

To:	Arun District Council	From:	Envireau Water
Ref:	2449 Eric Wall Longacre GH&Res \ TN2 Query Response.docx	Pages:	5 + Figures + Appendices
Re:	Glasshouse and reservoir development, Maypole Lane, Yapton (Y/92/15/PL)	Date:	23/01/19

1 INTRODUCTION

Eric Wall Holdings Ltd have planning permission (Y/92/15/PL) for the erection of a glasshouse, reservoir and associated buildings at their site at Long Acre Field, Maypole Lane, Yapton, West Sussex ("the Site"). The planning permission was granted by Arun District Council in January 2016 subject to approval of a series of conditions.

Subsequently, Envireau Water provided a technical note and plans (herein referred to as "TN1") to provide information to aid in the discharge of Planning Conditions 8, 9, 10 and 11 of the planning permission (Y/92/15/PL) at the Site. The conditions are related to the management of surface and foul water as part of the proposed development.

Following submission of TN1, Arun District Council raised 14 comments regarding the proposals in an email dated 7/12/2018. The response to these comments is provided in the following section. This technical note (TN2) should be read in conjunction with TN1.

2 RESPONSE TO COMMENTS

2.1 *Infiltration rates are also better than we would expect in this area. When were the infiltration tests completed? Infiltration testing needs to be completed within the winter. And were three successive tests completed at each location?*

The locations of the infiltration testing was provided in TN1 - Section 2.1. These tests were undertaken on the 27th September 2018. At each location, the test pit was wetted followed by a test for infiltration. A third successive test was not undertaken.

We understand the importance of winter testing and have recently undertaken winter testing between 9th and 14th January 2019.



The locations of test pits for the September 2018 testing were determined prior to the finalisation of the drainage scheme. The final scheme placed the infiltration swales in slightly different locations and only test pit TPS3A remained within the swale location. The January 2019 winter testing was undertaken within the proposed infiltration swales locations. The locations of the September 2018 and January 2019 test pits are shown on TN2 Figure 1.

For the January 2019 testing, four new test pits (named TPS A to D) were excavated to a depth of 1m at key locations along the infiltration swales (TN2 Figure 1). Groundwater was not encountered in any of the test pits. The test pit TPS D located in the same location as September 2018 test pit TPS3A, encountered a similar sandy horizon albeit more limited in extent to TPS3A. The other January 2019 test pits encountered cohesive soils.

Three tests were conducted at TPS D, producing an infiltration rate of 1.62×10^{-6} m/s (Appendix A). This is an order of magnitude less than the September 2018 test undertaken at TPS3A.

Testing of the other January 2019 test pits were undertaken (Appendix A); however, these pits did not drain fully after 5 days on a single test (estimated infiltration rate based on manipulation of data recorded for the single test is c. 3.48×10^{-7} to 2.32×10^{-7} m/s).

The January 2019 testing has shown that infiltration rates are below the threshold value of 1×10^{-6} m/s given in the CIRIA SuDS Manual v6 – Report C753.

In light of the January 2019 testing, the road access will be constructed as a permeable pavement. Details of the permeable pavement are provided in TN2 Figure 2 and will be constructed to the design principles set out in BS 7533-13:2009.

The swales will remain in the design, allowing the permeable pavement to be a partial infiltration system (System B) providing surface runoff storage with a slow drain of excess water to the swale system.

However, the previously proposed overflow from the reservoir to the swales will no longer be incorporated. The revised model drainage plan for the eastern section of the Site is provided in TN2 Figure 3.

2.2 *Groundwater was found to be a lot lower than we expected, I note that winter monitoring has not occurred at the locations where infiltration is proposed. This will need to occur.*

TN1 – section 2.2 presents details of a groundwater monitoring network across the Site and the locations of groundwater monitoring points are shown on TN2 Figure 4. Groundwater levels across the site vary, being shallower in the west at circa. 2mbgl and deeper in the east >4mbgl. This is due to the variability in geology, material permeability, and the location of lower level drain points on the eastern boundary of the site.

Table 1 provides water level measurements collected at the monitoring points between October 2017 and January 2019. Table 1 shows that for the eastern section of the site (at the proposed reservoir location) over the 2017/2018 winter period, groundwater levels were a minimum of 4mbgl. Monitoring during December 2018 and January 2019 showed the monitoring points to be dry.

Table 1 Groundwater Level Data

Date	Groundwater Level (metres below ground level)				
	TPS1A	TPS2	TPS3	Site 1	Site 2
October 2017				DRY (>4.17)	DRY (>4.05)
November 2017				DRY (>4.17)	DRY (>4.05)
December 2017				DRY (>4.17)	DRY (>4.05)
January 2018				DRY (>4.17)	DRY (>4.05)
February 2018				DRY (>4.17)	DRY (>4.05)
March 2018				DRY (>4.17)	DRY (>4.05)
April 2018				DRY (>4.17)	DRY (>4.05)
27/09/2018	DRY (>4.08)	2.19	2.25	DRY (>4.17)	DRY (>4.05)
18/10/2018	DRY (>4.08)	2.82	3.17	DRY (>4.17)	DRY (>4.05)
09/11/2018	DRY (>4.08)	2.82	3.17	DRY (>4.17)	DRY (>4.05)
20/12/2018	DRY (>4.08)	0.44	0.38	DRY (>4.17)	DRY (>4.05)
09/01/2019	DRY (>4.08)	1.57	1.45	DRY (>4.17)	DRY (>4.05)
11/01/2019		1.67	1.54		
14/01/2019	DRY (>4.08)	1.77	1.62	DRY (>4.17)	DRY (>4.05)
22/01/2019	DRY (>4.08)	1.57	1.39	DRY (>4.17)	DRY (>4.05)

Data on groundwater levels in the western section of the site was collected during December 2018 and January 2019. Manual measurements were supplemented with high frequency data in order to understand the response of the groundwater to rainfall recharge and to understand how the groundwater system drains. Groundwater level data loggers were installed at monitoring points TPS2 and TPS3.

TN2 - Figure 5 shows two graphs, one for TPS2 and one for TPS3. Groundwater levels in September, October and November 2017 were between 2 and 3.2mbgl. In mid-December, groundwater levels increased to c. 0.4mbgl responding quickly to rainfall recharge. Rapid response is illustrated by the peak on 23 December 2018. The continuous fall in groundwater level over the following 18 days illustrates the free draining nature of the geology and the rapid fall in groundwater levels below 1mbgl.

2.3 Is the storm event which the reservoir can hold calculated based upon total reservoir volume or volume above the utilised irrigation water depth?

The storm event which the reservoir can hold is calculated based on the volume above the utilised irrigation water depth.

2.4 I presume that the siphon invert level is the control on the maximum water depth stored within the reservoir for irrigation purposes?

That is correct. The siphon invert level is the control level on the maximum water depth stored within the reservoir for irrigation purposes. Details of the siphon are provided in TN2 Figure 6. The siphon system will have an air vacuum primer system for ease of start-up and control of flow rate. The siphon pipe will be a 50mm HDPE pipe to allow a maximum flow of 2.5 l/s.

The siphon invert will be set at 7.5mAOD, 2.0m below the rim of the reservoir.

2.5 *I note that you are planning on excavating to 3.5m depth to form the base of the reservoir I am surprised that groundwater has not been found above this depth. If it is flotation checks will need to be undertaken.*

Based on the monitoring to date, groundwater levels in the eastern section of the site are below the 3.5m excavation depth. As shown in Table 1, groundwater measurements collected in the eastern section in December 2018 and January 2019, remained below this depth.

2.6 *You are proposing an overflow at 8.0m to take water to the infiltration swales. What is the depth of water for the 1 in 100 year plus climate change event above that used for irrigation storage?*

TN1 - Section 2.4.3 provides the results for a modelling scenario for a high level outflow (for events greater than a 1 in 100 year return period) from the reservoir to the swale system. Based on the January 2019 infiltration testing, the design has been revised and **NO** overflow from the reservoir will occur.

The new scenario has been modelled giving a required storm storage level within the reservoir of:

- 8.32mAOD for the 1 in 1000 year, 7 day event or
- 8.26mAOD for the 1 in 100 + 30%, 7 day event

This gives a maximum depth of water above the maximum irrigation depth of 0.82m (1.18m below the rim of the reservoir).

2.7 *You state that the siphon taking water to receiving watercourse will not be utilised if it is in flood conditions. Please elaborate on this.*

We are aware that the receiving watercourse and adjacent road is prone to flooding. Therefore, it is highly likely that during a storm event, the receiving watercourse will be flooded and therefore, a discharge from the reservoir at this time would not be beneficial. Part of this runoff originates from fields where the reservoir is proposed.

In order to help alleviate this flooding issue, the reservoir will accommodate storm events without discharging (see 2.6 above). The siphon will then be manually primed to allow for discharge from the reservoir **ONLY IF** the receiving watercourse and adjacent road is not in flood.

This provides a betterment for the flooding issues experienced at the receiving watercourse and adjacent road.

2.8 *Please provide further details of the pumps you are planning on utilising.*

The siphon roof drainage system emanating from the glasshouse, siphons water to the reservoir. Following rainfall events, the siphon pipes will need draining. This is achieved by a sump and an evacuation pump located in the siphon pipework. The details of the sump are provided in TN2 - Figure 7.

The pump will be a submersible pump placed in the sump. This will evacuate the water at a rate of 80 to 160 L/min.

Example pump would be akin to a “Lowara Doc 3SG/A 230v”

<https://www.pumpsukitd.com/doc-3sg-a-230v-without-float-switch.html>

The siphon drainage will have two 500mm HDPE pipes entering the reservoir draining the east and west sections of the glasshouse independently. Each of these pipes will have sumps with evacuation pumps.

2.9 *I have dealt with Causeway recently and identified a bug in the software which means that the half drain time calculated is for the first storm duration only. The software developer accepted this bug and is/was working to fix this. Can you please check if the bug is fixed within the version you are using?*

During the drainage system design, the version of Causeway that we were using was v7.0. Causeway has confirmed that this version had the bug that you are referring to, and that this bug was fixed in v8.0. We have re-run the model with v8.0 and re-presented the results in Appendix B. All additional modelling referred to in this document has been undertaken using Causeway v8.0.

2.10 *Can you also select to just print results from the critical storm events, to reduce size.*

We have provided the results for just the critical storm events in Appendix B.

2.11 *Please provide exceedance flow routes.*

Based on the approach that the reservoir is to accommodate runoff for all storm events up to the 1 in 1000 year, 7 day event, a siphon drainage system designed to capture all runoff for harvesting and incorporation of permeable paving, no exceedance flow routes will be generated.

2.12 *Please provide further details of the flood risk barrier.*

All reservoirs present a **theoretical** flood risk to neighbouring properties, and in this case the theoretical risk is to properties along the eastern boundary. Therefore, a flood risk barrier will be placed along the eastern boundary of the site to protect the neighbouring properties. The barrier will be placed upstream of the reservoir and will continue along the eastern boundary to a point where it is downstream of the properties. The flood risk barrier is to provide protection from breach of the reservoir to prevent flooding and also prevent soil scour of the adjacent land.

The barrier will be a series of 1.2m high L-blocks. All the blocks will be anchored down onto a concrete hardstanding. An example of an appropriate L-Block is provided in Appendix C. The blocks will be joined together by a suitable jointing compound such as Fosroc Thioflex 600 Gun or equivalent. The technical sheet for this compound is also provided in Appendix C.

2.13 *Layout plans need to show: slopes, diameters and materials of pipes; cover levels and invert levels of all manholes and silt traps; base levels and bank levels of all swales; overflow levels; etc. i.e. they need to be of a construction standard.*

Further details are provided in TN1 Figures 1 to 3 and 6 to 13.

2.14 *Full construction detail drawings will need to be submitted.*

Further details are provided in TN1 Figures 1 to 3 and 6 to 13.

3 SUMMARY

The responses given above directly address the queries raised by Arun District Council in their email dated 7/12/2018. The work undertaken over December 2018 and January 2019 take account of the standing guidance of Arun District Council in “Supplementary Requirements for Surface Water Drainage Proposals” (undated) but accessible via <https://www.arun.gov.uk/making-a-planning-application>.

The planning conditions that we are seeking to discharge do not refer to the need for the drainage strategy to comply with any adopted guidance or supplementary documents, nor are there any informatives on the decision notice directing the applicant to any supplementary requirements.

Condition 12 refers to the design of the reservoir. The reason for condition 12 requiring approval of the design of the reservoir and flood barrier, as stated in the decision notice, is “To prevent flooding by ensuring the satisfactory storage of surface water from the site in accordance with the National Planning Policy Framework”. The work presented above has demonstrated that there is sufficient capacity for storage of surface water and will prevent flooding, and as such the details provided can be approved and the condition discharged.

As we understand it, Arun District Council has no objection in principle to the proposed strategy, layout, runoff-rates, reservoir capacity, location of outflows, construction of the floor barrier, etc. Arun District Council has already approved a site plan showing the layout/footprint of the reservoir and location/extent of the floor barrier and elevations showing cross sections of the reservoir (which show the level of excavation and height of the reservoir sides), by virtue of the list of approved plans on the original decision notice. The work presented in TN1 and above, confirms the reservoir has the necessary capacity to manage stormwater runoff from the site and includes the location of outflows and discharge rates and demonstrates that the design of the reservoir will prevent flooding by ensuring the satisfactory storage of surface water as required by Condition 12.

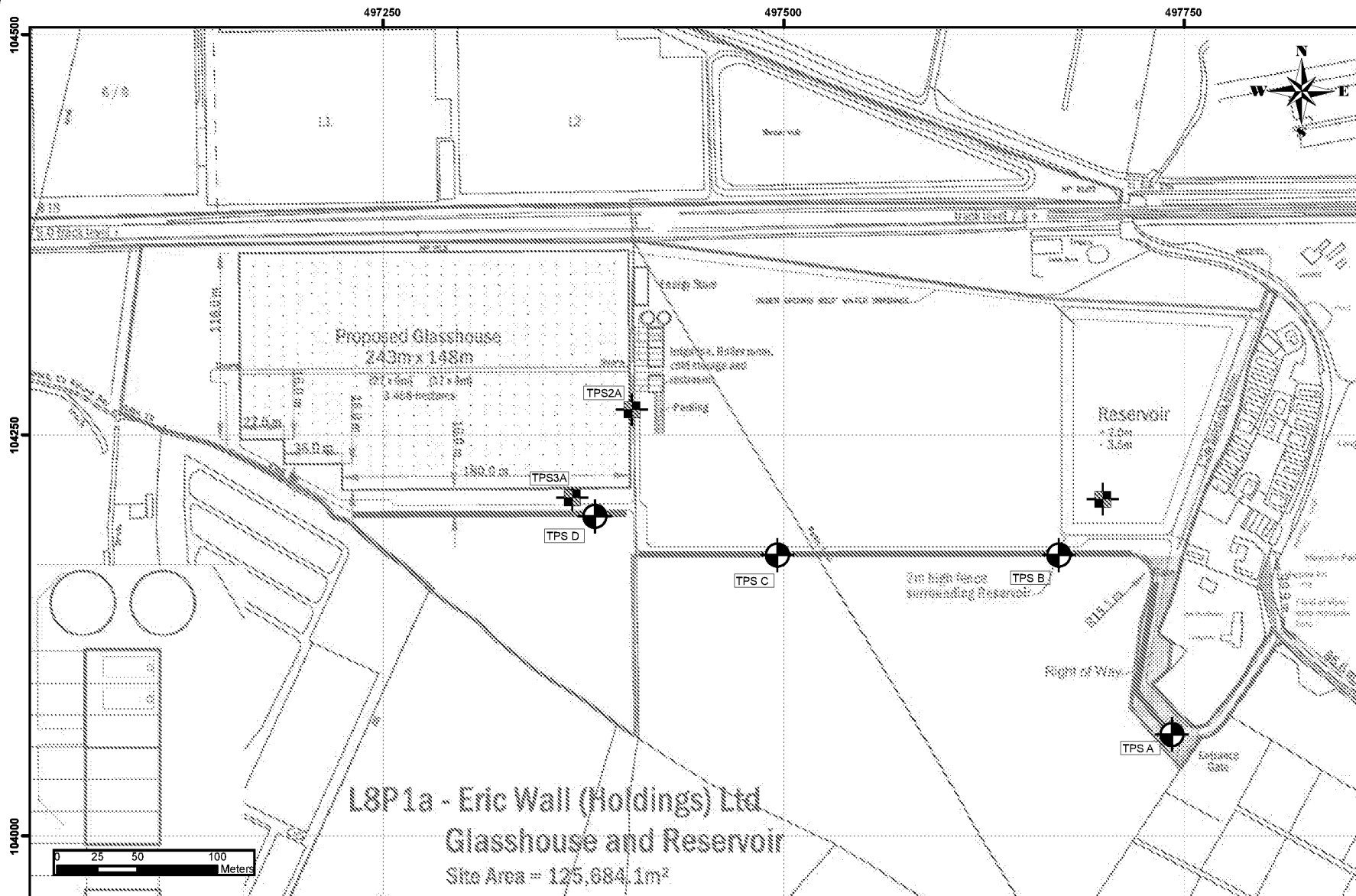
Please also bear in mind that there will need to be approvals and regular inspections of the reservoir under the Reservoirs Act, which is also relevant to the consideration of whether the requirements for approval of ‘reservoir design’ are met. Planning guidance is clear that planning conditions should not overlap with other

consents regimes, and therefore the level of detail provided at this stage should be sufficient to demonstrate compliance with Condition 12.

In our view, sufficient information has been presented in the application, TN1 and this technical note (TN2) to discharge Planning Conditions 8, 9, 10, 11 and 12.

Envireau Water
23/01/19

FIGURES



KEY

September 2018
Infiltration test pit

January 2019
Infiltration test pit

Swale

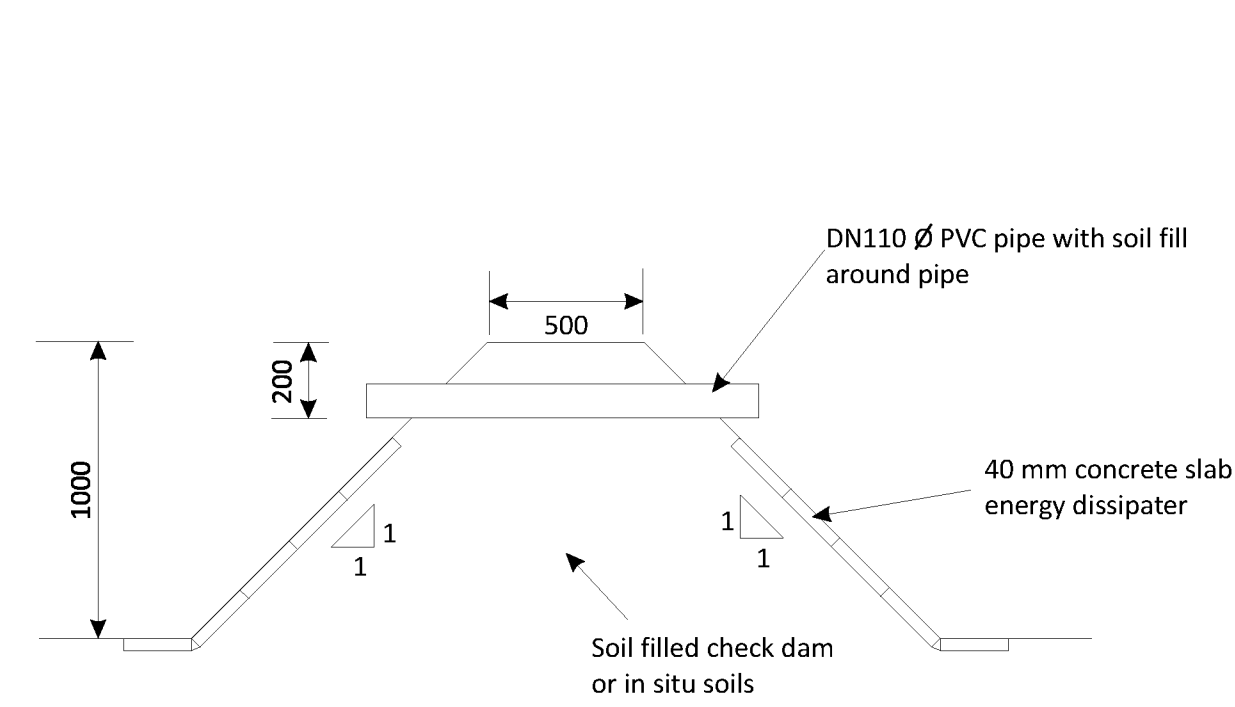
envireau
WATER

Ref: 2449 EricW Longacre GH&Res\ TN2 - FIG 1
Date:22/01/2019

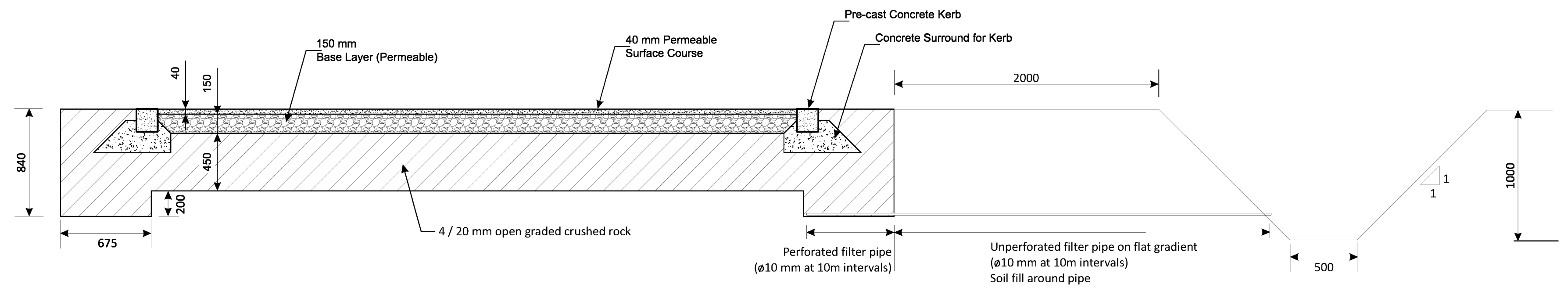
TN2 - Figure 1

Eric Wall Holdings Ltd

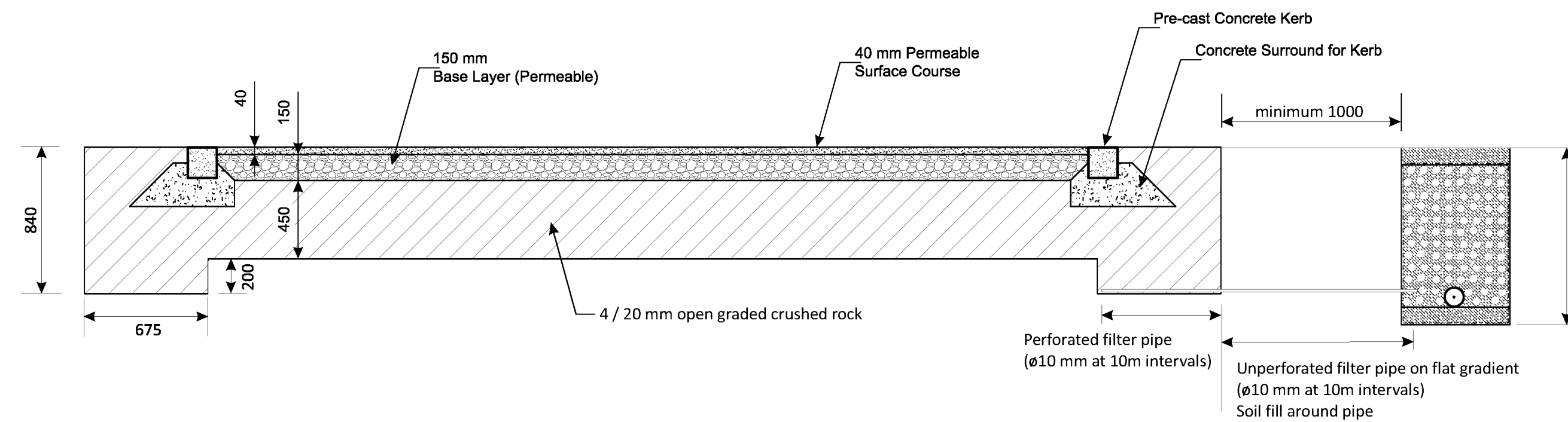
Infiltration Test Locations



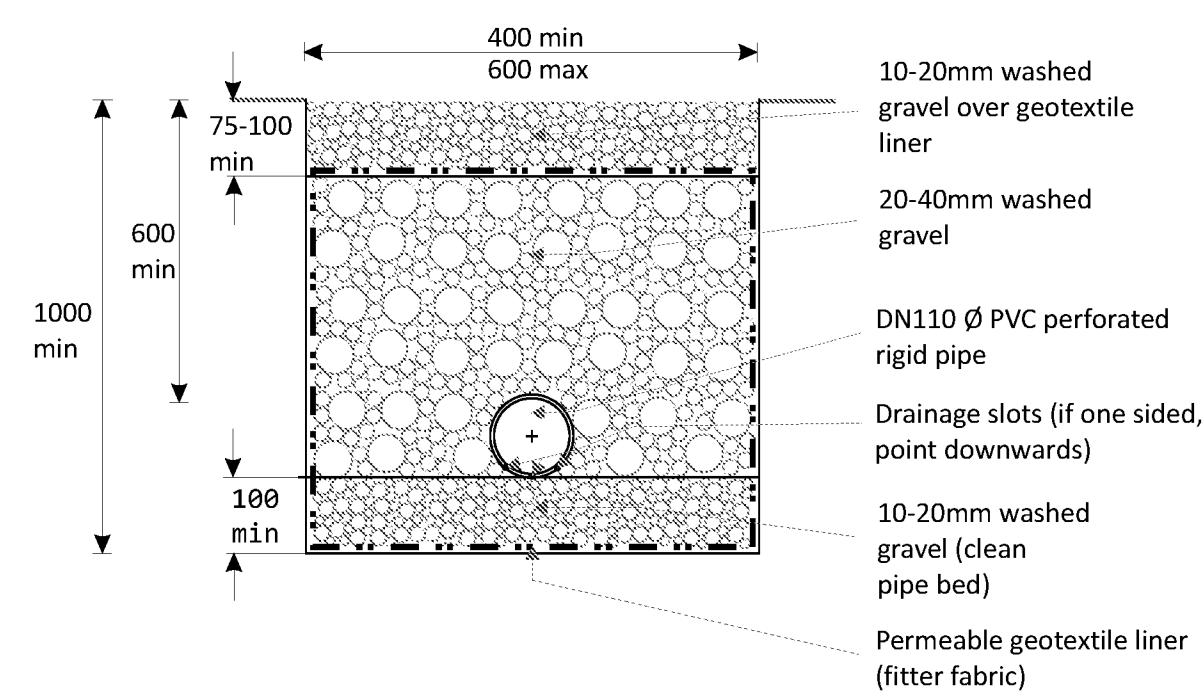
Typical Swale Check Dam Section
Scale 1 : 25 at A1



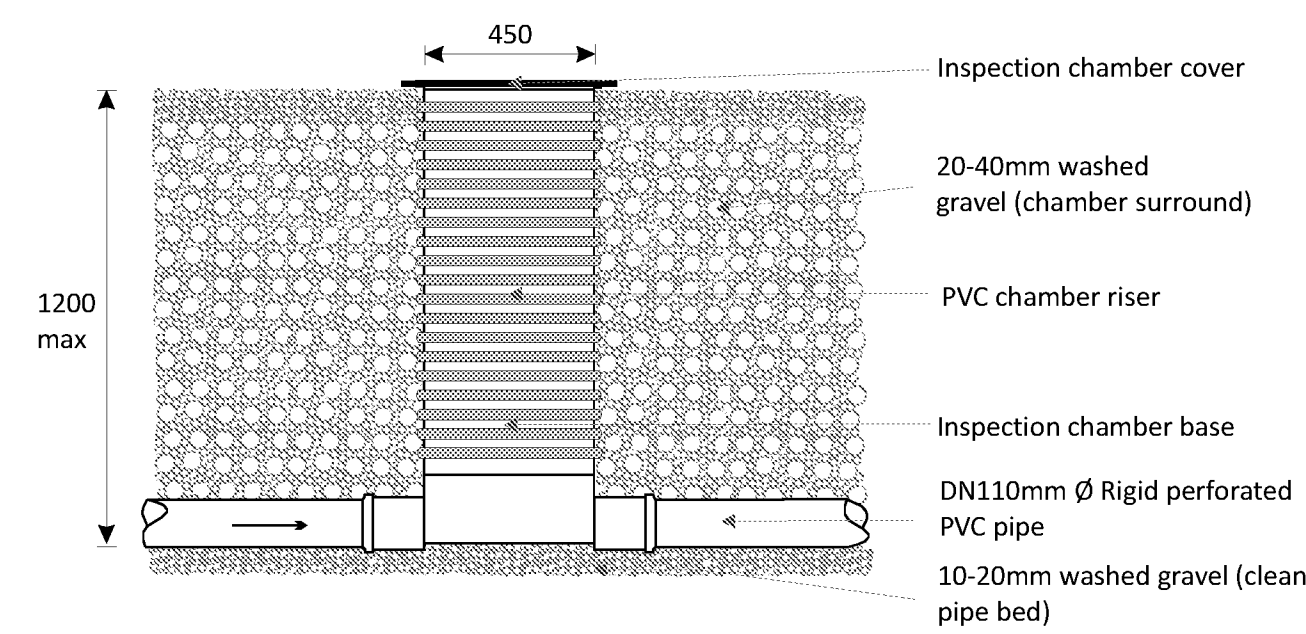
Typical Road and Swale Section
Scale 1 : 25 at A1



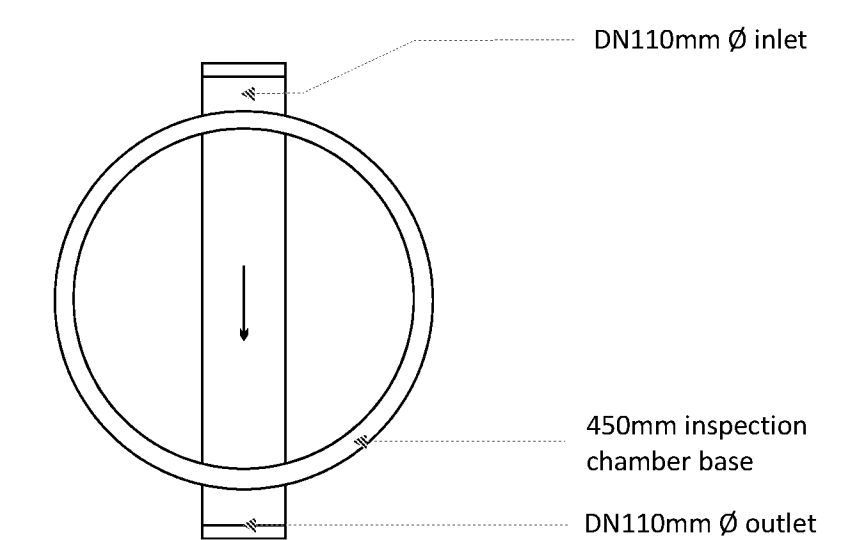
Typical Road and French Drain Section
Scale 1 : 25 at A1



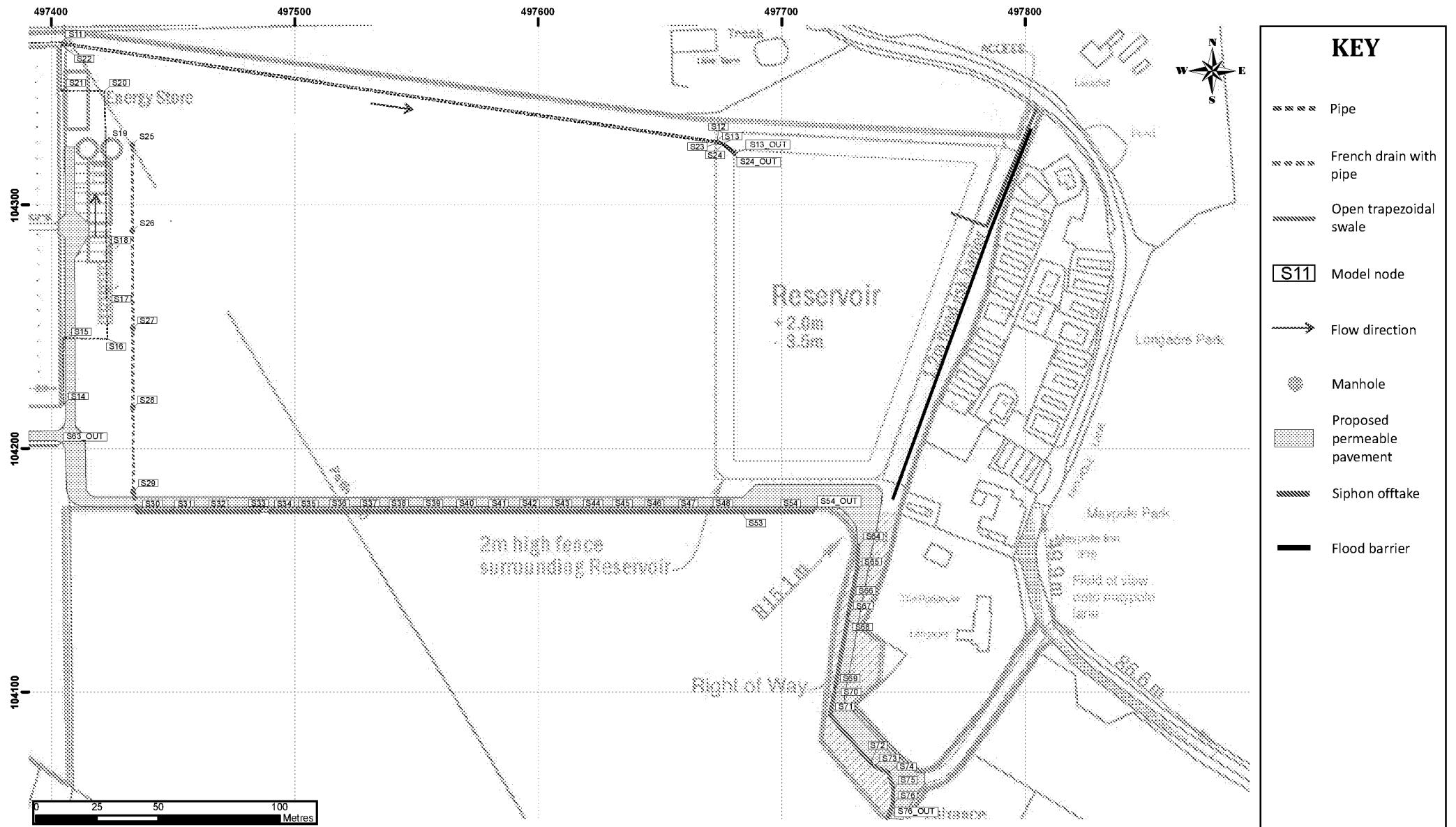
**Typical section through
Standard French Drain**
Scale 1:10 at A1

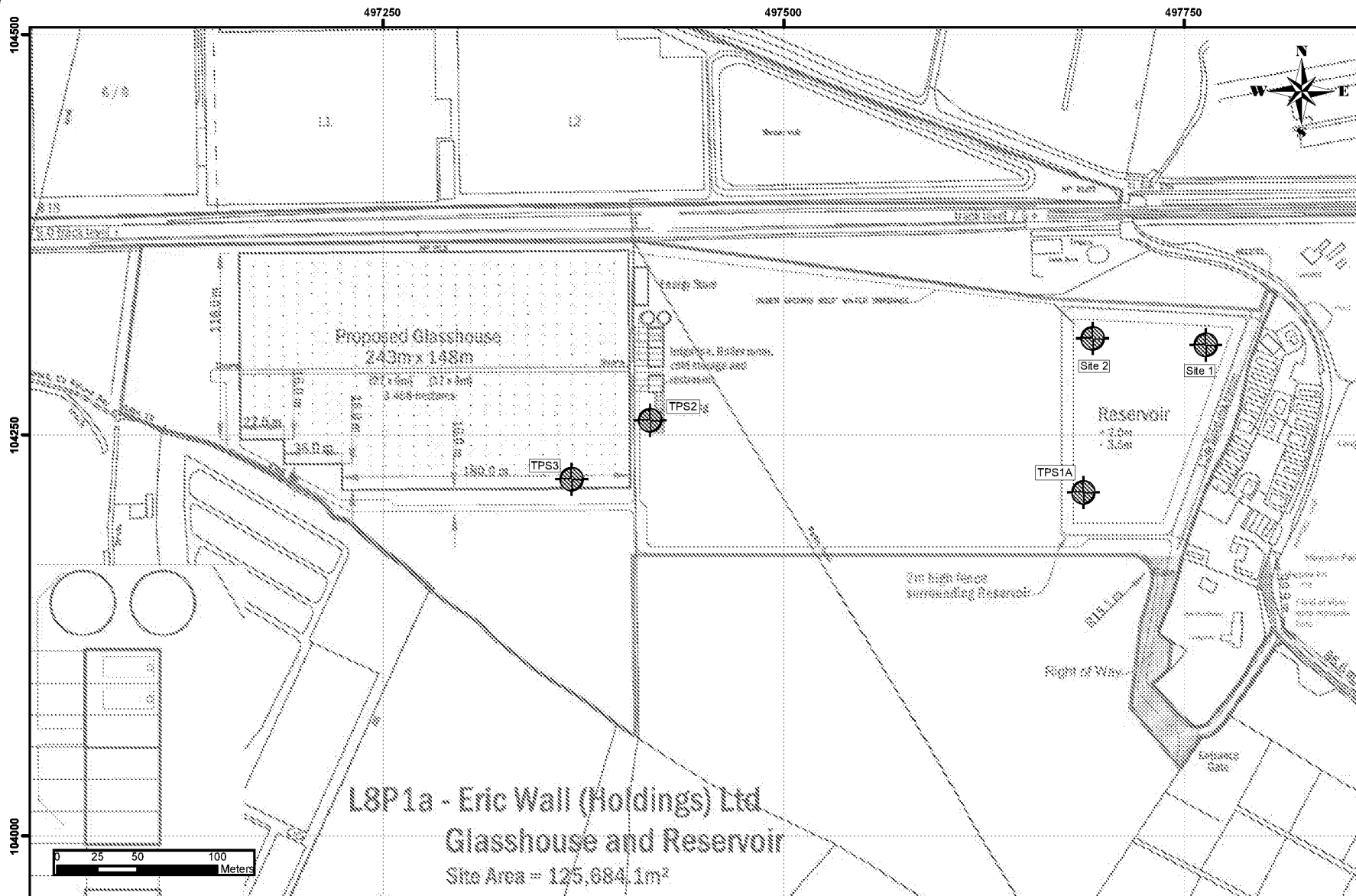


**Typical 450mm Ø inspection
chamber detail**
Scale 1:20 at A1



**Typical inspection
chamber base detail**
Scale 1 : 10 at A1





KEY

 Groundwater Monitoring Locations

envireau
WATER

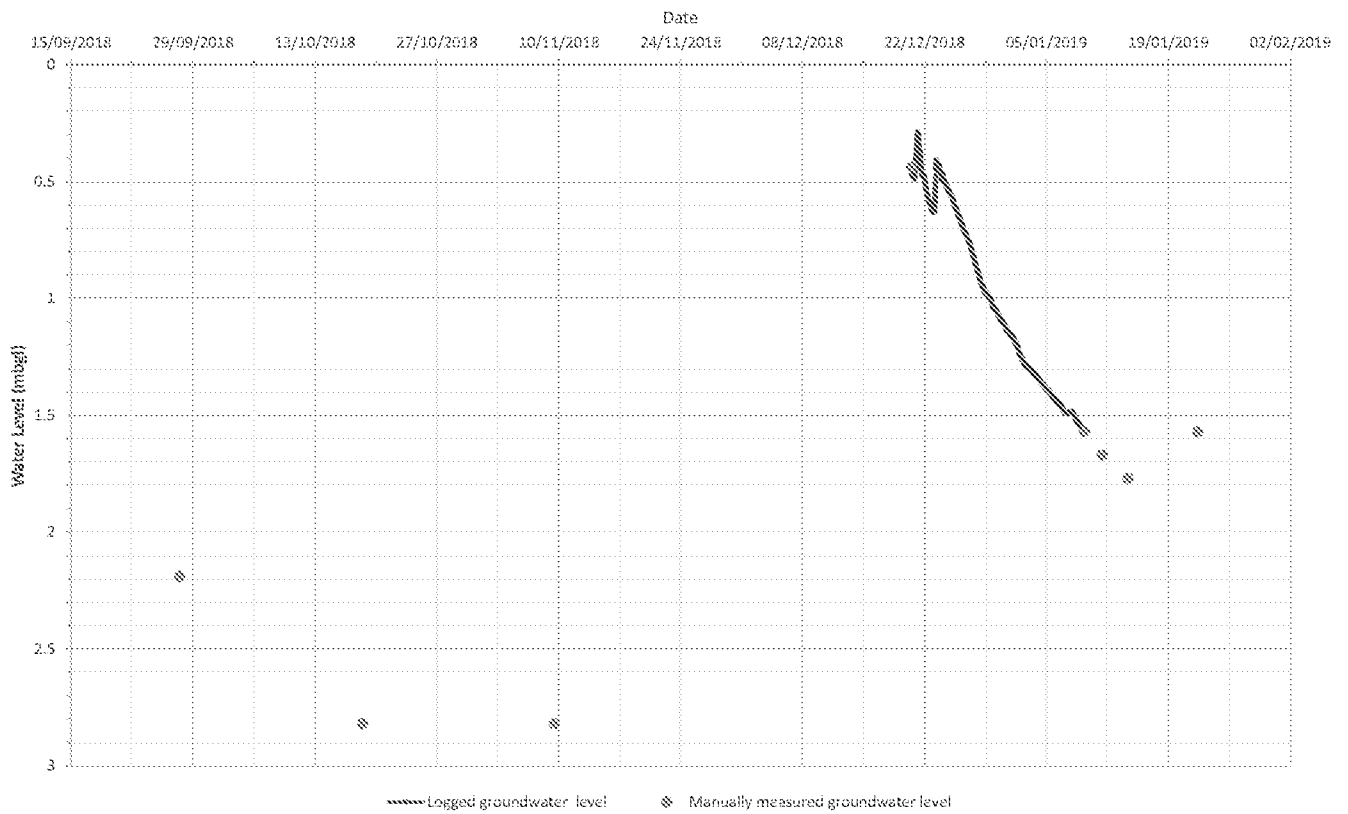
Ref: 2449 EricW Longacre GH&Res\ TN2 - FIG 4
Date:22/01/2019

TN2 - Figure 4

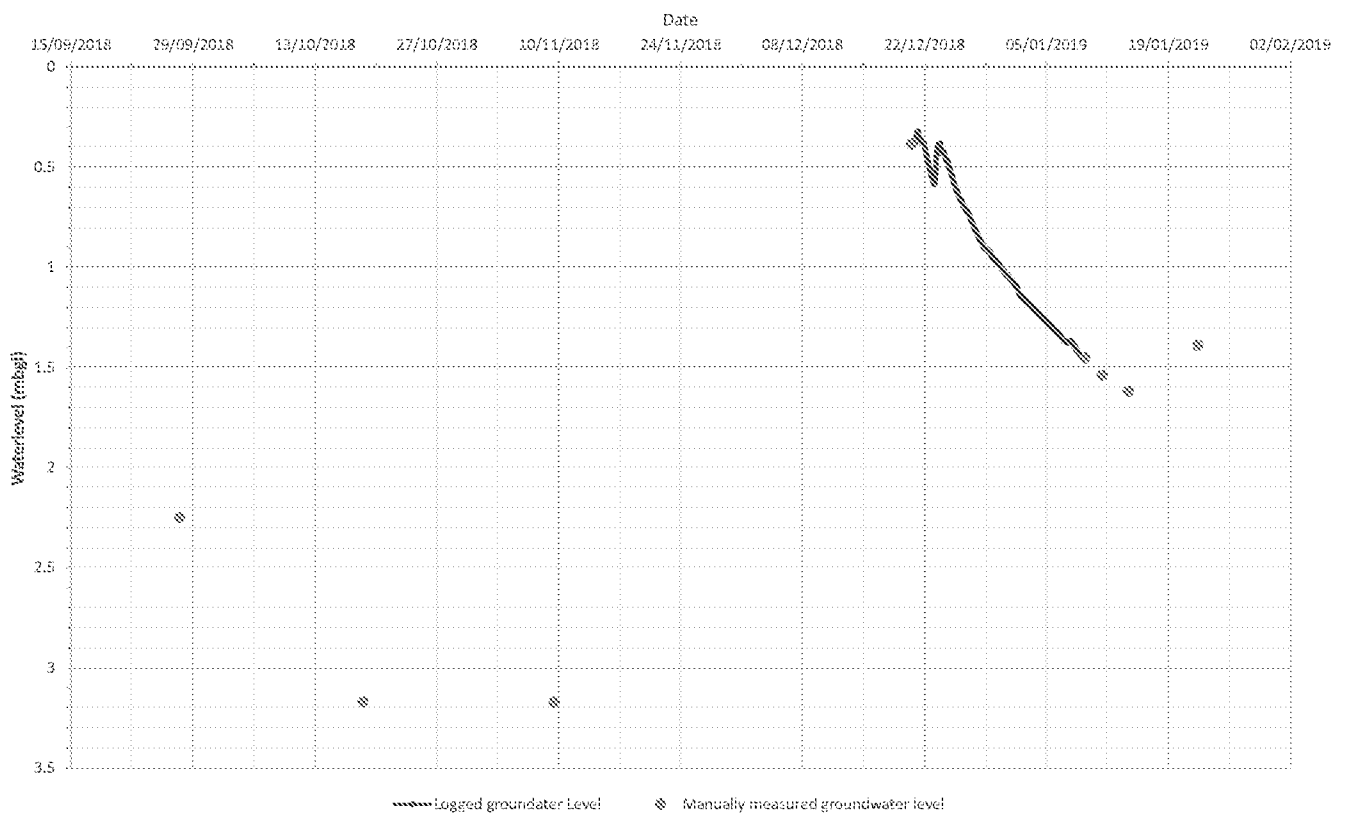
Eric Wall Holdings Ltd

Groundwater Monitoring Locations

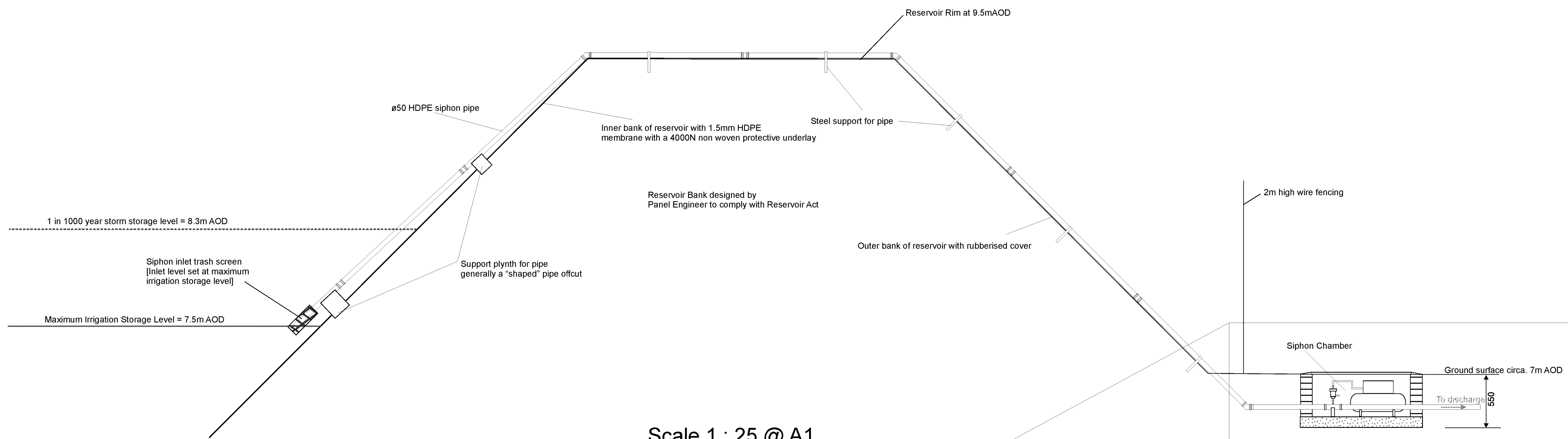
Eric Wall Longacre - TP52 Groundwater Level



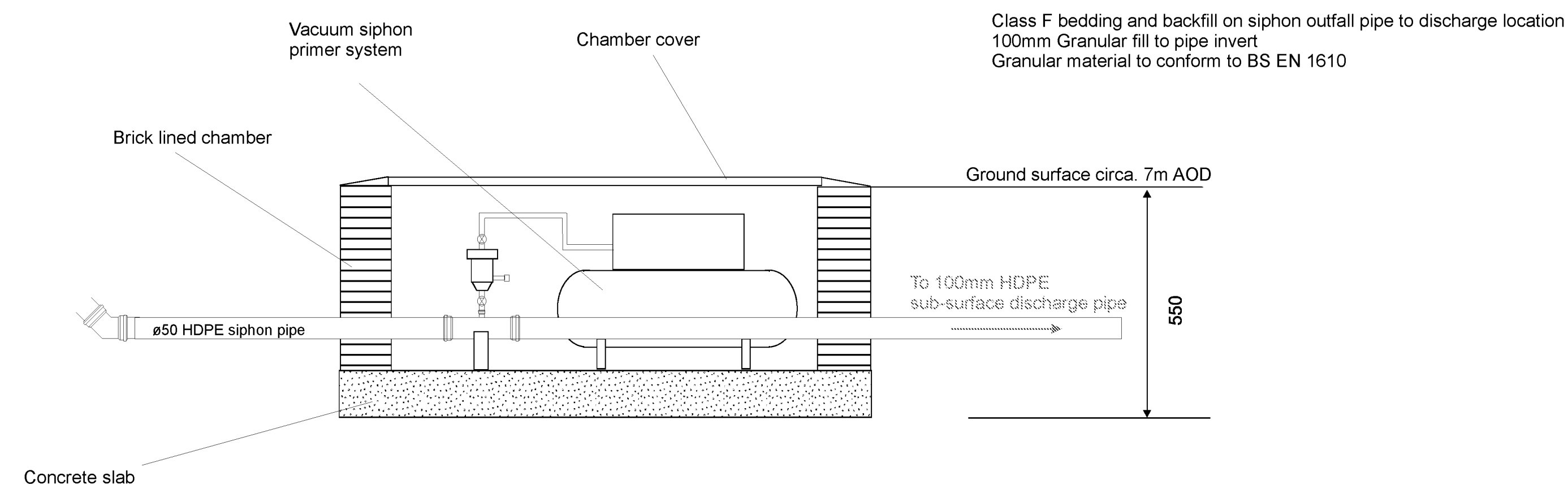
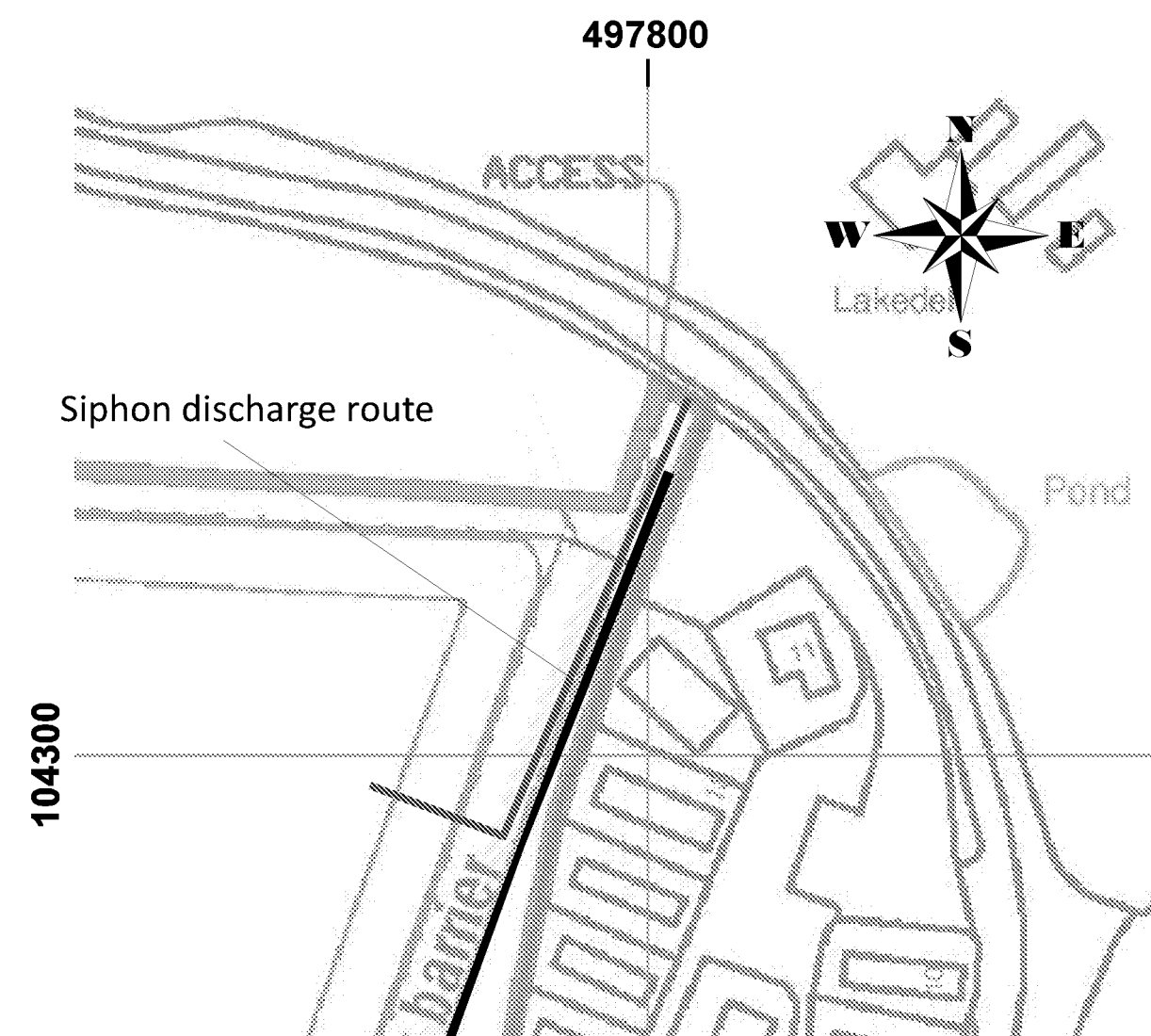
Eric Wall Longacre - TPS3 Groudwater Level



Eastern Bank of Reservoir

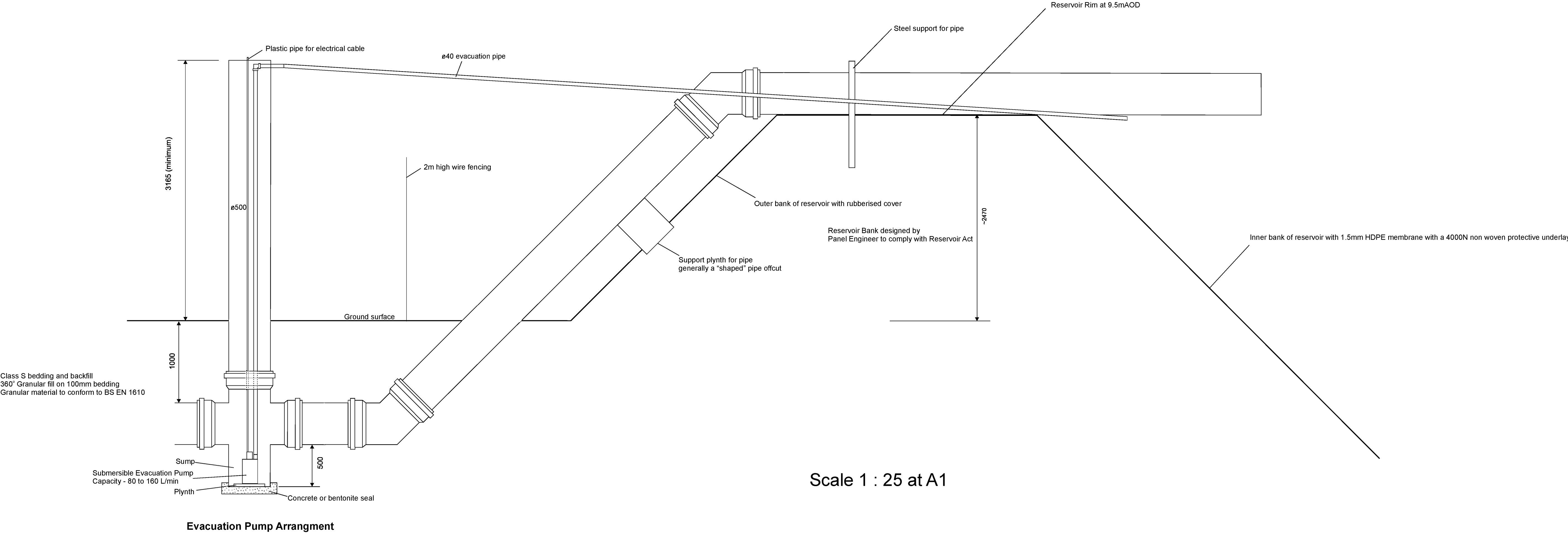


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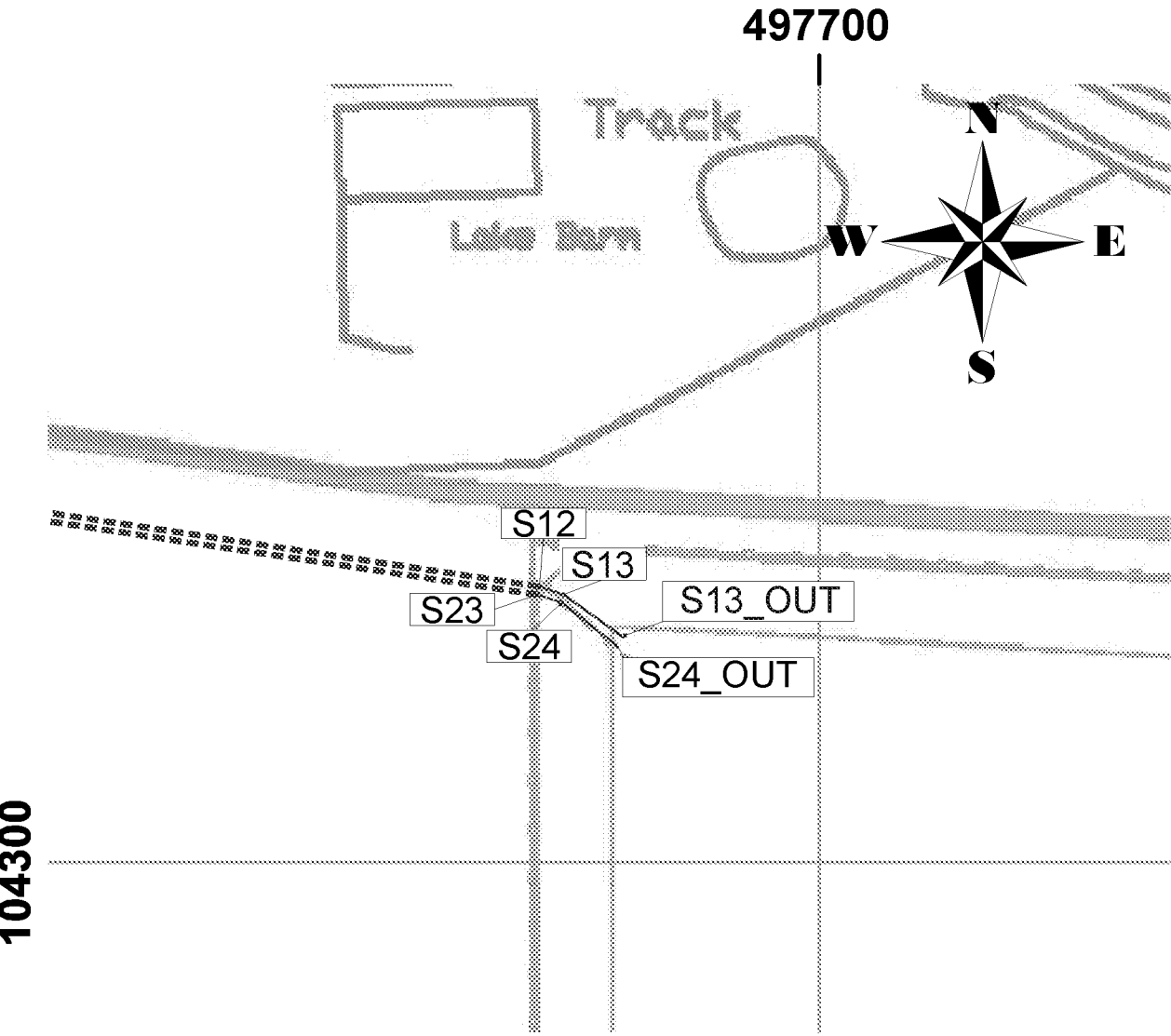


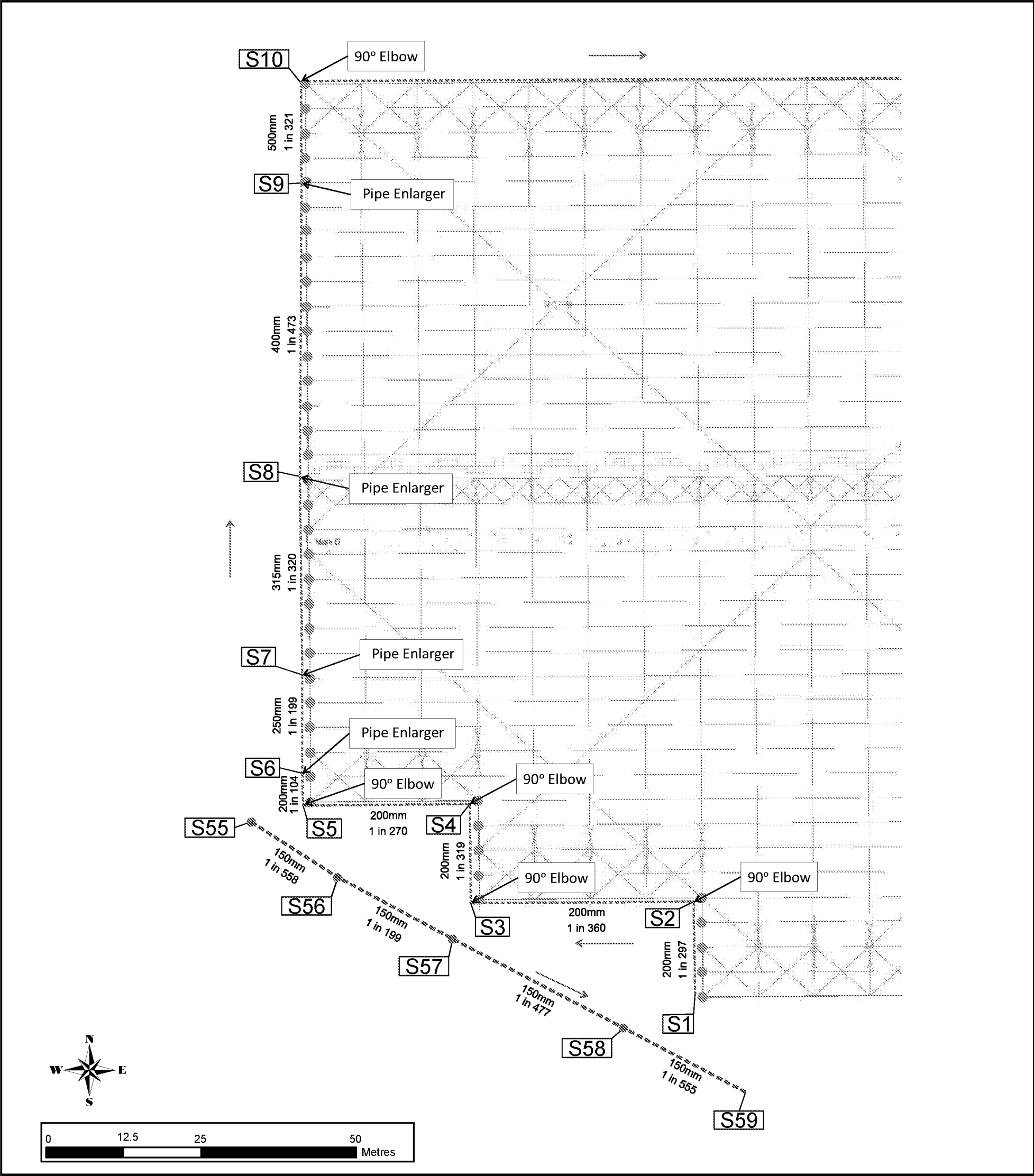
Scale 1 : 10 @ A1

Western Bank of Reservoir



Scale 1 : 25 at A1





KEY

===== Pipe

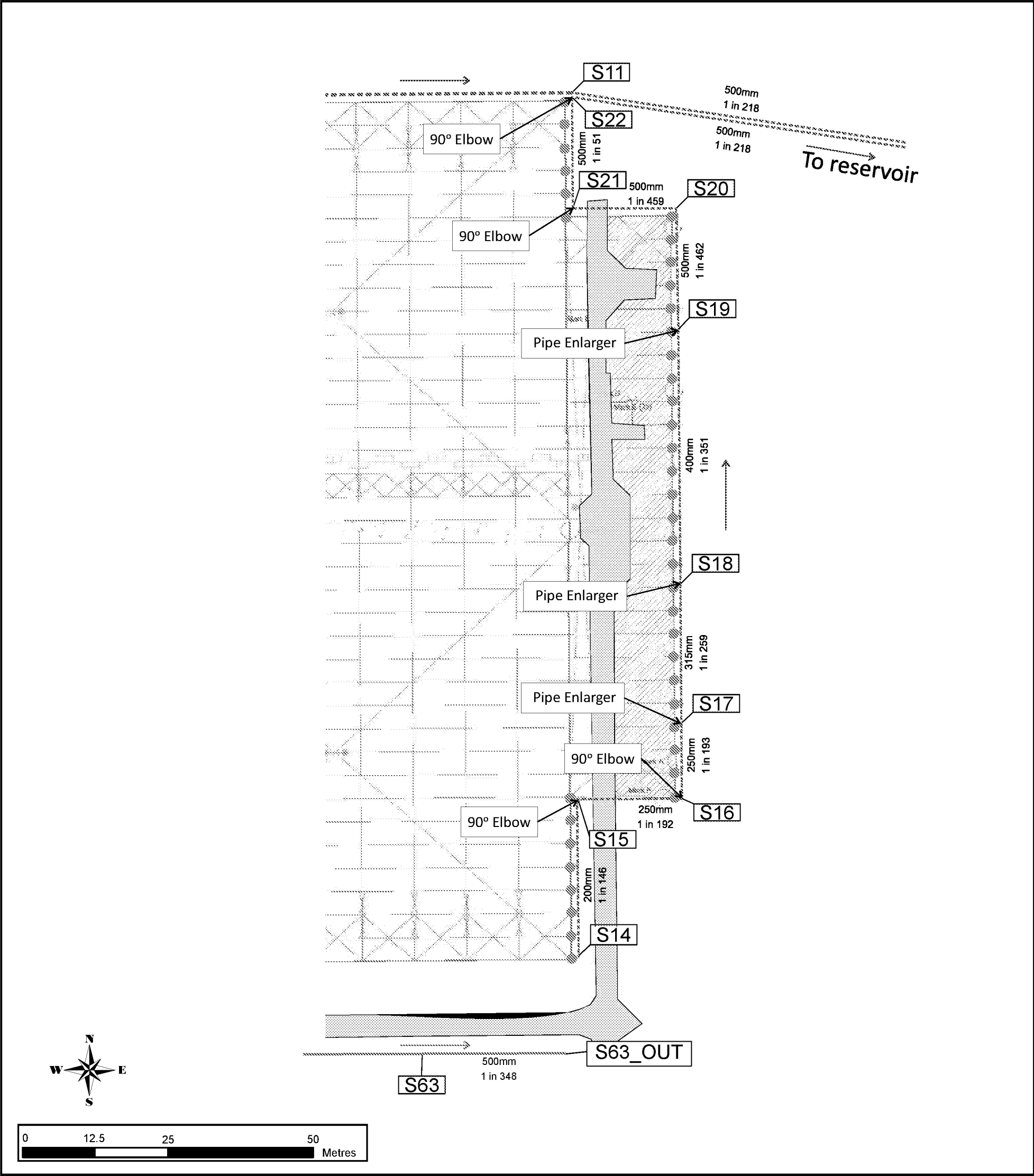
⊗ Downpipe with reducing tee

[S11] Model node

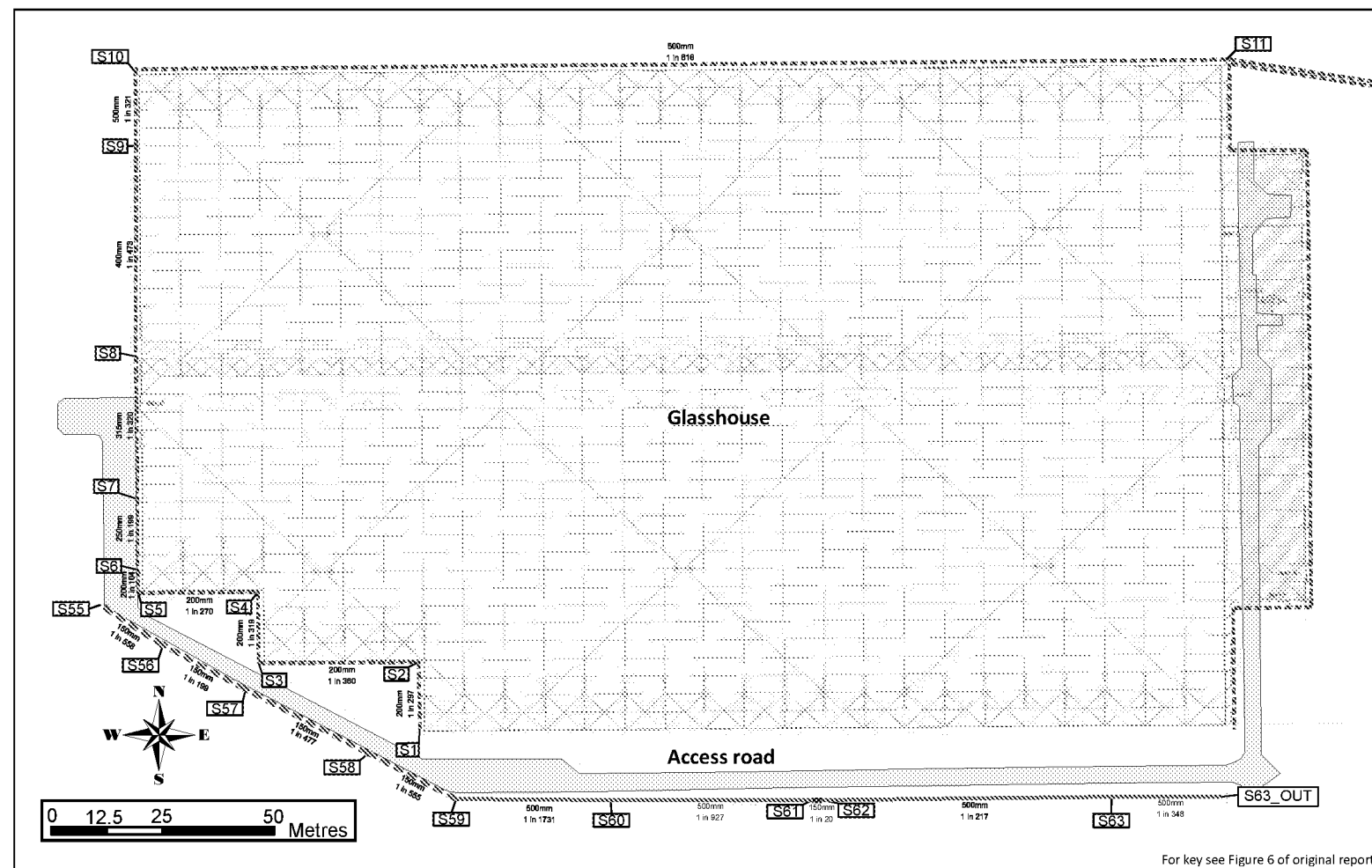
→ Flow direction

⊗ Manhole

----- French drain

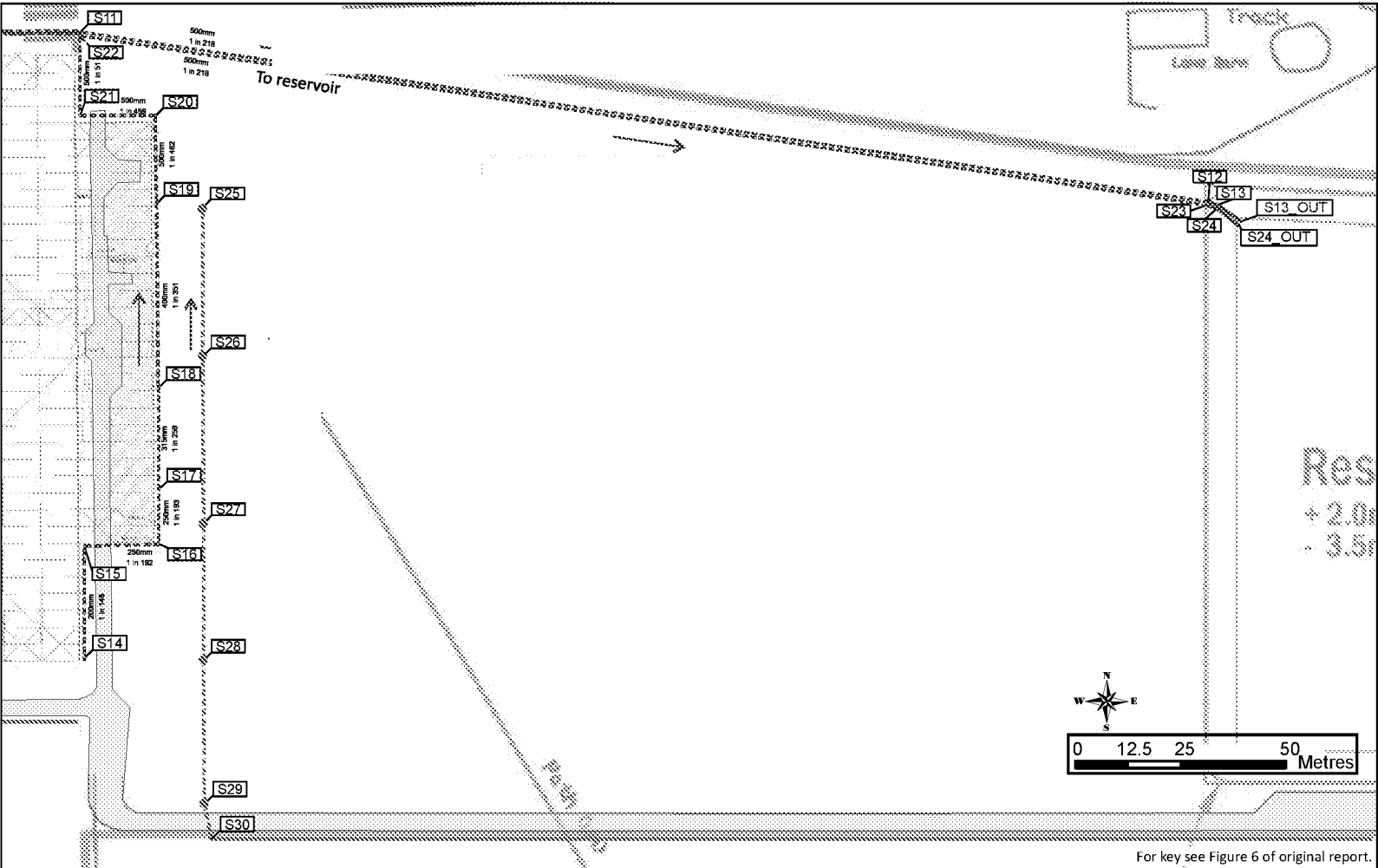


KEY	
Pipe	Flow direction
Downpipe with reducing tee	Proposed access road
Model node	Open trapezoidal channel (Infiltration/storage swale)



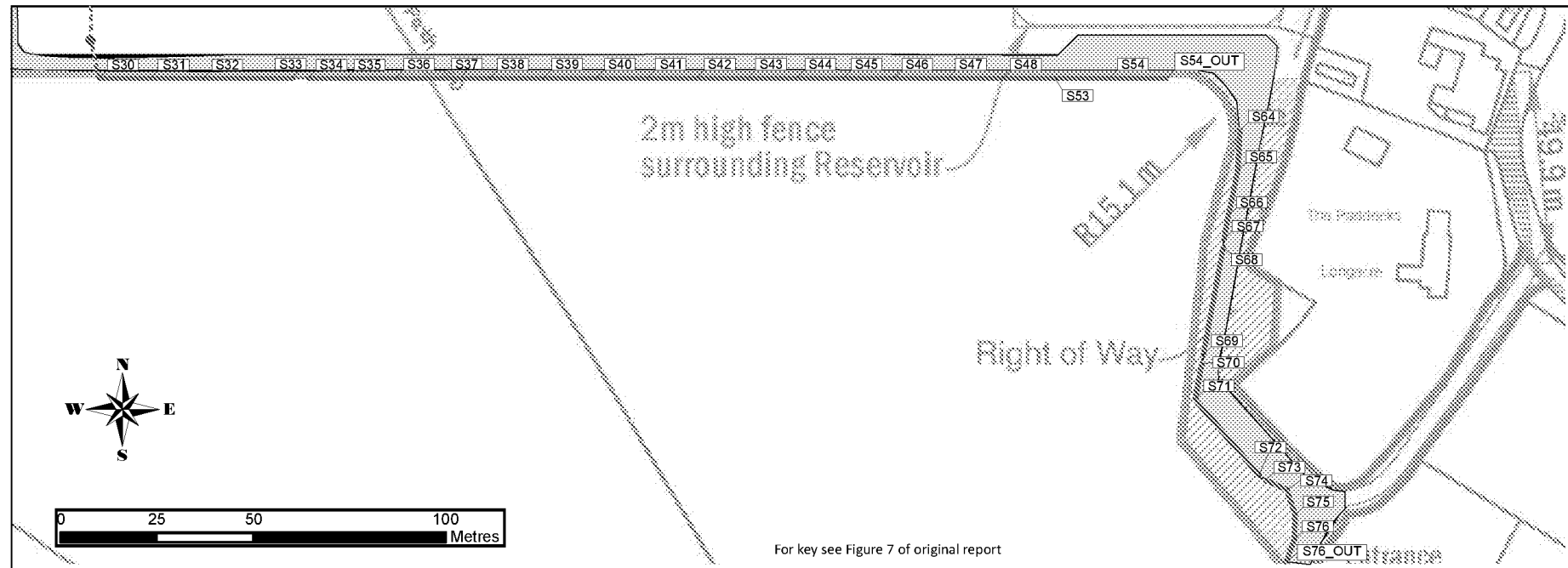
Schedule 1 - Nodes			
Model Node	Node Type	Easting (m)	Northing (m)
S1	Junction	497223	104217
S2	Junction	497223	104231
S3	Junction	497187	104231
S4	Junction	497187	104247
S5	Junction	497160	104247
S6	Junction	497159	104252
S7	Junction	497159	104268
S8	Junction	497159	104300
S9	Junction	497159	104347
S10	Junction	497159	104363
S11	Junction	497404	104367
S55	Manhole	497151	104244
S56	Manhole	497165	104235
S57	Manhole	497184	104225
S58	Manhole	497211	104211
S59	Junction	497231	104201
S60	Junction	497266	104200
S61	Junction	497311	104200
S62	Junction	497313	104200
S63	Junction	497378	104201
S63 OUT	Junction	497403	104201

Schedule 1 - Links												
Code	Section Type	Dia (mm)	Gradient (1:X)	Pipe Type	Upstream				Downstream			
					Node	Invert (mAOD)	Cover (mAOD)	Depth (m)	Node	Invert (mAOD)	Cover (mAOD)	Depth (m)
1.000	Pipe	200	297	HDPE	S1	9.30	9.80	0.30	S2	9.25	9.80	0.35
1.001	Pipe	200	360	HDPE	S2	9.25	9.80	0.35	S3	9.15	9.80	0.45
1.002	Pipe	200	319	HDPE	S3	9.15	9.80	0.45	S4	9.10	9.80	0.50
1.003	Pipe	200	270	HDPE	S4	9.10	9.80	0.50	S5	9.00	9.80	0.60
1.004	Pipe	200	104	HDPE	S5	9.00	9.80	0.60	S6	8.95	9.80	0.65
1.005	Pipe	250	199	HDPE	S6	8.90	9.80	0.65	S7	8.82	9.80	0.73
1.006	Pipe	315	320	HDPE	S7	8.75	9.80	0.74	S8	8.65	9.80	0.84
1.007	Pipe	400	473	HDPE	S8	8.55	9.80	0.85	S9	8.45	9.80	0.95
1.008	Pipe	500	321	HDPE	S9	8.35	9.80	0.95	S10	8.30	9.80	1.00
1.009	Pipe	500	816	HDPE	S10	8.30	9.80	1.00	S11	8.00	9.80	1.30
5.000	Filter Drain & Pipe	150	558	HDPE	S55	8.45	9.45	0.85	S56	8.42	9.42	0.85
5.001	Filter Drain & Pipe	150	199	HDPE	S56	8.42	9.42	0.85	S57	8.31	9.31	0.85
5.002	Filter Drain & Pipe	150	477	HDPE	S57	8.31	9.31	0.85	S58	8.25	9.25	0.85
5.003	Filter Drain & Pipe	150	555	HDPE	S58	8.25	9.25	0.85	S59	8.21	9.21	0.85
5.004	Swale	500	1731		S59	8.21	9.21	0.50	S60	8.19	9.19	0.50
5.005	Swale	500	927		S60	8.19	9.19	0.50	S61	8.14	9.14	0.50
5.006	Pipe	150	20	HDPE	S61	8.70	9.14	0.29	S62	8.60	9.14	0.39
5.007	Swale	500	217		S62	8.14	9.14	0.50	S63	7.84	8.84	0.50
5.008	Swale	500	348		S63	7.84	8.84	0.50	S63_OUT	7.77	8.77	0.50



Schedule 2 - Nodes			
Model Node	Node Type	Easting (m)	Northing (m)
S11	Junction	497404	104367
S12	Junction	497674	104326
S13	Junction	497676	104325
S13_OUT	Junction	497682	104324
S14	Junction	497405	104218
S15	Junction	497404	104244
S16	Junction	497423	104245
S17	Junction	497423	104258
S18	Junction	497423	104282
S19	Junction	497422	104326
S20	Junction	497422	104347
S21	Junction	497404	104347
S22	Junction	497404	104366
S23	Junction	497673	104326
S24	Junction	497676	104325
S24_OUT	Junction	497681	104323
S25	Manhole	497427	104325
S26	Manhole	497427	104289
S27	Manhole	497427	104249
S28	Manhole	497427	104217
S29	Manhole	497427	104181
S30	Junction	497429	104174

Schedule 2 - Links												
Code	Section Type	Dia (mm)	Gradient (1:X)	Pipe Type	Upstream				Downstream			
					Node	Invert (mAOD)	Cover (mAOD)	Depth (m)	Node	Invert (mAOD)	Cover (mAOD)	Depth (m)
1.010	Pipe	500	218	HDPE	S11	8.00	9.80	1.30	S12	6.75	7.75	0.50
1.011	Pipe	500		HDPE	S12	6.25	7.75	1.00	S13	9.50	Sitting on Surface	
1.012	Pipe	500	12	HDPE	S13	9.50	Sitting on Surface		S13_OUT	9.00	Sitting on Surface	
2.000	Pipe	200	159	HDPE	S14	9.30	9.80	0.30	S15	9.14	9.80	0.46
2.001	Pipe	250	199	HDPE	S15	9.09	9.80	0.46	S16	8.99	9.80	0.56
2.002	Pipe	250	193	HDPE	S16	8.99	9.80	0.56	S17	8.92	9.80	0.63
2.003	Pipe	315	259	HDPE	S17	8.86	9.80	0.63	S18	8.77	9.80	0.72
2.004	Pipe	400	351	HDPE	S18	8.68	9.80	0.72	S19	8.56	9.80	0.84
2.005	Pipe	500	462	HDPE	S19	8.46	9.80	0.84	S20	8.41	9.80	0.89
2.006	Pipe	500	459	HDPE	S20	8.41	9.80	0.89	S21	8.37	9.80	0.93
2.007	Pipe	500	51	HDPE	S21	8.37	9.80	0.93	S22	8.00	9.80	1.30
2.008	Pipe	500	218	HDPE	S22	8.00	9.80	1.30	S23	6.75	7.75	0.50
2.009	Pipe	500		HDPE	S23	6.25	7.75	1.00	S24	9.50	Sitting on Surface	
2.010	Pipe	500	12	HDPE	S24	9.50	Sitting on Surface		S24_OUT	9.00	Sitting on Surface	
3.000	Filter Drain & Pipe	150	98	HDPE	S25	8.80	9.80	0.85	S26	8.44	9.44	0.85
3.001	Filter Drain & Pipe	150	125	HDPE	S26	8.44	9.44	0.85	S27	8.12	9.12	0.85
3.002	Filter Drain & Pipe	150	78	HDPE	S27	8.12	9.12	0.85	S28	7.70	8.70	0.85
3.003	Filter Drain & Pipe	150	57	HDPE	S28	7.70	8.70	0.85	S29	7.07	8.07	0.85
3.004	Filter Drain & Pipe	150	41	HDPE	S29	7.07	8.07	0.85	S30	6.90	7.83	0.78



Schedule 3 - Links

Code	Section Type	Dia (mm)	Gradient (1:X)	Pipe Type	Upstream				Downstream			
					Node	Invert (mAOD)	Cover (mAOD)	Depth (m)	Node	Invert (mAOD)	Cover (mAOD)	Depth (m)
3.005	Swale	500	151		S30	6.83	7.83	0.50	S31	6.70	7.70	0.50
3.006	Swale	500	278		S31	6.70	7.70	0.50	S32	6.65	7.65	0.50
3.007	Swale	500	107		S32	6.65	7.65	0.50	S33	6.78	7.78	0.50
3.008	Swale	500	441		S33	6.78	7.78	0.50	S34	6.75	7.75	0.50
3.009	Swale	500	141		S34	6.75	7.75	0.50	S35	6.68	7.68	0.50
3.010	Swale	500	75		S35	6.68	7.68	0.50	S36	6.51	7.56	0.55
3.011	Pipe	150	24	HDPE	S36	7.20	7.56	0.21	S37	7.10	7.51	0.26
3.012	Swale	500	91		S37	6.51	7.51	0.50	S38	6.27	7.27	0.50
3.013	Swale	500	74		S38	6.27	7.27	0.50	S39	6.46	7.46	0.50
3.014	Swale	500	57		S39	6.46	7.46	0.50	S40	6.70	7.70	0.50
3.015	Swale	500	77		S40	6.70	7.70	0.50	S41	6.87	7.87	0.50
3.016	Swale	500	59		S41	6.87	7.87	0.50	S42	7.09	8.09	0.50
3.017	Swale	500	220		S42	7.09	8.09	0.50	S43	7.15	8.15	0.50
3.018	Swale	500	160		S43	7.15	8.15	0.50	S44	7.23	8.23	0.50
3.019	Swale	500	402		S44	7.23	8.23	0.50	S45	7.20	8.20	0.50
3.020	Swale	500	187		S45	7.20	8.20	0.50	S46	7.13	8.13	0.50
3.021	Swale	500	88		S46	7.13	8.13	0.50	S47	6.97	7.97	0.50
3.022	Swale	500	94		S47	6.97	7.97	0.50	S48	6.80	7.80	0.50
3.023	Swale	500	1374		S48	6.80	7.80	0.50	S53	6.79	7.50	2.22
3.024	Swale	500	88		S53	6.79	7.79	0.50	S54	6.63	7.63	0.50
3.025	Swale	500	125		S54	6.63	7.63	0.50	S54 OUT	6.51	7.51	0.50
6.000	Swale	500	174		S64	6.19	7.19	0.50	S65	6.13	7.13	0.50
6.001	Swale	500	376		S65	6.13	7.13	0.50	S66	6.09	7.11	0.51
6.002	Swale	500	373		S66	6.09	7.11	0.51	S67	6.08	7.11	0.53
6.003	Pipe	150	21	HDPE	S67	6.70	7.11	0.26	S68	6.60	7.11	0.36
6.004	Swale	500	31		S68	6.08	7.11	0.53	S69	5.77	6.77	0.50
6.005	Pipe	150	24	HDPE	S69	6.40	6.77	0.21	S70	6.30	6.76	0.31
6.006	Swale	500	131		S70	5.76	6.76	0.50	S71	5.69	6.69	0.50
6.007	Swale	500	0		S71	5.69	6.69	0.50	S72	5.69	6.69	0.50
6.008	Pipe	150	21	HDPE	S72	6.30	6.69	0.24	S73	6.20	6.71	0.36
6.009	Swale	500	0		S73	5.71	6.71	0.50	S74	5.71	6.71	0.50
6.010	Swale	500	0		S74	5.71	6.71	0.50	S75	5.71	6.71	0.50
6.011	Swale	500	93		S75	5.71	6.71	0.50	S76	5.64	6.69	0.55
6.012	Swale	500	0		S76	5.64	6.69	0.55	S76 OUT	5.64	6.64	0.50

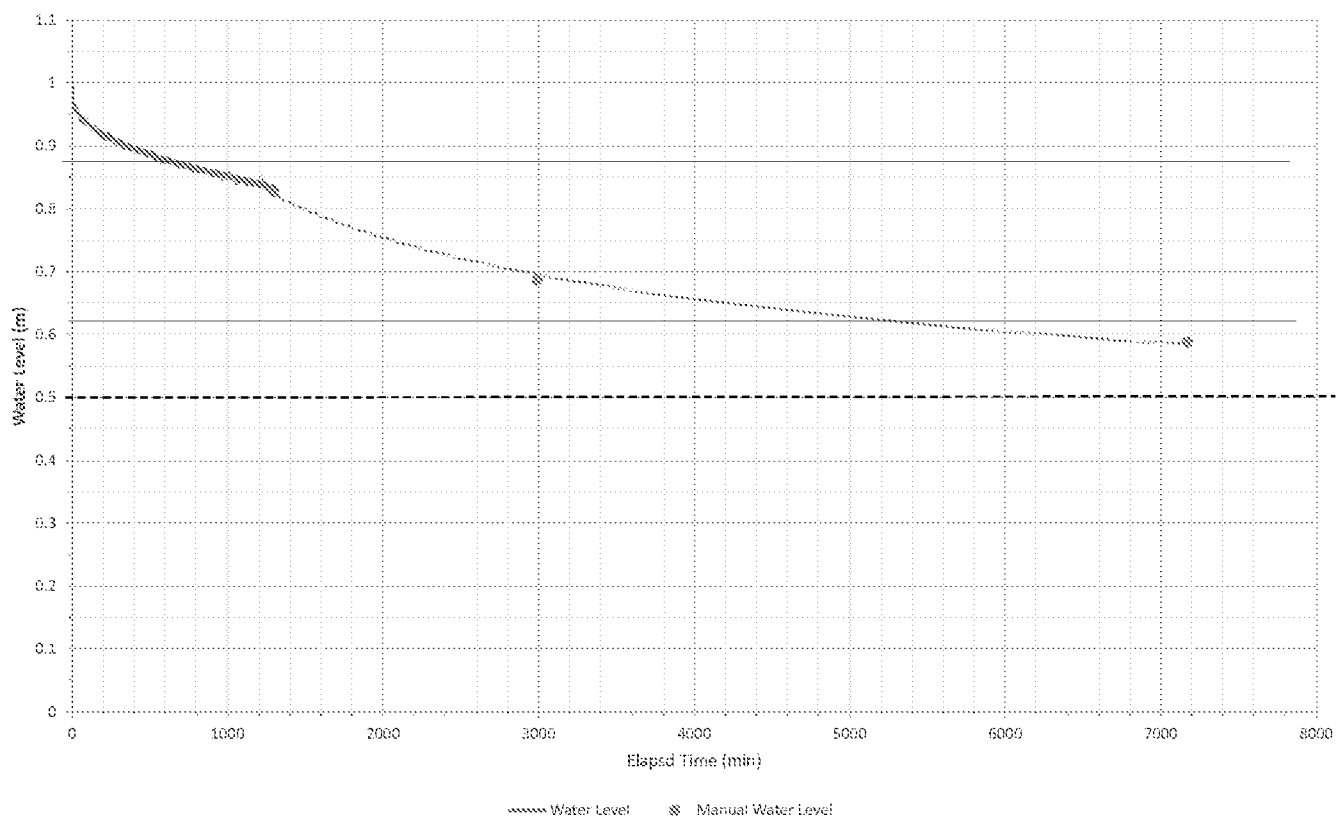
Schedule 3 - Nodes

Model Node	Node Type	Easting (m)	Northing (m)
S30	Junction	497429	104174
S31	Junction	497449	104174
S32	Junction	497462	104174
S33	Junction	497476	104174
S34	Junction	497490	104174
S35	Junction	497499	104174
S36	Junction	497512	104174
S37	Junction	497515	104174
S38	Junction	497537	104174
S39	Junction	497551	104174
S40	Junction	497564	104174
S41	Junction	497578	104174
S42	Junction	497590	104174
S43	Junction	497604	104174
S44	Junction	497616	104174
S45	Junction	497628	104174
S46	Junction	497642	104174
S47	Junction	497656	104174
S48	Junction	497670	104174
S53	Junction	497684	104174
S54	Junction	497698	104174
S54 OUT	Junction	497712	104174
S64	Junction	497729	104161
S65	Junction	497729	104150
S66	Junction	497726	104138
S67	Junction	497725	104132
S68	Junction	497725	104130
S69	Junction	497720	104102
S70	Junction	497720	104100
S71	Junction	497720	104091
S72	Junction	497734	104071
S73	Junction	497736	104070
S74	Junction	497742	104067
S75	Junction	497744	104061
S76	Junction	497744	104054
S76 OUT	Junction	497742	104048

APPENDIX A
JANUARY 2019 INFILTRATION TEST RESULTS

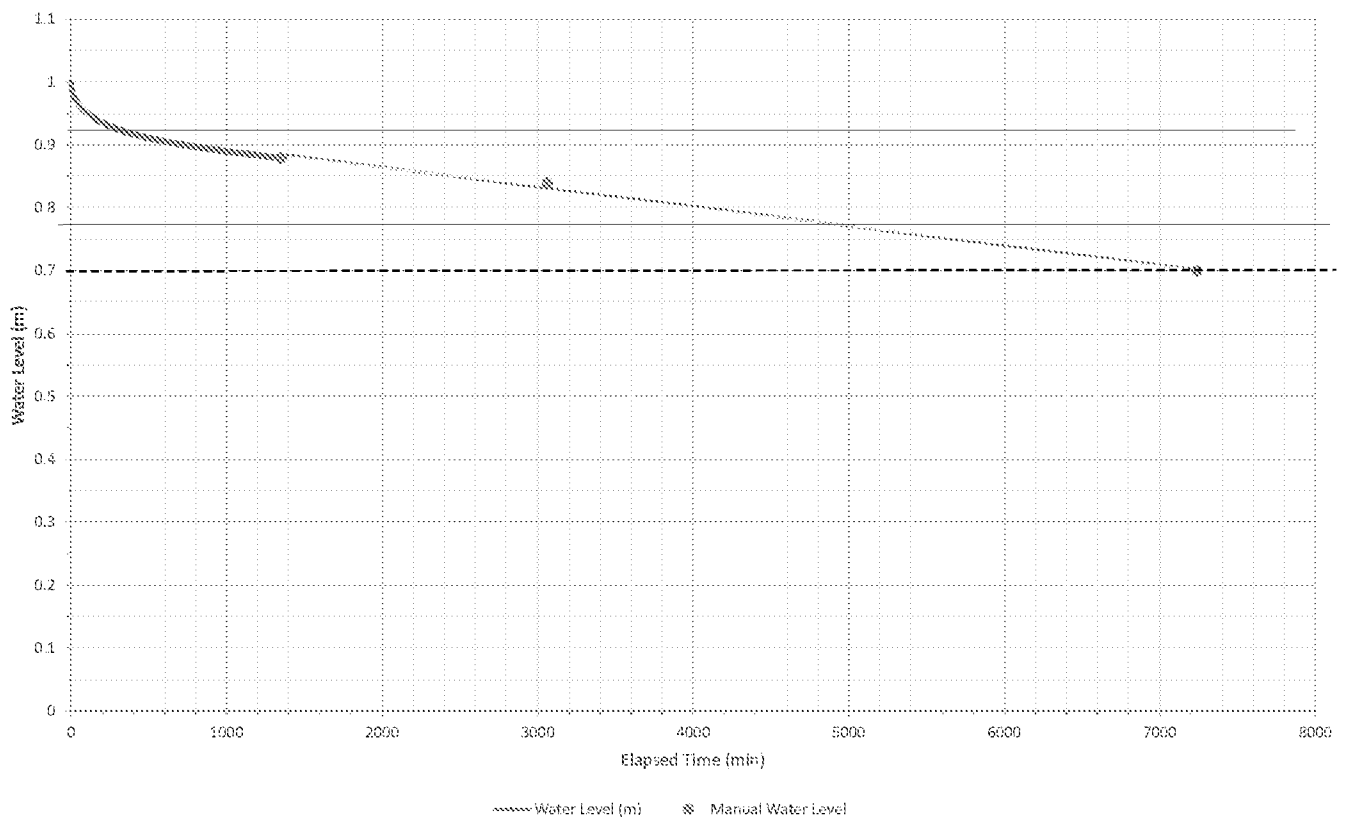
TPS A Test 1			
Width	0.45	m	
Length	1.15	m	
Depth	0.5	m	
Volume	0.26	m ³	
Volume (75-25)	0.13	m ³	
Time (75-25)	282000	seconds	
Wetted Area	1.32	m ²	
Infiltration rate	3.482E-07	m/s	
Infiltration rate	0.001	m/hr	

Eric Wall Glasshouses - Infiltration Testing TPS A



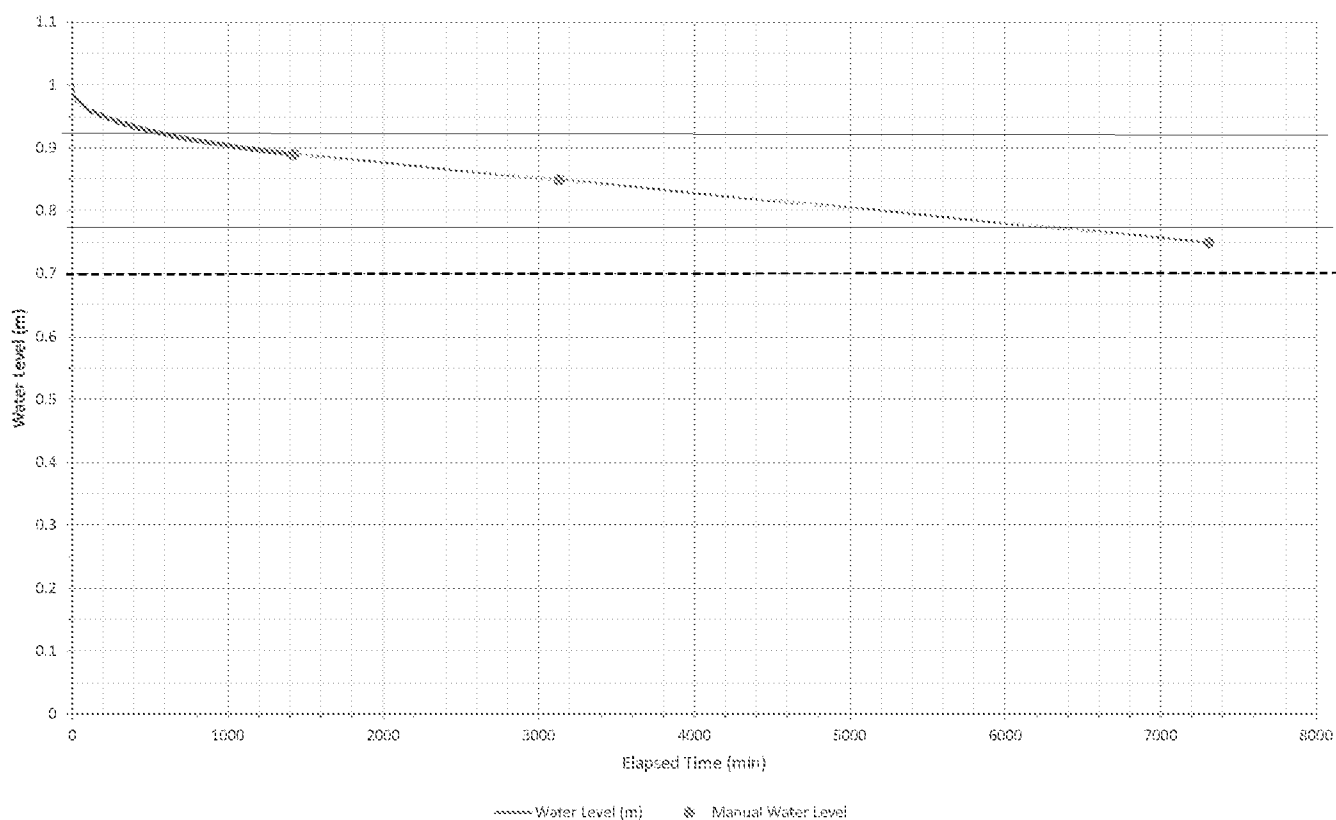
TPS B Test 1		
Width	0.45	m
Length	1.1	m
Depth	0.3	m
Volume	0.15	m3
Volume (75-25)	0.07	m3
Time (75-25)	282000	seconds
Wetted Area	0.96	m2
Infiltration rate	2.743E-07	m/s
Infiltration rate	0.001	m/hr

Eric Wall Glasshouses - Infiltration Testing TPS B



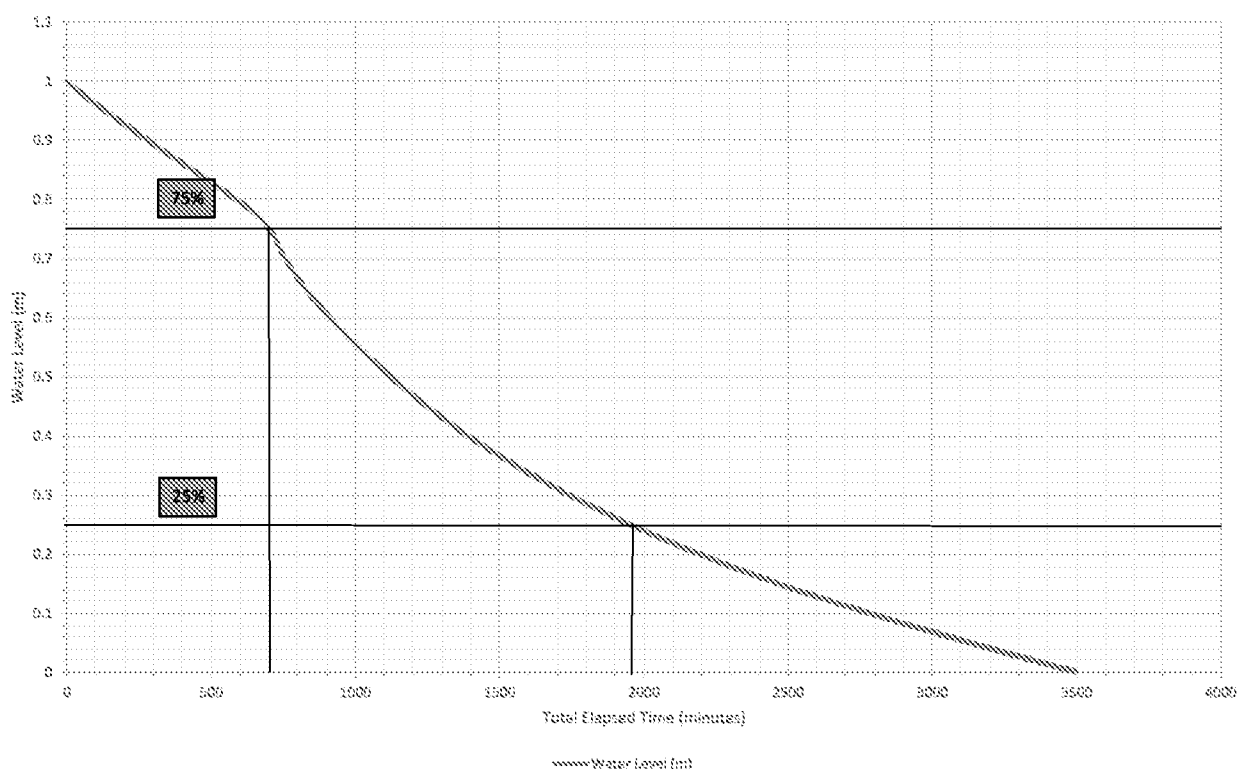
TPS C Test 1			
Width	0.45	m	
Length	1.2	m	
Depth	0.3	m	
Volume	0.16	m ³	
Volume (75-25)	0.08	m ³	
Time (75-25)	336000	seconds	
Wetted Area	1.04	m ²	
Infiltration rate	2.329E-07	m/s	
Infiltration rate	0.001	m/hr	

Eric Wall Glasshouses - Infiltration Testing -TPS C



TPS D Test 3			
Width	0.45	m	
Length	1.1	m	
Depth	1	m	
Volume	0.50	m ³	
Volume (75-25)	0.25	m ³	
Time (75-25)	74880	seconds	
Wetted Area	2.05	m ²	
Infiltration rate	1.616E-06	m/s	
Infiltration rate	0.006	m/hr	

Eric Wall Glasshouses - Infiltration Testing TPS D - Test 3



APPENDIX B
CAUSEWAY V8.0 CRITICAL STORM OUTPUT

Drainage Design Report

Flow+

v8.0

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Network	Storm Network
Filename	P:\Etc\W Longacre GH&Res (2449)\70 - Flow+Option B v8 0\Glasshouse and Reservoir (Option B Pumped) v8.0 swales removed.pfd
Username	Lee Clarke (leecclarke@envireauwater.co.uk)
Last analysed	23/01/2019 18:27:03
Report produced on	24/01/2019 07:55:47

Causeway Sales

Tel:

Fax:

Email:

Web:



www.causeway.com

Technical support web portal:

<http://support.causeway.com>

Rainfall Methodology	FEH-13
Return Period (years)	100
Additional Flow (%)	0
CV	0.750
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Inverts
Minimum Backdrop Height (m)	0.000
Preferred Cover Depth (m)	0.000
Include Intermediate Ground	
Enforce best practice design rules	X

	Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)	Notes
1			5.00		9.800	Junction				497222.782	104216.581	0.500	
2					9.800	Junction				497222.803	104231.427	0.550	
3					9.800	Junction				497188.815	104231.186	0.650	
4					9.800	Junction				497186.515	104247.097	0.700	
5					9.800	Junction				497159.548	104246.897	0.800	
6		0.371	5.00		9.800	Junction				497159.455	104252.074	0.900	
7		0.214	5.00		9.800	Junction				497159.378	104268.015	1.050	
8		0.429	5.00		9.800	Junction				497159.058	104300.022	1.250	
9		0.705	5.00		9.800	Junction				497159.382	104347.333	1.450	
10		0.133	5.00		9.800	Junction				497159.239	104363.385	1.500	
11					9.800	Junction				497403.894	104368.700	1.800	
12					7.750	Junction				497873.500	104326.244	1.500	
13					10.000	Junction				497875.850	104325.488	0.500	
13_OUT					10.000	Junction				497881.500	104323.500	2.487	
14			5.00		9.800	Junction				497405.082	104218.027	0.500	
15		0.285	5.00		9.800	Junction				497404.000	104244.000	0.714	
16					9.800	Junction				497422.890	104245.110	0.809	
17		0.148	5.00		9.800	Junction				497422.749	104258.032	0.941	
18		0.352	5.00		9.800	Junction				497422.579	104282.112	1.119	
19		0.606	5.00		9.800	Junction				497422.182	104325.955	1.344	
20					9.800	Junction				497421.878	104346.723	1.389	
21					9.800	Junction				497403.994	104348.755	1.428	
22		0.391	5.00		9.800	Junction				497403.874	104365.877	1.800	
23					7.750	Junction				497873.358	104325.506	1.500	
24					10.000	Junction				497875.694	104324.700	0.500	
24_OUT					10.000	Junction				497881.300	104322.800	2.487	
49		1.060	5.00		9.500	Manhole				497885.237	104195.709	2.000	

Name	US Node	DS Node	Length (m)	ks (mm) / n	Velocity Equation	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Con Offset (m)	Min DS IL (m)	Lateral Area (ha)	Lateral Ins Point (%)	Lateral T of E (mins)
1.000	1	2	14.907	0.8000	Causeway-White	9.900	9.250	0.650	287.5	200	Under	5.28	50.0					
1.001	2	3	16.908	0.8000	Causeway-White	8.250	9.130	0.100	160.8	200	Under	8.30	50.0					
1.002	3	4	15.931	0.8000	Causeway-White	9.150	9.100	0.050	119.0	200	Under	6.70	50.0					
1.003	4	5	25.370	0.8000	Causeway-White	9.000	9.900	0.900	289.0	200	Under	7.91	50.0					
1.004	5	6	5.178	0.8000	Causeway-White	9.000	9.960	0.960	190.6	200	Under	7.98	50.0					
1.005	6	7	11.941	0.8000	Causeway-White	9.900	8.820	0.080	193.0	250	Under	7.53	50.0					
1.006	7	8	52.909	0.8000	Causeway-White	9.750	8.890	0.100	520.1	3150	Under	8.24	50.0					
1.007	8	9	47.312	0.8000	Causeway-White	8.590	8.480	0.100	473.1	400	Under	6.19	50.0					
1.008	9	10	15.052	0.8000	Causeway-White	8.350	8.900	0.550	209.8	500	Under	8.58	50.0					
1.009	10	11	244.878	0.8000	Causeway-White	8.300	8.900	0.600	816.6	500	Under	14.50	50.0					
1.010	11	12	272.526	0.8000	Causeway-White	8.000	8.250	1.750	156.0	500	Under	17.40	50.0					
1.011	12	13	2.440	0.8000	Causeway-White	8.250	9.600	0.350	40.0	500	Under	17.48	50.0					
1.012	13	13_OUT	5.994	0.8000	Causeway-White	9.500	9.000	0.500	12.0	500	Under	17.47	50.0					
2.000	14	15	25.390	0.8000	Causeway-White	9.200	9.120	0.080	199.9	200	Under	6.62	50.0					
2.001	15	16	19.822	0.8000	Causeway-White	9.000	8.581	0.419	198.0	250	Under	6.77	50.0					
2.002	16	17	12.929	0.8000	Causeway-White	8.900	8.904	0.007	190.6	250	Under	6.89	50.0					
2.003	17	18	24.901	0.8000	Causeway-White	8.900	8.790	0.080	258.8	3150	Under	8.26	50.0					
2.004	18	19	43.849	0.8000	Causeway-White	8.801	8.580	0.120	254.8	400	Under	7.41	50.0					
2.005	19	20	20.770	0.8000	Causeway-White	8.490	8.411	0.066	481.8	500	Under	7.46	50.0					
2.006	20	21	17.852	0.8000	Causeway-White	8.410	8.372	0.038	498.9	500	Under	7.70	50.0					
2.007	21	22	19.120	0.8000	Causeway-White	8.372	8.000	0.372	51.4	500	Under	7.98	50.0					
2.008	22	23	272.491	0.8000	Causeway-White	8.000	8.250	1.750	156.0	500	Under	17.47	50.0					
2.009	23	24	2.471	0.8000	Causeway-White	8.250	9.500	0.250	40.0	500	Under	17.51	50.0					
2.010	24	24_OUT	5.995	0.8000	Causeway-White	9.500	9.000	0.500	12.0	500	Under	17.50	50.0					

Link Name	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node Name	Dia (mm)	Width (mm)	Node Type	MH Type	DS Node Name	Dia (mm)	Width (mm)	Node Type	MH Type
1.0140	14.888	297.3	200	Gravel	6.800	9.300	0.300	9.800	9.250	0.350				Junction		2			Junction	
1.0141	36.988	299.9	200	Gravel	9.800	9.250	0.350	9.800	9.150	0.450				Junction		3			Junction	
1.0142	175.521	315.8	200	Gravel	9.800	9.150	0.450	9.800	9.100	0.500				Junction		4			Junction	
1.0143	295.370	283.7	200	Gravel	9.800	9.100	0.500	9.800	9.050	0.550				Junction		5			Junction	
1.0144	8.178	193.0	200	Gravel	9.800	9.000	0.800	9.800	8.950	0.650				Junction		6			Junction	
1.0145	13.841	190.3	250	Gravel	9.800	8.300	0.850	9.800	8.520	0.730				Junction		7			Junction	
1.0146	10.008	320.1	315	Gravel	9.800	8.750	0.730	9.800	8.650	0.820				Junction		8			Junction	
1.0147	47.140	475.1	400	Gravel	9.800	8.550	0.250	9.800	8.450	0.250				Junction		9			Junction	
1.0148	16.636	329.8	500	Gravel	9.800	8.350	0.950	9.800	8.300	1.050				Junction		10			Junction	
1.0149	244.575	515.8	500	Gravel	9.800	8.300	1.000	9.800	8.050	1.250				Junction		11			Junction	
1.0149	1712.854	165.8	500	Gravel	9.800	8.000	1.300	7.750	8.250	1.000				Junction		12			Junction	
1.0111	2.490	0.0	500	Gravel	7.750	8.250	1.000	10.000	9.500	0.500				Junction		13			Junction	
1.0112	5.950	12.0	500	Gravel	10.000	9.500	0.000	10.000	9.600	0.500				Junction		13_OUT			Junction	
1.0140	26.980	188.9	200	Gravel	6.800	9.300	0.300	9.800	9.130	0.480				Junction		15			Junction	
1.0141	16.521	194.3	250	Gravel	9.800	9.080	0.480	9.800	9.080	0.250				Junction		16			Junction	
1.0142	12.535	189.3	250	Gravel	9.800	9.030	0.350	9.800	9.050	0.220				Junction		17			Junction	
1.0143	24.021	285.3	315	Gravel	9.800	8.550	0.820	9.800	8.740	0.710				Junction		18			Junction	
1.0144	43.848	350.8	400	Gravel	9.800	8.600	0.710	9.800	8.530	0.540				Junction		19			Junction	
1.0145	20.770	461.0	500	Gravel	9.800	8.450	0.844	9.800	8.410	0.580				Junction		20			Junction	
1.0146	17.580	450.5	500	Gravel	9.800	8.410	0.880	9.800	8.370	0.320				Junction		21			Junction	
1.0147	18.120	51.4	500	Gravel	9.800	8.370	0.920	9.800	8.000	1.300				Junction		22			Junction	
1.0148	272.481	165.7	500	Gravel	9.800	8.000	1.300	7.750	8.250	1.000				Junction		23			Junction	
1.0149	0.471	0.0	500	Gravel	7.750	8.250	1.000	10.000	9.500	0.500				Junction		24			Junction	
1.0149	0.898	10.0	500	Gravel	10.000	9.500	0.000	10.000	9.000	0.500				Junction		24_OUT			Junction	

Node Name	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type	Link ID	IL (m)	Dia (mm)	Link Type
1	497222.762	104216.561	9.800	0.500			Junction					
									0	1.000	9.300	200 Circular
2	497222.603	104231.427	9.800	0.550			Junction		1	1.000	9.250	200 Circular
									0	1.001	9.250	200 Circular
3	497186.515	104231.166	9.800	0.650			Junction		1	1.001	9.150	200 Circular
									0	1.002	9.150	200 Circular
4	497186.515	104247.097	9.800	0.700			Junction		1	1.002	9.100	200 Circular
									0	1.003	9.100	200 Circular
5	497159.546	104246.697	9.800	0.800			Junction		1	1.003	9.000	200 Circular
									0	1.004	9.000	200 Circular
6	497159.455	104252.074	9.800	0.900			Junction		1	1.004	8.950	200 Circular
									0	1.005	8.900	250 Circular
7	497159.378	104268.015	9.800	1.050			Junction		1	1.005	8.820	250 Circular
									0	1.006	8.750	315 Circular
8	497159.058	104300.022	9.800	1.250			Junction		1	1.006	8.650	315 Circular
									0	1.007	8.550	400 Circular
9	497159.362	104347.333	9.800	1.450			Junction		1	1.007	8.450	400 Circular
									0	1.008	8.350	500 Circular
10	497159.238	104363.365	9.800	1.500			Junction		1	1.008	8.300	500 Circular

P:\EricW Longacre GHRes (2449)\70 - Flow+Option B v8.0\Glasshouse and Reservoir (Option B Pumped) v8.0 swales removed.pfd
T COUNCIL Y/92/18/DOC

Rainfall Methodology	FEH-13	Return Period (years)	Climate Change (%)
Summer CV	0.750	2	0
Winter CV	0.840	30	0
Analysis Speed	Detailed	100	30
Skip Steady State	x	1000	0
Drain Down Time (mins)	240		
Additional Storage (m³/ha)	20.0		
Storm Durations (mins)	15		
	30		
	60		
	120		
	180		
	240		
	360		
	600		
	1440		
	10080		
Check Discharge Rate(s)			
1 year (l/s)	7.8		
30 year (l/s)	21.4		
100 year (l/s)	27.5		
Check Discharge Volume			
100 year 360 minute (m³)			

Site Makeup	Greenfield
Greenfield Method	ReFH2
Region	England, Wales, NI
Include Baseflow	
Positively Drained Area (ha)	3.632
Betterment (%)	0
Q 1 year (l/s)	7.8
Q 30 year (l/s)	21.4
Q 100 year (l/s)	27.6

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	3.832
Soil Index	1
SPR	0.10
CWI	
Return Period (years)	100
Climate Change (%)	0
Storm Duration (mins)	360
Betterment (%)	0
PR	
Runoff Volume (m3)	

Flow through Pond													
Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Main Channel Length (m)	Main Channel Slope (1:X)	Main Channel n	Inlets	Depth (m)	Area (m²)	Inf. Area (m²)
49	0.00001	0.00000	2.0	1.00	7.500		100.000	3000.0	0.001	13_OUT	0.000	8800.0	0.0
										24_OUT	2.000	10826.0	0.0

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	116.870	33.013
2 year 15 minute winter	81.873	33.013
2 year 30 minute summer	78.304	21.591
2 year 30 minute winter	53.548	21.591
2 year 60 minute summer	51.744	13.674
2 year 60 minute winter	34.377	13.674
2 year 120 minute summer	35.530	9.390
2 year 120 minute winter	23.605	9.390
2 year 180 minute summer	28.500	7.334
2 year 180 minute winter	18.528	7.334
2 year 240 minute summer	23.012	6.081
2 year 240 minute winter	15.289	6.081
2 year 360 minute summer	17.825	4.587
2 year 360 minute winter	11.588	4.587
2 year 600 minute summer	11.496	3.145
2 year 600 minute winter	7.855	3.145
2 year 1440 minute summer	6.001	1.608
2 year 1440 minute winter	4.033	1.608
2 year 10080 minute summer	1.836	0.488
2 year 10080 minute winter	1.185	0.488
30 year 15 minute summer	285.843	80.884
30 year 15 minute winter	200.592	80.884
30 year 30 minute summer	190.586	53.929
30 year 30 minute winter	133.745	53.929
30 year 60 minute summer	129.804	34.303
30 year 60 minute winter	88.239	34.303
30 year 120 minute summer	77.932	20.595
30 year 120 minute winter	51.776	20.595
30 year 180 minute summer	59.002	15.183
30 year 180 minute winter	38.353	15.183
30 year 240 minute summer	48.057	12.173
30 year 240 minute winter	30.599	12.173
30 year 360 minute summer	34.309	8.829
30 year 360 minute winter	22.362	8.829
30 year 600 minute summer	21.323	5.833
30 year 600 minute winter	14.569	5.833
30 year 1440 minute summer	10.583	2.838

30 year 1440 minute winter	7.113	2.838
30 year 10080 minute summer	2.607	0.718
30 year 10080 minute winter	1.811	0.718
100 year +30% 15 minute summer	485.918	131.839
100 year +30% 15 minute winter	328.960	131.839
100 year +30% 30 minute summer	312.662	88.473
100 year +30% 30 minute winter	219.412	88.473
100 year +30% 60 minute summer	215.290	56.895
100 year +30% 60 minute winter	143.034	56.895
100 year +30% 120 minute summer	128.917	33.540
100 year +30% 120 minute winter	84.321	33.540
100 year +30% 180 minute summer	95.471	24.568
100 year +30% 180 minute winter	62.058	24.568
100 year +30% 240 minute summer	74.221	19.515
100 year +30% 240 minute winter	49.311	19.515
100 year +30% 360 minute summer	54.918	14.132
100 year +30% 360 minute winter	35.888	14.132
100 year +30% 800 minute summer	34.012	9.303
100 year +30% 800 minute winter	23.239	9.303
100 year +30% 1440 minute summer	16.803	4.503
100 year +30% 1440 minute winter	11.283	4.503
100 year +30% 10080 minute summer	4.237	1.081
100 year +30% 10080 minute winter	2.735	1.081
1000 year 15 minute summer	532.271	150.614
1000 year 15 minute winter	373.524	150.614
1000 year 30 minute summer	384.494	103.139
1000 year 30 minute winter	255.785	103.139
1000 year 60 minute summer	253.729	67.053
1000 year 60 minute winter	168.572	67.053
1000 year 120 minute summer	152.513	40.305
1000 year 120 minute winter	101.326	40.305
1000 year 180 minute summer	114.855	29.558
1000 year 180 minute winter	74.859	29.558
1000 year 240 minute summer	89.452	23.640
1000 year 240 minute winter	59.430	23.640
1000 year 360 minute summer	66.915	17.219
1000 year 360 minute winter	43.486	17.219
1000 year 800 minute summer	41.693	11.404
1000 year 800 minute winter	28.487	11.404
1000 year 1440 minute summer	20.481	5.483

1000 year 1440 minute winter	13.765	5.489
1000 year 10080 minute summer	4.536	1.157
1000 year 10080 minute winter	2.927	1.157

Results for 2 year Critical Storm Duration.

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	1	108	9.773	0.473	0.4	0.0000	0.0000	FLOOD RISK	1.000	2	-0.4	-0.014	-0.020	0.4853	
180 minute winter	2	108	9.773	0.523	1.3	0.0000	0.0000	FLOOD RISK	1.001	3	-1.3	-0.082	-0.086	1.1284	
180 minute winter	3	108	9.781	0.631	13.9	0.0000	0.0000	FLOOD RISK	1.002	4	-13.9	-0.486	-0.658	6.4986	
180 minute winter	4	108	9.782	0.882	17.0	0.0000	0.0000	FLOOD RISK	1.003	5	-17.0	-0.544	-0.739	0.8441	
180 minute winter	5	108	9.785	0.785	18.6	0.0000	0.0000	FLOOD RISK	1.004	6	-18.6	-0.584	-0.487	0.1621	
180 minute winter	6	108	9.788	0.888	32.3	7.3092	0.0000	FLOOD RISK	1.005	7	-17.1	0.898	-0.353	0.7796	
180 minute winter	7	108	9.777	1.027	25.5	4.1879	0.0000	FLOOD RISK	1.006	8	24.6	0.885	0.351	2.4923	
180 minute winter	8	108	9.767	1.217	42.9	8.3537	0.0000	FLOOD RISK	1.007	9	42.5	0.928	0.393	5.9236	
180 minute winter	9	108	9.754	1.404	72.6	13.6559	0.0000	FLOOD RISK	1.008	10	68.8	0.821	0.299	3.1389	
120 minute winter	10	78	9.751	1.451	101.0	2.5733	0.0000	FLOOD RISK	1.009	11	101.3	0.999	0.685	47.8613	
240 minute summer	11	130	9.692	1.892	74.2	0.0000	0.0000	FLOOD RISK	1.010	12	60.4	0.656	0.177	53.3278	
15 minute summer	12	17	7.750	1.503	175.2	0.0000	0.0000	FLOOD RISK	1.011	13	0.0	0.000	0.000	0.2415	
180 minute winter	13	108	9.578	0.978	67.9	0.0000	0.0000	OK	1.012	13_OUT	67.9	3.472	0.065	0.1172	
10080 minute winter	13_OUT	9980	7.826	0.293	5.1	0.0000	0.0000	OK	Flow through pond	49	16.6	0.002	0.000	2735.9919	
120 minute summer	14	73	9.809	0.509	10.0	0.0000	0.0000	FLOOD RISK	2.000	15	-10.0	-0.321	-0.333	0.8138	
120 minute winter	15	73	9.800	0.714	24.3	5.8030	0.0000	FLOOD RISK	2.001	16	15.3	0.597	0.318	0.9254	
120 minute winter	16	73	9.800	0.809	17.2	0.0000	0.0000	FLOOD RISK	2.002	17	-17.2	0.900	-0.350	0.8320	
120 minute winter	17	73	9.800	0.941	38.8	2.9207	0.0000	FLOOD RISK	2.003	18	-31.0	0.902	-0.396	1.8750	
120 minute winter	18	73	9.787	1.108	42.6	5.9604	0.0000	FLOOD RISK	2.004	19	40.5	0.984	0.321	5.4890	
120 minute winter	19	73	9.781	1.326	72.8	11.9519	0.0000	FLOOD RISK	2.005	20	69.7	1.008	0.353	4.0028	
180 minute summer	20	100	9.788	1.377	85.2	0.0000	0.0000	FLOOD RISK	2.006	21	69.7	1.367	0.337	3.4879	
180 minute summer	21	100	9.784	1.412	77.4	0.0000	0.0000	FLOOD RISK	2.007	22	63.2	1.327	0.108	3.7404	
120 minute winter	22	73	9.759	1.759	87.2	7.6395	0.0000	FLOOD RISK	2.008	23	88.1	0.852	0.252	53.3017	
15 minute summer	23	13	7.750	1.500	231.2	0.0000	0.0000	FLOOD RISK	2.009	24	0.0	0.000	0.000	0.2417	
120 minute winter	24	72	9.588	0.988	86.2	0.0000	0.0000	OK	2.010	24_OUT	86.3	3.728	0.079	0.1388	
10080 minute winter	24_OUT	9960	7.829	0.293	5.0	0.0000	0.0000	OK	Flow through pond	49	16.6	0.002	0.000	2735.9919	
10080 minute winter	49	10140	7.623	0.323	19.0	3.4189	0.0000	OK	Infiltration		0.0				

Results for 30 year Critical Storm Duration.

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	11	9.800	0.503	13.2	0.0000	0.0000	FLOOD RISK	1.000	2	-13.2	-0.422	-0.603	0.4653	
15 minute summer	2	11	9.800	0.550	24.0	0.0000	0.0000	FLOOD RISK	1.001	3	-24.0	-0.875	-1.255	1.1284	
15 minute summer	3	11	9.800	0.550	31.5	0.0000	0.0000	FLOOD RISK	1.002	4	-31.5	-1.005	-1.438	0.4986	
15 minute summer	4	11	9.800	0.700	39.4	0.0000	0.0000	FLOOD RISK	1.003	5	-39.4	-1.258	-1.719	0.8441	
15 minute summer	5	10	9.800	0.893	45.3	0.0000	0.0000	FLOOD RISK	1.004	6	-45.3	-1.447	-1.211	0.1821	
15 minute summer	6	10	9.800	0.903	129.9	15.2253	0.0000	FLOOD RISK	1.005	7	71.0	1.433	1.433	0.7796	
15 minute summer	7	10	9.800	1.050	103.8	7.6482	0.0000	FLOOD RISK	1.006	8	100.0	1.285	1.425	2.4923	
15 minute summer	8	10	9.800	1.250	225.0	13.1318	0.0000	FLOOD RISK	1.007	9	193.1	1.542	1.785	5.9230	
15 minute summer	9	11	9.800	1.450	426.1	20.1585	0.0000	FLOOD RISK	1.008	10	380.7	1.947	1.898	3.1380	
15 minute summer	10	12	9.800	1.500	425.1	3.7112	0.0000	FLOOD RISK	1.009	11	372.7	1.927	2.522	47.8613	
15 minute summer	11	10	9.800	1.800	372.7	0.0000	0.0000	FLOOD RISK	1.010	12	283.4	1.677	0.831	53.3278	
15 minute summer	12	13	7.750	1.500	283.4	0.0000	0.0000	FLOOD RISK	1.011	13	252.7	1.918	1.287	0.2824	
60 minute winter	13	23	9.729	0.228	380.5	0.0000	0.0000	OK	1.012	13_OUT	288.6	6.783	0.233	0.4182	
60 minute winter	13_OUT	38	6.091	0.558	328.9	0.0000	0.0000	OK	Flow through pond	49	736.2	0.138	0.000	987.1115	
15 minute summer	14	11	9.800	0.500	20.6	0.0000	0.0000	FLOOD RISK	2.000	15	-20.6	-0.558	-0.683	0.8136	
15 minute summer	15	10	9.800	0.714	147.3	19.5751	0.0000	FLOOD RISK	2.001	16	57.3	1.220	1.182	0.9254	
15 minute summer	16	11	9.800	0.809	62.9	0.0000	0.0000	FLOOD RISK	2.002	17	-62.9	-1.286	-1.277	0.6320	
15 minute summer	17	11	9.800	0.941	86.1	8.0008	0.0000	FLOOD RISK	2.003	18	81.2	1.121	1.038	1.8750	
15 minute summer	18	11	9.800	1.119	180.9	16.9367	0.0000	FLOOD RISK	2.004	19	175.7	1.404	1.386	5.4880	
15 minute summer	19	10	9.800	1.344	378.1	25.1267	0.0000	FLOOD RISK	2.005	20	357.9	1.942	1.815	4.0828	
15 minute summer	20	11	9.800	1.388	357.9	0.0000	0.0000	FLOOD RISK	2.006	21	370.7	2.451	1.874	3.4979	
15 minute summer	21	11	9.800	1.428	370.7	0.0000	0.0000	FLOOD RISK	2.007	22	334.0	2.289	0.581	3.7404	
15 minute summer	22	10	9.800	1.500	464.8	13.2929	0.0000	FLOOD RISK	2.008	23	327.1	1.875	0.958	53.3617	
15 minute summer	23	10	7.750	1.500	327.1	0.0000	0.0000	FLOOD RISK	2.009	24	480.8	3.168	2.449	0.3347	
60 minute winter	24	22	9.784	0.264	470.3	0.0000	0.0000	OK	2.010	24_OUT	411.2	6.728	0.332	0.4977	
60 minute winter	24_OUT	21	5.259	0.722	411.2	0.0000	0.0000	OK	Flow through pond	49	443.7	0.114	0.000	703.4009	
10080 minute winter	49	10320	8.001	0.501	30.1	5.3119	0.0000	OK	Infiltration		0.0				

Results for 100 year +30% Critical Storm Duration.

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	10	9.800	0.503	14.4	0.0000	0.0000	FLOOD RISK	1.000	2	-14.4	-0.458	-0.658	0.4853	
15 minute summer	2	10	9.800	0.550	32.6	0.0000	0.0000	FLOOD RISK	1.001	3	-32.6	-1.098	-1.842	1.1294	
15 minute summer	3	10	9.800	0.550	42.9	0.0000	0.0000	FLOOD RISK	1.002	4	-42.9	-1.375	-2.027	0.4986	
15 minute summer	4	9	9.800	0.700	57.4	0.0000	0.0000	FLOOD RISK	1.003	5	-57.4	-1.834	-2.433	0.8441	
15 minute summer	5	9	9.800	0.893	71.4	0.0000	0.0000	FLOOD RISK	1.004	6	-71.4	-2.283	-1.911	0.1621	
15 minute summer	6	8	9.800	0.903	211.7	38.0842	0.0000	FLOOD RISK	1.005	7	89.8	1.837	1.853	0.7796	
15 minute summer	7	8	9.800	1.050	151.1	19.2180	0.0000	FLOOD RISK	1.006	8	120.2	1.544	1.712	2.4923	
15 minute summer	8	8	9.800	1.250	337.0	32.8589	0.0000	FLOOD RISK	1.007	9	261.4	2.088	2.416	5.9236	
15 minute summer	9	8	9.800	1.450	648.3	46.7027	0.0000	FLOOD RISK	1.008	10	540.5	2.783	2.289	3.1389	
15 minute summer	10	10	9.800	1.500	812.8	8.4375	0.0000	FLOOD RISK	1.009	11	449.9	2.308	3.045	47.8613	
15 minute summer	11	12	9.800	1.800	449.8	0.0000	0.0000	FLOOD RISK	1.010	12	338.3	1.730	0.992	53.3278	
15 minute summer	12	12	7.750	1.500	338.3	0.0000	0.0000	FLOOD RISK	1.011	13	511.3	3.476	2.604	0.3741	
60 minute winter	13	42	9.781	0.281	608.2	0.0000	0.0000	OK	1.012	13_OUT	483.5	7.578	0.391	0.5515	
60 minute winter	13_OUT	21	8.495	0.962	479.9	0.0000	0.0000	OK	Flow through pond	49	660.9	0.085	0.000	1379.7380	
15 minute summer	14	9	9.800	0.500	24.8	0.0000	0.0000	FLOOD RISK	2.000	15	-24.8	-0.792	-0.822	0.8138	
15 minute summer	15	8	9.800	0.714	213.6	41.5342	0.0000	FLOOD RISK	2.001	16	88.6	1.811	1.827	0.9254	
15 minute summer	16	8	9.800	0.809	88.8	0.0000	0.0000	FLOOD RISK	2.002	17	97.1	1.987	1.972	0.8320	
15 minute summer	17	8	9.800	0.941	136.3	16.2749	0.0000	FLOOD RISK	2.003	18	131.0	1.883	1.976	1.8750	
15 minute summer	18	8	9.800	1.119	263.1	33.3663	0.0000	FLOOD RISK	2.004	19	211.5	1.898	1.886	5.4896	
15 minute summer	19	8	9.800	1.344	458.8	47.3518	0.0000	FLOOD RISK	2.005	20	424.5	2.171	2.153	4.0028	
15 minute summer	20	8	9.800	1.388	424.5	0.0000	0.0000	FLOOD RISK	2.006	21	499.9	2.365	2.028	3.4879	
15 minute summer	21	8	9.800	1.428	400.9	0.0000	0.0000	FLOOD RISK	2.007	22	378.5	2.292	0.632	3.7404	
15 minute summer	22	8	9.800	1.500	521.5	22.9075	0.0000	FLOOD RISK	2.008	23	483.5	2.472	1.417	53.3617	
15 minute summer	23	8	7.750	1.500	483.5	0.0000	0.0000	FLOOD RISK	2.009	24	483.5	3.221	2.482	0.3399	
120 minute summer	24	88	9.788	0.288	516.6	0.0000	0.0000	OK	2.010	24_OUT	411.6	7.477	0.333	0.5217	
60 minute winter	24_OUT	22	8.785	1.252	522.2	0.0000	0.0000	OK	Flow through pond	49	690.9	0.085	0.000	1379.7380	
10080 minute winter	49	10320	8.258	0.758	34.6	8.0295	0.0000	OK	Infiltration		0.0				

Results for 1000 year Critical Storm Duration.

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	10	9.800	0.503	28.9	0.0000	0.0000	FLOOD RISK	1.000	2	-28.9	-0.927	-1.277	0.4853	
15 minute summer	2	10	9.800	0.550	33.5	0.0000	0.0000	FLOOD RISK	1.001	3	-33.5	-1.098	-1.650	1.1294	
15 minute summer	3	8	9.800	0.550	47.1	0.0000	0.0000	FLOOD RISK	1.002	4	-47.1	-1.504	-2.226	6.4986	
15 minute summer	4	8	9.800	0.700	82.6	0.0000	0.0000	FLOOD RISK	1.003	5	-82.6	-2.503	-2.718	0.8441	
15 minute summer	5	8	9.800	0.893	79.1	0.0000	0.0000	FLOOD RISK	1.004	6	-79.1	-2.527	-2.115	0.1621	
15 minute summer	6	8	9.800	0.903	241.9	47.7121	0.0000	FLOOD RISK	1.005	7	103.6	2.120	2.138	0.7796	
15 minute summer	7	8	9.800	1.050	188.8	23.9899	0.0000	FLOOD RISK	1.006	8	137.9	1.772	1.955	2.4923	
15 minute summer	8	8	9.800	1.250	375.4	40.6738	0.0000	FLOOD RISK	1.007	9	272.8	2.178	2.522	5.9236	
15 minute summer	9	8	9.800	1.450	727.1	57.0497	0.0000	FLOOD RISK	1.008	10	591.0	3.021	2.493	3.1389	
15 minute summer	10	8	9.800	1.500	877.7	10.2954	0.0000	FLOOD RISK	1.009	11	479.4	2.451	3.244	47.8613	
15 minute summer	11	11	9.800	1.803	479.4	0.0000	0.0000	FLOOD RISK	1.010	12	388.0	1.984	1.137	53.3278	
15 minute summer	12	11	7.750	1.503	388.0	0.0000	0.0000	FLOOD RISK	1.011	13	600.4	3.884	3.058	0.3714	
120 minute summer	13	70	9.770	0.270	608.0	0.0000	0.0000	OK	1.012	13_OUT	468.5	7.443	0.378	0.5535	
30 minute winter	13_OUT	23	8.624	1.091	478.4	0.0000	0.0000	OK	Flow through pond	49	884.1	0.088	0.000	1888.8631	
15 minute summer	14	8	9.800	0.500	26.2	0.0000	0.0000	FLOOD RISK	2.000	15	-26.2	-0.838	-0.870	0.8138	
15 minute summer	15	8	9.800	0.714	234.6	50.2871	0.0000	FLOOD RISK	2.001	16	98.9	2.023	2.040	0.9254	
15 minute summer	16	8	9.800	0.803	98.9	0.0000	0.0000	FLOOD RISK	2.002	17	108.6	2.221	2.205	0.8320	
15 minute summer	17	8	9.800	0.941	173.1	19.5339	0.0000	FLOOD RISK	2.003	18	145.8	1.872	1.865	1.8750	
15 minute summer	18	8	9.800	1.119	257.9	39.8795	0.0000	FLOOD RISK	2.004	19	235.1	1.875	1.868	5.4896	
15 minute summer	19	8	9.800	1.344	499.2	58.2208	0.0000	FLOOD RISK	2.005	20	465.4	2.073	2.058	4.0028	
15 minute summer	20	8	9.800	1.388	405.4	0.0000	0.0000	FLOOD RISK	2.006	21	412.4	2.327	2.084	3.4879	
15 minute summer	21	8	9.800	1.428	412.4	0.0000	0.0000	FLOOD RISK	2.007	22	419.3	2.173	0.704	3.7404	
15 minute summer	22	8	9.800	1.500	558.7	25.7442	0.0000	FLOOD RISK	2.008	23	539.5	2.758	1.551	53.3017	
15 minute summer	23	8	7.750	1.500	539.5	0.0000	0.0000	FLOOD RISK	2.009	24	539.5	3.308	2.748	0.3481	
30 minute winter	24	18	9.781	0.281	590.9	0.0000	0.0000	OK	2.010	24_OUT	591.0	8.415	0.478	0.5899	
30 minute winter	24_OUT	22	9.089	1.533	591.0	0.0000	0.0000	OK	Flow through pond	49	884.1	0.088	0.000	1888.8631	
10080 minute winter	49	10260	8.311	0.811	35.4	8.8000	0.0000	OK	Infiltration		0.0				

APPENDIX C
FLOOD DEFENCE BARRIER EXAMPLE

L-Bloc® / 1.2m / Reinforced

Overview

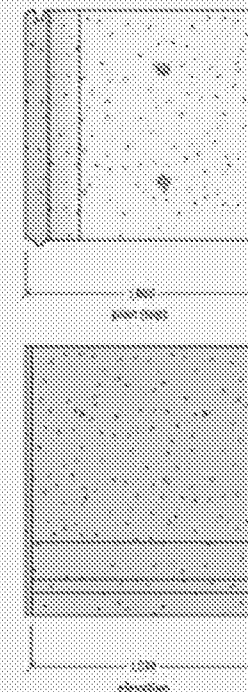
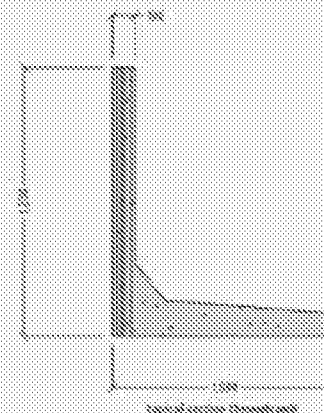
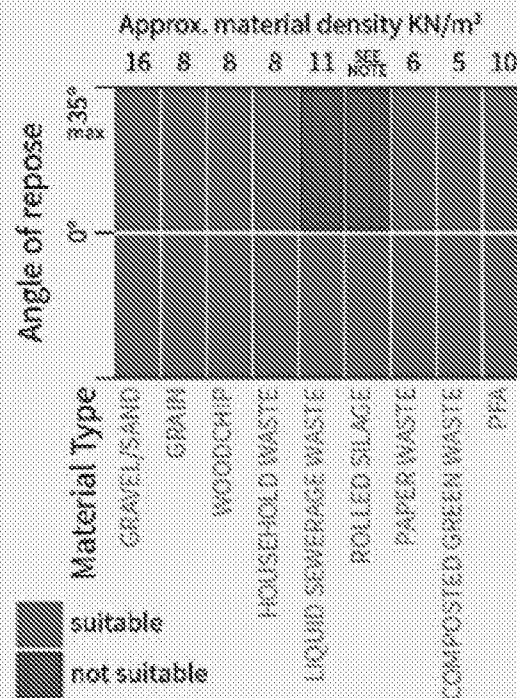
- Height 1,200mm
- Width 1,000mm
- Thickness 100mm (at stem)
- Foot 1,000mm
- Weight 0.6 tonnes

Anchoring

All units to be bolted down onto suitable concrete hardstanding with 2 x No.m20 stud anchors, 175mm embedment into slab.

Loading

L-Bloc® can be loaded from either side subject to anchoring.





Number: UK9-85

DECLARATION OF PERFORMANCE

In accordance with Annex III of Registration (EU) No. 305/2011

(Construction Product Regulation)

For the product Thioflex 600 Gun Grade

1. Unique identification code of the product-type:
EN 14188-2:2004 Cold applied joint sealant system M, type ns, class B, C
2. Type, batch or serial number or other identifying mark to identify the construction product as set out in Article 11 (4):
Batch Number: See product packaging
3. Intended use as foreseen by the manufacturer of the construction product in accordance with the harmonised technical specification:
EN 14188-2: Joint sealants for concrete pavements - cold applied
4. Name, registered trade name or registered trade mark and contact address of the manufacturer as set out in article 11 (5)



Fosroc Limited
Drayton Manor Business Park
Coleshill Road, Tamworth
Staffordshire, B78 3TL, UK

5. Name and contact address of the authorised representative who has received a mandate for the tasks set out on Article 12 (2):
Not Relevant
6. System or systems for assessment and verification of constancy of performance of the construction product in accordance with Annex V
System 4
7. In the case of a declaration of performance concerning a construction product that is covered by a harmonised standard
The product is subject to in-plant production control
8. In case of a declaration of performance concerning a construction product for which a European Technical Assessment was issued
Not Relevant

9. Declared performance

Essential Characteristics	Performance	Harmonised technical specification
Elastic recovery	>70%	EN ISO 7389
Extrudability	≥ 70ml/min	EN 29048
Change in mass/volume	≤ 5% by volume	EN ISO 10563
Rate of cure	≥80%	EN 14187-1
Change in mass/volume after immersion in liquid chemicals	≤25% by mass, no increase	EN 14187-4
Change in mass/volume after immersion in liquid chemicals	≤ ± 30% by volume	EN 14187-4
Resistance to hydrolysis	Shore A ≤ ±50%	EN 14187-5

Fosroc® Thioflex 600 Gun



constructive solutions

Number: UK9-85

Cohesion	No failure at -20°C $\leq 0.60\text{MPa}$	EN ISO 9047
Cohesion for cold climate areas	No failure at -30°C $\leq 1.00\text{MPa}$	EN 14187-9
Bonding strength at maintained extension	Tensile modulus at 100% at 23°C $\geq 0.15\text{MPa}$	EN ISO 8340
Bonding strength at maintained extension	Tensile modulus at 100% at -20°C $\leq 0.60\text{MPa}$	EN ISO 8340
Artificial weathering by UV irradiation	Change of tensile modulus at 100% extension $\leq \pm 20$	EN 14187-8
Adhesion/cohesion properties after immersion in liquid chemicals	No failure	EN 14187-6

When specified technical documentation in accordance with Articles 37 or 38 was used, the requirements that the product fulfils:

Not applicable

The performance of the product set out in numbers 1 and 2 corresponds to the declared performance set out in number 9. The manufacturer as defined in number 4 is solely responsible for drawing up this declaration of performance.

Signed for the manufacturer and in the name of the manufacturer by:



Neil Taylor,
Product Development Manager

Place and Date of Issue: 16/12/2013 Tamworth