

Verification Report

Metropolitan Police Specialist
Training Centre , Mark Lane,
Gravesend,

Kent DA12

25 September 2023

Produced By

Manoj Pun (BEng Hons)

Revision B

Checked By

**Mehrdad Bahari BEng, MSC, PhD, MCIOB, CEng,
MICE, MStructE**

Commercial property

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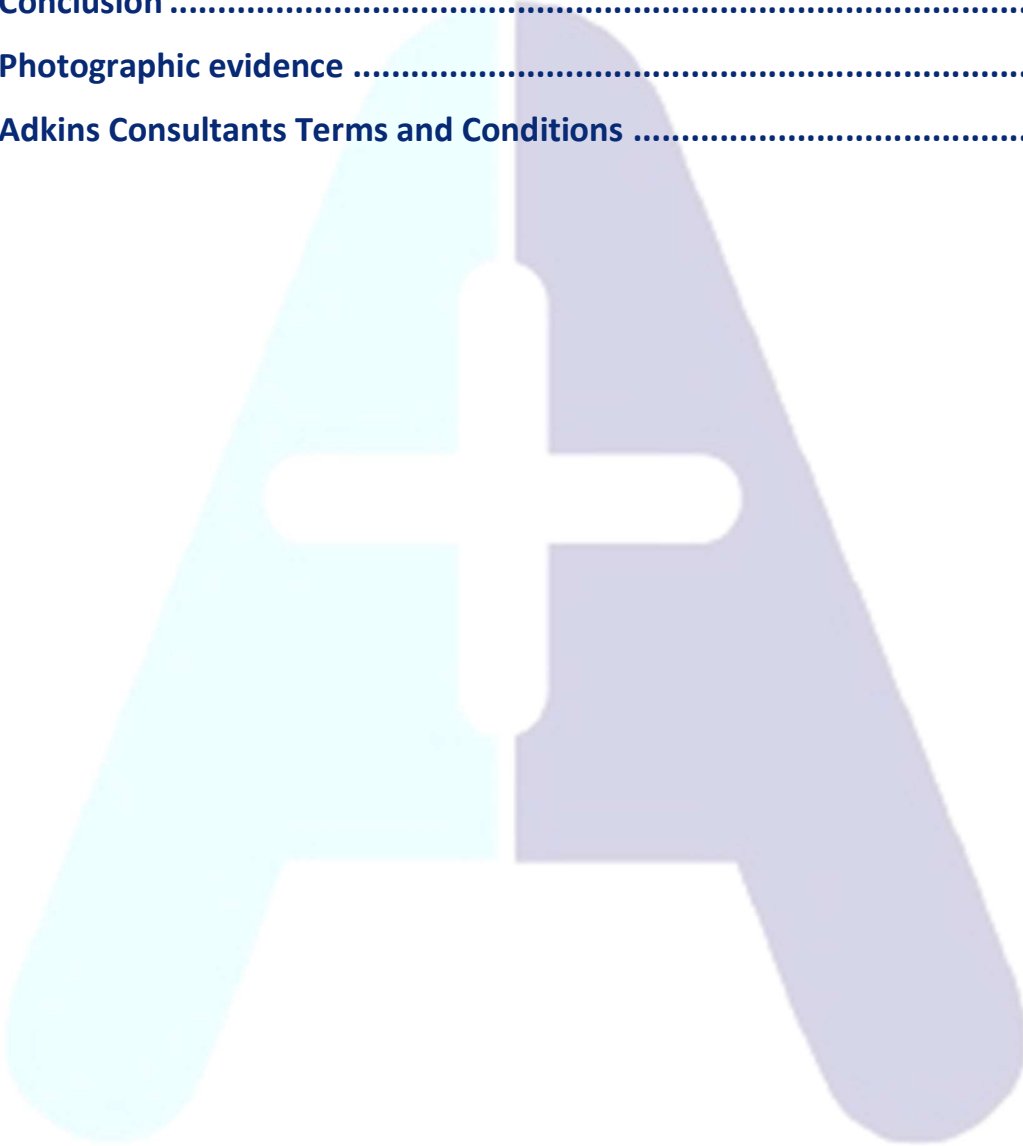
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1. Purpose

- 1.1. Stuart Durie contacted Adkins Consultants Ltd concerning some structural issues with their project. In particular, the client requested a verification report about the constructed drainage system on the above project. The client required an inspection of this. Dr Mehrdad Bahari from Adkins Consultants Ltd visited the property on 23 June 2023 and examined the property in respect of the problem.

2. Introduction

- 2.1. The property was a new build training centre for Met Police Gravesend.
- 2.2. The planning application **reference number is 20230740**.
- 2.3. The proposed training facility will be constructed within the carpark located in the North-East of the Metropolitan Police Training facility, located approximately 2.8km east of Gravesend town centre, Kent and centred on National Grid Reference 567280 174230.



Figure 1 Site location plan. Source: google map.

2.4. My remit was just to inspect the Property and comment on concerns raised by the client. During my inspection the following were examined and noted.

3. Findings

3.1. The following drawings are considered in the current report and attached.

3.1.1. Approved drainage plan 77443.02 100 P03

3.1.2. Drainage plan MP-A1-MM-14 Rev05

3.2. There are minor tweaks between the Approved drawings and the As Built drawings listed above:

3.2.1. S7 added on the existing pipe (outside of the buffer zone) due to the head pressure gradient constraints.

3.2.2. Exceedance overflow crates constructed to allow 10m³ justified with the calculation provided.

4. Further Justification

4.1.1. Full drainage network calculation has been carried out and attached. Please Appendix 4 Drainage Calculation Report Rev B and Appendix 1 Supporting Drainage Calculations.

4.1.2. Appendix 1 Supporting Drainage Calculations page 11 shows that the flood exceedance only occurs in 100 year return period +40% CC with **4.8m³** exceedance for which attenuation storage has been provided of **10m³**, this has been provided on design Appendix 3 WHARF ROAD DRAINAGE DRAWING REV5 and built on the site. Please see photographic evidence below.

4.1.3. Appendix 2_Chapter 5.4 Water Quality extract states pollution hazard level is **low** for proposed land use. Permeable pavement has also been provided which will act as further oil separator.

4.1.4. Appendix 3 Wharf Road Drainage Drawing Rev5 Drawing No. MP-A1-MM-17 provided shows the maintenance plan for all SUDS components in accordance with CIRIA SUDS Manual guidelines.

5. Conclusion

- 5.1. The minor tweaks observed between the As Built and Approved drawings are considered acceptable and do not pose any significant issues. These slight adjustments can often arise due to practical considerations during the construction process and do not deviate from the overall intent or functionality of the design. These tweaks, being minor in nature, do not compromise the safety, efficiency, or quality of the project. Overall, the negligible variances between the As Built and Approved drawings are within acceptable limits and do not give rise to any concerns.
- 5.2. I can confirm that the construction process has been carried out with careful attention to detail, regarding the drainage system, to ensure consistency with the original design. From the initial excavation for the drainage network to the installation of pipes, filters, and other components, every step has been closely monitored to align with the approved plans and specifications. Any minor adjustments or modifications made during the installation process have been done in accordance with engineering best practices, without compromising the overall functionality or effectiveness of the system.
- 5.3. Photographic evidence attached at the end of this report.
- 5.4. I can confirm that the flood exceedance has been designed as per the Flood Risk and Drainage Strategy report. Maintenance plan has considered of maintenance regime for the SUDs components of the proposed development. Pollution hazard level due to the proposed development is Low and permeable paving for the site is adequate for the issue of oil separator. Full drainage network calculation has been performed and I am satisfied that the as built condition of all drainage matters are adequately installed.

End of report.

6. Photographic evidence

















7. Adkins Consultants Terms and Conditions

Terms and Conditions

1. Additional Services

In the event of additional services being required, the fees will be adjusted by prior agreement between us.

2. Diligence and Care

Adkins Consultants will exercise reasonable care, skill and diligence in the performance of the Services.

3. Disbursements and Expenses

Disbursements and expenses are not included in our quoted fees unless stated to the contrary in our fee proposal.

4. Document Formats

The proposed fees allow for a digital copy usually in PDF format.

Hard copies of documents may be subject to a fee dependent on the type of document. Our printing costs are available upon request.

5. Copyright

Adkins Consultants retain copyright in any document and works they produce; in all cases the copyright will remain vested in Adkins Consultants. The Client, subject to payment of fees and disbursements due under the Agreement, will have a license to copy and use all such documents for any purpose related to the project in question. They will not have a license to use these documents for any other project and no liability will be held by Adkins Consultants.

6. Value Added Tax

All quotations are subject to the addition of VAT at the current rate.

7. Liability

7.1 None of our employees, partners or consultants individually has a contract with you or owes you a duty of care or personal responsibility. You agree that you will not bring any claim against any such individuals personally in connection with our services."

7.2 The liability of Adkins Consultants Ltd to the client, (or any third party claiming through the client) shall in no circumstance (except in case of death or personal injury) exceed the lesser of:

- (a) The amount that can be recovered from our professional indemnity insurance
- (b) We will have proportionate liability and this will be limited to 25% (twenty five percent) of any loss.

(c) The diminution in value of the property concerned.

7.3 Adkins Consultants shall have no liability to the Client (or to any third party claiming through the Client) whether in contract or in tort (including but not limited to negligence) or for breach of statutory duty or otherwise for any claim arising in connection with:-

- (a) pollution, contamination, terrorism, asbestos or any related risk or
- (b) designs or reports prepared by other professionals and specialist sub-contractors/suppliers.

7.4 The limitation period, before which any claim must commence, is six years.

7.5 If you suffer loss as a result of our breach of contract or negligence, our liability shall be limited to a just and equitable proportion of your loss having regard to the extent of responsibility of any other party. Our liability shall not increase by reason of a shortfall in recovery from any other party.

8. Payments

Payment shall be received in full before Adkins Consultants will release any work, save for clients with an account with Adkins Consultants.

8.1 Where such an account is available our invoices will be issued monthly for the work completed in that month or upon completion of the work, whichever occurs soonest. Payment shall become due on submission of the invoice and the final date of payment shall be 7 days after the invoice date. We reserve the right to charge interest at the statutory rate on any overdue amounts. Please note that all invoices not settled within our payment terms will be referred to our debt recovery agents, and will be subject to a surcharge of 15% plus VAT in lieu of our recovery charges.

8.2 If you do not have an account with Adkins Consultants Ltd, then payment is required prior to the release of information, unless agreed otherwise in the quotation, which would be unusual.

8.3 Please note that all invoices not settled within our payment terms will be referred to our debt recovery agents, and will be subject to a surcharge of 15% plus VAT in lieu of our recovery charges.

9. CDM Regulations

Under the current CDM Regulations 2015 it is held to be our responsibility to inform you that the aforementioned regulations may be applicable to your project.

We have attached an information sheet for your benefit and should you have any queries in connection with this, please contact us.

10. Changes in Terms and Conditions

Terms and conditions are liable to change without notice. Amended versions will supersede any printed or electronic versions held in the clients' possession. You can find an up-to-date copy of this Terms and Conditions Statement on our website.

11. Terms and Conditions further information

Unless otherwise agreed in writing by the Company these Conditions will override any terms and conditions stipulated or referred to by the Customer in his order or pre-contract negotiations.

12. Cancellations

Adkins Consultants will only accept cancellations at the discretion of Adkins Consultants unless they are within the cooling-off period of 14 days. Acceptance of the cancellation will only be binding on the company if it is sent in writing. Any cost or expenses incurred by the company up to the date of cancellation and all loss and damage resulting from the cancellation will be paid by the customer to the company, including within the cooling-off period if Adkins Consultants have started works during this time, which is a likely course of events given Adkins Consultant's desire to dispatch customer's instructions at a speedy rate.

13. Exclusions

In dispute of any assertion that anything is excluded, all warranties, conditions and other terms, implied, statutory or otherwise, are expressly excluded excepting so far as they are contained in these conditions or otherwise expressly agreed by Adkins Consultants Ltd in writing. If any legislation makes it unlawful to exclude any term from the Contract this clause will naturally not apply to such.

14. Resolutions of Disputes

14.1 The parties will endeavour to resolve any dispute amicably. Each of them shall in good faith consider any proposal by the other that a dispute be referred to mediation.

14.2 Disputes shall be finally resolved by the English Courts.

15. Governing Law

The Agreement shall be solely within the jurisdiction of and governed by English Courts.

Appendices

Appendix 1 Supporting Drainage Calculations

Appendix 2_Chapter 5.4 Water Quality

Appendix 3 Wharf Road Drainage Drawing Rev5

Appendix 4 Drainage Calculation Report Rev B

Appendix 5 SuDS Management and Maintenance Plan

Appendix 6 Record of Undertaker

Appendix 1

Gravesend Live Fire Skills House Flood Risk & Drainage Assessment



Appendix H – Supporting Drainage Calculations

The calculation below is to confirm that 4.8m³ is adequate for exceedance flow tank.

WYG Group Limited		Page 4
.	Live Fire Skills House	
.	Gravesend	
.		
Date 20/07/2020 23:41	Designed by CD	
File Source Control - Porus ...	Checked by ME	
XP Solutions	Source Control 2019.1	

Model Details

Storage is Online Cover Level (m) 2.400

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	13.0
Membrane Percolation (mm/hr)	1000	Length (m)	63.0
Max Percolation (l/s)	227.5	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	1.800	Cap Volume Depth (m)	0.450

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0062-2000-1400-2000
Design Head (m)	1.400
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	62
Invert Level (m)	1.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	2.0
Flush-Flo™	0.272	1.6
Kick-Flo®	0.553	1.3
Mean Flow over Head Range	-	1.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.4	1.200	1.9	3.000	2.8	7.000	4.2
0.200	1.6	1.400	2.0	3.500	3.0	7.500	4.4
0.300	1.6	1.600	2.1	4.000	3.2	8.000	4.5
0.400	1.6	1.800	2.2	4.500	3.4	8.500	4.6
0.500	1.5	2.000	2.4	5.000	3.6	9.000	4.7
0.600	1.4	2.200	2.5	5.500	3.8	9.500	4.9
0.800	1.6	2.400	2.6	6.000	3.9		
1.000	1.7	2.600	2.7	6.500	4.1		

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WYG Group Limited		Page 1																																																																																																																																																																																																																																																																																		
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Summary of Results for 1 year Return Period Half Drain Time : 46 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>1.941</td><td>0.141</td><td>0.0</td><td>1.7</td><td>1.7</td><td>3.9</td><td>O K</td></tr><tr><td>30 min Summer</td><td>1.971</td><td>0.171</td><td>0.0</td><td>1.7</td><td>1.7</td><td>5.7</td><td>O K</td></tr><tr><td>60 min Summer</td><td>1.987</td><td>0.187</td><td>0.0</td><td>1.7</td><td>1.7</td><td>6.8</td><td>O K</td></tr><tr><td>120 min Summer</td><td>1.995</td><td>0.195</td><td>0.0</td><td>1.7</td><td>1.7</td><td>7.4</td><td>O K</td></tr><tr><td>180 min Summer</td><td>1.993</td><td>0.193</td><td>0.0</td><td>1.7</td><td>1.7</td><td>7.3</td><td>O K</td></tr><tr><td>240 min Summer</td><td>1.987</td><td>0.187</td><td>0.0</td><td>1.7</td><td>1.7</td><td>6.9</td><td>O K</td></tr><tr><td>360 min Summer</td><td>1.968</td><td>0.168</td><td>0.0</td><td>1.7</td><td>1.7</td><td>5.5</td><td>O K</td></tr><tr><td>480 min Summer</td><td>1.947</td><td>0.147</td><td>0.0</td><td>1.7</td><td>1.7</td><td>4.2</td><td>O K</td></tr><tr><td>600 min Summer</td><td>1.926</td><td>0.126</td><td>0.0</td><td>1.7</td><td>1.7</td><td>3.1</td><td>O K</td></tr><tr><td>720 min Summer</td><td>1.906</td><td>0.106</td><td>0.0</td><td>1.6</td><td>1.6</td><td>2.2</td><td>O K</td></tr><tr><td>960 min Summer</td><td>1.867</td><td>0.067</td><td>0.0</td><td>1.6</td><td>1.6</td><td>0.9</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>1.5</td><td>1.5</td><td>0.0</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>1.1</td><td>1.1</td><td>0.0</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.9</td><td>0.9</td><td>0.0</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.6</td><td>0.6</td><td>0.0</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.5</td><td>0.5</td><td>0.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>1.960</td><td>0.160</td><td>0.0</td><td>1.7</td><td>1.7</td><td>5.0</td><td>O K</td></tr></table><table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>31.842</td><td>0.0</td><td>4.8</td><td>17</td></tr><tr><td>30 min Summer</td><td>20.519</td><td>0.0</td><td>7.4</td><td>31</td></tr><tr><td>60 min Summer</td><td>12.800</td><td>0.0</td><td>10.2</td><td>52</td></tr><tr><td>120 min Summer</td><td>7.814</td><td>0.0</td><td>13.4</td><td>84</td></tr><tr><td>180 min Summer</td><td>5.824</td><td>0.0</td><td>15.2</td><td>120</td></tr><tr><td>240 min Summer</td><td>4.721</td><td>0.0</td><td>16.8</td><td>154</td></tr><tr><td>360 min Summer</td><td>3.501</td><td>0.0</td><td>19.0</td><td>218</td></tr><tr><td>480 min Summer</td><td>2.818</td><td>0.0</td><td>20.4</td><td>282</td></tr><tr><td>600 min Summer</td><td>2.382</td><td>0.0</td><td>21.6</td><td>342</td></tr><tr><td>720 min Summer</td><td>2.076</td><td>0.0</td><td>22.7</td><td>398</td></tr><tr><td>960 min Summer</td><td>1.671</td><td>0.0</td><td>24.3</td><td>510</td></tr><tr><td>1440 min Summer</td><td>1.231</td><td>0.0</td><td>26.7</td><td>0</td></tr><tr><td>2160 min Summer</td><td>0.907</td><td>0.0</td><td>28.9</td><td>0</td></tr><tr><td>2880 min Summer</td><td>0.730</td><td>0.0</td><td>30.4</td><td>0</td></tr><tr><td>4320 min Summer</td><td>0.538</td><td>0.0</td><td>32.1</td><td>0</td></tr><tr><td>5760 min Summer</td><td>0.433</td><td>0.0</td><td>32.8</td><td>0</td></tr><tr><td>7200 min Summer</td><td>0.366</td><td>0.0</td><td>33.0</td><td>0</td></tr><tr><td>8640 min Summer</td><td>0.319</td><td>0.0</td><td>32.8</td><td>0</td></tr><tr><td>10080 min Summer</td><td>0.284</td><td>0.0</td><td>32.4</td><td>0</td></tr><tr><td>15 min Winter</td><td>31.842</td><td>0.0</td><td>5.9</td><td>17</td></tr></table>				Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	1.941	0.141	0.0	1.7	1.7	3.9	O K	30 min Summer	1.971	0.171	0.0	1.7	1.7	5.7	O K	60 min Summer	1.987	0.187	0.0	1.7	1.7	6.8	O K	120 min Summer	1.995	0.195	0.0	1.7	1.7	7.4	O K	180 min Summer	1.993	0.193	0.0	1.7	1.7	7.3	O K	240 min Summer	1.987	0.187	0.0	1.7	1.7	6.9	O K	360 min Summer	1.968	0.168	0.0	1.7	1.7	5.5	O K	480 min Summer	1.947	0.147	0.0	1.7	1.7	4.2	O K	600 min Summer	1.926	0.126	0.0	1.7	1.7	3.1	O K	720 min Summer	1.906	0.106	0.0	1.6	1.6	2.2	O K	960 min Summer	1.867	0.067	0.0	1.6	1.6	0.9	O K	1440 min Summer	1.800	0.000	0.0	1.5	1.5	0.0	O K	2160 min Summer	1.800	0.000	0.0	1.1	1.1	0.0	O K	2880 min Summer	1.800	0.000	0.0	0.9	0.9	0.0	O K	4320 min Summer	1.800	0.000	0.0	0.6	0.6	0.0	O K	5760 min Summer	1.800	0.000	0.0	0.5	0.5	0.0	O K	7200 min Summer	1.800	0.000	0.0	0.4	0.4	0.0	O K	8640 min Summer	1.800	0.000	0.0	0.4	0.4	0.0	O K	10080 min Summer	1.800	0.000	0.0	0.3	0.3	0.0	O K	15 min Winter	1.960	0.160	0.0	1.7	1.7	5.0	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	31.842	0.0	4.8	17	30 min Summer	20.519	0.0	7.4	31	60 min Summer	12.800	0.0	10.2	52	120 min Summer	7.814	0.0	13.4	84	180 min Summer	5.824	0.0	15.2	120	240 min Summer	4.721	0.0	16.8	154	360 min Summer	3.501	0.0	19.0	218	480 min 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4320 min Summer	1.800	0.000	0.0	0.6	0.6	0.0	O K																																																																																																																																																																																																																																																																													
5760 min Summer	1.800	0.000	0.0	0.5	0.5	0.0	O K																																																																																																																																																																																																																																																																													
7200 min Summer	1.800	0.000	0.0	0.4	0.4	0.0	O K																																																																																																																																																																																																																																																																													
8640 min Summer	1.800	0.000	0.0	0.4	0.4	0.0	O K																																																																																																																																																																																																																																																																													
10080 min Summer	1.800	0.000	0.0	0.3	0.3	0.0	O K																																																																																																																																																																																																																																																																													
15 min Winter	1.960	0.160	0.0	1.7	1.7	5.0	O K																																																																																																																																																																																																																																																																													
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																																																																																
15 min Summer	31.842	0.0	4.8	17																																																																																																																																																																																																																																																																																
30 min Summer	20.519	0.0	7.4	31																																																																																																																																																																																																																																																																																
60 min Summer	12.800	0.0	10.2	52																																																																																																																																																																																																																																																																																
120 min Summer	7.814	0.0	13.4	84																																																																																																																																																																																																																																																																																
180 min Summer	5.824	0.0	15.2	120																																																																																																																																																																																																																																																																																
240 min Summer	4.721	0.0	16.8	154																																																																																																																																																																																																																																																																																
360 min Summer	3.501	0.0	19.0	218																																																																																																																																																																																																																																																																																
480 min Summer	2.818	0.0	20.4	282																																																																																																																																																																																																																																																																																
600 min Summer	2.382	0.0	21.6	342																																																																																																																																																																																																																																																																																
720 min Summer	2.076	0.0	22.7	398																																																																																																																																																																																																																																																																																
960 min Summer	1.671	0.0	24.3	510																																																																																																																																																																																																																																																																																
1440 min Summer	1.231	0.0	26.7	0																																																																																																																																																																																																																																																																																
2160 min Summer	0.907	0.0	28.9	0																																																																																																																																																																																																																																																																																
2880 min Summer	0.730	0.0	30.4	0																																																																																																																																																																																																																																																																																
4320 min Summer	0.538	0.0	32.1	0																																																																																																																																																																																																																																																																																
5760 min Summer	0.433	0.0	32.8	0																																																																																																																																																																																																																																																																																
7200 min Summer	0.366	0.0	33.0	0																																																																																																																																																																																																																																																																																
8640 min Summer	0.319	0.0	32.8	0																																																																																																																																																																																																																																																																																
10080 min Summer	0.284	0.0	32.4	0																																																																																																																																																																																																																																																																																
15 min Winter	31.842	0.0	5.9	17																																																																																																																																																																																																																																																																																
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XP Solutions				Source Control 2019.1																																																																																																																																																																																																																																																																																				
Summary of Results for 30 year Return Period Half Drain Time : 152 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (1/s)</th><th>Max Control (1/s)</th><th>Max Σ Outflow (1/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>2.092</td><td>0.292</td><td>0.0</td><td>1.8</td><td>1.8</td><td>16.6</td><td>O K</td></tr><tr><td>30 min Summer</td><td>2.134</td><td>0.334</td><td>0.0</td><td>1.8</td><td>1.8</td><td>21.8</td><td>Flood Risk</td></tr><tr><td>60 min Summer</td><td>2.164</td><td>0.364</td><td>0.0</td><td>1.8</td><td>1.8</td><td>25.8</td><td>Flood Risk</td></tr><tr><td>120 min Summer</td><td>2.175</td><td>0.375</td><td>0.0</td><td>1.8</td><td>1.8</td><td>27.4</td><td>Flood Risk</td></tr><tr><td>180 min Summer</td><td>2.171</td><td>0.371</td><td>0.0</td><td>1.8</td><td>1.8</td><td>26.9</td><td>Flood Risk</td></tr><tr><td>240 min Summer</td><td>2.165</td><td>0.365</td><td>0.0</td><td>1.8</td><td>1.8</td><td>25.9</td><td>Flood Risk</td></tr><tr><td>360 min Summer</td><td>2.149</td><td>0.349</td><td>0.0</td><td>1.8</td><td>1.8</td><td>23.8</td><td>Flood Risk</td></tr><tr><td>480 min Summer</td><td>2.134</td><td>0.334</td><td>0.0</td><td>1.8</td><td>1.8</td><td>21.8</td><td>Flood Risk</td></tr><tr><td>600 min Summer</td><td>2.119</td><td>0.319</td><td>0.0</td><td>1.8</td><td>1.8</td><td>19.9</td><td>Flood Risk</td></tr><tr><td>720 min Summer</td><td>2.104</td><td>0.304</td><td>0.0</td><td>1.8</td><td>1.8</td><td>18.0</td><td>Flood Risk</td></tr><tr><td>960 min Summer</td><td>2.074</td><td>0.274</td><td>0.0</td><td>1.8</td><td>1.8</td><td>14.6</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>2.015</td><td>0.215</td><td>0.0</td><td>1.7</td><td>1.7</td><td>9.0</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>1.934</td><td>0.134</td><td>0.0</td><td>1.7</td><td>1.7</td><td>3.5</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>1.861</td><td>0.061</td><td>0.0</td><td>1.6</td><td>1.6</td><td>0.7</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>1.3</td><td>1.3</td><td>0.0</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>1.0</td><td>1.0</td><td>0.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.8</td><td>0.8</td><td>0.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.7</td><td>0.7</td><td>0.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>0.6</td><td>0.6</td><td>0.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>2.114</td><td>0.314</td><td>0.0</td><td>1.8</td><td>1.8</td><td>19.2</td><td>Flood Risk</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>78.157</td><td>0.0</td><td>17.9</td><td>18</td></tr><tr><td>30 min Summer</td><td>50.205</td><td>0.0</td><td>24.1</td><td>33</td></tr><tr><td>60 min Summer</td><td>30.811</td><td>0.0</td><td>30.4</td><td>62</td></tr><tr><td>120 min Summer</td><td>18.360</td><td>0.0</td><td>37.0</td><td>120</td></tr><tr><td>180 min Summer</td><td>13.429</td><td>0.0</td><td>40.9</td><td>148</td></tr><tr><td>240 min Summer</td><td>10.714</td><td>0.0</td><td>43.7</td><td>178</td></tr><tr><td>360 min Summer</td><td>7.765</td><td>0.0</td><td>47.6</td><td>246</td></tr><tr><td>480 min Summer</td><td>6.179</td><td>0.0</td><td>50.8</td><td>314</td></tr><tr><td>600 min Summer</td><td>5.173</td><td>0.0</td><td>53.2</td><td>380</td></tr><tr><td>720 min Summer</td><td>4.473</td><td>0.0</td><td>55.0</td><td>448</td></tr><tr><td>960 min Summer</td><td>3.553</td><td>0.0</td><td>58.2</td><td>578</td></tr><tr><td>1440 min Summer</td><td>2.566</td><td>0.0</td><td>62.8</td><td>822</td></tr><tr><td>2160 min Summer</td><td>1.852</td><td>0.0</td><td>67.2</td><td>1168</td></tr><tr><td>2880 min Summer</td><td>1.468</td><td>0.0</td><td>70.3</td><td>1496</td></tr><tr><td>4320 min Summer</td><td>1.058</td><td>0.0</td><td>74.2</td><td>0</td></tr><tr><td>5760 min Summer</td><td>0.838</td><td>0.0</td><td>76.6</td><td>0</td></tr><tr><td>7200 min Summer</td><td>0.699</td><td>0.0</td><td>78.0</td><td>0</td></tr><tr><td>8640 min Summer</td><td>0.603</td><td>0.0</td><td>78.8</td><td>0</td></tr><tr><td>10080 min Summer</td><td>0.532</td><td>0.0</td><td>79.2</td><td>0</td></tr><tr><td>15 min Winter</td><td>78.157</td><td>0.0</td><td>20.5</td><td>18</td></tr></table>								Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status	15 min Summer	2.092	0.292	0.0	1.8	1.8	16.6	O K	30 min Summer	2.134	0.334	0.0	1.8	1.8	21.8	Flood Risk	60 min Summer	2.164	0.364	0.0	1.8	1.8	25.8	Flood Risk	120 min Summer	2.175	0.375	0.0	1.8	1.8	27.4	Flood Risk	180 min Summer	2.171	0.371	0.0	1.8	1.8	26.9	Flood Risk	240 min Summer	2.165	0.365	0.0	1.8	1.8	25.9	Flood Risk	360 min Summer	2.149	0.349	0.0	1.8	1.8	23.8	Flood Risk	480 min Summer	2.134	0.334	0.0	1.8	1.8	21.8	Flood Risk	600 min Summer	2.119	0.319	0.0	1.8	1.8	19.9	Flood Risk	720 min Summer	2.104	0.304	0.0	1.8	1.8	18.0	Flood Risk	960 min Summer	2.074	0.274	0.0	1.8	1.8	14.6	O K	1440 min Summer	2.015	0.215	0.0	1.7	1.7	9.0	O K	2160 min Summer	1.934	0.134	0.0	1.7	1.7	3.5	O K	2880 min Summer	1.861	0.061	0.0	1.6	1.6	0.7	O K	4320 min Summer	1.800	0.000	0.0	1.3	1.3	0.0	O K	5760 min Summer	1.800	0.000	0.0	1.0	1.0	0.0	O K	7200 min Summer	1.800	0.000	0.0	0.8	0.8	0.0	O K	8640 min Summer	1.800	0.000	0.0	0.7	0.7	0.0	O K	10080 min Summer	1.800	0.000	0.0	0.6	0.6	0.0	O K	15 min Winter	2.114	0.314	0.0	1.8	1.8	19.2	Flood Risk	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	78.157	0.0	17.9	18	30 min Summer	50.205	0.0	24.1	33	60 min Summer	30.811	0.0	30.4	62	120 min Summer	18.360	0.0	37.0	120	180 min Summer	13.429	0.0	40.9	148	240 min Summer	10.714	0.0	43.7	178	360 min Summer	7.765	0.0	47.6	246	480 min Summer	6.179	0.0	50.8	314	600 min Summer	5.173	0.0	53.2	380	720 min Summer	4.473	0.0	55.0	448	960 min Summer	3.553	0.0	58.2	578	1440 min Summer	2.566	0.0	62.8	822	2160 min Summer	1.852	0.0	67.2	1168	2880 min Summer	1.468	0.0	70.3	1496	4320 min Summer	1.058	0.0	74.2	0	5760 min Summer	0.838	0.0	76.6	0	7200 min Summer	0.699	0.0	78.0	0	8640 min Summer	0.603	0.0	78.8	0	10080 min Summer	0.532	0.0	79.2	0	15 min Winter	78.157	0.0	20.5	18
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																	
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60 min Summer	2.164	0.364	0.0	1.8	1.8	25.8	Flood Risk																																																																																																																																																																																																																																																																																	
120 min Summer	2.175	0.375	0.0	1.8	1.8	27.4	Flood Risk																																																																																																																																																																																																																																																																																	
180 min Summer	2.171	0.371	0.0	1.8	1.8	26.9	Flood Risk																																																																																																																																																																																																																																																																																	
240 min Summer	2.165	0.365	0.0	1.8	1.8	25.9	Flood Risk																																																																																																																																																																																																																																																																																	
360 min Summer	2.149	0.349	0.0	1.8	1.8	23.8	Flood Risk																																																																																																																																																																																																																																																																																	
480 min Summer	2.134	0.334	0.0	1.8	1.8	21.8	Flood Risk																																																																																																																																																																																																																																																																																	
600 min Summer	2.119	0.319	0.0	1.8	1.8	19.9	Flood Risk																																																																																																																																																																																																																																																																																	
720 min Summer	2.104	0.304	0.0	1.8	1.8	18.0	Flood Risk																																																																																																																																																																																																																																																																																	
960 min Summer	2.074	0.274	0.0	1.8	1.8	14.6	O K																																																																																																																																																																																																																																																																																	
1440 min Summer	2.015	0.215	0.0	1.7	1.7	9.0	O K																																																																																																																																																																																																																																																																																	
2160 min Summer	1.934	0.134	0.0	1.7	1.7	3.5	O K																																																																																																																																																																																																																																																																																	
2880 min Summer	1.861	0.061	0.0	1.6	1.6	0.7	O K																																																																																																																																																																																																																																																																																	
4320 min Summer	1.800	0.000	0.0	1.3	1.3	0.0	O K																																																																																																																																																																																																																																																																																	
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15 min Winter	2.114	0.314	0.0	1.8	1.8	19.2	Flood Risk																																																																																																																																																																																																																																																																																	
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																																																																																				
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30 min Summer	50.205	0.0	24.1	33																																																																																																																																																																																																																																																																																				
60 min Summer	30.811	0.0	30.4	62																																																																																																																																																																																																																																																																																				
120 min Summer	18.360	0.0	37.0	120																																																																																																																																																																																																																																																																																				
180 min Summer	13.429	0.0	40.9	148																																																																																																																																																																																																																																																																																				
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360 min Summer	7.765	0.0	47.6	246																																																																																																																																																																																																																																																																																				
480 min Summer	6.179	0.0	50.8	314																																																																																																																																																																																																																																																																																				
600 min Summer	5.173	0.0	53.2	380																																																																																																																																																																																																																																																																																				
720 min Summer	4.473	0.0	55.0	448																																																																																																																																																																																																																																																																																				
960 min Summer	3.553	0.0	58.2	578																																																																																																																																																																																																																																																																																				
1440 min Summer	2.566	0.0	62.8	822																																																																																																																																																																																																																																																																																				
2160 min Summer	1.852	0.0	67.2	1168																																																																																																																																																																																																																																																																																				
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XP Solutions				Source Control 2019.1			
Summary of Results for 30 year Return Period							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.159	0.359	0.0	1.8	1.8	25.1	Flood Risk
60 min Winter	2.191	0.391	0.0	1.9	1.9	29.8	Flood Risk
120 min Winter	2.206	0.406	0.0	1.9	1.9	32.1	Flood Risk
180 min Winter	2.203	0.403	0.0	1.9	1.9	31.7	Flood Risk
240 min Winter	2.196	0.396	0.0	1.9	1.9	30.5	Flood Risk
360 min Winter	2.176	0.376	0.0	1.8	1.8	27.6	Flood Risk
480 min Winter	2.156	0.356	0.0	1.8	1.8	24.6	Flood Risk
600 min Winter	2.134	0.334	0.0	1.8	1.8	21.7	Flood Risk
720 min Winter	2.112	0.312	0.0	1.8	1.8	18.9	Flood Risk
960 min Winter	2.066	0.266	0.0	1.8	1.8	13.8	O K
1440 min Winter	1.975	0.175	0.0	1.7	1.7	6.0	O K
2160 min Winter	1.828	0.028	0.0	1.6	1.6	0.2	O K
2880 min Winter	1.800	0.000	0.0	1.3	1.3	0.0	O K
4320 min Winter	1.800	0.000	0.0	0.9	0.9	0.0	O K
5760 min Winter	1.800	0.000	0.0	0.7	0.7	0.0	O K
7200 min Winter	1.800	0.000	0.0	0.6	0.6	0.0	O K
8640 min Winter	1.800	0.000	0.0	0.5	0.5	0.0	O K
10080 min Winter	1.800	0.000	0.0	0.4	0.4	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	50.205	0.0	27.4	32			
60 min Winter	30.811	0.0	34.7	60			
120 min Winter	18.360	0.0	41.8	118			
180 min Winter	13.429	0.0	46.3	170			
240 min Winter	10.714	0.0	49.5	192			
360 min Winter	7.765	0.0	53.9	268			
480 min Winter	6.179	0.0	57.3	342			
600 min Winter	5.173	0.0	60.1	414			
720 min Winter	4.473	0.0	62.3	484			
960 min Winter	3.553	0.0	65.9	616			
1440 min Winter	2.566	0.0	71.1	852			
2160 min Winter	1.852	0.0	76.2	1124			
2880 min Winter	1.468	0.0	79.8	0			
4320 min Winter	1.058	0.0	84.6	0			
5760 min Winter	0.838	0.0	87.5	0			
7200 min Winter	0.699	0.0	89.5	0			
8640 min Winter	0.603	0.0	90.7	0			
10080 min Winter	0.532	0.0	91.6	0			
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XP Solutions		Source Control 2019.1																																																																																																																																																																																																																																																																																		
Summary of Results for 100 year Return Period (+40%) Half Drain Time : 321 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (1/s)</th><th>Max Control (1/s)</th><th>Max Σ Outflow (1/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>2.220</td><td>0.420</td><td>0.0</td><td>1.9</td><td>1.9</td><td>34.4</td><td>Flood Risk</td></tr><tr><td>30 min Summer</td><td>2.280</td><td>0.480</td><td>0.0</td><td>1.9</td><td>1.9</td><td>44.8</td><td>Flood Risk</td></tr><tr><td>60 min Summer</td><td>2.331</td><td>0.531</td><td>0.0</td><td>2.0</td><td>2.0</td><td>53.8</td><td>Flood Risk</td></tr><tr><td>120 min Summer</td><td>2.367</td><td>0.567</td><td>0.0</td><td>2.0</td><td>2.0</td><td>60.2</td><td>Flood Risk</td></tr><tr><td>180 min Summer</td><td>2.375</td><td>0.575</td><td>0.0</td><td>2.0</td><td>2.0</td><td>61.5</td><td>Flood Risk</td></tr><tr><td>240 min Summer</td><td>2.370</td><td>0.570</td><td>0.0</td><td>2.0</td><td>2.0</td><td>60.6</td><td>Flood Risk</td></tr><tr><td>360 min Summer</td><td>2.352</td><td>0.552</td><td>0.0</td><td>2.0</td><td>2.0</td><td>57.5</td><td>Flood Risk</td></tr><tr><td>480 min Summer</td><td>2.335</td><td>0.535</td><td>0.0</td><td>2.0</td><td>2.0</td><td>54.4</td><td>Flood Risk</td></tr><tr><td>600 min Summer</td><td>2.320</td><td>0.520</td><td>0.0</td><td>1.9</td><td>1.9</td><td>51.8</td><td>Flood Risk</td></tr><tr><td>720 min Summer</td><td>2.306</td><td>0.506</td><td>0.0</td><td>1.9</td><td>1.9</td><td>49.4</td><td>Flood Risk</td></tr><tr><td>960 min Summer</td><td>2.280</td><td>0.480</td><td>0.0</td><td>1.9</td><td>1.9</td><td>44.9</td><td>Flood Risk</td></tr><tr><td>1440 min Summer</td><td>2.233</td><td>0.433</td><td>0.0</td><td>1.9</td><td>1.9</td><td>36.6</td><td>Flood Risk</td></tr><tr><td>2160 min Summer</td><td>2.165</td><td>0.365</td><td>0.0</td><td>1.8</td><td>1.8</td><td>26.0</td><td>Flood Risk</td></tr><tr><td>2880 min Summer</td><td>2.100</td><td>0.300</td><td>0.0</td><td>1.8</td><td>1.8</td><td>17.6</td><td>Flood Risk</td></tr><tr><td>4320 min Summer</td><td>1.983</td><td>0.183</td><td>0.0</td><td>1.7</td><td>1.7</td><td>6.5</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>1.879</td><td>0.079</td><td>0.0</td><td>1.6</td><td>1.6</td><td>1.2</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>1.5</td><td>1.5</td><td>0.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>1.2</td><td>1.2</td><td>0.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>1.800</td><td>0.000</td><td>0.0</td><td>1.1</td><td>1.1</td><td>0.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>2.248</td><td>0.448</td><td>0.0</td><td>1.9</td><td>1.9</td><td>39.1</td><td>Flood Risk</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>142.146</td><td>0.0</td><td>35.8</td><td>18</td></tr><tr><td>30 min Summer</td><td>92.034</td><td>0.0</td><td>47.6</td><td>33</td></tr><tr><td>60 min Summer</td><td>56.713</td><td>0.0</td><td>59.7</td><td>62</td></tr><tr><td>120 min Summer</td><td>33.786</td><td>0.0</td><td>71.6</td><td>122</td></tr><tr><td>180 min Summer</td><td>24.646</td><td>0.0</td><td>78.6</td><td>180</td></tr><tr><td>240 min Summer</td><td>19.601</td><td>0.0</td><td>83.8</td><td>238</td></tr><tr><td>360 min Summer</td><td>14.125</td><td>0.0</td><td>90.6</td><td>290</td></tr><tr><td>480 min Summer</td><td>11.201</td><td>0.0</td><td>95.8</td><td>354</td></tr><tr><td>600 min Summer</td><td>9.350</td><td>0.0</td><td>100.0</td><td>420</td></tr><tr><td>720 min Summer</td><td>8.064</td><td>0.0</td><td>103.5</td><td>488</td></tr><tr><td>960 min Summer</td><td>6.381</td><td>0.0</td><td>109.2</td><td>624</td></tr><tr><td>1440 min Summer</td><td>4.582</td><td>0.0</td><td>117.1</td><td>894</td></tr><tr><td>2160 min Summer</td><td>3.285</td><td>0.0</td><td>125.4</td><td>1276</td></tr><tr><td>2880 min Summer</td><td>2.592</td><td>0.0</td><td>130.8</td><td>1640</td></tr><tr><td>4320 min Summer</td><td>1.854</td><td>0.0</td><td>138.8</td><td>2332</td></tr><tr><td>5760 min Summer</td><td>1.461</td><td>0.0</td><td>143.9</td><td>2952</td></tr><tr><td>7200 min Summer</td><td>1.213</td><td>0.0</td><td>147.4</td><td>0</td></tr><tr><td>8640 min Summer</td><td>1.043</td><td>0.0</td><td>150.1</td><td>0</td></tr><tr><td>10080 min Summer</td><td>0.917</td><td>0.0</td><td>152.0</td><td>0</td></tr><tr><td>15 min Winter</td><td>142.146</td><td>0.0</td><td>40.6</td><td>18</td></tr></table>				Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status	15 min Summer	2.220	0.420	0.0	1.9	1.9	34.4	Flood Risk	30 min Summer	2.280	0.480	0.0	1.9	1.9	44.8	Flood Risk	60 min Summer	2.331	0.531	0.0	2.0	2.0	53.8	Flood Risk	120 min Summer	2.367	0.567	0.0	2.0	2.0	60.2	Flood Risk	180 min Summer	2.375	0.575	0.0	2.0	2.0	61.5	Flood Risk	240 min Summer	2.370	0.570	0.0	2.0	2.0	60.6	Flood Risk	360 min Summer	2.352	0.552	0.0	2.0	2.0	57.5	Flood Risk	480 min Summer	2.335	0.535	0.0	2.0	2.0	54.4	Flood Risk	600 min Summer	2.320	0.520	0.0	1.9	1.9	51.8	Flood Risk	720 min Summer	2.306	0.506	0.0	1.9	1.9	49.4	Flood Risk	960 min Summer	2.280	0.480	0.0	1.9	1.9	44.9	Flood Risk	1440 min Summer	2.233	0.433	0.0	1.9	1.9	36.6	Flood Risk	2160 min Summer	2.165	0.365	0.0	1.8	1.8	26.0	Flood Risk	2880 min Summer	2.100	0.300	0.0	1.8	1.8	17.6	Flood Risk	4320 min Summer	1.983	0.183	0.0	1.7	1.7	6.5	O K	5760 min Summer	1.879	0.079	0.0	1.6	1.6	1.2	O K	7200 min Summer	1.800	0.000	0.0	1.5	1.5	0.0	O K	8640 min Summer	1.800	0.000	0.0	1.2	1.2	0.0	O K	10080 min Summer	1.800	0.000	0.0	1.1	1.1	0.0	O K	15 min Winter	2.248	0.448	0.0	1.9	1.9	39.1	Flood Risk	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	142.146	0.0	35.8	18	30 min Summer	92.034	0.0	47.6	33	60 min Summer	56.713	0.0	59.7	62	120 min Summer	33.786	0.0	71.6	122	180 min Summer	24.646	0.0	78.6	180	240 min Summer	19.601	0.0	83.8	238	360 min Summer	14.125	0.0	90.6	290	480 min Summer	11.201	0.0	95.8	354	600 min Summer	9.350	0.0	100.0	420	720 min Summer	8.064	0.0	103.5	488	960 min Summer	6.381	0.0	109.2	624	1440 min Summer	4.582	0.0	117.1	894	2160 min Summer	3.285	0.0	125.4	1276	2880 min Summer	2.592	0.0	130.8	1640	4320 min Summer	1.854	0.0	138.8	2332	5760 min Summer	1.461	0.0	143.9	2952	7200 min Summer	1.213	0.0	147.4	0	8640 min Summer	1.043	0.0	150.1	0	10080 min Summer	0.917	0.0	152.0	0	15 min Winter	142.146	0.0	40.6	18
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																													
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Designed by CD
Checked by ME

XP Solutions

Source Control 2019.1

Micro
Drainage

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.315	0.515	0.0	1.9	1.9	51.0	Flood Risk
60 min Winter	2.375	0.575	0.0	2.0	2.0	61.5	Flood Risk
120 min Winter	2.403	0.603	0.0	2.0	2.0	69.4	FLOOD
180 min Winter	2.405	0.605	0.0	2.0	2.0	71.4	FLOOD
240 min Winter	2.405	0.605	0.0	2.0	2.0	71.3	FLOOD
360 min Winter	2.402	0.602	0.0	2.0	2.0	67.9	FLOOD
480 min Winter	2.390	0.590	0.0	2.0	2.0	64.1	Flood Risk
600 min Winter	2.369	0.569	0.0	2.0	2.0	60.6	Flood Risk
720 min Winter	2.350	0.550	0.0	2.0	2.0	57.2	Flood Risk
960 min Winter	2.313	0.513	0.0	1.9	1.9	50.6	Flood Risk
1440 min Winter	2.242	0.442	0.0	1.9	1.9	38.2	Flood Risk
2160 min Winter	2.142	0.342	0.0	1.8	1.8	22.8	Flood Risk
2880 min Winter	2.042	0.242	0.0	1.7	1.7	11.4	O K
4320 min Winter	1.838	0.038	0.0	1.6	1.6	0.3	O K
5760 min Winter	1.800	0.000	0.0	1.3	1.3	0.0	O K
7200 min Winter	1.800	0.000	0.0	1.0	1.0	0.0	O K
8640 min Winter	1.800	0.000	0.0	0.9	0.9	0.0	O K
10080 min Winter	1.800	0.000	0.0	0.8	0.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	92.034	0.0	53.8	33
60 min Winter	56.713	0.0	67.3	62
120 min Winter	33.786	3.1	80.9	120
180 min Winter	24.646	4.8	88.8	176
240 min Winter	19.601	4.6	94.3	232
360 min Winter	14.125	1.8	102.1	336
480 min Winter	11.201	0.0	108.0	378
600 min Winter	9.350	0.0	112.7	454
720 min Winter	8.064	0.0	116.7	530
960 min Winter	6.381	0.0	123.0	676
1440 min Winter	4.582	0.0	131.9	964
2160 min Winter	3.285	0.0	141.2	1344
2880 min Winter	2.592	0.0	147.7	1700
4320 min Winter	1.854	0.0	156.8	2244
5760 min Winter	1.461	0.0	162.9	0
7200 min Winter	1.213	0.0	167.2	0
8640 min Winter	1.043	0.0	170.5	0
10080 min Winter	0.917	0.0	173.0	0

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The SuDS design should seek to provide an appropriate management train of SuDS features to effectively mitigate the pollution risks associated with the proposed land uses.

In accordance with Table 26.2 of The SuDS Manual CIRIA C753, the pollution hazard level is considered to be 'Low' for the proposed land use. Therefore, the requirements for discharge to surface waters state that the 'Simple index approach' should be used. Step 1 of the simple index approach is to identify the pollution hazard indices for the proposed land use as set out in Table 6 below, which is an extract of Table 26.2.

Table 6 – Pollution Hazard Indices

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

Step 2 of the simple index approach is to select SuDS features with a total pollution mitigation index that equals or exceeds the pollution hazard index. Table 26.4 of The SuDS Manual states the mitigation indices for discharges to groundwater. These are shown below in Table 7 below.

Table 7 – SuDS Mitigation Indices

SuDS Feature	TSS	Metals	Hydrocarbons
Permeable paving	0.7	0.6	0.7

The treatment train of permeable paving does provide sufficient treatment to mitigate the potential pollution hazard indices.

It should be noted that alternative SuDS options may also be considered during the detailed design stage which achieves or exceeds the water quality objective. Provided that the mitigation indices of the treatment techniques are greater than or equal to the hazard indices

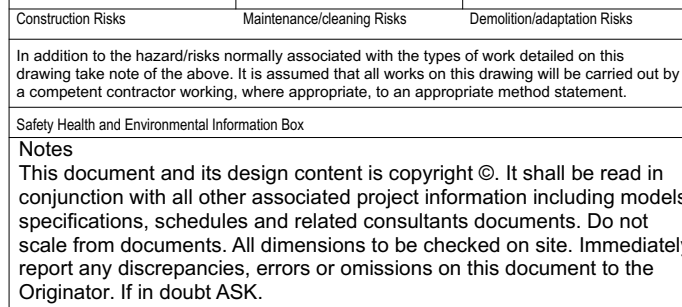
for the proposed development then there should be no reduction in the overall water quality within the receiving system.

Adkins Consultants^{td}
Surveying, Structural Engineering & Quantity Surveying
for the Construction Industry

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building
engineers

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1. FOUL DRAINAGE SYSTEM DESIGNED BY OTHERS.
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14. SEWAGE TREATMENT PLANT AND ATTENUATION TANK INSTALLATION PROCEDURE TO BE CONSULTED WITH MANUFACTURER.

Scales @ A1	Issuing Office Kent	Project No. 101M220716
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	A - Approved
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	C - Do Not Use
Status	Purpose of Issue

Originator	
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Adkins Consultants Ltd
130 Ashford Rd, Bearsted, Maidstone ME14 4AF

Project
SPECIALIST FIREARMS COMMAND

SCOT9, WHARF ROAD, GRAVESEND

Layout Title **DRAINAGE PLAN**

**METROPOLITAN POLICE SERVICE
(MPS)**

project	originator	zone	level	type	role	number	rev
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1:200

GENERAL NOTES

- All highway or drainage works assumed to be private. Any works on adopted highways or drainage prior to issue of Technical Approval is entirely at the risk of the Contractor/Client.
- At the commencement of works on site the contractor is to carry out trial pits and liaise with Utility Companies in order to establish the exact position of all existing statutory utility plant in the vicinity of works and take adequate precautions for their protection.
- All manhole covers/valves/inspection covers in existing carriageway/verges to be adjusted where necessary to suit design levels.
- Where the works involve the obstruction of a footway, the Contractor shall provide an alternative safe footway properly signed, guarded and lit.
- The Contractor is to comply fully with the CDM Regulations 2015 in the course of constructing the works.
- The Contractor shall ascertain the CBR of the subgrade in order to determine the required sub-base/capping thickness.
- Prior to laying any material the subgrade must be inspected and any soft spots removed and filled with 6F2 capping material.
- Prior to construction of any drainage works, the Contractor is to confirm the invert levels of existing manholes and sewers. Any variations from the designed levels shown on the drawings shall be reported to the Engineer in advance of construction works commencing.
- All drain and sewer pipes to be laid soffit to soffit, unless shown otherwise.
- Contractor to refer to Health & Safety Executive 'Note 47-Avoiding Danger from Underground Services' and 'Document G56 - Avoiding Danger from Overhead Electric Lines'.
- Where the deposits of debris and mud are unavoidable, warning signs must be exhibited whilst work is in progress and affected carriageways/footways must be regularly cleaned.
- All levels are in metres above Ordnance Datum.
- All foul and storm water drains which are not subject to adoption as public sewers must be constructed in accordance with the latest Building Regulations, BS8301, and, where appropriate, the relevant agreement certificates.
- Private drainage pipework to be 100mmØ unless shown otherwise on Engineering Layout Plans.

DOMESTIC DRAINAGE NOTES

All domestic drainage to comply with the British Standard BS EN 752:2008 'Drain and Sewer Systems Outside Buildings' and Part H of the Building Regulations 2010(2015 Edition).

Domestic foul drainage to be 100mmØ UPVC laid at a minimum gradient of 1 in 80 with minimum of 1 x WC connection unless stated otherwise on the drawings. Domestic surface water to be 100mmØ UPVC laid at a minimum gradient of 1 in 100 unless stated otherwise on the drawings. Minimum cover to be 350mm (600mm for UpVC) unless concrete bed and surround is provided.

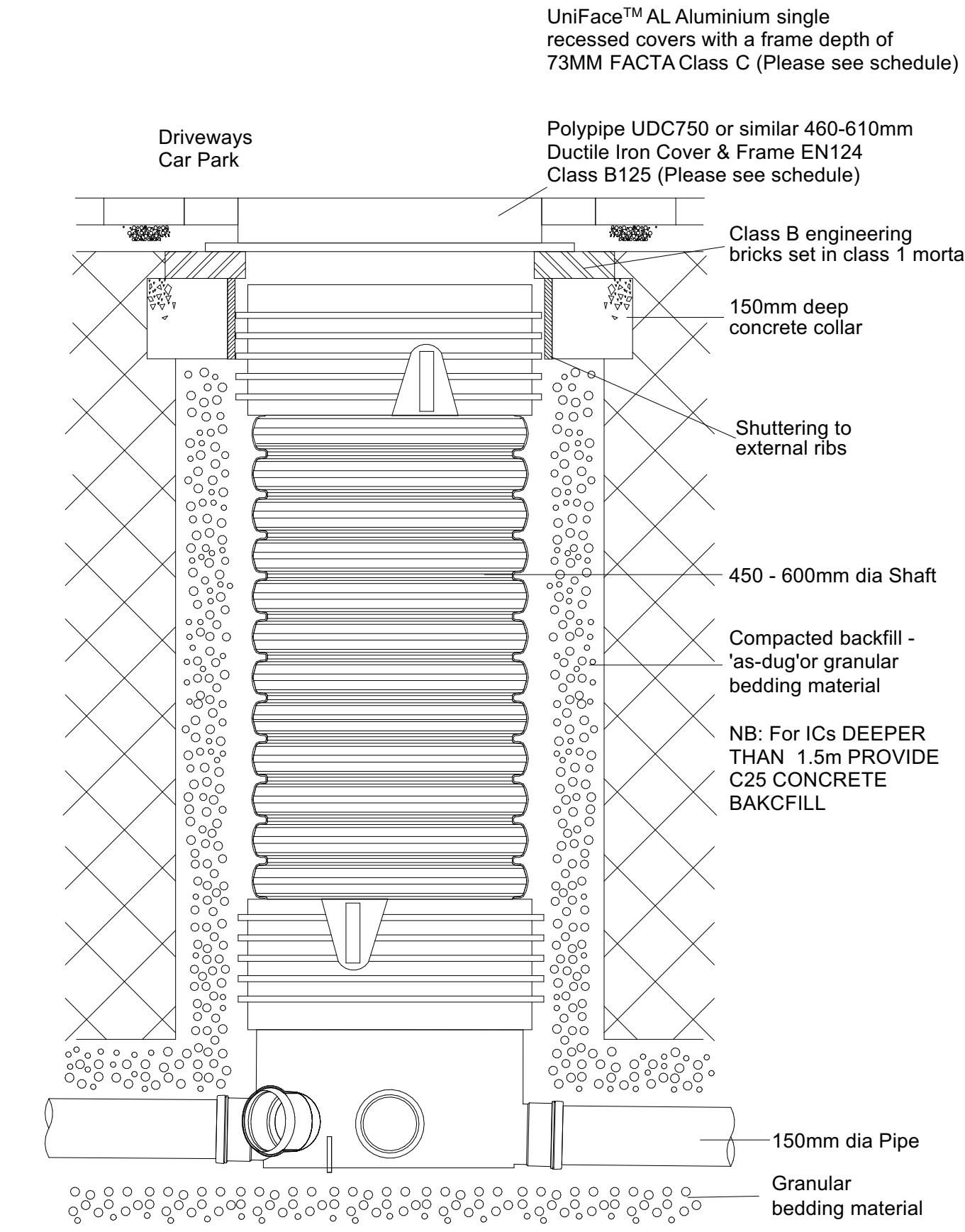
Pipe bedding as specified by the drainage manufacturer. All pipes that pass under buildings to have a minimum 100mm granular surround. Where drains pass through external walls the pipe is to be lintelled over with a minimum 50mm clear space around the pipe. The opening masked with rigid sheet material to prevent ingress of fill or vermin. It is important that the void is also filled with a compressible sealant to prevent ingress of gas.

Types of Inspection Chambers (Non-man access) and minimum internal dimensions to be as follows:-

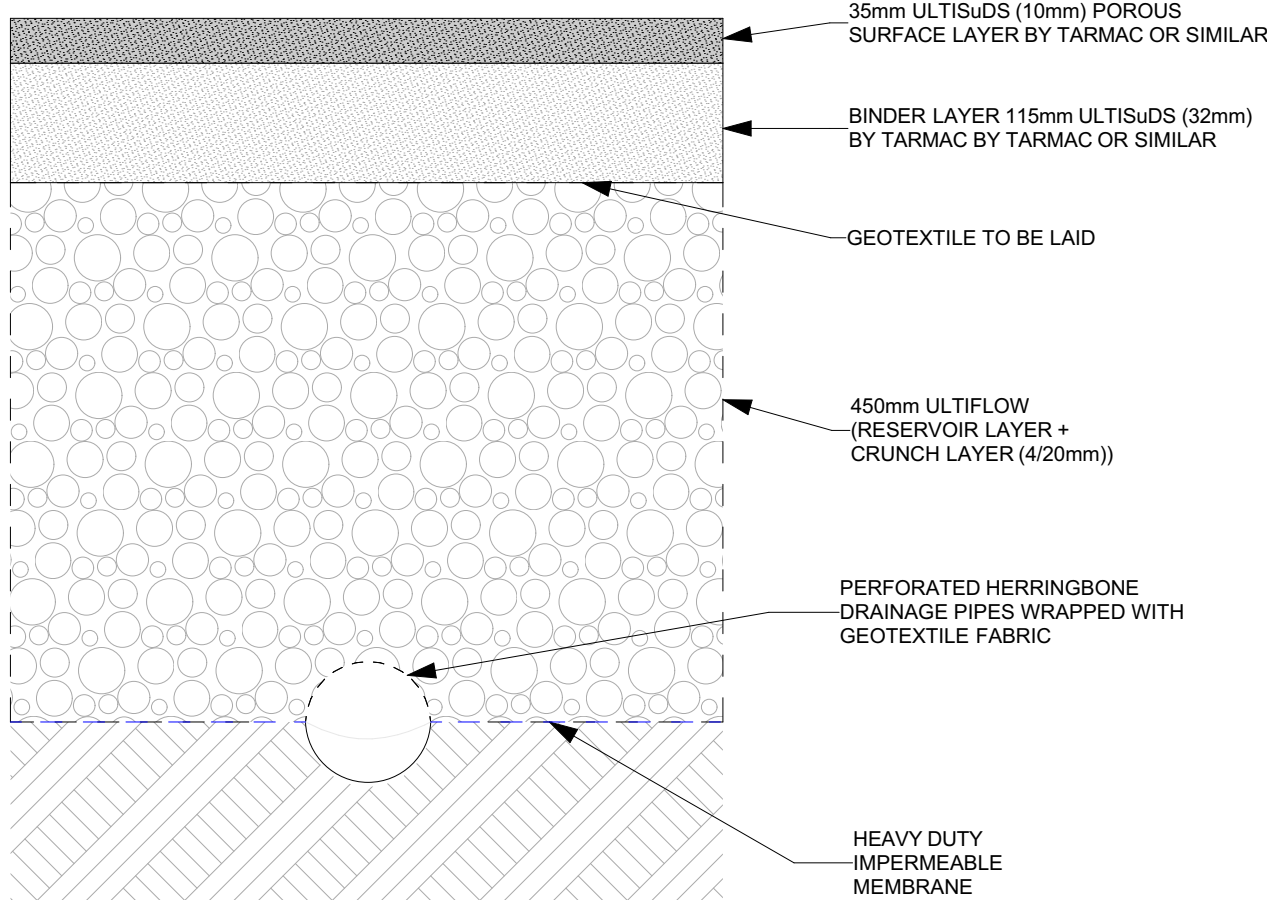
- 0 to 0.6m deep:- Shallow Access Chamber 225mm x 100mm rectangular or 225mmØ.
- 0.6m to 1.2m deep:- Inspection Chamber 450mm x 450mm square or 450mmØ.
- 1.2m to 3m deep:- Inspection Chamber 450mm x 450mm square or 450mmØ with access restricted to a maximum of 350mm.

Chamber Covers and Frames to comply with BS EN 124.

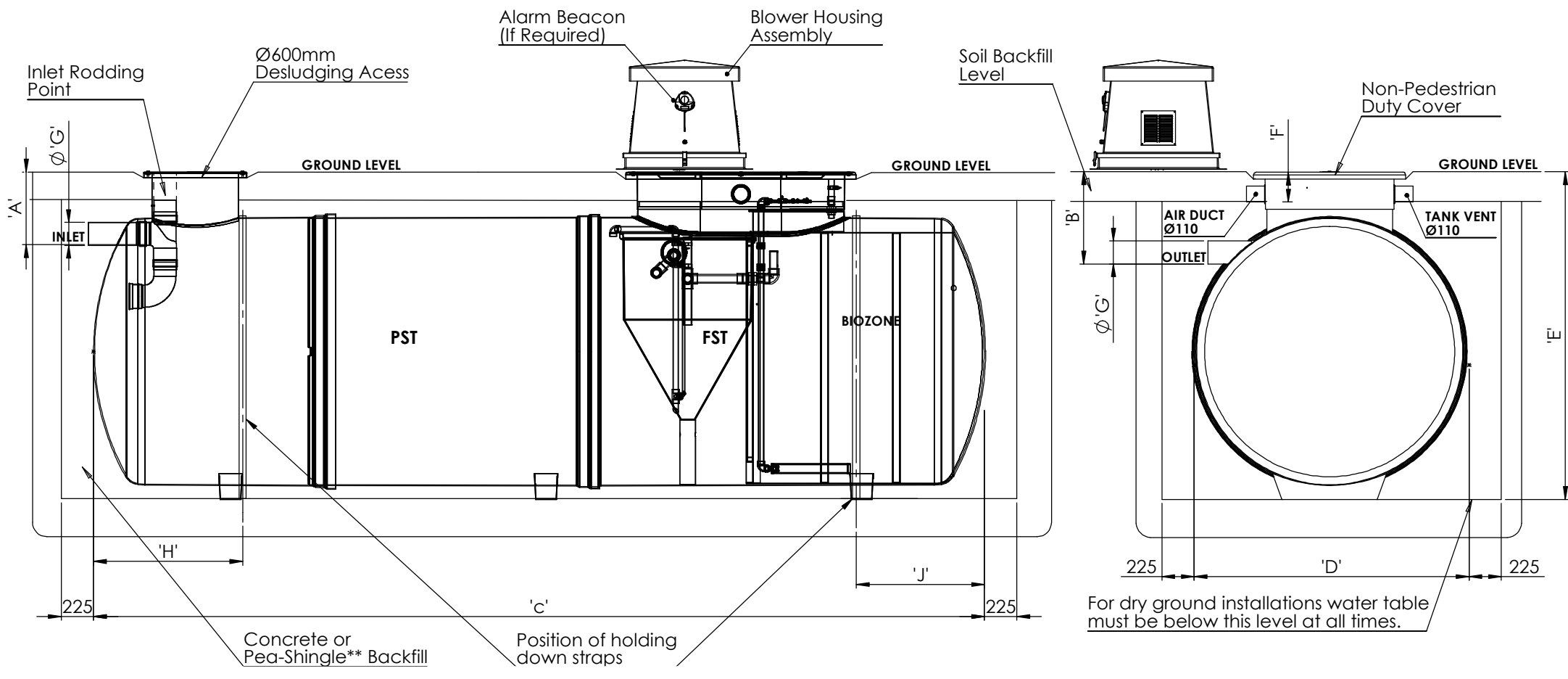
Class D400 for areas with frequent vehicular usage such as roads.
Class C250 for areas with light vehicular usage such as car parks.
Class B125 for pavements and pedestrian areas.
Class A15 for areas inaccessible to motor vehicles.



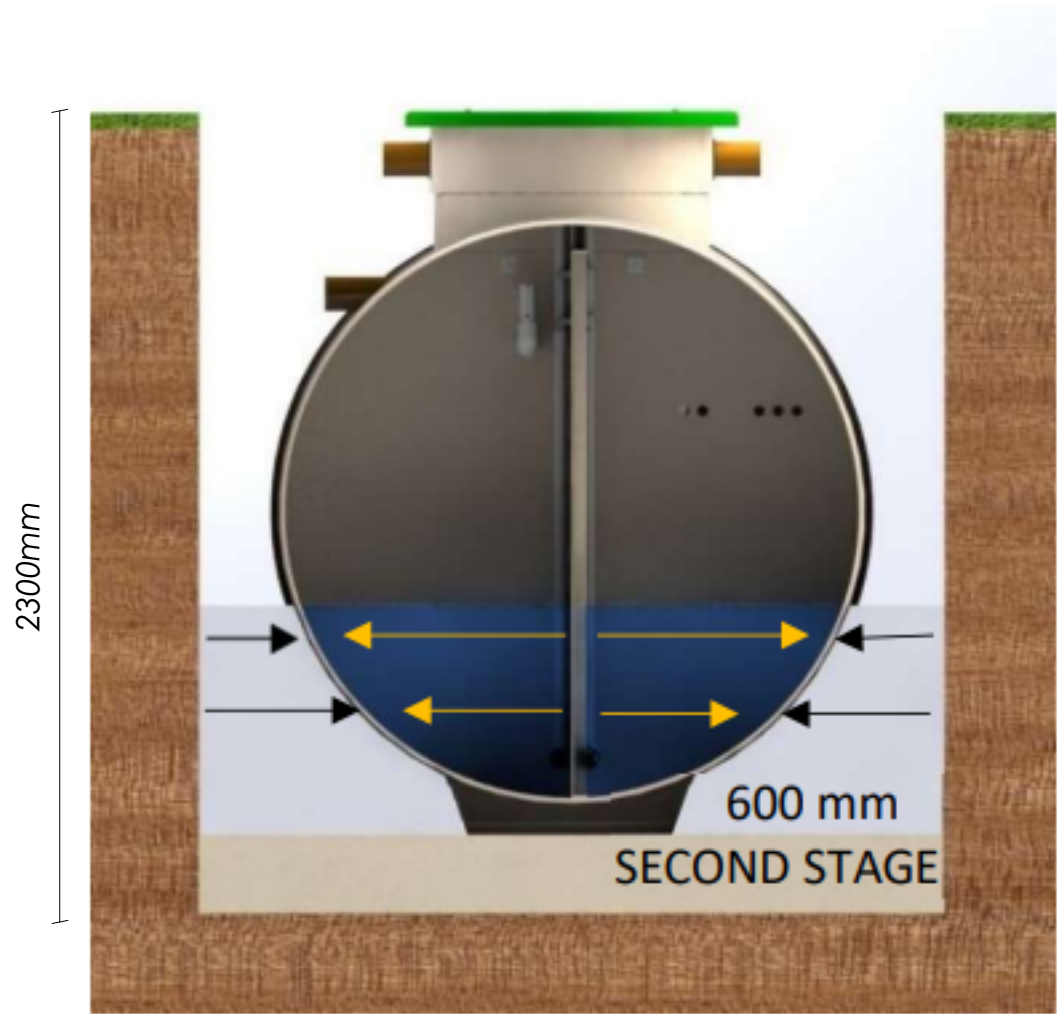
INSPECTION CHAMBER DETAIL NTS



PERFORATED DRAINAGE PIPE DETAIL NTS



BIOFICIENT 6 TREATMENT PLANT NTS



SEWAGE TREATMENT PLANT DETAIL NTS

BioFicient 6 Sewage Treatment Plant to be encased in concrete

Continue to fill the tank with water and backfill evenly around the tank, consolidating in 300 mm layers.

C25/30 CONCRETE TO BE POURED AS PER INSTALLATION GUIDE. CONCRETE COVER TO BE 300mm ALL AROUND AND UPTO COVER LEVEL TO AVOID FLOATATION MAX AGGREGATE SIZE 20mm SLUMP CLASS S1

Construction Risks Maintenance/Sealing Risks Demolition/Adaptation Risks

In addition to the hazards/risks normally associated with the types of work detailed on this drawing take note of the above. It is assumed that all works on this drawing will be carried out by a competent contractor working, where appropriate, to an appropriate method statement.

Safety Health and Environmental Information Box

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RevID	Issue ID	Issue Name	Issue Date	Issue Initials	Status	Approved by
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03	03	ICR APPROVAL	18/01/23	AAA	FA	AAA
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Scales @ A1	Issuing Office	Project No.
	Kent	101M220716

Client Approval	
A - Approved	
B - Approved with Comments	
C - Do Not Use	
Status	Purpose of Issue

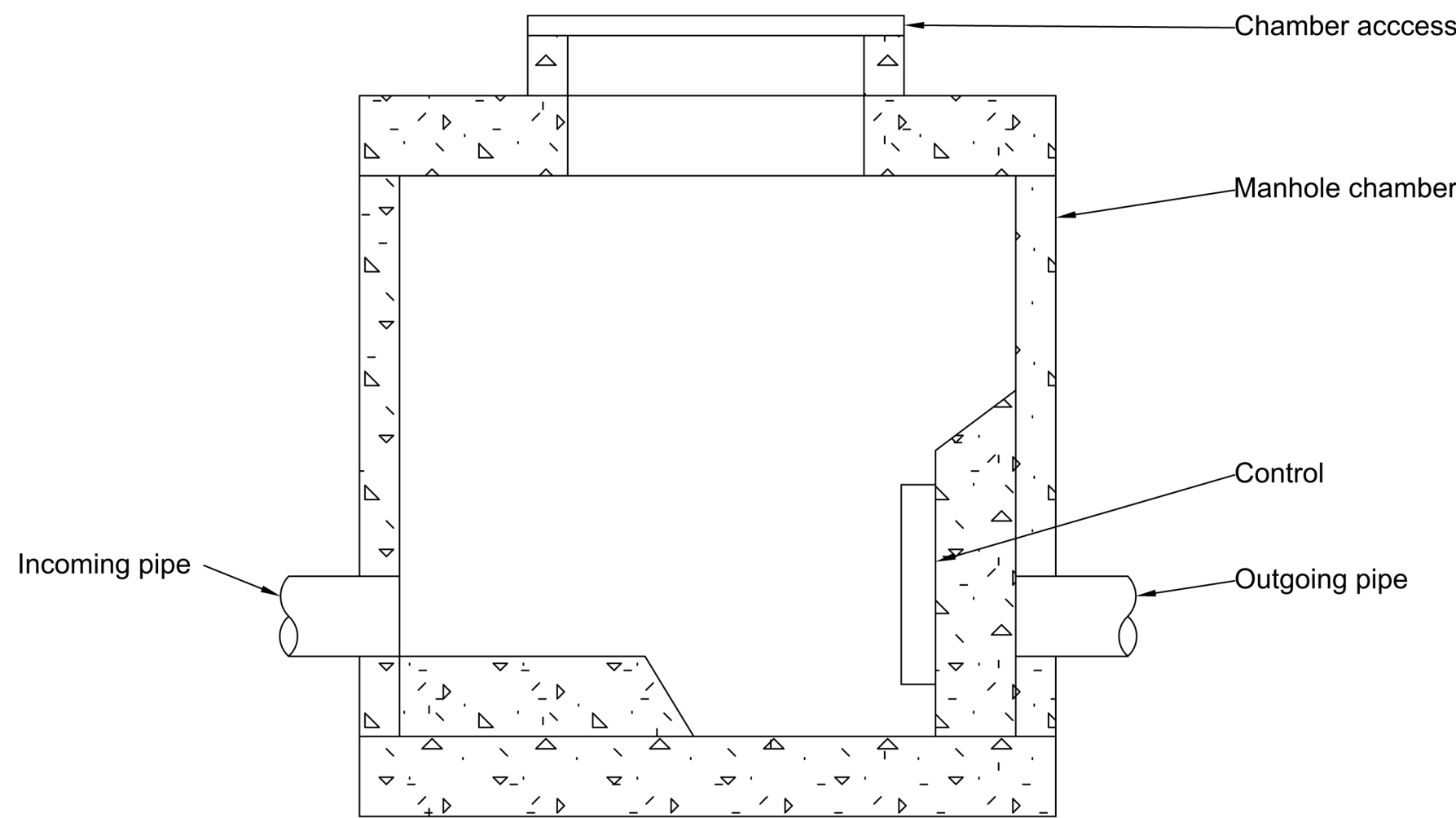
Originator	Adkins Consultants Ltd 130 Ashford Rd, Bearsted, Maidstone ME14 4AF
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Project	SPECIALIST FIREARMS COMMAND SCO19, WHARF ROAD, GRAVESEND
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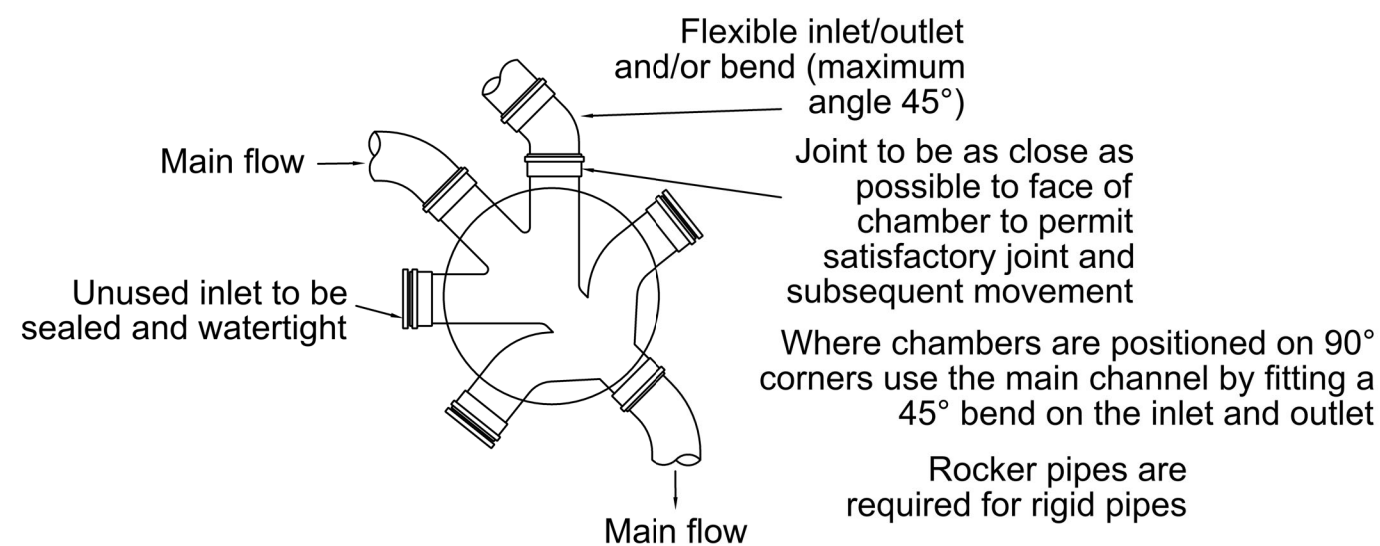
Layout Title	Drainage Details
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Client	METROPOLITAN POLICE SERVICE (MPS)
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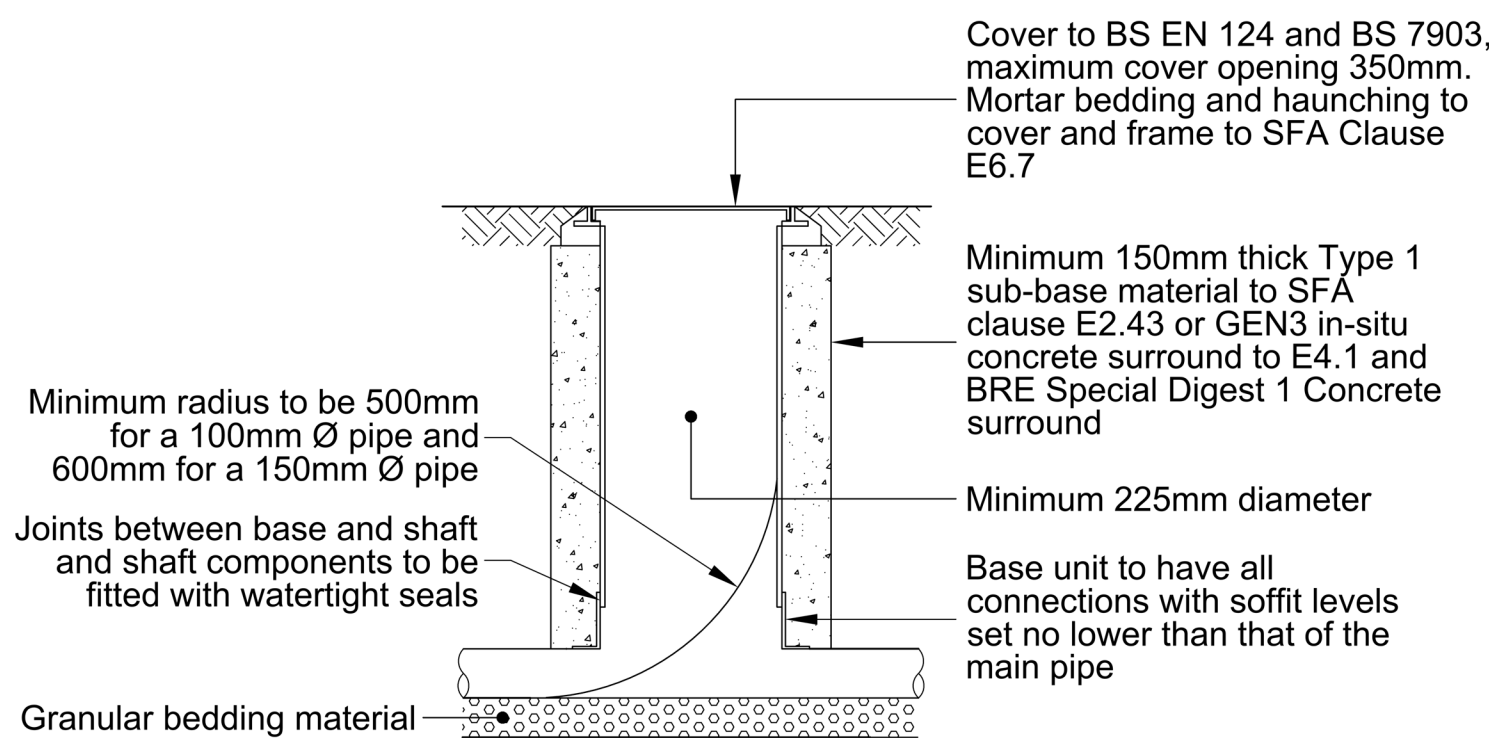
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project	originator	zone	level	type	role	number	rev
MP-A1-MM-15							05



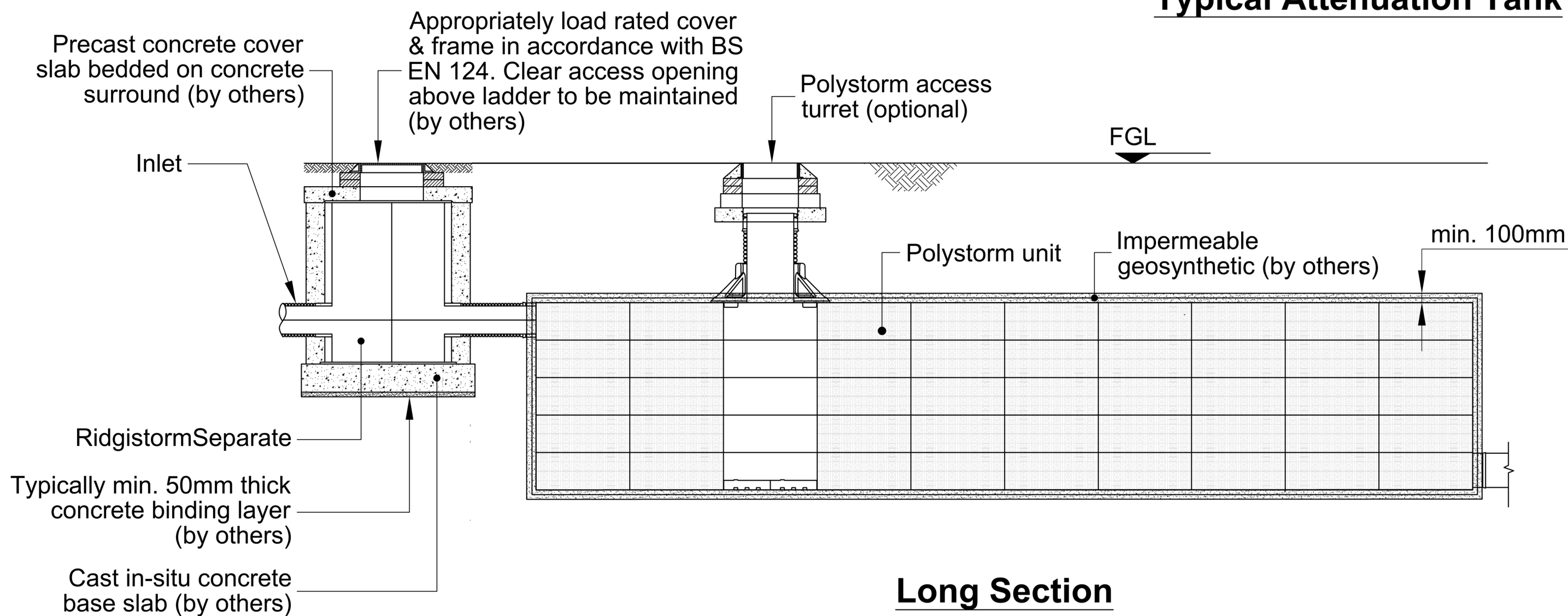
Typical control chamber
(Design to be specified by manufacturer)



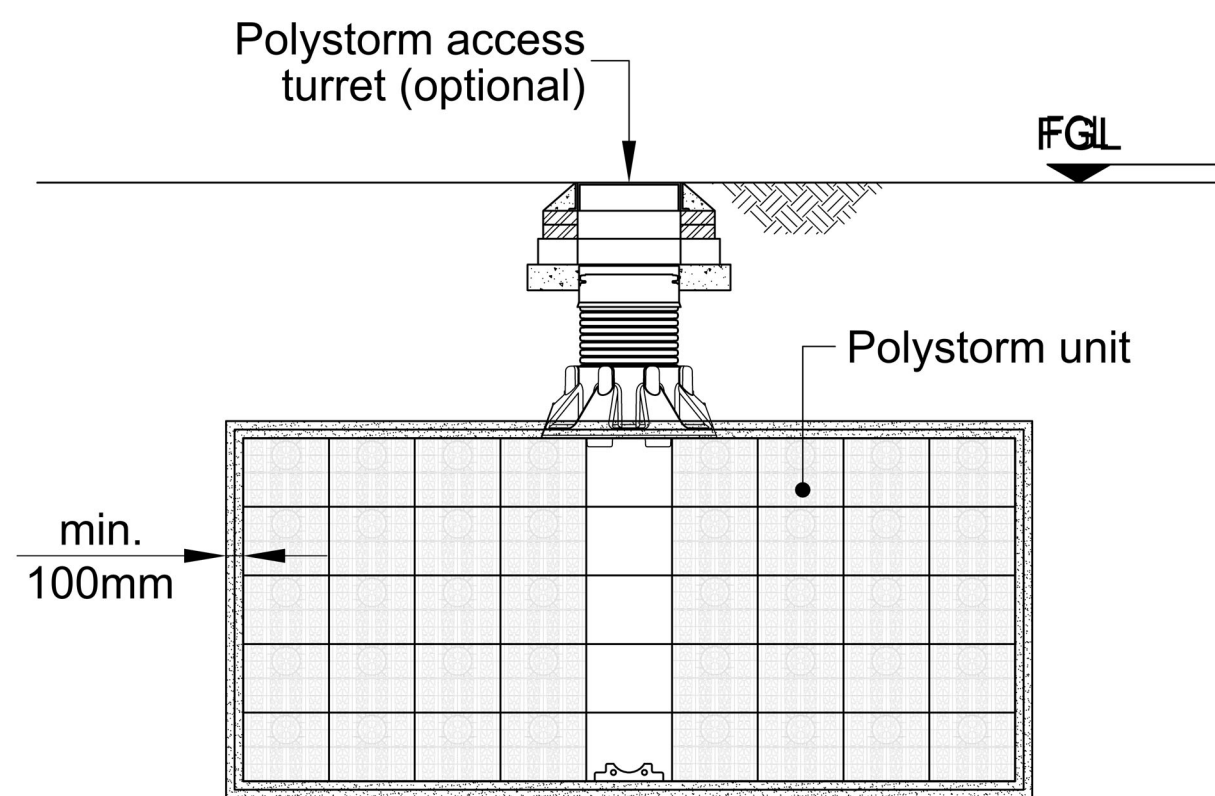
Typical base layout of Type 3 chambers



Typical Inspection Chamber
(no vehicle access)



Long Section



Cross Section

Construction Risks Maintenance/Cleaning Risks Demolition/Adaptation Risks

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03	03	FOR APPROVAL	08/11/23	AA	FA	AA
04	04	FOR APPROVAL	19/10/23	AA	FA	AA
05	05	FOR APPROVAL	11/08/23	AA	FA	AA

Scales @ A1	Issuing Office	Project No.
1:100	Kent	101M220716

Client Approval	
A - Approved	
B - Approved with Comments	
C - Do Not Use	
Status	Purpose of Issue

Originator	Adkins Consultants Ltd 130 Ashford Rd, Bearsted, Maidstone ME14 4AF
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Project	SPECIALIST FIREARMS COMMAND SCO19, WHARF ROAD, GRAVESEND
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Layout Title	Details
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Client	METROPOLITAN POLICE SERVICE (MPS)
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Drawing Number							
project	originator	zone	level	type	role	number	rev
MP-A1-MM-16							05

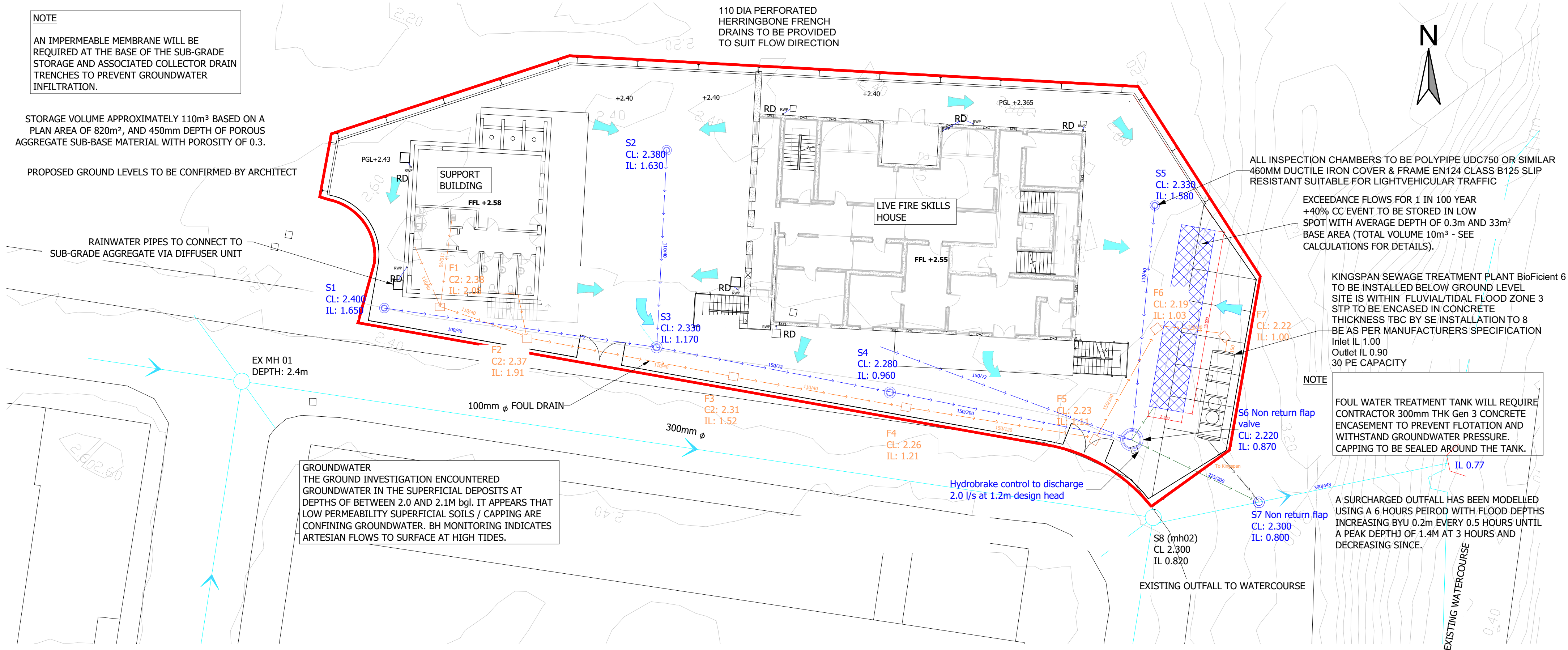
Protection to drainage during construction

- Fencing or barrier to be erected to prevent buried pipes, manholes, catchpits and sub-base replacement from over-run by construction vehicles.
- If fencing protection is not suitable to sections of buried pipes then pipes to have concrete protection.
- Heavy materials shall not be stored over the drainage system or permeable paving.
- Construction traffic shall not run on permeable pavement surfaces if it could cause clogging or over-compaction of the surface.
- The proposed drainage system shall be inspected at the end of construction and any silts removed.

Management of run-off during construction

- Identify any drains within or adjacent to the site and protect the drains from run off during construction.
- Vegetation clearance to be kept to a minimum to reduce the potential for sediment run off.
- Run off polluted by silts should be treated by filtration / settlement or other suitable method.
- Runoff from the construction area shall not enter the proposed drainage system unless all pollution and silts have been removed.

NB: Maintenance instruction shall be provided by the products suppliers to the clients e.g for Diffuser Units



1:200

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

	Maintenance schedule	Required action	Typical frequency
	Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
		Change the filter media	As recommended by manufacturer
		Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
	Remedial actions	Replace malfunctioning parts or structures	As required
	Monitoring	Inspect for evidence of poor operation	Six monthly
		Inspect filter media and establish appropriate replacement frequencies	Six monthly
		Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months



**Adkins
Consultants ^{Ltd}**
Surveying, Structural Engineering & Quantity Surveying
for the Construction Industry



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Notes
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GENERAL NOTES

1. FOUL DRAINAGE SYSTEM DESIGNED BY OTHERS.
2. PROVIDE SILT TRAP TO MANUFACTURER DETAILS.
3. SOAKAWAY CRATES ARE DESIGNED FOR 1:100 YEARS EVENT WITH 40% INCREASE DUE TO CLIMATE CHANGE. PROVIDE 1:200 BED SLOPE.
4. PROVIDE NON-RETURN VALVES AS PER MANUFACTURER DETAILS.
5. CONTRACTOR TO CONFIRM THE APPROVAL FOR THE TYPE OF PIPE AND BEDDING BEING USED WITH THE ADOPTING AUTHORITY PRIOR TO ANY CONSTRUCTION COMMENCING.
6. PROVIDE HERRINGBONE DRAINAGE SYSTEM FOR THE PERMEABLE ROAD AND DIVERT TO SOAKAWAY.
7. MANHOLE DEPTH GREATER THAN 1M TO BE MADE OF PCC RINGS OR BRICKWORK.
8. THE CONTRACTOR IS TO ALLOW FOR JET WASHING ALL LENGTHS OF EXISTING SEWERS WHICH ARE TO BE RETAINED.
9. ALL PRIVATE DRAINAGE WORKS TO BE IN ACCORDANCE WITH PART H7.5 OF THE CURRENT BUILDING REGULATIONS AND BS EN 752.
10. ALL RWP, SVP AND FOUL DRAINAGE POSITIONS, INCLUDING UNDERSLAB GULLIES, ARE TO BE CONFIRMED BY THE ARCHITECT.
11. CONTRACTOR IS TO ALLOW FOR ALL ABANDONED DRAINAGE RUNS AND MANHOLES / SOAKAWAYS TO BE FULLY GROUDED UP OR REMOVED AS NECESSARY.
12. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS, ARCHITECTS AND SUB-CONTRACTORS DRAWINGS AND DETAILS.
13. ANY DISCREPANCIES ARE TO BE REPORTED TO ADKINS CONSULTING ENGINEERS IMMEDIATELY.
14. SEWAGE TREATMENT PLANT AND ATTENUATION TANK INSTALLATION PROCEDURE TO BE CONSULTED WITH MANUFACTURER.

Construction Risks	Maintenance/Identifying Risks	Demolition/adaptation Risks

Safety Health and Environmental Information Box

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Rev/ID	Issue ID	Issue Name	Issue Date	Issued By	Status	Approved by
01	001	FOR APPROVAL	22/01/22	AAA	FA	AAA
04	001	FOR APPROVAL	08/01/22	AAA	FA	AAA
05	001	FOR APPROVAL	26/11/22	AAA	FA	AAA
02	001	FOR APPROVAL	16/01/22	AAA	FA	AAA
01	001	FOR APPROVAL	01/01/22	AAA	FA	AAA
01	001	FOR APPROVAL	11/08/22	AAA	FA	AAA

Scales @ A1
1:200

Issuing Office
Kent

Project No.
101M220716

Client Approval

☐ A - Approved

☐ B - Approved with Comments

☐ C - Do Not Use

Status **Purpose of Issue**

Originator

Adkins Consultants Ltd
130 Ashford Rd, Bearsted, Maidstone ME14 6AF

Project

SPECIALIST FIREARMS COMMAND
SCO19, WHARF ROAD, GRAVESEND

Layout Title

MAINTENANCE PLAN

Client

METROPOLITAN POLICE SERVICE
(MPS)

Drawing Number						
project	originator	zone	level	type	role	number
MP-A1-MM-17						05

Drainage Calculation Report

Revision B

**SPECIALIST FIREARMS COMMAND SCO19,
WHARF ROAD, GRAVESEND**



26 September 2023

Produced By
Manoj Pun, BEng (Hons)

Checked by:
Mehrdad Bahari BEng, MSC, PhD, MCI OB, CEng, MICE,
MIStructE



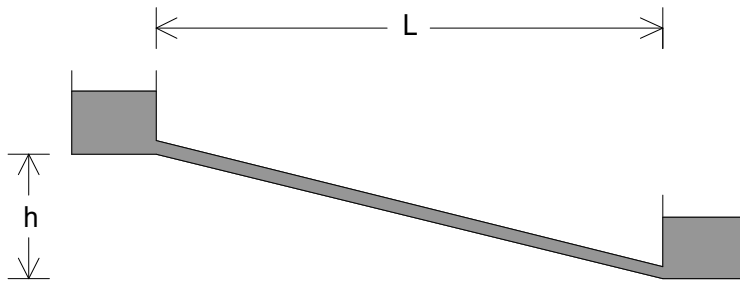
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Calculations

DESIGN OF A FOUL SEWER

TEDDS calculation version 1.0.04



Design pipe flow limited to 0.75 times full depth

Sewer design details

Design flow rate $Q_{\text{design}} = 2.50 \times 10^{-3} \text{ m}^3/\text{s}$
 Length of the sewer $L = 72.0 \text{ m}$
 Fall along length of sewer $h = 1.740 \text{ m}$
 Gradient of sewer $i = h / L = 0.024 \text{ (1 in 41)}$

(Library item Sewer design details)

Minimum flow velocity $V_{\text{min}} = 1.000 \text{ m/s}$
 Minimum pipe diameter $D_{\text{min}} = 100 \text{ mm}$
 Surface roughness $k_s = 0.6 \text{ mm}$
 Mean hydraulic depth factor $m = 0.30$
 Kinematic viscosity of fluid $\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$

Using the Chezy equation

Constant $c = 56$
 Diameter of pipe required $D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 54 \text{ mm}$
 Nearest pipe diameter $D_{\text{chezy}} = 100 \text{ mm}$
 Flow velocity using Chezy $V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.508 \text{ m/s}$

Using the Eschritt equation

Diameter of pipe required $D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 60 \text{ mm}$
 Nearest pipe diameter $D_{\text{eschritt}} = 100 \text{ mm}$
 Flow velocity using Eschritt $V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) = 1.204 \text{ m/s}$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter $D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 100 \text{ mm}$
 Constant $Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.218$
 Flow velocity $V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s}))) \times 1 \text{ m/s}$

$V_{\text{full}} = 1.198 \text{ m/s}$

Flow rate running full

$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 9.41 \times 10^{-3} \text{ m}^3/\text{s}$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$x = 0.351$

PASS - Design pipe flow less than 0.75 times full depth

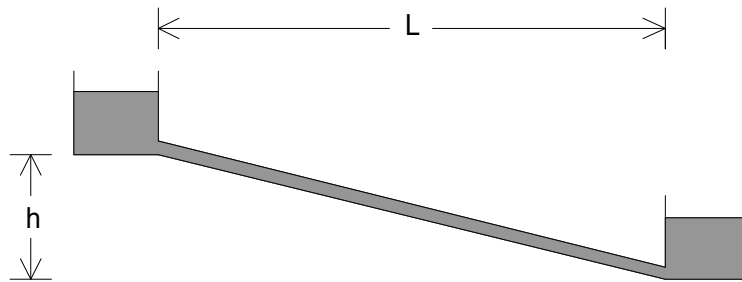
Flow velocity at design flow rate

$V_{\text{design}} = 1.015 \text{ m/s}$

PASS - Design velocity is greater than 1.000 m/s

Design of a surface water drain

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 3.00 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 20.1 \text{ m}$$

Fall along length of drain

$$h = 0.500 \text{ m}$$

Gradient of drain

$$i = h / L = 0.025 \text{ (1 in 40)}$$

(Library item Drain design details)

Minimum flow velocity

$$V_{\text{min}} = 1.000 \text{ m/s}$$

Minimum pipe diameter

$$D_{\text{min}} = 100 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 60 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 100 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.397 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i)} / 0.00035 \text{ m}^3/\text{s})^{0.382} \times 1 \text{ mm} = 64 \text{ mm}$$

mm

Nearest pipe diameter

$$D_{\text{eschritt}} = 100 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i)} \times 60) =$$

$$1.221 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 100 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.221$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times$$

$$D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s})) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 1.216 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 9.55 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.384$$

Flow velocity at design flow rate

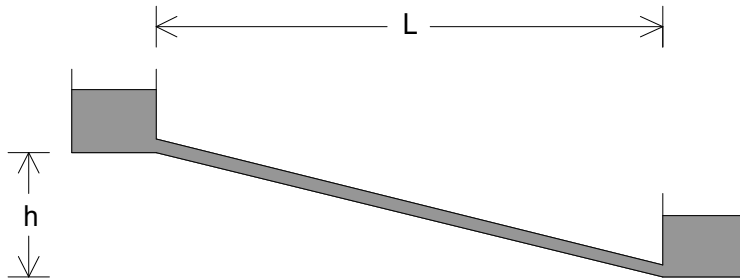
$$V_{\text{design}} = 1.076 \text{ m/s}$$

PASS - Design velocity is greater than 1.000 m/s

S1 TO S3

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 2.00 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 20.1 \text{ m}$$

Fall along length of drain

$$h = 0.480 \text{ m}$$

Gradient of drain

$$i = h / L = 0.024 \text{ (1 in 42)}$$

(Library item Drain design details)

Minimum flow velocity

$$V_{\text{min}} = 0.750 \text{ m/s}$$

Minimum pipe diameter

$$D_{\text{min}} = 100 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 51 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 100 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.368 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 56 \text{ mm}$$

mm

Nearest pipe diameter

$$D_{\text{eschritt}} = 100 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) =$$

$$1.197 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 100 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.216$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times$$

$$D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s})) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 1.191 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 9.35 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.313$$

Flow velocity at design flow rate

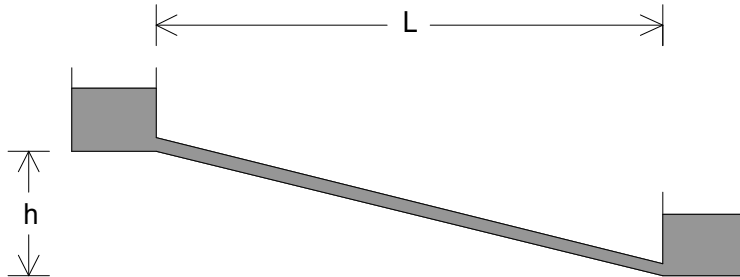
$$V_{\text{design}} = 0.948 \text{ m/s}$$

PASS - Design velocity is greater than 0.750 m/s

S2 TO S3

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 2.00 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 14.5 \text{ m}$$

Fall along length of drain

$$h = 0.460 \text{ m}$$

Gradient of drain

$$i = h / L = 0.032 \text{ (1 in 32)}$$

(Library item Drain design details)

Minimum flow velocity

$$V_{\text{min}} = 0.750 \text{ m/s}$$

Minimum pipe diameter

$$D_{\text{min}} = 100 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 48 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 100 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.577 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i)} / 0.00035 \text{ m}^3/\text{s})^{0.382} \times 1 \text{ mm} = 53 \text{ mm}$$

mm

Nearest pipe diameter

$$D_{\text{eschritt}} = 100 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i)} \times 60) =$$

$$1.379 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 100 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.249$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times$$

$$D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s})) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 1.375 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 10.8 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.291$$

Flow velocity at design flow rate

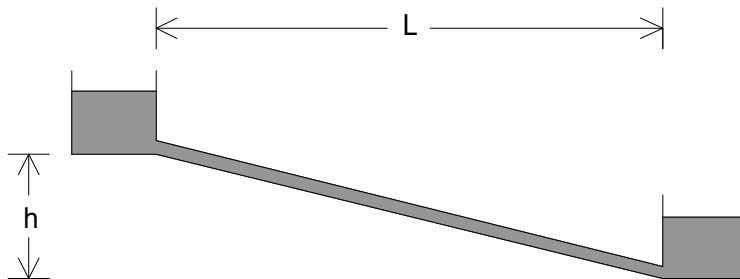
$$V_{\text{design}} = 1.052 \text{ m/s}$$

PASS - Design velocity is greater than 0.750 m/s

S3 TO S6

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 7.00 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 35.5 \text{ m}$$

Fall along length of drain

$$h = 0.300 \text{ m}$$

Gradient of drain

$$i = h / L = 0.008 \text{ (1 in 118)}$$

(Library item Drain design details)

Minimum flow velocity

$$V_{\text{min}} = 0.750 \text{ m/s}$$

Minimum pipe diameter

$$D_{\text{min}} = 150 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 104 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 150 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 0.997 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i)} / 0.00035 \text{ m}^3/\text{s})^{0.382} \times 1 \text{ mm} = 109 \text{ mm}$$

mm

Nearest pipe diameter

$$D_{\text{eschritt}} = 150 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i)} \times 60) =$$

$$0.915 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 150 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.158$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times$$

$$D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s})) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 0.919 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 16.2 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.459$$

Flow velocity at design flow rate

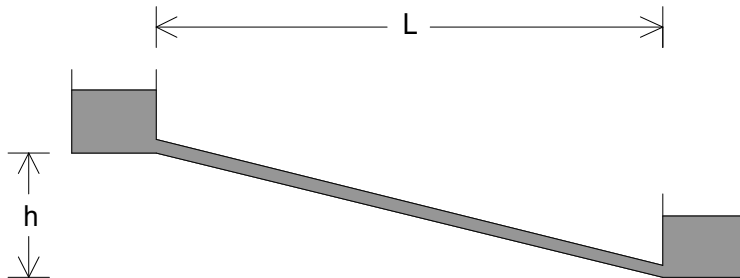
$$V_{\text{design}} = 0.885 \text{ m/s}$$

PASS - Design velocity is greater than 0.750 m/s

S4 TO S6

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 10.0 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 18.0 \text{ m}$$

Fall along length of drain

$$h = 0.090 \text{ m}$$

Gradient of drain

$$i = h / L = 0.005 \text{ (1 in 200)}$$

(Library item Drain design details)

Minimum flow velocity

$$V_{\text{min}} = 0.750 \text{ m/s}$$

Minimum pipe diameter

$$D_{\text{min}} = 150 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 133 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 150 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 0.767 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 139 \text{ mm}$$

mm

Nearest pipe diameter

$$D_{\text{eschritt}} = 150 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) =$$

$$0.704 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 150 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.121$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times$$

$$D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s})) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 0.703 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 12.4 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.681$$

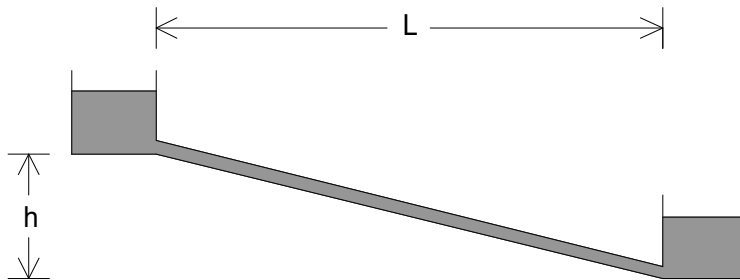
Flow velocity at design flow rate

$$V_{\text{design}} = 0.780 \text{ m/s}$$

S5 TO S6

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 2.00 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 17.2 \text{ m}$$

Fall along length of drain

$$h = 0.710 \text{ m}$$

Gradient of drain

$$i = h / L = 0.041 \text{ (1 in 24)}$$

(Library item Drain design details)

Minimum flow velocity

$$V_{\text{min}} = 0.750 \text{ m/s}$$

Minimum pipe diameter

$$D_{\text{min}} = 100 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 46 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 100 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.799 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i) / 0.00035 \text{ m}^3/\text{s}})^{0.382} \times 1 \text{ mm} = 50 \text{ mm}$$

mm

Nearest pipe diameter

$$D_{\text{eschritt}} = 100 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i) \times 60}) =$$

$$1.573 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 100 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.285$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times$$

$$D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s})) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 1.571 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 12.3 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.271$$

Flow velocity at design flow rate

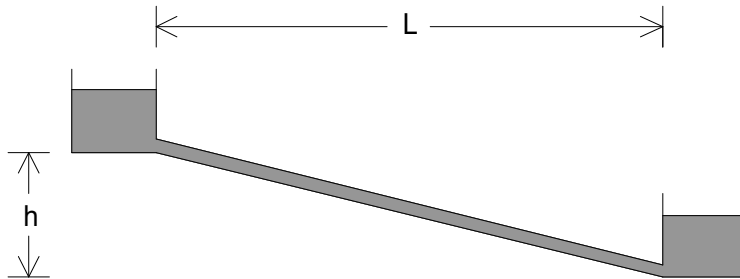
$$V_{\text{design}} = 1.158 \text{ m/s}$$

PASS - Design velocity is greater than 0.750 m/s

S6 TO S7

DESIGN OF A SURFACE WATER DRAIN

TEDDS calculation version 1.0.04



Drain design details

Design flow rate

$$Q_{\text{design}} = 2.00 \times 10^{-3} \text{ m}^3/\text{s}$$

Length of the drain

$$L = 10.0 \text{ m}$$

Fall along length of drain

$$h = 0.070 \text{ m}$$

Gradient of drain

$$i = h / L = 0.007 \text{ (1 in 143)}$$

(Library item Drain design details)

Minimum flow velocity

$$V_{\text{min}} = 0.500 \text{ m/s}$$

Minimum pipe diameter

$$D_{\text{min}} = 200 \text{ mm}$$

Surface roughness

$$k_s = 0.6 \text{ mm}$$

Mean hydraulic depth factor

$$m = 0.25$$

Kinematic viscosity of fluid

$$\nu = 1.31 \times 10^{-6} \text{ m}^2/\text{s}$$

Using the Chezy equation

Constant

$$c = 56$$

Diameter of pipe required

$$D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1 \text{ m/s}^2))^{0.2} = 65 \text{ mm}$$

Nearest pipe diameter

$$D_{\text{chezy}} = 200 \text{ mm}$$

Flow velocity using Chezy

$$V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1 \text{ m/s}^2)} = 1.048 \text{ m/s}$$

Using the Eschritt equation

Diameter of pipe required

$$D = (Q_{\text{design}} \times 1000 \times \sqrt{(1 / i)} / 0.00035 \text{ m}^3/\text{s})^{0.382} \times 1 \text{ mm} = 70 \text{ mm}$$

mm

Nearest pipe diameter

$$D_{\text{eschritt}} = 200 \text{ mm}$$

Flow velocity using Eschritt

$$V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1 \text{ mm})^{0.62} \times 1 \text{ m/s} / (\sqrt{(1 / i)} \times 60) =$$

$$0.996 \text{ m/s}$$

Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter

$$D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = 200 \text{ mm}$$

Constant

$$Z = \sqrt{(2 \times (g_{\text{acc}} / 1 \text{ m/s}^2) \times (D_{\text{design}} / 1000 \text{ mm}) \times i)} = 0.166$$

Flow velocity

$$V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times$$

$$D_{\text{design}})) + ((2.51 \times \nu) / (D_{\text{design}} \times Z \times 1 \text{ m/s})) \times 1 \text{ m/s}$$

$$V_{\text{full}} = 1.008 \text{ m/s}$$

Flow rate running full

$$Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = 31.7 \times 10^{-3} \text{ m}^3/\text{s}$$

PASS - Maximum flow rate is greater than design flow rate

From Hydraulics Research Tables 35 and 36

Depth as proportion of D

$$x = 0.170$$

Flow velocity at design flow rate

$$V_{\text{design}} = 0.563 \text{ m/s}$$

PASS - Design velocity is greater than 0.500 m/s

If you have any queries about items specified, please contact us and we will gladly help.

End of Report.

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All quotations are subject to the addition of VAT at the current rate.

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7.1 None of our employees, partners or consultants individually has a contract with you or owes you a duty of care or personal responsibility. You agree that you will not bring any claim against any such individuals personally in connection with our services."

7.2 The liability of Adkins Consultants Ltd to the client, (or any third party claiming through the client) shall in no circumstance (except in case of death or personal injury) exceed the lesser of:

- (a) The amount that can be recovered from our professional indemnity insurance
- (b) We will have proportionate liability and this will be limited to 25% (twenty five percent) of any loss.

(c) The diminution in value of the property concerned.

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- (a) pollution, contamination, terrorism, asbestos or any related risk or
- (b) designs or reports prepared by other professionals and specialist sub-contractors/suppliers.

7.4 The limitation period, before which any claim must commence, is six years.

7.5 If you suffer loss as a result of our breach of contract or negligence, our liability shall be limited to a just and equitable proportion of your loss having regard to the extent of responsibility of any other party. Our liability shall not increase by reason of a shortfall in recovery from any other party.

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11. Terms and Conditions further information

Unless otherwise agreed in

writing by the Company these Conditions will override any terms and conditions stipulated or referred to by the Customer in his order or pre-contract negotiations.

12. Cancellations

Adkins Consultants will only accept cancellations at the discretion of Adkins Consultants unless they are within the cooling-off period of 14 days. Acceptance of the cancellation will only be binding on the company if it is sent in writing. Any cost or expenses incurred by the company up to the

date of cancellation and all loss and damage resulting from the cancellation

will be paid by the customer to the company, including within the cooling-off period if Adkins Consultants have started works during this time, which is a likely course of events given Adkins Consultant's desire to dispatch customer's instructions at a speedy rate .

13. Exclusions

In dispute of any assertion that anything is excluded, all warranties, conditions and other terms, implied, statutory or otherwise, are expressly excluded excepting

so far as they are contained in these conditions or otherwise expressly agreed by Adkins Consultants Ltd in writing. If any legislation makes it unlawful to exclude any term from the Contract this clause will naturally not apply to such.

14. Resolutions of Disputes

14.1 The parties will endeavour to resolve any dispute amicably. Each of them shall in good faith consider any proposal by the other that a dispute be referred to mediation.

14.2 Disputes shall be finally resolved by the English Courts.

15. Governing Law

The Agreement shall be solely within the jurisdiction of and governed by English Courts.



SUDS MANAGEMENT & MAINTENANCE PLAN

**Metropolitan Police Specialist Training
Centre , Mark Lane, Gravesend, Kent DA12**

26 September 2023

**Produced By
Manoj Pun BEng (Hons)**

**Checked by:
Mehrddad Bahari BEng, MSC, PhD, MCIQB, CEng,
MICE**

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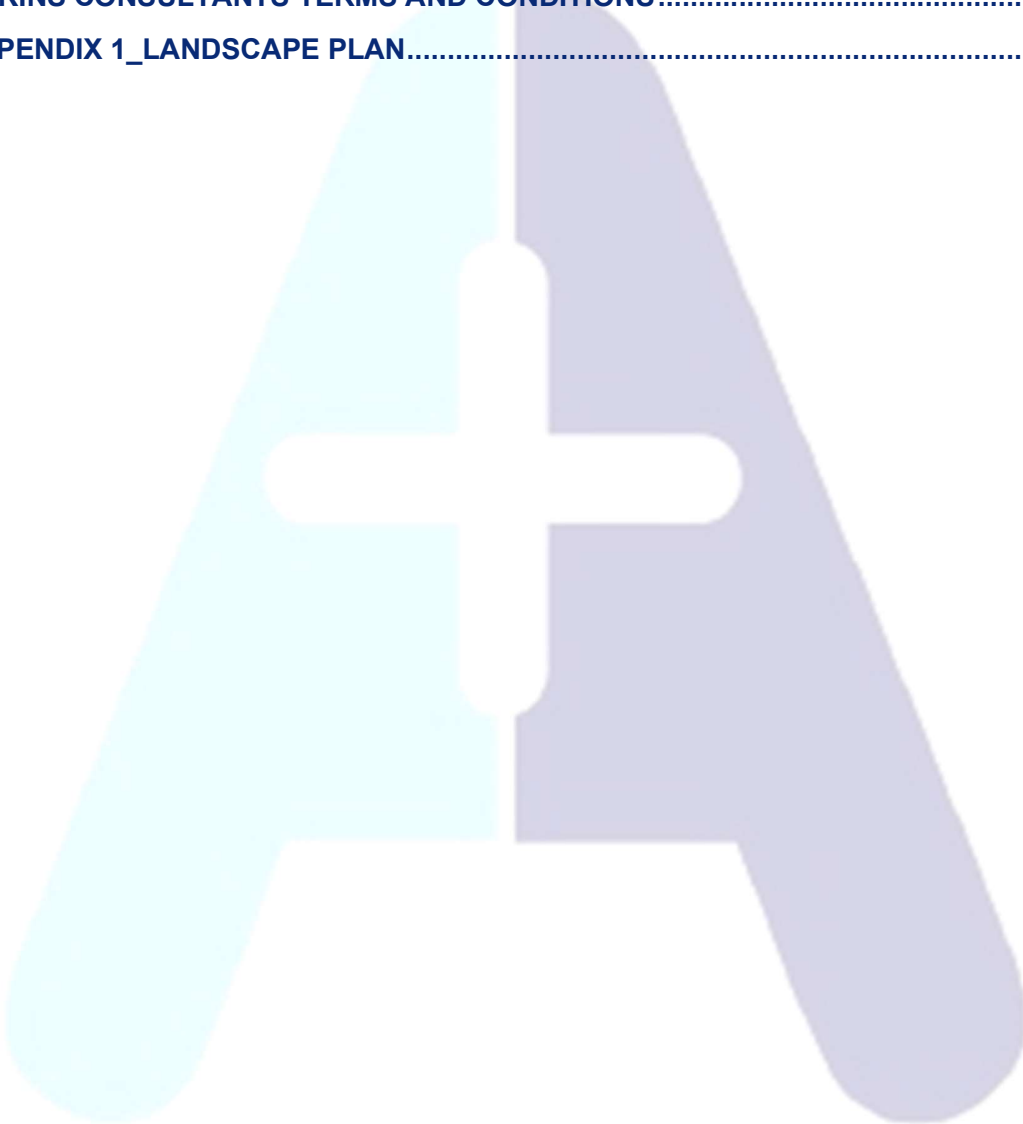
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1. INTRODUCTION

- 1.1. This document sets out the principles for the long term operation and maintenance of the surface water Sustainable Drainage Systems (SuDS) constructed at Metropolitan Police Specialist Training Centre , Mark Lane, Gravesend, Kent DA12
- 1.2. This SuDS aim to Control the flow, volume and frequency of water leaving a development area and prevent pollution by intercepting silt and cleaning runoff from hard surfaces.

2. SCHEDULE OF MAINTENANCE

- 2.1. Once appointed the Contractor will prepare a site specific method statement for the control of silt and other pollutants during construction. CIRIA Report C532, Control of water pollution from construction sites, provides further guidance on this.
- 2.2. The Contractor will maintain the proposed drainage system during construction and until the handing over of the site.
- 2.3. Upon completion management of the shared drainage facilities (where not adopted) will be passed on to the owner/management team.
- 2.4. Maintenance of individual property drainage connections will be the responsibility of owner/management team.

3. SUDS AT METROPOLITAN POLICE SPECIALIST TRAINING CENTRE , MARK LANE, GRAVESEND, KENT DA12

- 3.1. This document sets out the storm water drainage strategy for the built development is utilises SuDS features to intercept and convey all pluvial surface water runoff. The design of the system aims to attenuate runoff and encourage infiltration.
- 3.2. The proposed storm water system consists of the following SuDS components as shown in Appendix 3 Wharf Road Drainage Drawing Rev5 MP-A1-MM-17
- 3.2.1 Permeable Surface
 - 3.2.2 Attenuation
 - 3.2.3 Bioficient Treatment Plant
 - 3.2.4 Hydrobrake

3.3. There are three categories of maintenance activities referred to in this report:

3.3.1 Regular maintenance (including inspections and monitoring)

Consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal.

1.1.1 Occasional maintenance

Comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks

3.3.2 Remedial Actions

Comprises intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.

3.3.3 Monitoring

Comprises of inspections of SuDS components although the likelihood

4. SUDS MAINTENANCE SPECIFICATION

4.1. Permeable Surface

Permeable block paving, porous asphalt, gravel that allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Permeable block paving and porous asphalt can be cleaned by suction brushing.

4.1.1 After installation

- Protect the system from construction and maintenance trades involving heavy plant and equipment.
- Prevent loose building and landscaping materials being dropped on the surface as these will clog the pores of the asphalt.
- Traditional pressure washing equipment should not be used as this forces dirt deeper into the asphalt.

4.1.2 New building work

- Any new building or landscaping works on site may place the system at risk, hence an effective protection method should be agreed with all trades using the system area, in particular those requiring heavy plant, equipment and materials which may damage or clog the surface.

4.1.3 Emergency intervention

- Oil and fuel spillages can be cleaned up using absorbent cloths with any residues left for treatment within the pavement itself.
- High levels of spillage or long term deposits of oil and fuel may force minor repairs to the system layers. An experienced contractor should be employed.

4.1.4 Routine maintenance

- Litter should be brushed or if possible vacuumed off the surface.
- Periodic use of a standard road sweeper is permitted.

4.1.5 Winter maintenance

- Winter maintenance can be undertaken using BS 3247 Fine Grade 6.3mm rock salt however, effective dispersal across the surface is highly recommended and reduces clogging of the asphalt pores. As such, applicators or spreaders should be employed.
- Snow clearance by unmodified or general plant must be prohibited. All clearance equipment such as JCB type loading shovels or tractors should use either plastic/rubber ploughs or buckets protected with rubber sheaths to prevent damage to the surface.

In addition to above guidelines, Table 20.15 operation and maintenance requirements for pervious surface should be utilized as shown below.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm 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	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	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 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

4.2. Attenuation Storage Maintenance Specification

4.2.1 After installation

A pre-handover inspection should be carried out and the system cleaned prior to final handover. Traditional pressure washing equipment should not be used as this forces dirt deeper into the asphalt.

4.2.2 Routine Inspection

- Inspection of systems
- Removal of silts
- Decanting of oils and hydrocarbons
- Channel jetting
- Water sampling and testing at point of discharge (if required) Excess silt/debris held within the system and gullies should be cleared manually or with a vacuum tank. We do not recommend pressure led cleaning.

1.1.1 Remedial Measures

As soon as a spillage is identified, the drain inlets in that area should be covered to prevent pollution entering the system. The pollution should then be cleared from the road or car park surface. The system receiving the spillage should be emptied of all pollution that has entered. A spillage kit appropriate to the size of the car park should be kept by the site caretaker. This should include absorbent pads, socks and rain seals.

In addition to above guidelines, Table 21.3 operation and maintenance requirements for attenuation storage tank should be utilized as shown below.

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

4.3. Bioefficient Treatment Plan Maintenance Specification

4.3.1 Daily

Check the operation of the compressor. It should be possible to hear it running by standing close to the unit.

4.3.2 Monthly

Check the operation of the compressors (bubbles should be rising in the reactors and media should be seen slowly rotating). Visually check that the inlet and outlet zones are clear of debris. Visually check the biomass growth on the filter media. The biomass colours should vary from light brown colour, (not white or grey.) to rich brown. Odour from the plant should be 'earthy' and hydrogen sulphide odours ('rotten eggs') should not be present. Visually check the final effluent. If cloudy or containing many suspended particles, then the humus and or primary tank is likely to require desludging.

4.3.3 Three monthly

Assess the depth of the thickness of the floating sludge in the primary and final zones. Check the blower filter, and replace if necessary. Note. The filter will collect dirt particles from the air and the location of blower/inlet will influence the frequency of filter change.

4.3.4 Annually

The unit is designed to be emptied of sludge every 12 months

In addition to above guidelines, Table 14.2 operation and maintenance requirements for proprietary treatment system should be utilized as shown below.

TABLE 14.2 An example of operation and maintenance requirements for a proprietary treatment system

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

4.4. The following maintenance schedule details the typical tasks to be undertaken at different intervals.

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove sediment and debris	Monthly or as required
	Inspect Hydrobrake Chamber	3 Months
	Surface and foul water pipework – jetting / rodding	Every 2 years or as required
	Visual inspection of permeable paving for defects and settlement	Annually, or after leaf fall
	Inspection chambers and manholes	Every 3 months and after leaf fall
	Surface Water and Foul water pipework	Every 2 year
	Bioficient Treatment plant	Monthly, Empty annually
	Sweeping / brushing / Vacuuming of permeable paving	Annually, or after leaf fall
Remedial Actions	Repairs to access chambers / manhole covers	As required
	Replace any broken permeable surface, remedial works to any depressions or rutting	As required
	Inspect inlet, outlet from downpipe and gullies for blockages, standing water and clear	As required
	Service cellular attenuation storage crate	As required
	Full inspection and service of Permeable Paving System	Minimum of every 25 years or as required
	Replace cellular storage crate and soakaways	Minimum of every 50 years or as required
	Bioficient Treatment plant	Minimum of every 50 years or as required
	Replace Hydrobrake	Minimum of every 25 years or as required

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Unless otherwise agreed in writing by the Company these Conditions will override any terms and conditions stipulated or referred to by the Customer in his order or pre-contract negotiations.

12. Cancellations

Adkins Consultants will only accept cancellations at the discretion of Adkins Consultants unless they are within the cooling-off period of 14 days. Acceptance of the cancellation will only be binding on the company if it is sent in writing. Any cost or expenses incurred by the company up to the date of cancellation and all loss and damage resulting from the cancellation will be paid by the customer to the company, including within the cooling-off period if Adkins Consultants have started works during this time, which is a likely course of events given Adkins Consultant's desire to dispatch customer's instructions at a speedy rate.

13. Exclusions

In dispute of any assertion that anything is excluded, all warranties, conditions and other terms, implied, statutory or otherwise, are expressly excluded excepting so far as they are contained in these conditions or otherwise expressly agreed by Adkins Consultants Ltd in writing. If any legislation makes it unlawful to exclude any term from the Contract this clause will naturally not apply to such.

14. Resolutions of Disputes

14.1 The parties will endeavour to resolve any dispute amicably. Each of them shall in good faith consider any proposal by the other that a dispute be referred to mediation.

14.2 Disputes shall be finally resolved by the English Courts.

15. Governing Law

The Agreement shall be solely within the jurisdiction of and governed by English Courts.

Appendices

Appendix 1A_Landscape Plan



[illegible]



RECORD OF UNDERTAKER

**Metropolitan Police Specialist Training
Centre , Mark Lane, Gravesend, Kent DA12**

26 September 2023

**Produced By
Manoj Pun BEng (Hons)**

**Checked by:
Mehrdad Bahari BEng, MSC, PhD, MCIOB, CEng,
MICE**

Commercial Property

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A. Contact Information in case of further queries:

Name of Person Completing Form	Manoj Pun (BEng Hons)
Checked By	Dr. Mehrdad Bahari Mehrabani BEng, MSc, PhD, MCIQB, CEng, MICE, MlstructE
Company	Adkins Consultants
Phone Number	01622 236500
Email Address	m.pun@adkinsconstulatnts.com M.Mehrabani@AdkinsConsultants.com
Date Form Completed	26/09/2023

B. Site Address

Proposal	New Training Centre
Site Name	Metropolitan police specialist training centre
Site Postcode/location	DA12 2HD
Planning Reference	20221174
Planning Authority	Gravesham Borough Council

C. Site Information

Proposed start date	October 2022
First occupation date	April 2024
Completion date	August 2023

D. Maintenance Completed by

Contractor Name	Bouygues E&S UK
Address	Same as the site address
Phone Number	+44 (0)7769 138759
Email Address	mark.farrington@bouygues-es.co.uk
Completion Date	August 2023

E. Further Operation and Maintenance

Contractor Name	Bouygues E&S UK
Address	Same as the site address
Phone Number	+44 (0)7769 138759
Email Address	mark.farrington@bouygues-es.co.uk

Build out period (Per month for each year of development)												
Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2022												
2023												