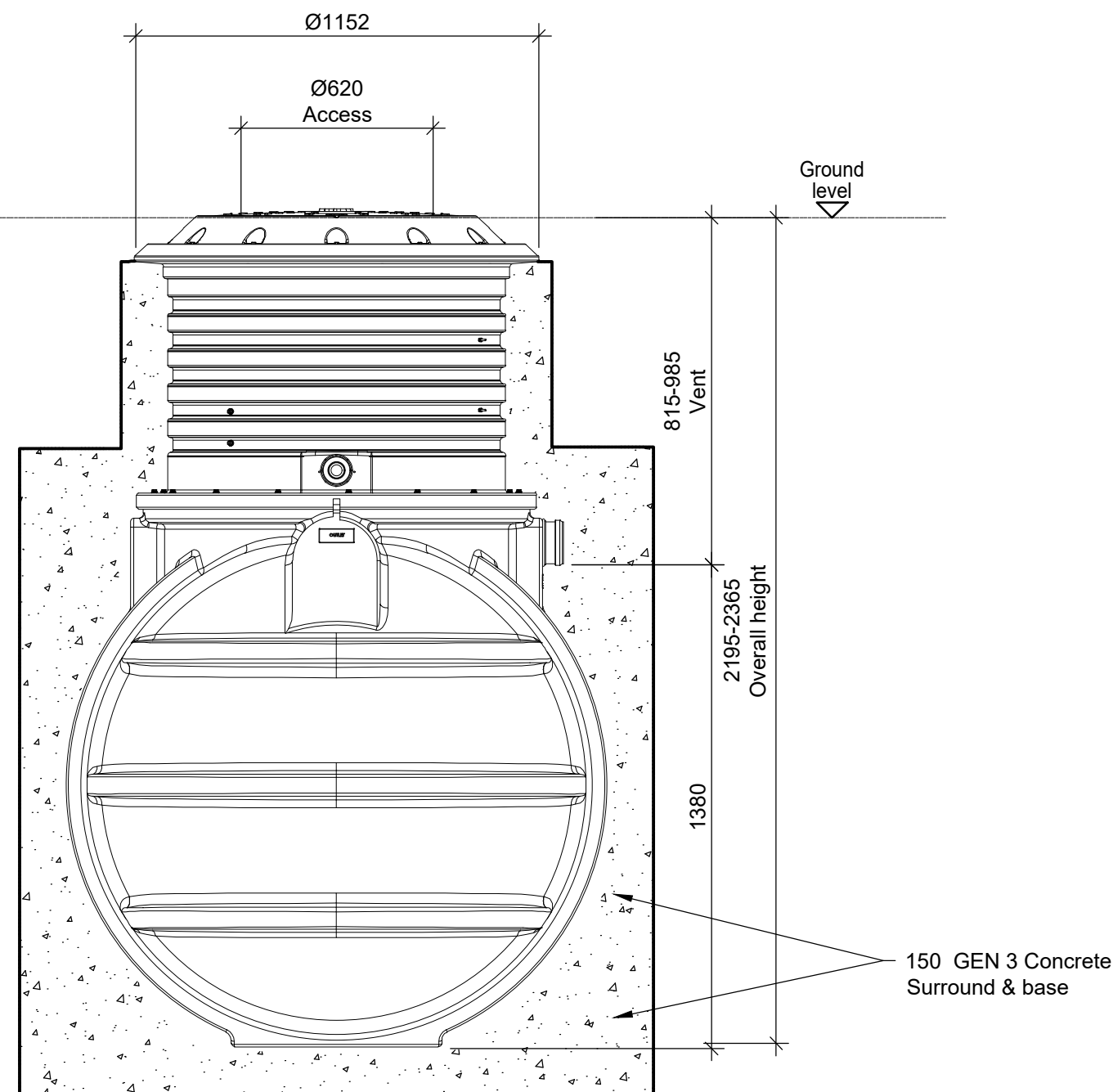
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Notes :

1. Inlet is Ø110mm. Suitable reducers should be used to step down from bigger pipework. Supplied by others.
OUTLET is Ø50mm outside diameter MDPE compression fitting.
2. Units invert is adjustable by trimming external riser to required height.
3. Selection of correct invert is key and must be suitable for drainage and ground levels on site.
4. Ext neck kit available for deeper inverts up to a maximum invert of 1400mm.
5. See extension neck drawing for assembly details.
It is important to read and understand installation operation and maintenance guidelines before attempting to install this unit.
6. Vent pipe connection is supplied but vent runs and stacks are supplied by others.
7. Air hose for tank internals is supplied with blower housing and is run through the vent.
8. Cable for the outlet pump is run through the vent.
9. Tank Weight (Empty) - 185 kg
10. Socket, Upper pipe & Blanking cap supplied by others.



KINGSPAN BIO-TEC+ 2 (PUMPED) DETAILS

NOTES

1. **Co-ordination:** Read this drawing in conjunction with all relevant Architect's, Engineer's and specialist's drawings and specifications
2. **Scale:** Do not scale from this drawing, use written dimensions only. All dimensions are in millimetres and levels in metres. To check the drawing has been printed at the intended scale this bar should be 50mm long at A1 or 25mm long at A3.
3. **Health & Safety:** All specific drawing notes are to be read in conjunction with the Project Health & Safety Issues: Construction Stage document.
4. **General Notes:** Refer to drawing 31856-0002.

P01	15.05.25	SE	HD	Stage 3
Rev.	Date	Dwn.	Eng.	Amendment

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BELOW GROUND
DRAINAGE DETAILS
SHEET 4

Status
FOR TENDER
NOT FOR CONSTRUCTION

Drawn	SE	Eng.	HD
Scales	1:20 at A1 U.N.O.	1:40 at A3	
Drawing No.	31856 / 6103	Rev.	P01
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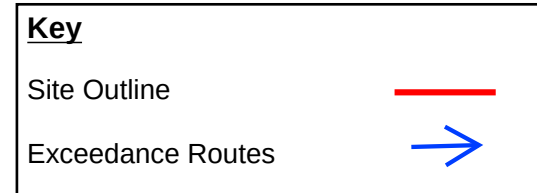
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Appendix F

Exceedance Routes



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