Technical Note:

Hamble Quarry: Updated Drainage Design

Published by Stantec UK Limited
November 2023

Document reference:

331201108TN3rev1

Report status:

Final

Prepared for CEMEX UK Materials

Document reference: 331201108TN3rev1, November 2023

This report has been prepared by Stantec UK Ltd (Stantec) in its professional capacity as environmental specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by Stantec solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to Stantec at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, Stantec may, by prior written agreement, agree to such release, provided that it is acknowledged that Stantec accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. Stantec accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against Stantec except as expressly agreed with Stantec in writing.

	Name	Signature
Author	Pickersgill, Rob	
Checked by	Kelvin Limbrick	
Reviewed by	Rob Sears	

Revision 1 Changes:
Updated location of restoration phase drainage features to accommodate site constraints such as proposed footpaths and easements associated with existing buried pipelines. Also amended restoration phase attenuation basin shapes and catchment areas to better align with the operational and restoration phase drawings.

Summary

The Drainage Design for Hamble Quarry has been updated following infiltration testing and an analysis of proposed groundwater levels. As part of the restoration phase for the quarry, it is proposed that inert fill material is used to restore ground levels to the existing levels. The calculations accompanying the amended drainage design, presented in this document, demonstrate that runoff associated with the design event, a 1 in 100-year storm with Climate Change, can infiltrate to ground via infiltration features (after temporary storage within detention basins in some locations) without increasing surface water discharges from the site. These calculations assume that the inert fill material does not provide any infiltration and uses a safety factor of 2 when applying the measured infiltration rates. Furthermore, in line with CIRIA guidance, the invert level of each infiltration feature has been set at least 1m above the maximum anticipated groundwater level.

Contents

1 Introduction

1.1 Background

Following submission of a planning application for sand and gravel extraction, followed by restoration with inert materials at Hamble Airfield (the Site), CEMEX UK Materials Ltd (CEMEX) has entered into correspondence with consultees. The Lead Local Flood Authority (LLFA) has requested further clarification of the proposed drainage design, following updates to infiltration rates and proposed groundwater levels, as outlined in the soakaway testing report (Stantec, 2022b) and the groundwater flow technical note (Stantec, 2023) respectively.

Correspondence with regard to surface water issues is summarised below.

Flood and Water management team, Economy, Transport & Environment Department, Hampshire County Council;

- Initial letter from Flood and Water management team SWM/2022/0033 dated 7 February 2022 to which Stantec UK Ltd (Stantec) responded by letter on 24 May 2022,
- Stantec letter response 331201108pbond001 dated 24 May 2022,
- Follow up letter from Flood and Water management team SWM/2022/0033 dated 30 January 2023.

The majority of the issues raised by the latest Flood and Water management team letter relate to surface water issues which are addressed within this Technical Note. However, the point "*A technical assessment on how the proposed material will impact groundwater flows and any mitigation proposed to manage the risk of groundwater flow obstruction*" relates to hydrogeological issues and this is dealt with in the groundwater flow technical note (Stantec, 2023).

1.2 Scope of work

In order to address concerns regarding the proposed drainage design raised by the Flood and Water management team, this Technical Note presents further calculations to demonstrate that the proposed drainage design can allow for the infiltration of all surface water runoff in a 1 in 100 year + Climate Change event, with all infiltration features having a base / invert level situated at least 1 m above the maximum groundwater level, in line with CIRIA guidance for SuDS design[1].

A plan showing the updated proposed restoration drainage design is included as Appendix A, which also shows details of invert levels, groundwater levels and discharge rates (where applicable). Full MicroDrainage calculations for each element of the drainage design are provided within Appendix B.

Furthermore, the exceedance flow routes have been shown, demonstrating that, in events that exceed the design capacity of the drainage system and surface water overtops the drainage features, surface water will follow the existing ground contours, and will not lead to an increase in surface water flood risk for properties downslope of the site.

[1] Section 25.2.2, CIRIA report C753 – The SuDS Manual. 2015.

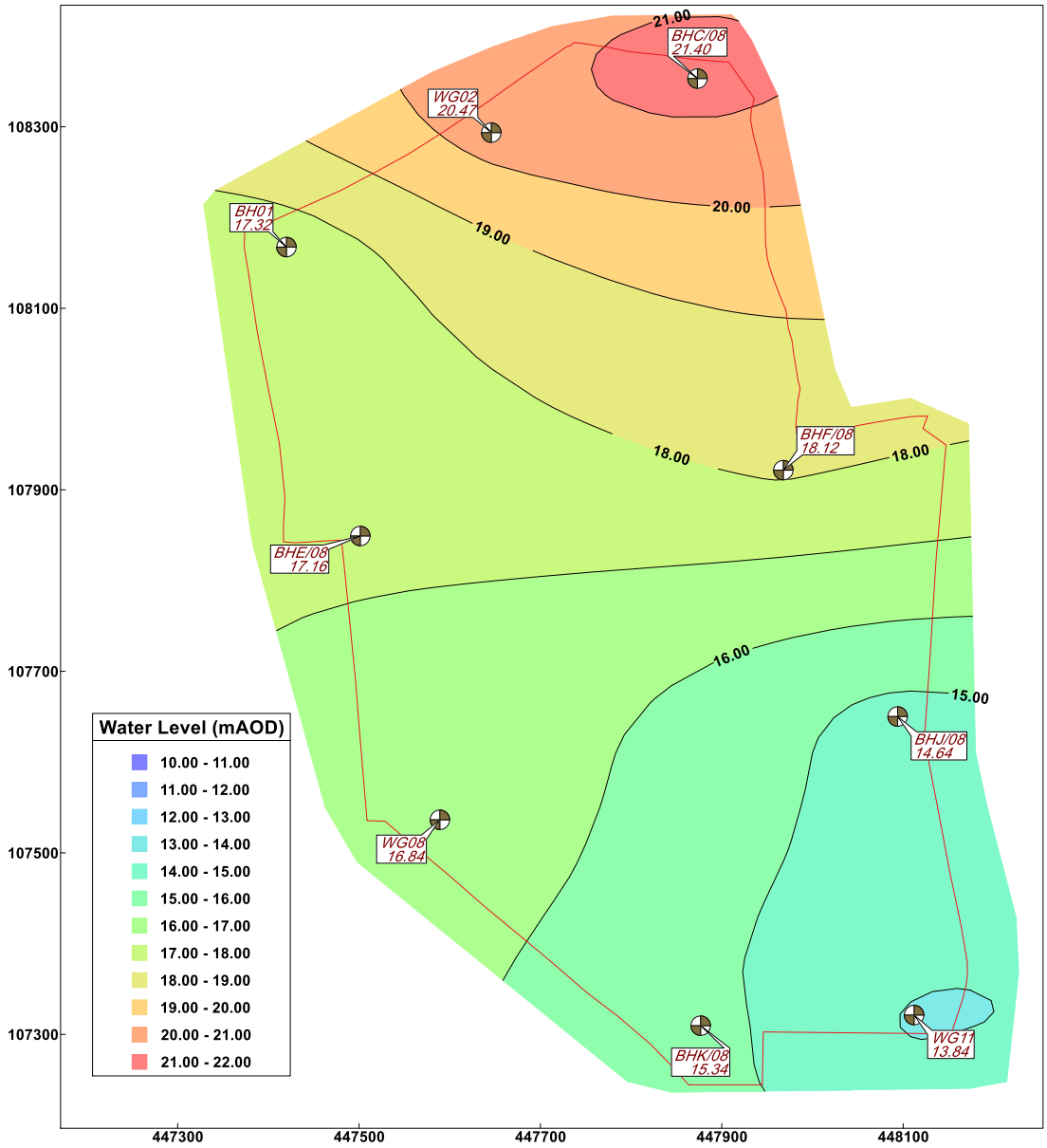
2 Groundwater Levels

As the proposed restoration drainage design discharges all rainfall up to and including the design event via infiltration, features such as linear infiltration trenches and infiltration basins are necessary for the drainage design. The inert fill material is anticipated to have a lower permeability than the sand and gravel being extracted from the quarry. As a conservative measure, it has been assumed that the inert fill material provides no infiltration, and so infiltration features associated with the drainage design have been located outside the proposed extraction area. In these locations, infiltration rates have been taken from the results of Infiltration Testing carried out by Stantec (2022b).

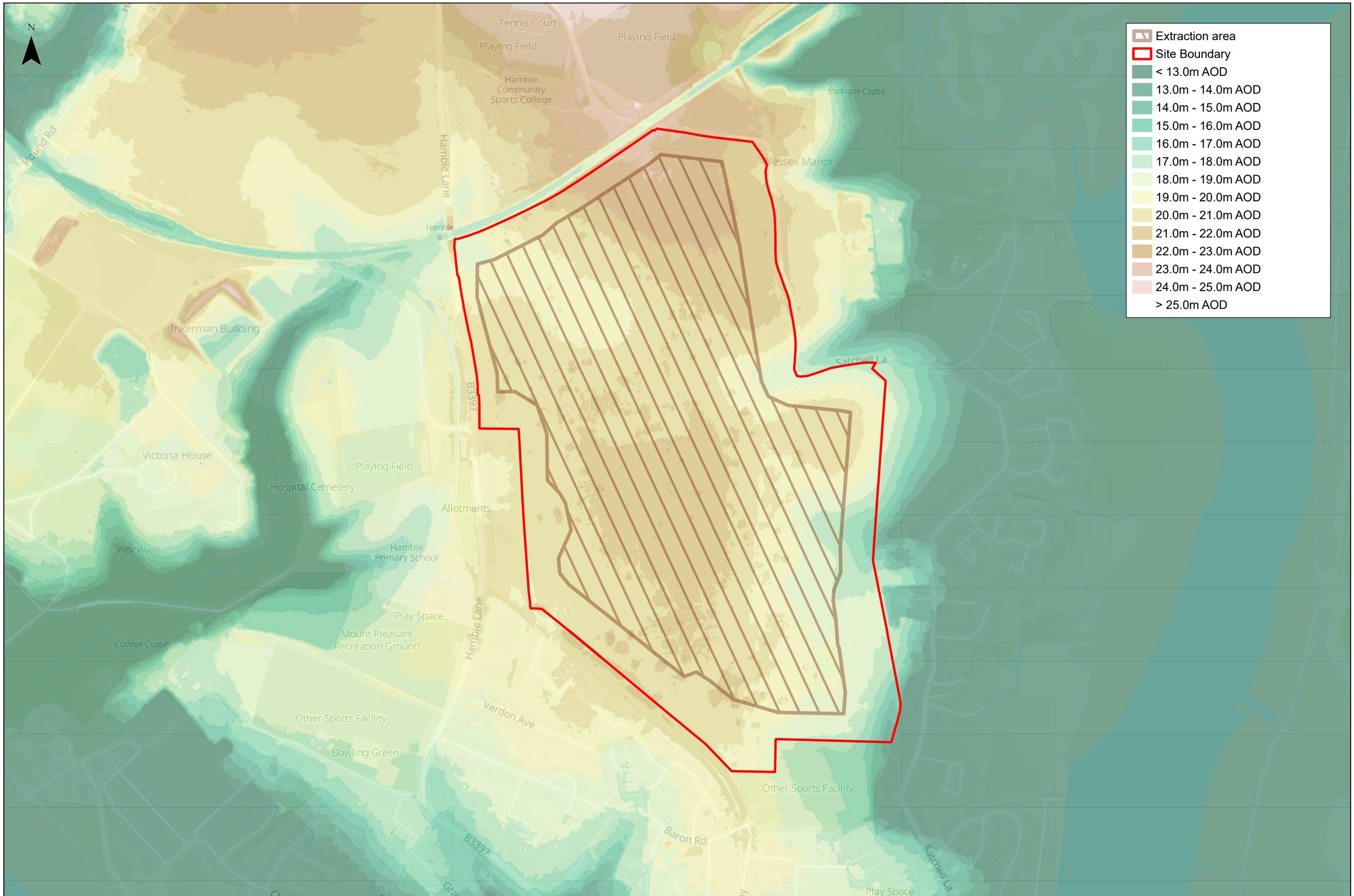
The CIRIA technical guidance for SuDS design recommends that, in designing infiltration systems, the base of any infiltration component is at least 1m above the maximum anticipated groundwater level. This is in order to ensure a depth of unsaturated soils to help ensure the infiltration performance of the component and protect underlying groundwater from contamination.

As part of the restoration plan, the quarry void will be filled with lower permeability inert fill material. However, as demonstrated in the groundwater flow technical note (Stantec, 2023), it is not anticipated that groundwater levels in the surrounding superficial strata will be significantly impacted by this and the drainage design can be based on the January 2023 groundwater contours for the River Terrace Deposits as shown in Figure 2.1, which represents the seasonal maximum groundwater levels.

Figure 2.1 River Terrace Deposit anticipated ground water levels January 2023.



By examining the LiDAR Digital Terrain Model (DTM) for the site (Figure 2.2), the ground levels towards the north-east corner of the site are shown to be approximately 22 mAOD. As the maximum groundwater level in the RTD is less than 1m below the ground surface, infiltration features are not suitable in this location. However, all other areas of the site are underlain by an unsaturated zone of at least 1m depth below ground level.



Stantec

Client: CEMEX

HAMBLE QUARRY

LiDAR 1m Topography

0 300 600 m

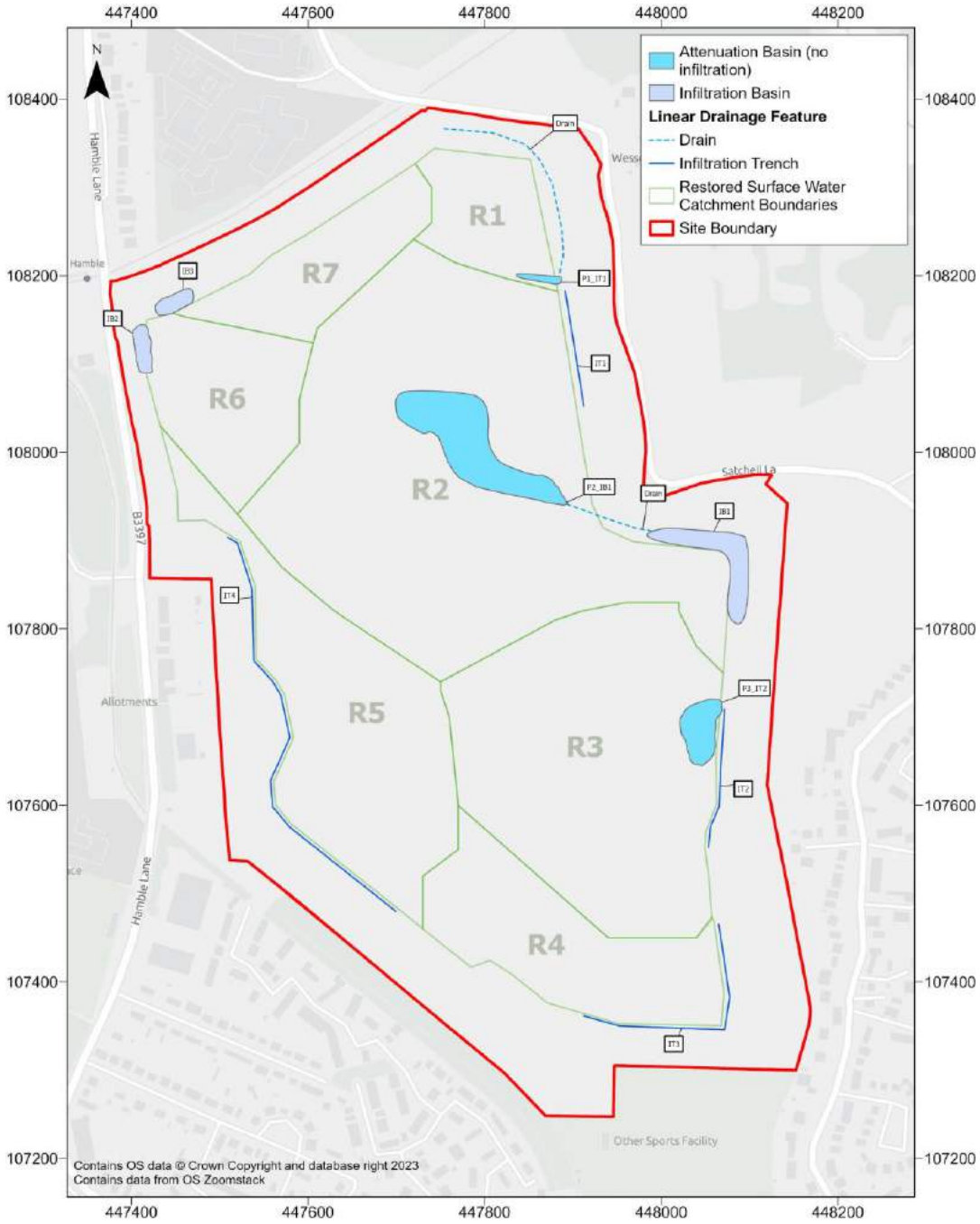
1:6,000 @ A3	Date: 02/11/2023
Drawn: RP	Checked: RS
Figure: 2-2	Rev: A

Document Path: C:\Users\rpickersgill\Documents\ArcGIS\Projects\Hamble_2\Hamble_2.aprx

3 Drainage Design

The restored site has been separated into subcatchments, as shown in Figure 3.1. Full details of each restoration phase drainage element are provided in Appendix A.

Figure 3.1 Updated restoration subcatchments



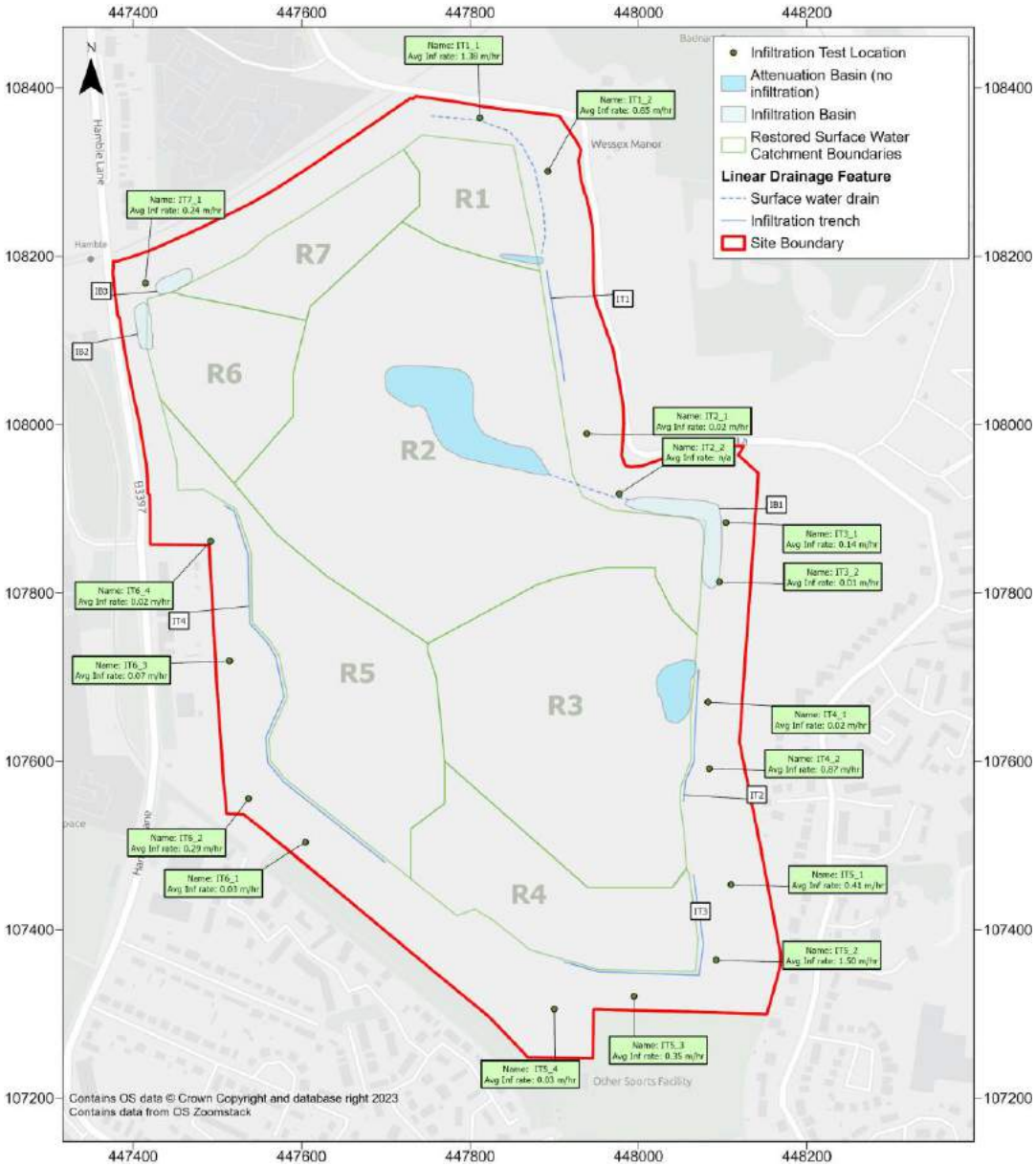
For each subcatchment, the rainfall has been calculated using the Revitalised Flood Hydrograph method (ReFH) to derive 1 in 100 year rainfall rates and hydrographs for the site, in line with the original FRA drainage calculations (Stantec, 2021). It is assumed that the restoration phase of the development has a lifetime of over 100 years, so a 45% climate change factor was then applied to this rainfall, in line with the recommended Upper End 2070s rainfall allowance for the Test and Itchen Management Catchment. The Upper End allowance has been used following the guidance for peak rainfall as part of the Climate Change (UK

Government, 2022). The original drainage design used a 40% climate change uplift, in line with the guidance in place at the time of the FRA.

The 1 in 100 year + Climate Change hydrograph has then been pro-rated based on subcatchment area. MicroDrainage software was then used to test each subcatchment to ensure that the proposed dimensions of each feature is sufficient to allow for infiltration in the design event.

Average infiltration rates used in the calculations were taken from the results of the infiltration testing (Stantec, 2022) (Figure 3.2). Note: infiltration testing was inconclusive at test location "IT2_2" and therefore no infiltration is assumed for the surface water drain located here. In the MicroDrainage calculations, a Factor of Safety of 2 has been used, which means that the infiltration rates used in the calculations are halved as a conservative measure. Results of the MicroDrainage calculations are provided in Appendix B.

Figure 3.2 Infiltration testing results(Source: Stantec, 2022b)



As with the original drainage design, surface water is managed through a combination of attenuation basins (which assume zero infiltration to ground), discharge control structures, infiltration basins and infiltration trenches. Infiltration features are sited on unextracted ground, such as in locations where screening bunds are

located for the operational phase but the mineral below is not worked, to maximise on the highly permeably soil already in place at the site, and to minimise any additional earth works on land that will otherwise be outside the operational footprint of the site.

As mentioned in Section 2, groundwater levels in the north east of the site are too close to the ground surface to allow for an infiltration feature, despite the high infiltration rate in this location. Therefore, a shallow surface water drain is proposed at the edge of the extraction area in this location in order to divert surface water to the south, into an attenuation basin. This will then release surface water via a controlled discharge (such as an orifice plate or Hydrobrake™ system) into infiltration trench IT1 at a maximum rate of 35 l/s. The typical flows encountered in the shallow surface water drain are considered to be small, and a surface water "grip" is anticipated to be sufficient; a 0.5 m wide, shallow trench, approximately 250 mm deep. Further details will be provided as part of the detailed drainage design.

Similarly, a surface water channel is required to convey discharge from attenuation basin P2_IB1, which has a discharge restricted to a maximum rate of 89 l/s. Again, a 250 mm deep channel would be sufficient to convey this small flow, but further dimensions are to be provided as part of the detailed design.

Another attenuation basin is located in subcatchment R3, which discharges into infiltration trench IT2 at a maximum rate of 62 l/s. This attenuation basin is partially sited on the side of the extraction boundary, and so it is anticipated that water can also infiltrate to ground through the face of the pond that is not comprised of inert fill material.

A summary of the drainage mechanisms for each restoration subcatchment is provided in Table 3.1, with a summary of dimensions of infiltration trenches and basins (both for attenuation and for infiltration) shown in Table 3.2 and Table 3.3 respectively. It is noted that attenuation basin P2_IB1 is located in an area proposed to be restored to a groundwater fed wetland area. The volumes shown in the calculations below demonstrate the volume required above the invert of the flow control unit (at a level of 19.3 mAOD), and uses a conservative assumption that the basin has a water level of 19.3 mAOD at the start of a flood event. Water levels in the wetland area would return to 19.3 mAOD via the discharge control system to infiltration basin IB1. Water levels are likely to fall to the groundwater level of 18 mAOD through gradual infiltration and evapotranspiration, however as a conservative measure, this has not been factored into the storage calculations. The infiltration trenches will be relatively shallow and will span undulating ground levels. Therefore, they will require check dams in order to withhold the stated capacity along their length.

Table 3.1 Subcatchment summary

Sub-catchment	Area (ha)	Drainage Element(s)	Destination
R1	1.76	Attenuation Basin – P1_IT1, discharging to: Infiltration Trench – IT1	East
R2	14.81	Attenuation Basin – P2_IB1, discharging to: Infiltration Basin – IB1	East
R3	9.05	Attenuation Basin – P3_IT2 (partial infiltration potential), discharging to: Infiltration Trench – IT2	East
R4	3.91	Infiltration Trench – IT3	East
R5	6.13	Infiltration Trench – IT4	West
R6	2.84	Infiltration Basin – IB2	West
R7	2.25	Infiltration Basin – IB3	West

Table 3.2 Infiltration trench dimensions

Reference	Invert level (mAOD)	Maximum Groundwater level (mAOD)	Ground level (mAOD)	Depth (m)	Width (m)	Length (m)	Infiltration rate (m/hr)
IT1	21.0	~20	21.7	0.7	3.8	130	0.33
IT2	15.7	14.6	18.1	1.1	4	180	0.45
IT3	15.4	13.8	16.5	1.1	2.5	350	0.57
IT4	17.9	16.8	20.3	1.4	5	530	0.10

Note: all infiltration trenches assumed to be gravel-filled with porosity of 30%

Table 3.3 Infiltration and attenuation basin dimensions

Reference	Type	Base level (mAOD)	Max ground-water level (mAOD)	Ground level (mAOD)	Depth (m)	Footprint (m^2)	Volume (m^3)	Infiltration rate (m/hr)	Discharge rate (l/s)
P1_IT1	Attenuation	21.0	n/a	22.0	1	350	261	n/a	35
P2_IB1	Attenuation	19.3	n/a	19.8	0.5	32234	12220	n/a	85
IB1	Infiltration	19	~18	19.3	0.3	4220	1235	0.14	n/a
P3_IT2	Attenuation / Infiltration	15.7	n/a	17.1	1.4	2500	2945	0.45	62
IB2	Infiltration	18.32	17.32	19	0.68	967	600	0.24	n/a
IB3	Infiltration	18.32	17.32	19	0.68	910	548	0.24	n/a

Note: all basins assumed to have side slopes of 1:3 gradient.

4 Updated Restoration Flow Exceedance Routes

As can be demonstrated by the MicroDrainage calculations (Appendix B), conservative assumptions have been made throughout the design process, such as assuming that the inert fill material does not have any infiltration potential, and the use of a factor of safety of 2 when applying infiltration rates. In the event that the capacity of the SuDS features described here are exceeded, exceedance flows would be eastwards and westward, radially from the Site, in line with the current surface water flood risk mapping for the site. As outlined in the FRA (Stantec, 2021), due to the existing site contours, 53% of the land cover drains to the River Hamble to the east, while 47% of the land drains to the west, to Southampton Water. Under the restoration topography, sub-catchments R1 to R4 drain to the east, which have a 66% proportion of the site land cover, whereas sub-catchments R5 to R7 drain to the west, which have a 34% proportion of the site land cover.

The proposed updated restoration flow exceedance routes are illustrated in Appendix C. While these flow routes are the same as in the baseline scenario, changes in topography mean that a larger area will drain to the eastern catchment compared to the western catchment. As surface water drainage will be along known surface water drainage routes, avoiding properties downslope of the site, and there is no surface water discharge contribution from the site in events up to the design 1 in 100 year + Climate Change event due to the infiltration features, it is anticipated that the change in topography in the restoration phase does not represent an increase in surface water flood risk when compared to baseline surface water flood risk.

5 Conclusions

CEMEX is proposing to extract sand and gravel from the former Hamble Airfield Site near Southampton, Hampshire. The Site would be progressively worked and restored back to levels comparable with the current topography.

Following further work to demonstrate the restoration phase groundwater levels and to measure the infiltration rate at several locations on the perimeter of the site, the restoration plan for surface water has been updated to account for groundwater levels, observed infiltration rates and a slightly increased Climate Change allowance.

Dimensions of the proposed restoration phase SUDS features have been provided and calculations have been provided to demonstrate the surface water features' effectiveness for a 6 hour 1 in 100 year + 45% Climate Change design storm event. An exceedance flow diagram has also been updated to demonstrate the flow pathways for storm events that exceed the design storm event, demonstrating that it is anticipated that exceedance flow continues to follow the route of existing surface water, by comparing the exceedance flow routes with the Environment Agency surface water flood maps.

6 References

CIRIA, 2015. The SuDS Manual. Reference: Report C753

Stantec, 2021. Hamble Airfield Quarry – Flood Risk Assessment. November 2021

Stantec, 2022a. Proposed extraction of sand and gravel at Hamble Airfield: further response to consultee queries. Our ref: 331201108pbond002. 23 June 2022.

Stantec, 2022b. Hamble Quarry: Infiltration Testing. Reference: 331201108R6. October 2022.

UK Government, 2022. Flood risk assessments: climate change allowances. Accessed at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Stantec, 2023. Hamble Quarry: Groundwater Flow. Reference: 331201108TN2. May 2023.

Appendices

Appendix A

Updated Drainage Layout

N

Badnam Copse

Hamble Lane

Essex Manor

Hamble

Inkerman Building

Victoria House

Playing Field

Hospital Cemetery

West Wood

College Copse

Play Space

Mount Pleasant Recreation Ground

Other Sports Facility

Bowling Green

R1

R2

R3

R4

R5

R6

R7

Name: IT1_1
Avg Inf rate: 1.38 m/hr

January GW levels within 0.3m of ground level, so infiltration not possible in this location

Name: IT1_2
Avg Inf rate: 0.65 m/hr

Name: IT1
Length: 130 m
Width: 3.8 m
Min Depth: 0.7 m
Max Level: 21.7 mAOD
Infiltration Rate: 0.33 m/hr
GW Level: 20 mAOD

Name: P1_IT1
Max Level: 22 mAOD
Footprint: 350 m²
Max Volume: 261 m³
Depth: 1 m
Discharge Rate: 35 l/s
Discharge level: 21 mAOD

Name: IB3
Footprint: 874 m²
Max Volume: 548 m³
Depth: 0.68 m
Invert Level: 19 mAOD

Name: IB2
Footprint: 980 m²
Max Volume: 600 m³
Depth: 0.68 m
Invert Level: 19 mAOD

Name: IT7_1
Avg Inf rate: 0.24 m/hr

Name: P2_IB1
Max Level: 20.3 mAOD
Footprint: 9746 m²
Max Volume: 9231 m³
Depth: 1 m
Discharge Rate: 89 l/s
Discharge level: 19.3 mAOD

Name: IT2_1
Avg Inf rate: 0.02 m/hr

Name: IB1
Footprint: 4220 m²
Max Volume: 1235 m³
Depth: 0.3 m
Invert Level: 19 mAOD

Name: IT2_2
Avg Inf rate: n/a

Name: IT3_1
Avg Inf rate: 0.14 m/hr

Name: P3_IT2
Max Level: 17.1 mAOD
Footprint: 2500 m²
Max Volume: 2945 m³
Depth: 1.4 m
Discharge Rate: 62 l/s
Discharge level: 15.7 mAOD

Name: IT3_2
Avg Inf rate: 0.01 m/hr

Name: IT4_1
Avg Inf rate: 0.02 m/hr

Name: IT2
Length: 180 m
Width: 4 m
Min Depth: 1.1 m
Max Level: 18.1 mAOD
Infiltration Rate: 0.45 m/hr
GW Level: 14.64 mAOD

Name: IT4_2
Avg Inf rate: 0.87 m/hr

Name: IT3
Length: 350 m
Width: 2.5 m
Min Depth: 1.1 m
Max Level: 16.5 mAOD
Infiltration Rate: 0.57 m/hr
GW Level: 13.84 mAOD

Name: IT5_1
Avg Inf rate: 0.41 m/hr

Name: IT5_2
Avg Inf rate: 1.50 m/hr

Name: IT5_3
Avg Inf rate: 0.35 m/hr

Name: IT5_4
Avg Inf rate: 0.03 m/hr

Name: IT6_1
Avg Inf rate: 0.03 m/hr

Name: IT6_2
Avg Inf rate: 0.29 m/hr

Name: IT6_3
Avg Inf rate: 0.07 m/hr

Name: IT6_4
Avg Inf rate: 0.02 m/hr

Name:
Length: 530 m
Width: 5 m
Min Depth: 1.4 m
Max Level: 20.3 mAOD
Infiltration Rate: 0.1 m/hr
GW Level: 16.8 mAOD

Linear Drainage Feature
- Drain
- Infiltration Trench
- Restored Surface Water Catchment Boundaries

Esso Pipeline
- Esso Pipeline
- 20m Easement
- MP gas pipe
- Infiltration Test Location
- Infiltration Basin
- Attenuation Basin (no infiltration)
- Site Boundary

Stantec

Client: CEMEX

HAMBLE QUARRY
Updated Restored Drainage Layout

0 250 500 m

1:5,000 @ A3 | Date: 03/11/2023

Drawn: RP | Checked:

Appendix A | Rev: B

Document Path: C:\Users\rpickersgill\Documents\ArcGIS\Projects\Hamble_2\Hamble_2.aprx

Appendix B

MicroDrainage Calculations

01 – Attenuation Basin 1 (P1_IT1)

02 – Infiltration Trench IT1

03 – Attenuation Basin 2 (P2_IB1)

04 – Infiltration Basin IB1

05 – Attenuation Basin 3 (P3_IT2)

06 – Infiltration Trench IT2

07 – Infiltration Trench IT3

08 – Infiltration Trench IT4

09 – Infiltration Basin IB2

10 – Infiltration Basin IB3

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 135 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	18.414	0.094	25.4	67.7	O K
30 min Summer	18.465	0.145	26.4	105.0	O K
60 min Summer	18.517	0.197	27.5	144.2	O K
120 min Summer	18.617	0.297	29.5	222.4	O K
180 min Summer	18.692	0.372	31.1	282.5	O K
240 min Summer	18.752	0.432	32.3	332.0	Flood Risk
360 min Summer	18.842	0.522	34.2	408.0	Flood Risk
480 min Summer	18.896	0.576	35.3	454.7	Flood Risk
600 min Summer	18.929	0.609	36.0	484.1	Flood Risk
720 min Summer	18.951	0.631	36.5	503.1	Flood Risk
960 min Summer	18.925	0.605	36.0	480.5	Flood Risk
1440 min Summer	18.875	0.555	34.9	436.7	Flood Risk
2160 min Summer	18.823	0.503	33.8	391.8	Flood Risk
2880 min Summer	18.761	0.441	32.5	338.8	Flood Risk
4320 min Summer	18.703	0.383	31.3	291.6	Flood Risk
5760 min Summer	18.625	0.305	29.7	228.7	O K
7200 min Summer	18.577	0.257	28.7	190.4	O K
8640 min Summer	18.533	0.213	27.8	156.7	O K
15 min Winter	18.400	0.080	25.1	57.3	O K
30 min Winter	18.439	0.119	25.9	85.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	158
30 min Summer	92.702	0.0	193
60 min Summer	57.398	0.0	226
120 min Summer	35.539	0.0	282
180 min Summer	26.848	0.0	334
240 min Summer	22.004	0.0	382
360 min Summer	16.624	0.0	474
480 min Summer	13.624	0.0	566
600 min Summer	11.676	0.0	646
720 min Summer	10.293	0.0	718
960 min Summer	8.164	0.0	844
1440 min Summer	5.889	0.0	1104
2160 min Summer	4.248	0.0	1504
2880 min Summer	3.369	0.0	1904
4320 min Summer	2.508	0.0	2708
5760 min Summer	2.035	0.0	3496
7200 min Summer	1.730	0.0	4272
8640 min Summer	1.515	0.0	5040
15 min Winter	149.721	0.0	147
30 min Winter	92.702	0.0	183

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	18.493	0.173	27.0	126.0	O K
120 min Winter	18.627	0.307	29.7	229.8	O K
180 min Winter	18.719	0.399	31.6	304.3	Flood Risk
240 min Winter	18.797	0.477	33.2	369.2	Flood Risk
360 min Winter	18.921	0.601	35.9	476.5	Flood Risk
480 min Winter	18.964	0.644	36.8	515.0	Flood Risk
600 min Winter	18.986	0.666	37.2	534.9	Flood Risk
720 min Winter	18.996	0.676	37.5	544.4	Flood Risk
960 min Winter	18.957	0.637	36.6	508.6	Flood Risk
1440 min Winter	18.883	0.563	35.1	443.5	Flood Risk
2160 min Winter	18.771	0.451	32.7	347.3	Flood Risk
2880 min Winter	18.664	0.344	30.5	259.5	O K
4320 min Winter	18.540	0.220	27.9	162.3	O K
5760 min Winter	18.427	0.107	25.6	77.0	O K
7200 min Winter	18.370	0.050	24.4	35.4	O K
8640 min Winter	18.366	0.046	22.6	32.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	57.398	0.0	220
120 min Winter	35.539	0.0	282
180 min Winter	26.848	0.0	336
240 min Winter	22.004	0.0	384
360 min Winter	16.624	0.0	474
480 min Winter	13.624	0.0	564
600 min Winter	11.676	0.0	646
720 min Winter	10.293	0.0	724
960 min Winter	8.164	0.0	860
1440 min Winter	5.889	0.0	1148
2160 min Winter	4.248	0.0	1580
2880 min Winter	3.369	0.0	1996
4320 min Winter	2.508	0.0	2820
5760 min Winter	2.035	0.0	3592
7200 min Winter	1.730	0.0	4192
8640 min Winter	1.515	0.0	4960

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Model Details

Storage is Online Cover Level (m) 19.000

Infiltration Basin Structure

Invert Level (m) 18.320 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.24000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.24000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	705.0	0.680	910.1

Cascade Summary of Results for Restored - IT1_v5.SRCX

Upstream Structures	Outflow To	Overflow To
Restored - Pond1_to_IT1.SRCX	(None)	(None)

Half Drain Time : 38 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	21.073	0.073	23.5	10.9	O K
30 min Summer	21.156	0.156	24.6	23.1	O K
60 min Summer	21.254	0.254	25.8	37.7	O K
120 min Summer	21.458	0.458	28.3	67.9	Flood Risk
180 min Summer	21.584	0.584	29.8	86.6	Flood Risk
240 min Summer	21.663	0.663	30.8	98.2	Flood Risk
360 min Summer	21.706	0.706	31.2	109.9	FLOOD
480 min Summer	21.710	0.710	31.2	114.0	FLOOD
600 min Summer	21.711	0.711	31.2	114.5	FLOOD
720 min Summer	21.710	0.710	31.2	113.5	FLOOD
960 min Summer	21.722	0.722	31.2	126.1	FLOOD
1440 min Summer	21.719	0.719	31.2	122.8	FLOOD
2160 min Summer	21.691	0.691	31.1	102.4	Flood Risk
2880 min Summer	21.498	0.498	28.7	73.8	Flood Risk
4320 min Summer	21.314	0.314	26.5	46.5	O K
5760 min Summer	21.140	0.140	24.4	20.7	O K
7200 min Summer	21.052	0.052	23.3	7.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	143
30 min Summer	92.702	0.0	175
60 min Summer	57.398	0.0	210
120 min Summer	35.539	0.0	284
180 min Summer	26.848	0.0	356
240 min Summer	22.004	0.0	426
360 min Summer	16.624	6.1	552
480 min Summer	13.624	10.3	662
600 min Summer	11.676	10.7	768
720 min Summer	10.293	9.8	870
960 min Summer	8.164	22.3	956
1440 min Summer	5.889	19.1	1138
2160 min Summer	4.248	0.0	1448
2880 min Summer	3.369	0.0	1804
4320 min Summer	2.508	0.0	2560
5760 min Summer	2.035	0.0	3288
7200 min Summer	1.730	0.0	3944

Cascade Summary of Results for Restored - IT1_v5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	21.047	0.047	22.0	7.0	O K
15 min Winter	21.054	0.054	23.3	8.0	O K
30 min Winter	21.106	0.106	23.9	15.7	O K
60 min Winter	21.196	0.196	25.0	29.1	O K
120 min Winter	21.467	0.467	28.4	69.2	Flood Risk
180 min Winter	21.615	0.615	30.2	91.2	Flood Risk
240 min Winter	21.699	0.699	31.2	103.6	Flood Risk
360 min Winter	21.703	0.703	31.2	106.8	FLOOD
480 min Winter	21.706	0.706	31.2	109.3	FLOOD
600 min Winter	21.708	0.708	31.2	112.2	FLOOD
720 min Winter	21.711	0.711	31.2	115.1	FLOOD
960 min Winter	21.731	0.731	31.2	134.6	FLOOD
1440 min Winter	21.711	0.711	31.2	115.0	FLOOD
2160 min Winter	21.445	0.445	28.1	65.9	Flood Risk
2880 min Winter	21.203	0.203	25.1	30.0	O K
4320 min Winter	21.048	0.048	22.2	7.1	O K
5760 min Winter	21.042	0.042	19.4	6.2	O K
7200 min Winter	21.038	0.038	17.8	5.7	O K
8640 min Winter	21.036	0.036	16.6	5.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
8640 min Summer	1.515	0.0	4616
15 min Winter	149.721	0.0	134
30 min Winter	92.702	0.0	163
60 min Winter	57.398	0.0	200
120 min Winter	35.539	0.0	282
180 min Winter	26.848	0.0	364
240 min Winter	22.004	0.0	444
360 min Winter	16.624	3.0	602
480 min Winter	13.624	5.5	704
600 min Winter	11.676	8.5	798
720 min Winter	10.293	11.4	884
960 min Winter	8.164	30.9	958
1440 min Winter	5.889	11.2	1118
2160 min Winter	4.248	0.0	1472
2880 min Winter	3.369	0.0	1856
4320 min Winter	2.508	0.0	2548
5760 min Winter	2.035	0.0	3296
7200 min Winter	1.730	0.0	4256
8640 min Winter	1.515	0.0	5032

Cascade Rainfall Details for Restored - IT1_v5.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Cascade Model Details for Restored - IT1_v5.SRCX

Storage is Online Cover Level (m) 21.700

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.33000	Trench Width (m)	3.8
Infiltration Coefficient Side (m/hr)	0.33000	Trench Length (m)	130.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	21.000	Cap Infiltration Depth (m)	0.000

Cascade Summary of Results for Restored - Pond2_to_IB1_above_wetland.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Restored - IB1_v5.SRCX	(None)

Critical storm may not be identified, please run longer storm durations.

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	19.412	0.112	13.3	2115.9	O K
30 min Summer	19.433	0.133	18.2	2534.0	O K
60 min Summer	19.451	0.151	23.2	2928.7	O K
120 min Summer	19.484	0.184	33.0	3656.3	O K
180 min Summer	19.509	0.209	41.0	4212.3	Flood Risk
240 min Summer	19.529	0.229	48.0	4686.6	Flood Risk
360 min Summer	19.563	0.263	59.7	5492.0	Flood Risk
480 min Summer	19.589	0.289	68.8	6142.2	Flood Risk
600 min Summer	19.610	0.310	76.1	6702.6	Flood Risk
720 min Summer	19.629	0.329	82.0	7197.5	Flood Risk
960 min Summer	19.645	0.345	85.9	7620.9	Flood Risk
1440 min Summer	19.665	0.365	86.7	8182.5	Flood Risk
2160 min Summer	19.688	0.388	87.5	8813.1	Flood Risk
2880 min Summer	19.694	0.394	87.7	8998.1	Flood Risk
4320 min Summer	19.724	0.424	88.4	9875.1	Flood Risk
5760 min Summer	19.733	0.433	88.5	10139.6	Flood Risk
7200 min Summer	19.747	0.447	88.7	10547.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	974.4	753
30 min Summer	92.702	0.0	1308.8	566
60 min Summer	57.398	0.0	2962.3	442
120 min Summer	35.539	0.0	3948.7	462
180 min Summer	26.848	0.0	4714.8	496
240 min Summer	22.004	0.0	5371.7	534
360 min Summer	16.624	0.0	6483.9	618
480 min Summer	13.624	0.0	7366.1	710
600 min Summer	11.676	0.0	8108.6	804
720 min Summer	10.293	0.0	8737.9	906
960 min Summer	8.164	0.0	9158.8	1118
1440 min Summer	5.889	0.0	9358.5	1562
2160 min Summer	4.248	0.0	16192.3	2248
2880 min Summer	3.369	0.0	17123.6	2836
4320 min Summer	2.508	0.0	18065.0	3664
5760 min Summer	2.035	0.0	26592.4	4456
7200 min Summer	1.730	0.0	29094.0	5304

Cascade Summary of Results for Restored - Pond2_to_IB1_above_wetland.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Summer	19.756	0.456	88.8	10825.5	Flood Risk
15 min Winter	19.410	0.110	12.8	2060.6	O K
30 min Winter	19.426	0.126	16.6	2406.1	O K
60 min Winter	19.446	0.146	21.7	2809.6	O K
120 min Winter	19.489	0.189	34.4	3750.5	O K
180 min Winter	19.518	0.218	44.2	4422.6	Flood Risk
240 min Winter	19.543	0.243	52.8	5023.4	Flood Risk
360 min Winter	19.587	0.287	68.2	6101.6	Flood Risk
480 min Winter	19.612	0.312	76.7	6748.7	Flood Risk
600 min Winter	19.633	0.333	83.2	7305.8	Flood Risk
720 min Winter	19.652	0.352	86.2	7807.9	Flood Risk
960 min Winter	19.670	0.370	86.9	8316.4	Flood Risk
1440 min Winter	19.696	0.396	87.7	9050.0	Flood Risk
2160 min Winter	19.714	0.414	88.2	9564.3	Flood Risk
2880 min Winter	19.715	0.415	88.2	9589.5	Flood Risk
4320 min Winter	19.726	0.426	88.4	9926.7	Flood Risk
5760 min Winter	19.718	0.418	88.3	9696.3	Flood Risk
7200 min Winter	19.713	0.413	88.2	9554.3	Flood Risk
8640 min Winter	19.705	0.405	88.0	9299.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.515	0.0	30959.3	6152
15 min Winter	149.721	0.0	918.1	976
30 min Winter	92.702	0.0	1205.7	809
60 min Winter	57.398	0.0	2891.9	640
120 min Winter	35.539	0.0	4203.6	470
180 min Winter	26.848	0.0	5139.5	498
240 min Winter	22.004	0.0	5981.6	534
360 min Winter	16.624	0.0	7488.1	612
480 min Winter	13.624	0.0	8351.7	700
600 min Winter	11.676	0.0	9066.4	794
720 min Winter	10.293	0.0	9660.3	898
960 min Winter	8.164	0.0	10072.3	1112
1440 min Winter	5.889	0.0	10216.3	1548
2160 min Winter	4.248	0.0	17426.1	2204
2880 min Winter	3.369	0.0	18173.5	2812
4320 min Winter	2.508	0.0	18857.3	3568
5760 min Winter	2.035	0.0	26607.1	4440
7200 min Winter	1.730	0.0	28633.6	5336
8640 min Winter	1.515	0.0	30128.9	6208

Cascade Rainfall Details for Restored - Pond2_to_IB1_above_wetland.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Cascade Model Details for Restored - Pond2_to_IB1_above_wetland.SRCX

Storage is Online Cover Level (m) 19.800

Tank or Pond Structure

Invert Level (m) 19.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	17400.0	0.500	32234.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0383-8900-0600-8900
Design Head (m)	0.600
Design Flow (l/s)	89.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	383
Invert Level (m)	19.300
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	89.0
Flush-Flo™	0.482	88.9
Kick-Flo®	0.580	87.6
Mean Flow over Head Range	-	57.2

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	10.7	1.200	124.6	3.000	195.0	7.000	292.0
0.200	38.1	1.400	134.3	3.500	210.3	7.500	302.5
0.300	72.7	1.600	143.4	4.000	224.5	8.000	312.7
0.400	87.8	1.800	151.9	4.500	237.9	8.500	322.5
0.500	88.8	2.000	159.9	5.000	250.5	9.000	332.1
0.600	89.0	2.200	167.5	5.500	262.5	9.500	341.4
0.800	102.3	2.400	174.8	6.000	274.0		
1.000	114.0	2.600	181.8	6.500	281.0		

Cascade Summary of Results for Restored - IB1_v5.SRCX

Upstream Structures	Outflow To	Overflow To
Restored - Pond2_to_IB1_above_wetland.SRCX	(None)	(None)

Half Drain Time : 117 minutes.

Critical storm may not be identified, please run longer storm durations.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	19.009	0.009	13.8	34.2	Flood Risk
30 min Summer	19.012	0.012	18.5	46.2	Flood Risk
60 min Summer	19.015	0.015	23.3	58.3	Flood Risk
120 min Summer	19.021	0.021	32.8	83.1	Flood Risk
180 min Summer	19.026	0.026	40.7	103.1	Flood Risk
240 min Summer	19.030	0.030	47.9	120.8	Flood Risk
360 min Summer	19.037	0.037	59.0	150.8	Flood Risk
480 min Summer	19.043	0.043	68.6	173.3	Flood Risk
600 min Summer	19.048	0.048	75.8	192.0	Flood Risk
720 min Summer	19.056	0.056	79.6	226.6	Flood Risk
960 min Summer	19.083	0.083	80.3	335.4	Flood Risk
1440 min Summer	19.120	0.120	81.3	487.1	Flood Risk
2160 min Summer	19.164	0.164	82.5	666.6	Flood Risk
2880 min Summer	19.188	0.188	83.2	766.9	Flood Risk
4320 min Summer	19.240	0.240	84.6	983.0	Flood Risk
5760 min Summer	19.260	0.260	85.2	1067.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	762
30 min Summer	92.702	0.0	525
60 min Summer	57.398	0.0	486
120 min Summer	35.539	0.0	548
180 min Summer	26.848	0.0	562
240 min Summer	22.004	0.0	582
360 min Summer	16.624	0.0	696
480 min Summer	13.624	0.0	740
600 min Summer	11.676	0.0	856
720 min Summer	10.293	0.0	1082
960 min Summer	8.164	0.0	1466
1440 min Summer	5.889	0.0	2088
2160 min Summer	4.248	0.0	2928
2880 min Summer	3.369	0.0	3620
4320 min Summer	2.508	0.0	5076
5760 min Summer	2.035	0.0	6256

Cascade Summary of Results for Restored - IB1_v5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
7200 min Summer	19.277	0.277	85.6	1139.0	Flood Risk
8640 min Summer	19.286	0.286	85.9	1177.0	Flood Risk
15 min Winter	19.008	0.008	13.0	32.2	Flood Risk
30 min Winter	19.011	0.011	17.0	42.2	Flood Risk
60 min Winter	19.014	0.014	21.7	54.3	Flood Risk
120 min Winter	19.022	0.022	34.4	86.5	Flood Risk
180 min Winter	19.028	0.028	43.9	110.9	Flood Risk
240 min Winter	19.033	0.033	52.7	133.0	Flood Risk
360 min Winter	19.043	0.043	67.8	171.6	Flood Risk
480 min Winter	19.048	0.048	76.6	193.6	Flood Risk
600 min Winter	19.061	0.061	79.7	246.6	Flood Risk
720 min Winter	19.091	0.091	80.5	369.1	Flood Risk
960 min Winter	19.118	0.118	81.3	480.2	Flood Risk
1440 min Winter	19.156	0.156	82.3	636.3	Flood Risk
2160 min Winter	19.188	0.188	83.2	766.8	Flood Risk
2880 min Winter	19.203	0.203	83.6	830.2	Flood Risk
4320 min Winter	19.236	0.236	84.5	964.8	Flood Risk
5760 min Winter	19.241	0.241	84.6	985.4	Flood Risk
7200 min Winter	19.242	0.242	84.6	990.3	Flood Risk
8640 min Winter	19.236	0.236	84.5	967.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
7200 min Summer	1.730	0.0	7424
8640 min Summer	1.515	0.0	8368
15 min Winter	149.721	0.0	978
30 min Winter	92.702	0.0	810
60 min Winter	57.398	0.0	650
120 min Winter	35.539	0.0	520
180 min Winter	26.848	0.0	546
240 min Winter	22.004	0.0	570
360 min Winter	16.624	0.0	666
480 min Winter	13.624	0.0	736
600 min Winter	11.676	0.0	1024
720 min Winter	10.293	0.0	1332
960 min Winter	8.164	0.0	1724
1440 min Winter	5.889	0.0	2372
2160 min Winter	4.248	0.0	3128
2880 min Winter	3.369	0.0	3736
4320 min Winter	2.508	0.0	4996
5760 min Winter	2.035	0.0	6000
7200 min Winter	1.730	0.0	6912
8640 min Winter	1.515	0.0	7632

Cascade Rainfall Details for Restored - IB1_v5.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Cascade Model Details for Restored - IB1_v5.SRCX

Storage is Online Cover Level (m) 19.300

Infiltration Basin Structure

Invert Level (m) 19.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.14000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.14000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4015.0	0.300	4219.7

Cascade Summary of Results for Restored - Pond3_to_IT2.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Restored - IT2_v5.SRCX	Restored - IT2_v5.SRCX

Half Drain Time : 334 minutes.

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
15 min Summer	15.994	0.294	3.4	55.7	59.2	531.1	O K
30 min Summer	16.065	0.365	4.3	60.7	64.9	666.5	O K
60 min Summer	16.145	0.445	5.2	61.7	66.9	821.1	O K
120 min Summer	16.309	0.609	7.1	62.0	68.8	1148.6	O K
180 min Summer	16.439	0.739	8.6	62.0	69.2	1419.9	O K
240 min Summer	16.548	0.848	9.9	62.0	69.2	1655.1	O K
360 min Summer	16.729	1.029	12.0	62.0	69.2	2058.4	O K
480 min Summer	16.850	1.150	13.4	62.0	69.8	2338.5	Flood Risk
600 min Summer	16.936	1.236	14.4	62.0	72.8	2543.3	Flood Risk
720 min Summer	16.999	1.299	15.1	62.0	74.9	2695.8	Flood Risk
960 min Summer	16.998	1.298	15.1	62.0	74.9	2692.3	Flood Risk
1440 min Summer	16.958	1.258	14.7	62.0	73.5	2596.8	Flood Risk
2160 min Summer	16.932	1.232	14.4	62.0	72.6	2533.6	Flood Risk
2880 min Summer	16.882	1.182	13.8	62.0	70.9	2415.3	Flood Risk
4320 min Summer	16.881	1.181	13.8	62.0	70.8	2411.6	Flood Risk
5760 min Summer	16.808	1.108	12.9	62.0	69.2	2241.1	Flood Risk
7200 min Summer	16.767	1.067	12.4	62.0	69.2	2146.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	1544.3	202
30 min Summer	92.702	0.0	1898.3	225
60 min Summer	57.398	0.0	2663.3	264
120 min Summer	35.539	0.0	3360.3	334
180 min Summer	26.848	0.0	3898.2	388
240 min Summer	22.004	0.0	4360.5	438
360 min Summer	16.624	0.0	5152.6	536
480 min Summer	13.624	0.0	5799.6	620
600 min Summer	11.676	0.0	6364.9	714
720 min Summer	10.293	0.0	6869.1	816
960 min Summer	8.164	0.0	7326.2	1010
1440 min Summer	5.889	0.0	7940.1	1298
2160 min Summer	4.248	0.0	10344.7	1712
2880 min Summer	3.369	0.0	11156.4	2136
4320 min Summer	2.508	0.0	12877.7	3004
5760 min Summer	2.035	0.0	15505.3	3872
7200 min Summer	1.730	0.0	17104.1	4736

Cascade Summary of Results for Restored - Pond3_to_IT2.SRCX

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
8640 min Summer	16.701	1.001	11.7	62.0	69.2	1994.7	O K
15 min Winter	15.975	0.275	3.2	51.5	54.7	495.1	O K
30 min Winter	16.030	0.330	3.8	59.8	63.7	597.9	O K
60 min Winter	16.111	0.411	4.8	61.4	66.2	755.1	O K
120 min Winter	16.326	0.626	7.3	62.0	68.8	1185.1	O K
180 min Winter	16.486	0.786	9.2	62.0	69.2	1519.9	O K
240 min Winter	16.627	0.927	10.8	62.0	69.2	1828.5	O K
360 min Winter	16.863	1.163	13.5	62.0	70.2	2368.6	Flood Risk
480 min Winter	16.965	1.265	14.7	62.0	73.7	2612.7	Flood Risk
600 min Winter	17.038	1.338	15.6	62.0	76.2	2790.3	Flood Risk
720 min Winter	17.090	1.390	16.2	62.0	78.0	2921.1	Flood Risk
960 min Winter	17.084	1.384	16.1	62.0	77.8	2906.2	Flood Risk
1440 min Winter	17.035	1.335	15.6	62.0	76.1	2784.6	Flood Risk
2160 min Winter	16.943	1.243	14.5	62.0	73.0	2559.9	Flood Risk
2880 min Winter	16.827	1.127	13.1	62.0	69.2	2284.1	Flood Risk
4320 min Winter	16.649	0.949	11.1	62.0	69.2	1877.0	O K
5760 min Winter	16.410	0.710	8.3	62.0	69.1	1358.6	O K
7200 min Winter	16.259	0.559	6.5	62.0	68.4	1048.6	O K
8640 min Winter	16.144	0.444	5.2	61.7	66.9	819.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.515	0.0	18467.3	5568
15 min Winter	149.721	0.0	1509.0	203
30 min Winter	92.702	0.0	1818.6	217
60 min Winter	57.398	0.0	2641.6	254
120 min Winter	35.539	0.0	3562.4	336
180 min Winter	26.848	0.0	4213.0	392
240 min Winter	22.004	0.0	4798.5	444
360 min Winter	16.624	0.0	5856.5	534
480 min Winter	13.624	0.0	6493.4	620
600 min Winter	11.676	0.0	7045.5	710
720 min Winter	10.293	0.0	7537.1	810
960 min Winter	8.164	0.0	8029.2	1004
1440 min Winter	5.889	0.0	8739.7	1326
2160 min Winter	4.248	0.0	11104.7	1776
2880 min Winter	3.369	0.0	11806.4	2252
4320 min Winter	2.508	0.0	13241.8	3160
5760 min Winter	2.035	0.0	15518.1	3928
7200 min Winter	1.730	0.0	16820.6	4696
8640 min Winter	1.515	0.0	17914.6	5424

Cascade Rainfall Details for Restored - Pond3_to_IT2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Cascade Model Details for Restored - Pond3_to_IT2.SRCX

Storage is Online Cover Level (m) 17.100

Cellular Storage Structure

Invert Level (m) 15.700 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.45000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1731.0	0.0	1.400	2500.0	261.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0318-6200-1400-6200
Design Head (m)	1.400
Design Flow (l/s)	62.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	318
Invert Level (m)	15.700
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	62.0
Flush-Flo™	0.515	62.0
Kick-Flo®	1.030	53.4
Mean Flow over Head Range	-	51.5

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	9.5	1.200	57.5	3.000	89.7	7.000	135.5
0.200	32.5	1.400	62.0	3.500	96.6	7.500	140.2
0.300	56.9	1.600	66.1	4.000	103.1	8.000	144.7
0.400	61.2	1.800	70.0	4.500	109.2	8.500	149.0
0.500	62.0	2.000	73.6	5.000	115.0	9.000	153.2
0.600	61.7	2.200	77.1	5.500	120.5	9.500	157.4
0.800	59.8	2.400	80.5	6.000	125.7		
1.000	54.9	2.600	83.6	6.500	130.7		

Cascade Summary of Results for Restored - IT2_v5.SRCX

Upstream Structures	Outflow To	Overflow To
Restored - Pond3_to_IT2.SRCX	(None)	(None)

Half Drain Time : 25 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	16.058	0.358	50.3	57.2	O K
30 min Summer	16.315	0.615	56.2	111.8	O K
60 min Summer	16.418	0.718	58.5	133.8	O K
120 min Summer	16.499	0.799	60.3	150.9	O K
180 min Summer	16.520	0.820	60.8	155.5	Flood Risk
240 min Summer	16.526	0.826	60.9	156.6	Flood Risk
360 min Summer	16.521	0.821	60.8	155.5	Flood Risk
480 min Summer	16.522	0.822	60.8	155.7	Flood Risk
600 min Summer	16.524	0.824	60.9	156.1	Flood Risk
720 min Summer	16.525	0.825	60.9	156.4	Flood Risk
960 min Summer	16.525	0.825	60.9	156.5	Flood Risk
1440 min Summer	16.526	0.826	60.9	156.6	Flood Risk
2160 min Summer	16.525	0.825	60.9	156.5	Flood Risk
2880 min Summer	16.529	0.829	61.0	157.4	Flood Risk
4320 min Summer	16.550	0.850	61.5	161.7	Flood Risk
5760 min Summer	16.551	0.851	61.5	162.0	Flood Risk
7200 min Summer	16.552	0.852	61.5	162.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	276
30 min Summer	92.702	0.0	346
60 min Summer	57.398	0.0	428
120 min Summer	35.539	0.0	564
180 min Summer	26.848	0.0	690
240 min Summer	22.004	0.0	816
360 min Summer	16.624	0.0	1078
480 min Summer	13.624	0.0	1292
600 min Summer	11.676	0.0	1480
720 min Summer	10.293	0.0	1650
960 min Summer	8.164	0.0	1876
1440 min Summer	5.889	0.0	2282
2160 min Summer	4.248	0.0	2876
2880 min Summer	3.369	0.0	3400
4320 min Summer	2.508	0.0	4460
5760 min Summer	2.035	0.0	5208
7200 min Summer	1.730	0.0	6008

Cascade Summary of Results for Restored - IT2_v5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
8640 min Summer	16.554	0.854	61.6	162.6	Flood Risk
15 min Winter	15.960	0.260	48.1	36.4	O K
30 min Winter	16.228	0.528	54.2	93.4	O K
60 min Winter	16.387	0.687	57.8	127.2	O K
120 min Winter	16.505	0.805	60.5	152.3	Flood Risk
180 min Winter	16.525	0.825	60.9	156.5	Flood Risk
240 min Winter	16.526	0.826	60.9	156.7	Flood Risk
360 min Winter	16.523	0.823	60.9	156.0	Flood Risk
480 min Winter	16.525	0.825	60.9	156.4	Flood Risk
600 min Winter	16.526	0.826	60.9	156.6	Flood Risk
720 min Winter	16.526	0.826	60.9	156.7	Flood Risk
960 min Winter	16.527	0.827	61.0	156.8	Flood Risk
1440 min Winter	16.527	0.827	61.0	156.9	Flood Risk
2160 min Winter	16.527	0.827	61.0	156.8	Flood Risk
2880 min Winter	16.530	0.830	61.0	157.5	Flood Risk
4320 min Winter	16.556	0.856	61.6	162.9	Flood Risk
5760 min Winter	16.563	0.863	61.8	164.6	Flood Risk
7200 min Winter	16.571	0.871	61.9	166.1	Flood Risk
8640 min Winter	16.558	0.858	61.7	163.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
8640 min Summer	1.515	0.0	6736
15 min Winter	149.721	0.0	260
30 min Winter	92.702	0.0	313
60 min Winter	57.398	0.0	406
120 min Winter	35.539	0.0	576
180 min Winter	26.848	0.0	730
240 min Winter	22.004	0.0	894
360 min Winter	16.624	0.0	1220
480 min Winter	13.624	0.0	1414
600 min Winter	11.676	0.0	1586
720 min Winter	10.293	0.0	1744
960 min Winter	8.164	0.0	1958
1440 min Winter	5.889	0.0	2352
2160 min Winter	4.248	0.0	2884
2880 min Winter	3.369	0.0	3356
4320 min Winter	2.508	0.0	4148
5760 min Winter	2.035	0.0	4608
7200 min Winter	1.730	0.0	5088
8640 min Winter	1.515	0.0	5592

Cascade Rainfall Details for Restored - IT2_v5.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Cascade Model Details for Restored - IT2_v5.SRCX

Storage is Online Cover Level (m) 16.800

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.45000	Trench Width (m)	4.0
Infiltration Coefficient Side (m/hr)	0.45000	Trench Length (m)	177.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	15.700	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 15 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	15.697	0.297	65.8	33.0	O K
30 min Summer	15.749	0.349	73.0	45.4	O K
60 min Summer	15.783	0.383	74.7	53.4	O K
120 min Summer	15.900	0.500	80.7	81.7	O K
180 min Summer	15.996	0.596	85.6	104.6	O K
240 min Summer	16.066	0.666	89.2	121.4	O K
360 min Summer	16.152	0.752	93.5	142.1	O K
480 min Summer	16.193	0.793	95.7	152.0	O K
600 min Summer	16.218	0.818	96.9	157.9	Flood Risk
720 min Summer	16.231	0.831	97.6	161.1	Flood Risk
960 min Summer	16.146	0.746	93.2	140.6	O K
1440 min Summer	15.987	0.587	85.1	102.4	O K
2160 min Summer	15.825	0.425	76.9	63.5	O K
2880 min Summer	15.715	0.315	70.2	37.2	O K
4320 min Summer	15.682	0.282	62.1	29.7	O K
5760 min Summer	15.653	0.253	55.2	24.0	O K
7200 min Summer	15.637	0.237	51.3	21.1	O K
8640 min Summer	15.624	0.224	48.4	18.8	O K
15 min Winter	15.673	0.273	59.9	27.9	O K
30 min Winter	15.710	0.310	69.1	36.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Time-Peak (mins)
15 min Summer	149.721	0.0	123
30 min Summer	92.702	0.0	135
60 min Summer	57.398	0.0	156
120 min Summer	35.539	0.0	204
180 min Summer	26.848	0.0	248
240 min Summer	22.004	0.0	288
360 min Summer	16.624	0.0	362
480 min Summer	13.624	0.0	428
600 min Summer	11.676	0.0	496
720 min Summer	10.293	0.0	562
960 min Summer	8.164	0.0	692
1440 min Summer	5.889	0.0	950
2160 min Summer	4.248	0.0	1324
2880 min Summer	3.369	0.0	1664
4320 min Summer	2.508	0.0	2408
5760 min Summer	2.035	0.0	3160
7200 min Summer	1.730	0.0	3920
8640 min Summer	1.515	0.0	4664
15 min Winter	149.721	0.0	123
30 min Winter	92.702	0.0	134

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	15.737	0.337	72.4	42.6	O K
120 min Winter	15.894	0.494	80.4	80.2	O K
180 min Winter	16.018	0.618	86.7	109.8	O K
240 min Winter	16.117	0.717	91.8	133.7	O K
360 min Winter	16.257	0.857	98.9	167.4	Flood Risk
480 min Winter	16.257	0.857	98.9	167.2	Flood Risk
600 min Winter	16.238	0.838	97.9	162.7	Flood Risk
720 min Winter	16.211	0.811	96.6	156.2	Flood Risk
960 min Winter	16.071	0.671	89.4	122.5	O K
1440 min Winter	15.849	0.449	78.1	69.4	O K
2160 min Winter	15.699	0.299	66.4	33.6	O K
2880 min Winter	15.662	0.262	57.3	25.6	O K
4320 min Winter	15.625	0.225	48.5	18.9	O K
5760 min Winter	15.598	0.198	42.4	14.7	O K
7200 min Winter	15.583	0.183	38.8	12.5	O K
8640 min Winter	15.571	0.171	36.2	11.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	57.398	0.0	154
120 min Winter	35.539	0.0	204
180 min Winter	26.848	0.0	248
240 min Winter	22.004	0.0	290
360 min Winter	16.624	0.0	368
480 min Winter	13.624	0.0	438
600 min Winter	11.676	0.0	508
720 min Winter	10.293	0.0	578
960 min Winter	8.164	0.0	712
1440 min Winter	5.889	0.0	976
2160 min Winter	4.248	0.0	1332
2880 min Winter	3.369	0.0	1728
4320 min Winter	2.508	0.0	2500
5760 min Winter	2.035	0.0	3360
7200 min Winter	1.730	0.0	4176
8640 min Winter	1.515	0.0	5000

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Model Details

Storage is Online Cover Level (m) 16.500

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.57000	Trench Width (m)	2.5
Infiltration Coefficient Side (m/hr)	0.57000	Trench Length (m)	320.0
Safety Factor	2.0	Slope (1:X)	1000.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	15.400	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 172 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	18.453	0.153	39.9	121.8	O K
30 min Summer	18.550	0.250	41.3	198.7	O K
60 min Summer	18.648	0.348	42.8	276.5	O K
120 min Summer	18.841	0.541	45.7	429.8	O K
180 min Summer	18.989	0.689	48.0	547.9	O K
240 min Summer	19.112	0.812	49.8	645.2	O K
360 min Summer	19.302	1.002	52.7	796.3	O K
480 min Summer	19.428	1.128	54.6	896.7	Flood Risk
600 min Summer	19.510	1.210	55.9	962.0	Flood Risk
720 min Summer	19.565	1.265	56.7	1005.8	Flood Risk
960 min Summer	19.519	1.219	56.0	969.3	Flood Risk
1440 min Summer	19.432	1.132	54.7	899.8	Flood Risk
2160 min Summer	19.353	1.053	53.5	837.4	O K
2880 min Summer	19.251	0.951	52.0	755.9	O K
4320 min Summer	19.185	0.885	51.0	703.3	O K
5760 min Summer	19.059	0.759	49.0	603.3	O K
7200 min Summer	18.988	0.688	48.0	546.8	O K
8640 min Summer	18.920	0.620	46.9	492.7	O K
15 min Winter	18.422	0.122	39.4	97.3	O K
30 min Winter	18.498	0.198	40.5	157.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	175
30 min Summer	92.702	0.0	208
60 min Summer	57.398	0.0	240
120 min Summer	35.539	0.0	304
180 min Summer	26.848	0.0	356
240 min Summer	22.004	0.0	404
360 min Summer	16.624	0.0	494
480 min Summer	13.624	0.0	586
600 min Summer	11.676	0.0	672
720 min Summer	10.293	0.0	752
960 min Summer	8.164	0.0	886
1440 min Summer	5.889	0.0	1150
2160 min Summer	4.248	0.0	1560
2880 min Summer	3.369	0.0	1972
4320 min Summer	2.508	0.0	2804
5760 min Summer	2.035	0.0	3624
7200 min Summer	1.730	0.0	4440
8640 min Summer	1.515	0.0	5240
15 min Winter	149.721	0.0	164
30 min Winter	92.702	0.0	198

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	18.598	0.298	42.1	236.8	O K
120 min Winter	18.850	0.550	45.9	437.2	O K
180 min Winter	19.031	0.731	48.6	580.9	O K
240 min Winter	19.187	0.887	51.0	705.5	O K
360 min Winter	19.449	1.149	55.0	913.8	Flood Risk
480 min Winter	19.557	1.257	56.6	999.1	Flood Risk
600 min Winter	19.622	1.322	57.6	1050.7	Flood Risk
720 min Winter	19.661	1.361	58.2	1081.7	Flood Risk
960 min Winter	19.595	1.295	57.2	1029.6	Flood Risk
1440 min Winter	19.478	1.178	55.4	936.1	Flood Risk
2160 min Winter	19.293	0.993	52.6	789.7	O K
2880 min Winter	19.108	0.808	49.8	642.6	O K
4320 min Winter	18.905	0.605	46.7	480.7	O K
5760 min Winter	18.690	0.390	43.5	310.3	O K
7200 min Winter	18.552	0.252	41.4	200.4	O K
8640 min Winter	18.439	0.139	39.6	110.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	57.398	0.0	234
120 min Winter	35.539	0.0	304
180 min Winter	26.848	0.0	358
240 min Winter	22.004	0.0	406
360 min Winter	16.624	0.0	494
480 min Winter	13.624	0.0	582
600 min Winter	11.676	0.0	672
720 min Winter	10.293	0.0	758
960 min Winter	8.164	0.0	908
1440 min Winter	5.889	0.0	1196
2160 min Winter	4.248	0.0	1644
2880 min Winter	3.369	0.0	2084
4320 min Winter	2.508	0.0	2956
5760 min Winter	2.035	0.0	3792
7200 min Winter	1.730	0.0	4600
8640 min Winter	1.515	0.0	5368

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Model Details

Storage is Online Cover Level (m) 19.700

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.10200	Trench Width (m)	5.0
Infiltration Coefficient Side (m/hr)	0.10200	Trench Length (m)	530.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	18.300	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 128 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	18.386	0.086	26.8	65.4	O K
30 min Summer	18.431	0.131	27.7	100.7	O K
60 min Summer	18.479	0.179	28.7	138.9	O K
120 min Summer	18.574	0.274	30.7	216.3	O K
180 min Summer	18.644	0.344	32.2	275.8	O K
240 min Summer	18.701	0.401	33.4	325.0	Flood Risk
360 min Summer	18.787	0.487	35.3	400.5	Flood Risk
480 min Summer	18.837	0.537	36.4	446.5	Flood Risk
600 min Summer	18.869	0.569	37.0	475.4	Flood Risk
720 min Summer	18.889	0.589	37.5	494.0	Flood Risk
960 min Summer	18.863	0.563	36.9	470.5	Flood Risk
1440 min Summer	18.814	0.514	35.8	425.0	Flood Risk
2160 min Summer	18.761	0.461	34.7	377.5	Flood Risk
2880 min Summer	18.698	0.398	33.4	322.1	O K
4320 min Summer	18.639	0.339	32.1	271.4	O K
5760 min Summer	18.561	0.261	30.4	206.1	O K
7200 min Summer	18.512	0.212	29.4	166.0	O K
8640 min Summer	18.469	0.169	28.5	131.2	O K
15 min Winter	18.374	0.074	26.5	55.9	O K
30 min Winter	18.408	0.108	27.2	82.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	152
30 min Summer	92.702	0.0	188
60 min Summer	57.398	0.0	222
120 min Summer	35.539	0.0	278
180 min Summer	26.848	0.0	330
240 min Summer	22.004	0.0	380
360 min Summer	16.624	0.0	472
480 min Summer	13.624	0.0	562
600 min Summer	11.676	0.0	642
720 min Summer	10.293	0.0	714
960 min Summer	8.164	0.0	840
1440 min Summer	5.889	0.0	1100
2160 min Summer	4.248	0.0	1500
2880 min Summer	3.369	0.0	1896
4320 min Summer	2.508	0.0	2696
5760 min Summer	2.035	0.0	3480
7200 min Summer	1.730	0.0	4248
8640 min Summer	1.515	0.0	5000
15 min Winter	149.721	0.0	139
30 min Winter	92.702	0.0	177

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	18.456	0.156	28.2	120.9	O K
120 min Winter	18.582	0.282	30.9	223.6	O K
180 min Winter	18.670	0.370	32.8	297.5	O K
240 min Winter	18.744	0.444	34.3	362.1	Flood Risk
360 min Winter	18.862	0.562	36.9	469.1	Flood Risk
480 min Winter	18.902	0.602	37.8	506.7	Flood Risk
600 min Winter	18.922	0.622	38.2	525.6	Flood Risk
720 min Winter	18.932	0.632	38.4	534.2	Flood Risk
960 min Winter	18.892	0.592	37.5	496.7	Flood Risk
1440 min Winter	18.817	0.517	35.9	428.2	Flood Risk
2160 min Winter	18.705	0.405	33.5	327.9	Flood Risk
2880 min Winter	18.599	0.299	31.2	237.2	O K
4320 min Winter	18.477	0.177	28.7	137.0	O K
5760 min Winter	18.371	0.071	26.5	53.8	O K
7200 min Winter	18.348	0.048	24.8	36.0	O K
8640 min Winter	18.344	0.044	23.0	33.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	57.398	0.0	216
120 min Winter	35.539	0.0	278
180 min Winter	26.848	0.0	332
240 min Winter	22.004	0.0	380
360 min Winter	16.624	0.0	472
480 min Winter	13.624	0.0	562
600 min Winter	11.676	0.0	644
720 min Winter	10.293	0.0	720
960 min Winter	8.164	0.0	856
1440 min Winter	5.889	0.0	1142
2160 min Winter	4.248	0.0	1572
2880 min Winter	3.369	0.0	1988
4320 min Winter	2.508	0.0	2800
5760 min Winter	2.035	0.0	3520
7200 min Winter	1.730	0.0	4176
8640 min Winter	1.515	0.0	4952

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Model Details

Storage is Online Cover Level (m) 19.000

Infiltration Basin Structure

Invert Level (m) 18.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.24000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.24000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	750.0	0.700	967.7

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 135 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	18.414	0.094	25.4	67.7	O K
30 min Summer	18.465	0.145	26.4	105.0	O K
60 min Summer	18.517	0.197	27.5	144.2	O K
120 min Summer	18.617	0.297	29.5	222.4	O K
180 min Summer	18.692	0.372	31.1	282.5	O K
240 min Summer	18.752	0.432	32.3	332.0	Flood Risk
360 min Summer	18.842	0.522	34.2	408.0	Flood Risk
480 min Summer	18.896	0.576	35.3	454.7	Flood Risk
600 min Summer	18.929	0.609	36.0	484.1	Flood Risk
720 min Summer	18.951	0.631	36.5	503.1	Flood Risk
960 min Summer	18.925	0.605	36.0	480.5	Flood Risk
1440 min Summer	18.875	0.555	34.9	436.7	Flood Risk
2160 min Summer	18.823	0.503	33.8	391.8	Flood Risk
2880 min Summer	18.761	0.441	32.5	338.8	Flood Risk
4320 min Summer	18.703	0.383	31.3	291.6	Flood Risk
5760 min Summer	18.625	0.305	29.7	228.7	O K
7200 min Summer	18.577	0.257	28.7	190.4	O K
8640 min Summer	18.533	0.213	27.8	156.7	O K
15 min Winter	18.400	0.080	25.1	57.3	O K
30 min Winter	18.439	0.119	25.9	85.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	149.721	0.0	158
30 min Summer	92.702	0.0	193
60 min Summer	57.398	0.0	226
120 min Summer	35.539	0.0	282
180 min Summer	26.848	0.0	334
240 min Summer	22.004	0.0	382
360 min Summer	16.624	0.0	474
480 min Summer	13.624	0.0	566
600 min Summer	11.676	0.0	646
720 min Summer	10.293	0.0	718
960 min Summer	8.164	0.0	844
1440 min Summer	5.889	0.0	1104
2160 min Summer	4.248	0.0	1504
2880 min Summer	3.369	0.0	1904
4320 min Summer	2.508	0.0	2708
5760 min Summer	2.035	0.0	3496
7200 min Summer	1.730	0.0	4272
8640 min Summer	1.515	0.0	5040
15 min Winter	149.721	0.0	147
30 min Winter	92.702	0.0	183

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
60 min Winter	18.493	0.173	27.0	126.0	O K
120 min Winter	18.627	0.307	29.7	229.8	O K
180 min Winter	18.719	0.399	31.6	304.3	Flood Risk
240 min Winter	18.797	0.477	33.2	369.2	Flood Risk
360 min Winter	18.921	0.601	35.9	476.5	Flood Risk
480 min Winter	18.964	0.644	36.8	515.0	Flood Risk
600 min Winter	18.986	0.666	37.2	534.9	Flood Risk
720 min Winter	18.996	0.676	37.5	544.4	Flood Risk
960 min Winter	18.957	0.637	36.6	508.6	Flood Risk
1440 min Winter	18.883	0.563	35.1	443.5	Flood Risk
2160 min Winter	18.771	0.451	32.7	347.3	Flood Risk
2880 min Winter	18.664	0.344	30.5	259.5	O K
4320 min Winter	18.540	0.220	27.9	162.3	O K
5760 min Winter	18.427	0.107	25.6	77.0	O K
7200 min Winter	18.370	0.050	24.4	35.4	O K
8640 min Winter	18.366	0.046	22.6	32.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	57.398	0.0	220
120 min Winter	35.539	0.0	282
180 min Winter	26.848	0.0	336
240 min Winter	22.004	0.0	384
360 min Winter	16.624	0.0	474
480 min Winter	13.624	0.0	564
600 min Winter	11.676	0.0	646
720 min Winter	10.293	0.0	724
960 min Winter	8.164	0.0	860
1440 min Winter	5.889	0.0	1148
2160 min Winter	4.248	0.0	1580
2880 min Winter	3.369	0.0	1996
4320 min Winter	2.508	0.0	2820
5760 min Winter	2.035	0.0	3592
7200 min Winter	1.730	0.0	4192
8640 min Winter	1.515	0.0	4960

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447250 107950 SU 47250 07950
C (1km)	-0.026
D1 (1km)	0.428
D2 (1km)	0.314
D3 (1km)	0.392
E (1km)	0.299
F (1km)	2.303
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	8640
Climate Change %	+45

Model Details

Storage is Online Cover Level (m) 19.000

Infiltration Basin Structure

Invert Level (m) 18.320 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.24000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.24000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	705.0	0.680	910.1

Appendix C

Exceedance Flow Routes

N

Site Boundary

LiDAR DTM Level

- < 13.0m AOD
- 13.0m - 14.0m AOD
- 14.0m - 15.0m AOD
- 15.0m - 16.0m AOD
- 16.0m - 17.0m AOD
- 17.0m - 18.0m AOD
- 18.0m - 19.0m AOD
- 19.0m - 20.0m AOD
- 20.0m - 21.0m AOD
- 21.0m - 22.0m AOD
- 22.0m - 23.0m AOD
- 23.0m - 24.0m AOD
- 24.0m - 25.0m AOD
- > 25.0m AOD

Environment Agency Risk of Flooding from Surface Water

- High (3.3%) - 1 in 30 Annual Probability
- Medium (1%) - 1 in 100 Annual Probability
- Low (0.1%) - 1 in 1000 Annual Probability
- Very Low (<0.1%) - Less than 1 in 1000 Annual Probability

Attenuation Basin (no infiltration)

Infiltration Basin

Linear Drainage Feature

- Drain
- Infiltration Trench
- Exceedance Flow Direction

Stantec

Client: CEMEX

HAMBLE QUARRY

Exceedance Flow Routes

0 350 700 m

1:7,000 @ A3 | Date: 03/11/2023

Drawn: RP | Checked: RS

Appendix C | Rev: B

Document Path: C:\Users\rpickersgill\Documents\ArcGIS\Projects\Hamble_2\Hamble_2.aprx