Project Name: Land North of Folly View, Willersey

Project Number: P24-3059

Report Name: Flood Risk and Drainage Addendum

Author: Natalie Morgan

Checked by: Tom Graham

Approved by: Tom Graham

Date: 06/02/2026

1. Introduction

1.1. Pegasus was previously appointed by Eagle One Ltd to undertake a Flood Risk Assessment and Drainage Strategy (FRA) (report reference P24-3059 Flood Risk and Drainage Strategy V2) to support an outline planning application for 30 dwellings at Land North of Folly View, Willersey.

1.2. Following submission of the planning application, comments on flood risk and the proposed drainage strategy were received from Gloucestershire County Council (GCC) in its capacity as the Lead Local Flood Authority (LLFA). A copy of the comments is provided in **Appendix A**.

1.3. A meeting was held between Pegasus and the LLFA in January 2026 to review the consultation comments and agree the actions needed to resolve the concerns.

1.4. This Addendum, which should be read in conjunction with the submitted FRA, addresses the LLFA comments and incorporates the key points arising from the meeting where relevant.

2. Response to the LLFA Comments

2.1. The LLFA provided the following comments (***in bold italics***) in October 2025. Pegasus's response directly follows each comment.

"As shown in the Flood Risk Assessment and Drainage Strategy (P24-3059); September 2025) (FRA) the site is in flood zone 1 and mostly at very low risk according to the Risk of Flooding from Surface Water (RoFSW) maps. However, there is an area at medium and high risk along the eastern boundary in which, according to the masterplan, there will be properties situated. This could either put these properties at risk or displace the flood water and increasing the risk elsewhere, if not mitigated. No modelling has been carried out as it is being proposed to do so before a reserved matters application if the application is approved.

It should be noted that modelling of the watercourse was carried out to support a previous application (20/04553/OUT) and shows that the site might be at higher risk than the RoFSW maps show and the impact over a wider area of the site. This should be addressed in the application."

2.2. The Environment Agency (EA) RoFSW mapping indicates the flood risk along the eastern site boundary is up to 0.2 metres (m) in the location of the proposed properties. The mapping shows the areas with depths up to 0.3m are contained within the banks of the watercourse.

2.3. A review of the site topographical survey against the RoFSW 1 in 1,000 year plus climate change extents indicated the flood depths across the east of the site range between approximately 86 millimetres (mm) and negligible amounts. The RoFSW cross sections are presented in **Appendix B**.

2.4. The cross sections show the low flood volumes can be accommodated by lowering levels and through the landscape design within the maintenance corridor along the eastern site boundary. Finished Floor Levels (FFLs) would also be raised approximately 0.3m above the ground level to mitigate any residual flood risk. This approach and level analysis was deemed acceptable by the LLFA during the meeting.

2.5. The hydraulic modelling to support a previous application approximately 0.3 kilometres (km) to the north of the site was undertaken in 2014. It is considered this modelling is now outdated, and the latest EA data is more accurate than the model for the previous application; the rainfall data and EA models have since been updated and use more recent LiDAR information.

"This watercourse is not mapped, the LLFA has no information on it and none has been provided with the FRA. According to the topographic survey and the LiDAR information the LLFA has, the site appears to fall and therefore drain to the northeast rather than towards the watercourse identified. It will also require extensive work outside the redline boundary and may require approval from third party land. For these reasons, further information should be provided.

It should also be noted that the National Standards for Sustainable Drainage Systems state that when discharging to a surface water body, the outfall should be a vegetated channel or reuse an existing outfall rather than building a new engineered outfall in the watercourse."

2.6. According to the topographical survey, the western half of the site naturally drains to the watercourse at the proposed outfall. The eastern half drains to a watercourse in the north-east, associated with the surface water flood extent on site. Both watercourses are within the same drainage catchment, and ultimately flow to the River Avon to the north-west of the site.

2.7. The watercourse at the proposed outfall flows through undeveloped fields, in contrast to the north-eastern watercourse which conveys flows across Willersey village. As a result, the drainage proposals would reroute a small volume of surface water runoff away from properties at risk of flooding without increasing flood risk elsewhere within an urbanised catchment.

2.8. The proposed discharge rate of 2.0 litres per second (l/s) is less than QBAR (3.6l/s) and would offer betterment compared to the existing scenario for all rainfall events up to the 1 in 100 year plus 40% climate change storm.

2.9. Owing to the presence of the watercourse in the north-east of the site, the LLFA have agreed to condition a survey of the watercourse at the proposed outfall to confirm the hydraulic connectivity.

2.10. Although the outfall is located within land beyond the red line boundary, it controlled by the same landowner. As such, third-party approval would not be a constraint on delivering the drainage proposals.

2.11. The outfall to the watercourse would be designed in accordance with the hierarchy set out in the National Standards.

"SuDS will be incorporated into the drainage strategy with an attenuation basin, underground cellular storage and permeable paving being provided. While it's been shown that the strategy can accommodate a 1% Annual Exceedance Probability (AEP) rainfall event plus 40% for climate change (Standard 3 of the National Standards) it hasn't been shown that it will meet Standard 2 (manging the first 5mm of rainfall for the majority of events without producing runoff)."

2.12. The development is anticipated to produce 0.643 hectares (ha) impermeable area (excluding an allowance for urban creep), and the following revisions to the drainage strategy are proposed to ensure the requirements of Standard 2 are met:

- All private roads, parking courtyards and private driveways (2,171 square metres (m^2)) would comprise lined permeable paving. There would be no additional area drained to the permeable paving, so this is assumed to comply with the requirements of Standard 2.
- Half of the roof areas (1,175m^2) would drain via rain gardens, which would have a total area of no less than 235m^2 (the impermeable area would be up to five times the rain garden surface area).
- Half of the roof areas (1,175m^2) plus the remaining roads and footways (1,912m^2) would drain to the basin, which would have a base area of no less than 618m^2 (the impermeable area would be up to five times the basin base area).

2.13. The above values incorporate all proposed impermeable areas and have been designed in accordance with the National Standards guidance for permeable surfaces, rain gardens and detention basins.

2.14. The increased basin outline extents are presented in the updated drainage strategy drawing in **Appendix C**. The larger basin can be accommodated within the surrounding areas of open space without significant changes to the proposed layout.

"Underground cellular storage is not mentioned in the National Standards and their use is not considered sustainable given its onerous maintenance requirements and the inability to easily check if it is functioning. They should be replaced with more above ground features that can provide multiple benefits to the development."

2.15. The drainage strategy has been updated in accordance with the requirements of the National Standards. The amended attenuation comprises increased extents of lined permeable paving and a larger detention basin, and the previously proposed underground cellular storage has been removed. The updated drainage strategy drawing and associated calculations are provided in **Appendix C**.

2.16. Although surface water generated by the development would also drain via the proposed rain gardens and swales, these provide little attenuation capacity and have therefore not been modelled within the drainage calculations.

"The areas draining through the permeable paving and then the attenuation basin will be part of a SuDS treatment train to manage water quality, however, the remaining hardstanding area will not be. This is particularly pertinent for the access road, which could introduce hydrocarbons and sediments to the surface water."

2.17. The impermeable areas draining to the basin without receiving additional treatment comprise the adoptable roads and footways. Some of these areas would drain via the proposed swales before being attenuated within the basin. Flows draining directly to the basin would receive sufficient treatment; the FRA sets out that the SuDS pollution mitigation indices exceed the pollution hazard indices for the development.

2.18. Incorporating permeable paving across all roads would likely preclude adoptability, and previous comments from the case officer highlighted various issues which could arise if these roads are not adopted.

"The masterplan does show swales around the site but these haven't been incorporated into the SuDS strategy."

2.19. The swales would be incorporated within the site-wide drainage strategy for conveyance and water treatment, as indicatively shown in **Appendix C**. As the swales would not offer significant attenuation volumes, they have not been modelled within the drainage calculations at this stage. Similarly, the narrow swales would offer a negligible contribution towards meeting Standard 2 of the National Standards.

"A plan showing where surface water will flow through and off the site in events that exceed the design of the drainage have not been included but will depend on the final topography of the site."

2.20. The levels design for the site would ensure that exceedance flows are routed within the proposed roads, directed towards areas of open space, and diverted around new buildings to avoid risk to people and property.

2.21. The LLFA noted that an exceedance plan would be conditioned as part of the planning approval.

3. Summary

3.1. This Addendum sets out how the LLFA's comments can be resolved, including proposed amendments to the drainage strategy to ensure compliance with the National Standards.

3.2. The existing flood risk can be appropriately managed within the layout, and the revised drainage strategy meets the requirements of Standard 2.

Appendix A – LLFA Comments

Lead Local Flood Authority
Shire Hall
Gloucester
GL1 2TH

Martin Perks
Cotswold District Council
Trinity Road
Cirencester
Gloucestershire
GL7 1PX

email: peter.siret@gloucestershire.gov.uk

Please ask for: Peter Siret

Phone:

Our Ref: C/2025/058352 | Your Ref: 25/02983/OUT | Date: 29 October 2025

Dear Martin Perks,

TOWN AND COUNTRY PLANNING ACT 1990
LEAD LOCAL FLOOD AUTHORITY RECOMMENDATION

LOCATION: Land North Of Folly View Broadway Road Willersey
PROPOSED: Outline application for the erection of up to 30 dwellings with associated means of access, car parking, public open space, landscaping, sustainable drainage system (SuDS) and associated infrastructure (all matters reserved except for access)

I refer to the notice received by the Lead Local Flood Authority (LLFA) requesting comments on the above proposal. The LLFA is a statutory consultee for surface water flood risk and management and has made the following observations and recommendation.

Flood Risk
As shown in the Flood Risk Assessment and Drainage Strategy (P24-3059; September 2025) (FRA) The site is in flood zone 1 and mostly at very low risk according to the Risk of Flooding from Surface Water (RoFSW) maps. However, there is an area at medium and high risk along the eastern boundary in which, according to the masterplan, there will be properties situated. This could either put these properties at risk or displace the flood water an increasing the risk elsewhere, if not mitigated. No modelling has been carried out as it is being proposed to do so before a reserved matters application if the application is approved.

It should be noted that modelling of the watercourse was carried out to support a previous application (20/04553/OUT) and shows that the site might be at higher risk than the RoFSW maps show and the impact over a wider area of the site. This should be addressed in this application.

Surface Water Management
Runoff Destination

The geology of the site is Charmouth Mudstone, which is not conducive for infiltration. Instead, it is proposed to discharge surface water to a watercourse to the northwest of the site.

This watercourse is not mapped, the LLFA has no information on it and none has been provided with the FRA. According to the topographic survey and the LiDAR information the LLFA has, the site appears to fall and therefore drain to the northeast rather than towards the watercourse identified. It will also require extensive work outside of the redline boundary and may require approval from third party land. For these reasons, further information should be provided.

It should also be noted that the National Standards for Sustainable Drainage Systems state that when discharging to a surface water body, the outfall should be a vegetated channel or reuse an existing outfall rather than building a new engineered outfall in the watercourse.

Discharge rate and volume

The proposed discharge rate is 3.6 l/s, which is approximately equal to the greenfield runoff rate for QBar and which will help manage runoff volume.

Sustainable Drainage System (SuDS) strategy and indicative plan

SuDS will be incorporated into the drainage strategy with an attenuation basin, underground cellular storage and permeable paving being provided. While it’s been shown that the strategy can accommodate a 1% Annual Exceedance Probability (AEP) rainfall event plus 40% for climate change (Standard 3 of the National Standards) it hasn’t been shown that it will meet Standard 2 (managing the first 5mm of rainfall for the majority of events without producing runoff).

Underground cellular storage is not mentioned in the National Standards and their use is not considered sustainable given it’s onerous maintenance requirements and the inability to easily check if it is functioning. They should be replaced with more above ground features that can provide multiple benefits to the development.

The areas draining through the permeable paving and then the attenuation basin will be part of a SuDS treatment train to manage water quality, however, the remaining hardstanding area will not be. This is particularly pertinent for the access road, which could introduce hydrocarbons and sediments to the surface water.

The masterplan does show swales around the site but these haven’t been incorporated into the SuDS Strategy.

Climate change

Climate change has been included at a value of 40%, which is in line with the Environment Agency’s estimates.

Exceedance flow plan

A plan showing where surface water will flow through and off the site in events that exceed the design of the drainage have not been included but will depend on the final topography of the site.

LLFA Recommendation

More information should be provided to demonstrate the site would not be at undue risk of flooding and won’t increase the risk elsewhere. Furthermore, more information should be provided on the runoff destination and it should be demonstrated that the strategy can meet the National Standards for SuDS, as described above.

NOTE 1 :The Lead Local Flood Authority (LLFA) will give consideration to how the proposed sustainable drainage system can incorporate measures to help protect water quality, however pollution control is the responsibility of the Environment Agency

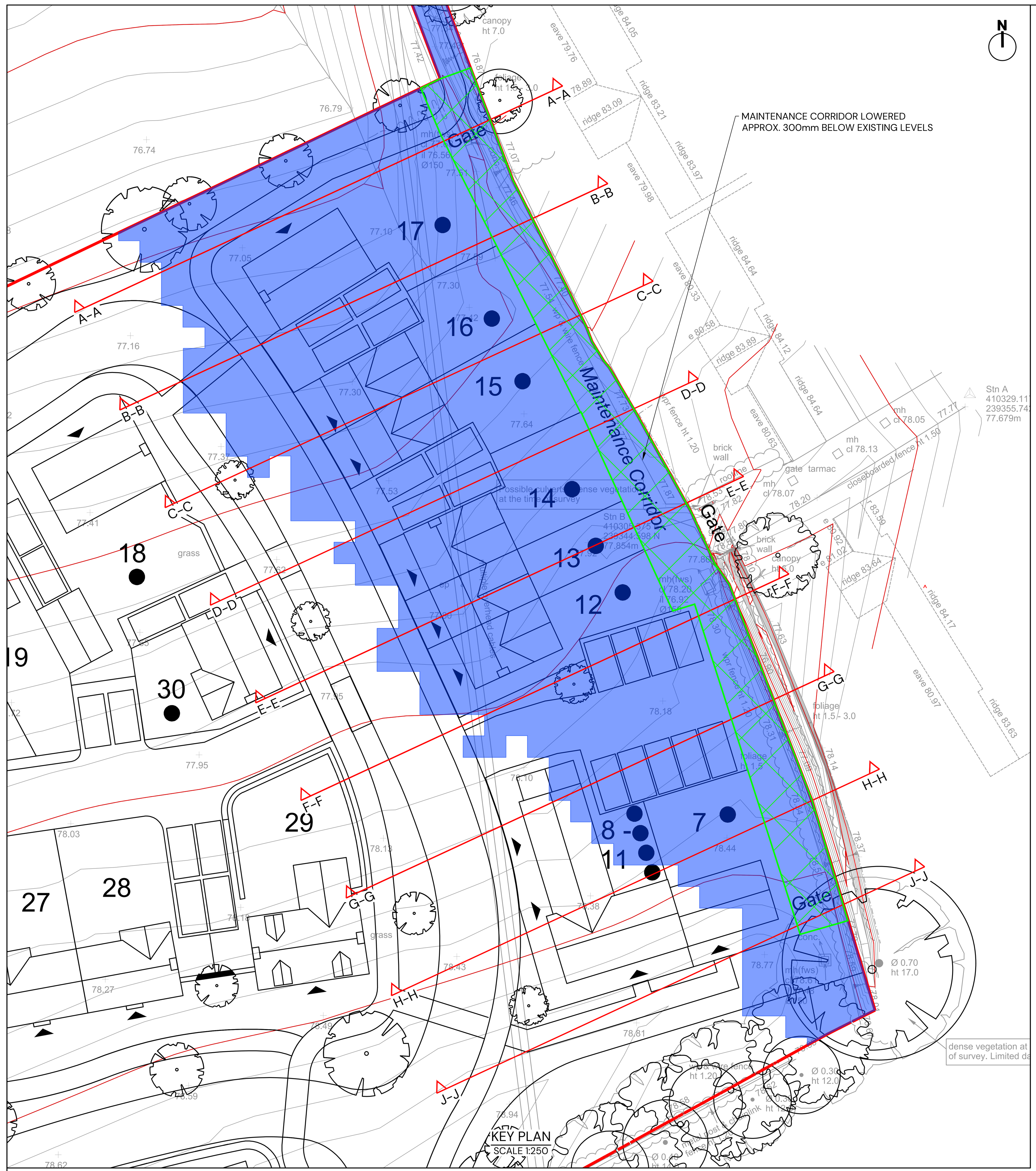
NOTE 2 : Future management of Sustainable Drainage Systems is a matter that will be dealt with by the Local Planning Authority and has not, therefore, been considered by the LLFA.

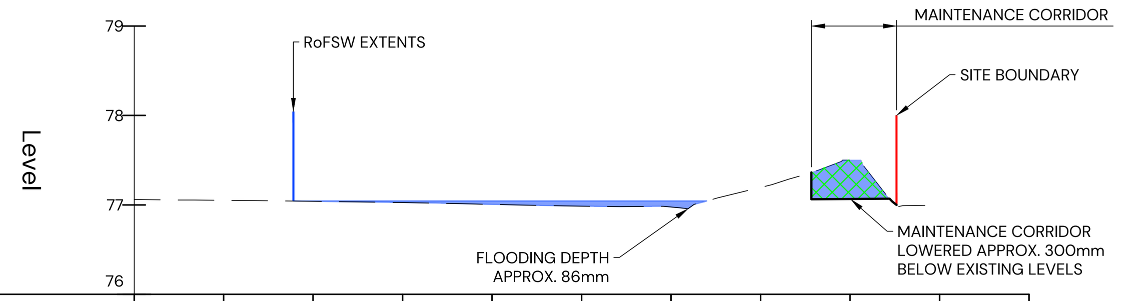
NOTE 3: Any revised documentation will only be considered by the LLFA when resubmitted through suds@gloucestershire.gov.uk e-mail address. Please quote the planning application number in the subject field.

Yours sincerely,

Peter Siret
Sustainable Drainage Engineer

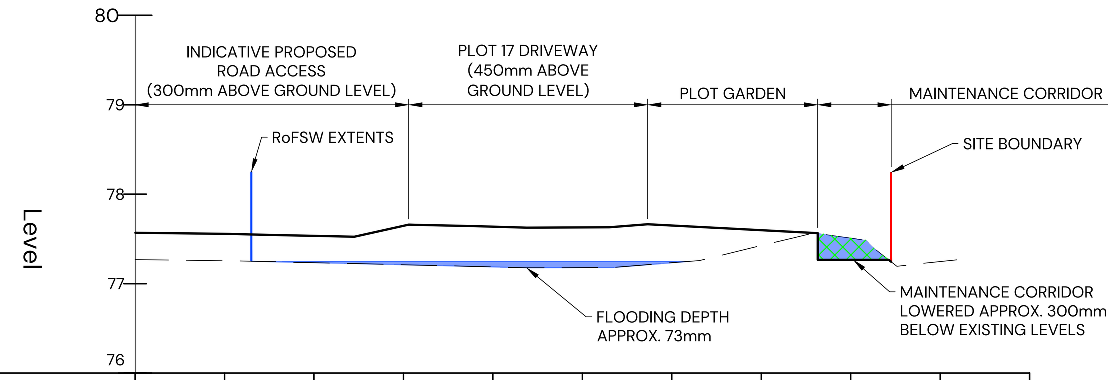
Appendix B – RoFSW Cross Sections





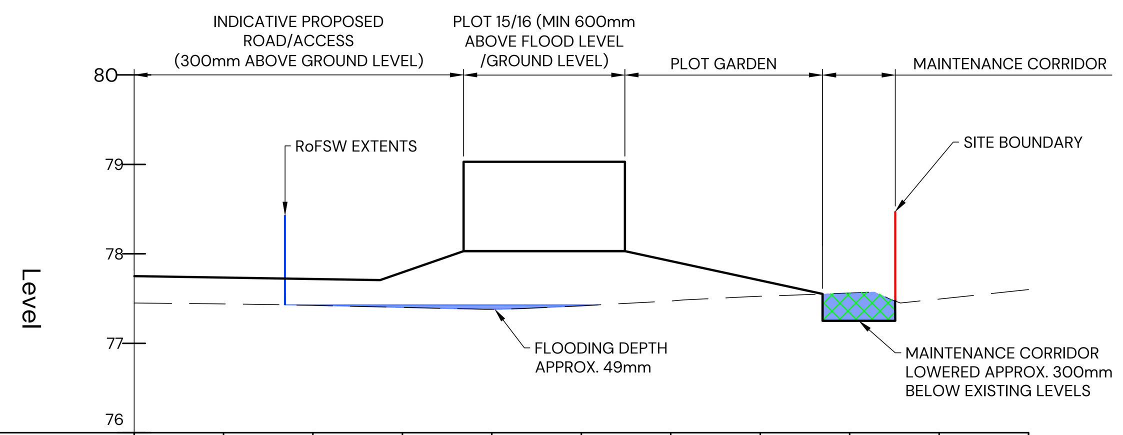
Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	77.060	77.052	77.040	77.026	77.006	76.986	76.976	77.195	77.500		

A-A
SCALE: H 1:250,V 1:50. DATUM: 76.000



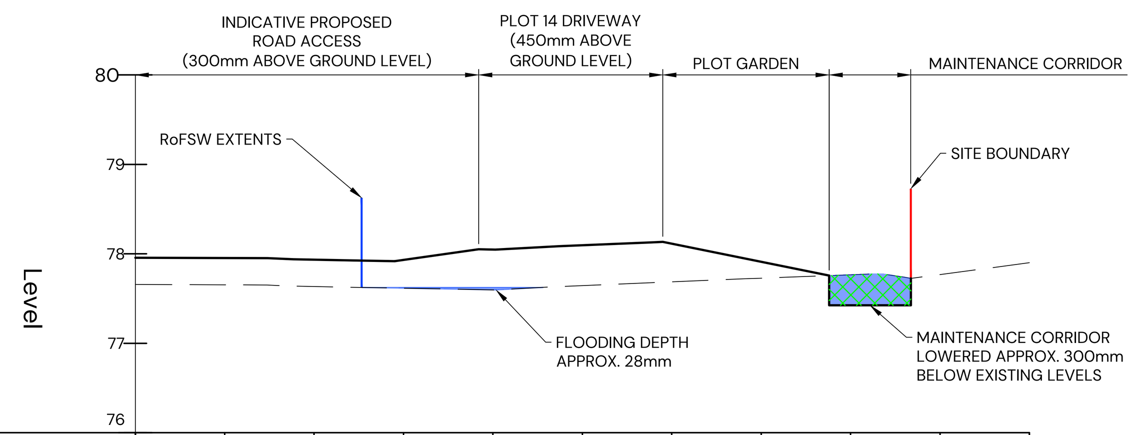
Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	77.268	77.256	77.234	77.211	77.187	77.179	77.234	77.425	77.508	77.247	

B-B
SCALE: H 1:250,V 1:50. DATUM: 76.000



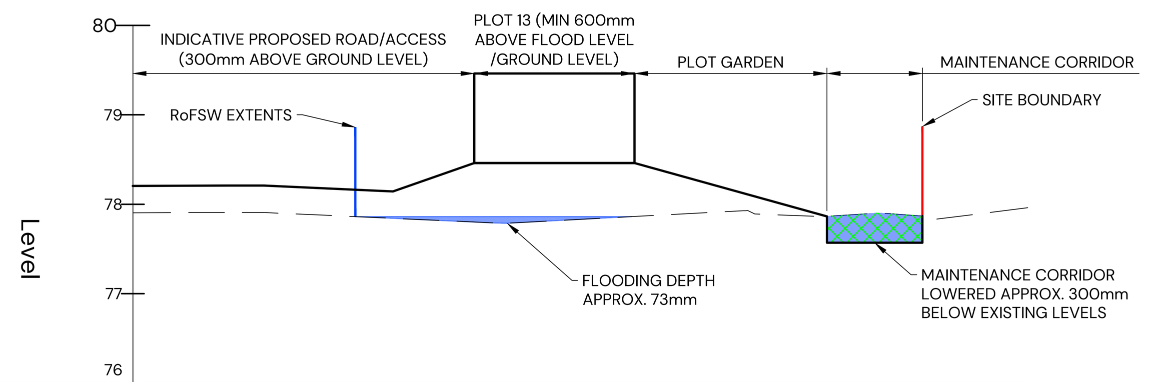
Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	77.450	77.440	77.424	77.401	77.381	77.420	77.474	77.526	77.563	77.495	77.602

C-C
SCALE: H 1:250,V 1:50. DATUM: 76.000



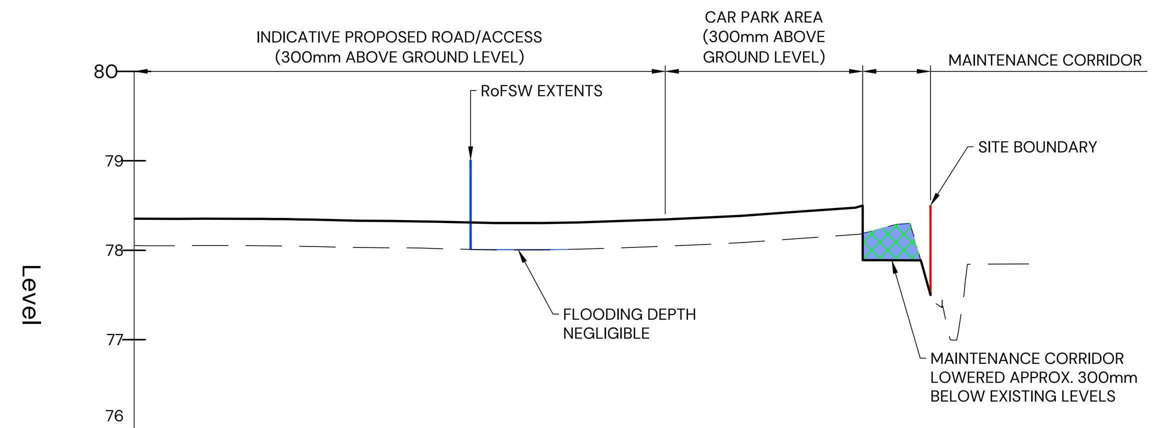
Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	77.657	77.654	77.635	77.616	77.598	77.645	77.687	77.728	77.766	77.769	77.901

D-D
SCALE: H 1:250,V 1:50. DATUM: 76.000



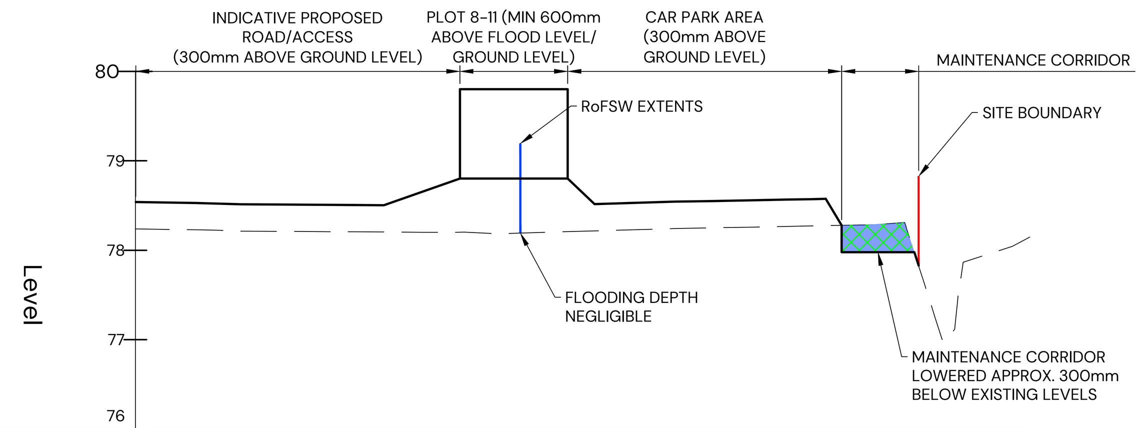
Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	77.904	77.909	77.883	77.838	77.793	77.831	77.884	77.889	77.880	77.835	77.962

E-E
SCALE: H 1:250,V 1:50. DATUM: 76.000



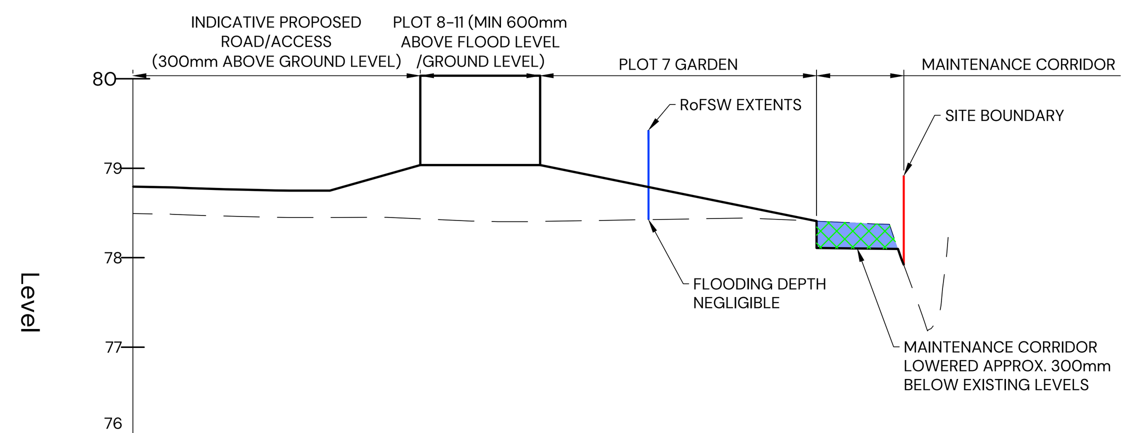
Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	78.053	78.052	78.042	78.026	78.004	78.012	78.047	78.100	78.171	77.380	77.846

F-F
SCALE: H 1:250,V 1:50. DATUM: 76.000



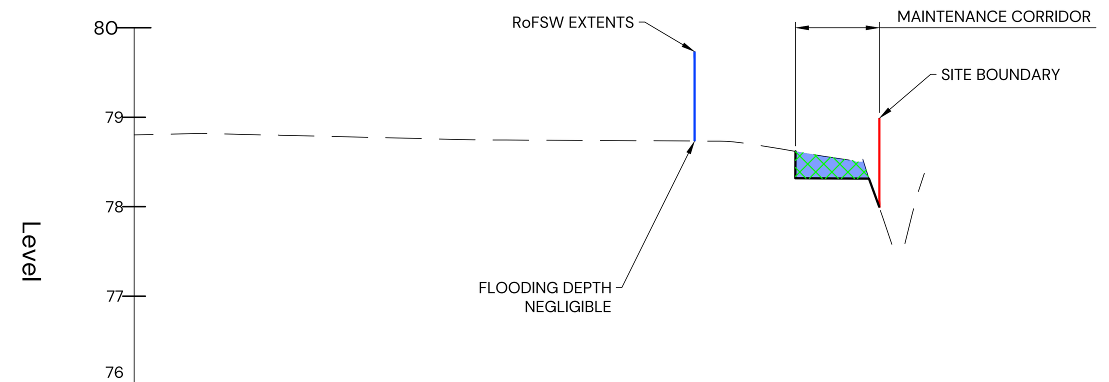
Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	78.238	78.221	78.208	78.202	78.187	78.212	78.241	78.260	78.280	77.065	78.147

G-G
SCALE: H 1:250,V 1:50. DATUM: 76.000



Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	78.494	78.466	78.449	78.444	78.405	78.413	78.430	78.438	78.392	77.307	

H-H
SCALE: H 1:250,V 1:50. DATUM: 76.000



Chainage	00.000	05.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
Existing Levels	78.804	78.813	78.791	78.767	78.746	78.741	78.735	78.683	78.521		

J-J
SCALE: H 1:250,V 1:50. DATUM: 76.000

1:250 0 10m 25m

NOTES:

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LEGEND:

- SITE BOUNDARY
- 1 IN 1,000 YEAR PLUS CLIMATE CHANGE RoFSW EXTENTS
- SECTION MARKER
- MAINTENANCE CORRIDOR
- PROPOSED GROUND PROFILE
- EXISTING GROUND PROFILE

REV	DATE	DESCRIPTION	REVISED	CHECKED	APPROVED
P2	06.02.2026	REVISED FOLLOWING MEETING WITH LLFA	SOM	NM	TG
P1	07.01.2026	FIRST ISSUE	KC	NM	TG

RoFSW SECTIONS

BROADWAY ROAD, WILLERSEY

CLIENT:
BLUE CEDAR HOMES

DATE: 07.01.2026
SCALE: AS SHOWN @A0
DRAWN BY: KC
CHECKED BY: NM
APPROVED BY: TG

DRAWING NUMBER: P24-3059-PEG-XX-XX-DR-C- 002 -P2
PG OFFICE / TEAM: SOL/INFRA

PEGASUS REF No: P24-3059
DRAWING STATUS: SO

PEGASUS GROUP

Appendix C – Proposed Drainage Strategy and Calculations

N

1:500 0 12.5m 25m

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LEGEND:

- SITE BOUNDARY
- INDICATIVE PROPOSED SURFACE WATER MANHOLE AND SEWER
- INDICATIVE PROPOSED LINED PERMEABLE PAVING
- INDICATIVE PROPOSED HEADWALL
- INDICATIVE ATTENUATION BASIN WITH 1:3 SIDE SLOPES
- INDICATIVE PROPOSED FLOW CONTROL (SUBJECT TO DETAILED DESIGN)
- INDICATIVE PROPOSED RAIN GARDEN
- INDICATIVE PROPOSED SWALE
- INDICATIVE PROPOSED PRIVATE DRAINAGE CONNECTION

REV	DATE	DESCRIPTION	REVISED	CHECKED	APPROVED
P5	06.02.2026	PROPOSED DRAINAGE STRATEGY UPDATED	NM	TG	TG
P4	22.09.2025	PROPOSED OUTFALL AND DITCH LEVELS UPDATED	NM	TG	SAJ
P3	10.09.2025	PROPOSED OUTFALL TO EXISTING DITCH UPDATED	SOM	TG	TG
P2	12.08.2025	SITE BOUNDARY UPDATED	SOM	NM	TG
P1	06.08.2025	PRELIMINARY ISSUE	SOM	NM	SAJ

PRELIMINARY DRAINAGE STRATEGY

BROADWAY ROAD,
WILLERSEY

CLIENT:
BLUE CEDAR HOMES

DATE: 06.08.2025
SCALE: 1:500 @ A1
DRAWN BY: SOM
CHECKED BY: NM
APPROVED BY: SAJ

DRAWING NUMBER: P24-3059-PEG-XX-XX-DR-C- 001 -P5
PG OFFICE / TEAM: SOL / INFRA

PEGASUS REF No: P24-3059
DRAWING STATUS: S2

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	40	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.000
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SW1	0.073	5.00	78.900	1200	410277.040	239288.224	1.225
SW2	0.000		78.450	1200	410281.673	239301.910	1.225
SW3	0.000		78.200	1200	410281.098	239312.255	1.225
PP1	0.045	5.00	77.900	1200	410257.844	239319.502	0.800
PP2	0.026	5.00	78.100	1200	410287.482	239323.898	0.800
SW4	0.072	5.00	77.950	1200	410274.789	239327.187	1.575
SW5	0.000		77.400	1200	410262.919	239351.440	1.375
SW6	0.077	5.00	77.200	1200	410256.027	239359.934	1.450
SW7	0.000		77.150	1200	410247.691	239359.630	1.450
SW8	0.000		77.200	1200	410227.651	239347.473	1.561
PP3	0.035	5.00	77.300	1200	410217.122	239337.631	0.800
PP4	0.025	5.00	77.500	1200	410210.707	239326.926	0.800
SW9	0.100	5.00	77.200	1200	410205.190	239339.344	1.623
SW10	0.020	5.00	76.900	1200	410172.936	239330.231	1.450
PP5	0.086	5.00	78.550	1500	410207.261	239268.707	0.800
SW11	0.035	5.00	78.250	1200	410202.060	239279.532	1.300
SW12	0.070	5.00	78.000	1200	410184.015	239279.939	1.409
BASIN	0.000		76.400	1200	410160.705	239315.342	1.400
BASIN HYDRB	0.000		76.400	1200	410159.532	239332.548	1.472
OUTFALL	0.000		75.200	1200	410132.431	239393.735	1.000

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW1	SW2	14.449	0.600	77.675	77.225	0.450	32.1	225	5.10	50.0
1.001	SW2	SW3	10.361	0.600	77.225	76.975	0.250	41.4	225	5.19	50.0
1.002	SW3	SW4	16.210	0.600	76.975	76.525	0.450	36.0	225	5.31	50.0
2.000	PP1	SW4	18.606	0.600	77.100	76.600	0.500	37.2	150	5.19	50.0
3.000	PP2	SW4	13.112	0.600	77.300	76.600	0.700	18.7	150	5.09	50.0
1.003	SW4	SW5	27.002	0.600	76.375	76.025	0.350	77.1	375	5.53	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	2.317	92.1	18.5	1.000	1.000	0.073	0.0	68	1.821
1.001	2.038	81.0	18.5	1.000	1.000	0.073	0.0	73	1.655
1.002	2.186	86.9	18.5	1.000	1.200	0.073	0.0	70	1.742
2.000	1.655	29.2	11.4	0.650	1.200	0.045	0.0	65	1.551
3.000	2.338	41.3	6.6	0.650	1.200	0.026	0.0	40	1.711
1.003	2.064	228.0	54.6	1.200	1.000	0.216	0.0	124	1.705

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.004	SW5	SW6	10.938	0.600	76.025	75.825	0.200	54.7	375	5.60	50.0
1.005	SW6	SW7	8.342	0.600	75.750	75.700	0.050	166.8	450	5.69	50.0
1.006	SW7	SW8	23.439	0.600	75.700	75.639	0.061	385.0	450	6.07	50.0
1.007	SW8	SW9	23.887	0.600	75.639	75.577	0.062	385.0	450	6.46	50.0
5.000	PP3	SW9	12.054	0.600	76.500	75.877	0.623	19.3	150	5.09	50.0
4.000	PP4	SW9	13.588	0.600	76.700	75.877	0.823	16.5	150	5.09	50.0
1.008	SW9	SW10	33.517	0.600	75.577	75.450	0.127	263.9	450	6.91	50.0
1.009	SW10	BASIN	19.269	0.600	75.450	75.000	0.450	42.8	450	7.01	50.0
6.000	PP5	SW11	12.010	0.600	77.750	76.950	0.800	15.0	300	5.05	50.0
6.001	SW11	SW12	18.050	0.600	76.950	76.591	0.359	50.3	300	5.18	50.0
6.002	SW12	BASIN	42.388	0.600	76.591	75.150	1.441	29.4	300	5.43	50.0
1.010	BASIN	BASIN HYDRB	17.246	0.600	75.000	74.928	0.072	238.0	450	7.23	50.0
1.011	BASIN HYDRB	OUTFALL	66.920	0.600	74.928	74.200	0.728	91.9	300	7.91	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.004	2.454	271.0	54.6	1.000	1.000	0.216	0.0	114	1.939
1.005	1.571	249.8	74.1	1.000	1.000	0.293	0.0	167	1.376
1.006	1.030	163.8	74.1	1.000	1.111	0.293	0.0	212	1.005
1.007	1.030	163.8	74.1	1.111	1.173	0.293	0.0	212	1.005
5.000	2.300	40.6	8.9	0.650	1.173	0.035	0.0	47	1.839
4.000	2.491	44.0	6.3	0.650	1.173	0.025	0.0	38	1.778
1.008	1.246	198.2	114.6	1.173	1.000	0.453	0.0	246	1.289
1.009	3.113	495.1	119.7	1.000	0.950	0.473	0.0	150	2.583
6.000	4.078	288.2	21.8	0.500	1.000	0.086	0.0	55	2.436
6.001	2.222	157.1	30.6	1.000	1.109	0.121	0.0	89	1.735
6.002	2.909	205.6	48.3	1.109	0.950	0.191	0.0	99	2.394
1.010	1.313	208.9	168.0	0.950	1.022	0.664	0.0	307	1.454
1.011	1.640	115.9	168.0	1.172	0.700	0.664	0.0	300	1.661

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	14.449	32.1	225	Circular	78.900	77.675	1.000	78.450	77.225	1.000
1.001	10.361	41.4	225	Circular	78.450	77.225	1.000	78.200	76.975	1.000
1.002	16.210	36.0	225	Circular	78.200	76.975	1.000	77.950	76.525	1.200
2.000	18.606	37.2	150	Circular	77.900	77.100	0.650	77.950	76.600	1.200
3.000	13.112	18.7	150	Circular	78.100	77.300	0.650	77.950	76.600	1.200
1.003	27.002	77.1	375	Circular	77.950	76.375	1.200	77.400	76.025	1.000
1.004	10.938	54.7	375	Circular	77.400	76.025	1.000	77.200	75.825	1.000

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW1	1200	Manhole	Adoptable	SW2	1200	Manhole	Adoptable
1.001	SW2	1200	Manhole	Adoptable	SW3	1200	Manhole	Adoptable
1.002	SW3	1200	Manhole	Adoptable	SW4	1200	Manhole	Adoptable
2.000	PP1	1200	Manhole	Adoptable	SW4	1200	Manhole	Adoptable
3.000	PP2	1200	Manhole	Adoptable	SW4	1200	Manhole	Adoptable
1.003	SW4	1200	Manhole	Adoptable	SW5	1200	Manhole	Adoptable
1.004	SW5	1200	Manhole	Adoptable	SW6	1200	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.005	8.342	166.8	450	Circular	77.200	75.750	1.000	77.150	75.700	1.000
1.006	23.439	385.0	450	Circular	77.150	75.700	1.000	77.200	75.639	1.111
1.007	23.887	385.0	450	Circular	77.200	75.639	1.111	77.200	75.577	1.173
5.000	12.054	19.3	150	Circular	77.300	76.500	0.650	77.200	75.877	1.173
4.000	13.588	16.5	150	Circular	77.500	76.700	0.650	77.200	75.877	1.173
1.008	33.517	263.9	450	Circular	77.200	75.577	1.173	76.900	75.450	1.000
1.009	19.269	42.8	450	Circular	76.900	75.450	1.000	76.400	75.000	0.950
6.000	12.010	15.0	300	Circular	78.550	77.750	0.500	78.250	76.950	1.000
6.001	18.050	50.3	300	Circular	78.250	76.950	1.000	78.000	76.591	1.109
6.002	42.388	29.4	300	Circular	78.000	76.591	1.109	76.400	75.150	0.950
1.010	17.246	238.0	450	Circular	76.400	75.000	0.950	76.400	74.928	1.022
1.011	66.920	91.9	300	Circular	76.400	74.928	1.172	75.200	74.200	0.700

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.005	SW6	1200	Manhole	Adoptable	SW7	1200	Manhole	Adoptable
1.006	SW7	1200	Manhole	Adoptable	SW8	1200	Manhole	Adoptable
1.007	SW8	1200	Manhole	Adoptable	SW9	1200	Manhole	Adoptable
5.000	PP3	1200	Manhole	Adoptable	SW9	1200	Manhole	Adoptable
4.000	PP4	1200	Manhole	Adoptable	SW9	1200	Manhole	Adoptable
1.008	SW9	1200	Manhole	Adoptable	SW10	1200	Manhole	Adoptable
1.009	SW10	1200	Manhole	Adoptable	BASIN	1200	Manhole	Adoptable
6.000	PP5	1500	Manhole	Adoptable	SW11	1200	Manhole	Adoptable
6.001	SW11	1200	Manhole	Adoptable	SW12	1200	Manhole	Adoptable
6.002	SW12	1200	Manhole	Adoptable	BASIN	1200	Manhole	Adoptable
1.010	BASIN	1200	Manhole	Adoptable	BASIN HYDRB	1200	Manhole	Adoptable
1.011	BASIN HYDRB	1200	Manhole	Adoptable	OUTFALL	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	1440	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		

Storm Durations

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

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

Node BASIN HYDRB Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	74.928	Product Number	CTL-SHE-0066-2000-1100-2000
Design Depth (m)	1.100	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node PP1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	77.100	Slope (1:X)	450.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.500
Safety Factor	2.0	Width (m)	8.900	Inf Depth (m)	
Porosity	0.30	Length (m)	50.400		

Node PP2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	77.300	Slope (1:X)	450.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.500
Safety Factor	2.0	Width (m)	11.000	Inf Depth (m)	
Porosity	0.30	Length (m)	23.800		

Node PP3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	76.500	Slope (1:X)	450.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.500
Safety Factor	2.0	Width (m)	12.000	Inf Depth (m)	
Porosity	0.30	Length (m)	29.000		

Node PP4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	76.700	Slope (1:X)	450.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.500
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	25.100		

Node PP5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	77.750	Slope (1:X)	450.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.500
Safety Factor	2.0	Width (m)	97.700	Inf Depth (m)	
Porosity	0.30	Length (m)	8.800		

Node BASIN Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	75.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	618.0	0.0	1.400	1069.0	0.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.80%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	77.773	0.098	33.0	0.1103	0.0000	OK
15 minute summer	SW2	10	77.335	0.110	32.9	0.1245	0.0000	OK
15 minute summer	SW3	10	77.077	0.102	32.7	0.1152	0.0000	OK
15 minute summer	PP1	12	77.174	0.074	20.3	3.3577	0.0000	OK
15 minute summer	PP2	12	77.348	0.048	11.7	1.7544	0.0000	OK
15 minute summer	SW4	11	76.540	0.165	83.1	0.1872	0.0000	OK
15 minute summer	SW5	11	76.197	0.172	83.3	0.1951	0.0000	OK
15 minute summer	SW6	11	76.059	0.309	116.5	0.3497	0.0000	OK
15 minute summer	SW7	11	76.026	0.326	116.3	0.3682	0.0000	OK
15 minute summer	SW8	11	75.966	0.327	115.7	0.3702	0.0000	OK
15 minute summer	PP3	12	76.555	0.055	15.8	2.5470	0.0000	OK
15 minute summer	PP4	12	76.747	0.047	11.3	1.5225	0.0000	OK
15 minute summer	SW9	11	75.906	0.329	176.5	0.3721	0.0000	OK
15 minute summer	SW10	10	75.713	0.263	185.5	0.2969	0.0000	OK
30 minute summer	PP5	21	77.803	0.053	35.4	11.0675	0.0000	OK
30 minute summer	SW11	19	77.041	0.091	30.2	0.1029	0.0000	OK
15 minute summer	SW12	11	76.703	0.112	58.0	0.1264	0.0000	OK
1440 minute winter	BASIN	1410	75.582	0.582	16.0	415.0065	0.0000	SURCHARGED
1440 minute winter	BASIN HYDRB	1410	75.582	0.654	2.1	0.7398	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	74.200	0.000	1.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	32.9	1.838	0.357	0.2585	
15 minute summer	SW2	1.001	SW3	32.7	1.778	0.403	0.1904	
15 minute summer	SW3	1.002	SW4	32.4	1.949	0.373	0.2696	
15 minute summer	PP1	2.000	SW4	13.1	1.574	0.450	0.1558	
15 minute summer	PP2	3.000	SW4	8.4	1.793	0.204	0.0617	
15 minute summer	SW4	1.003	SW5	83.3	1.735	0.365	1.3001	
15 minute summer	SW5	1.004	SW6	83.3	1.634	0.307	0.6663	
15 minute summer	SW6	1.005	SW7	116.3	1.010	0.465	0.9966	
15 minute summer	SW7	1.006	SW8	115.7	0.940	0.707	2.8869	
15 minute summer	SW8	1.007	SW9	115.3	0.960	0.704	2.9585	
15 minute summer	PP3	5.000	SW9	10.7	1.884	0.264	0.0688	
15 minute summer	PP4	4.000	SW9	8.6	1.891	0.196	0.0619	
15 minute summer	SW9	1.008	SW10	176.9	1.714	0.892	3.6469	
15 minute summer	SW10	1.009	BASIN	188.4	3.596	0.380	1.0576	
30 minute summer	PP5	6.000	SW11	19.5	1.611	0.068	0.1559	
30 minute summer	SW11	6.001	SW12	29.9	1.502	0.191	0.3744	
15 minute summer	SW12	6.002	BASIN	57.6	2.472	0.280	0.9880	
1440 minute winter	BASIN	1.010	BASIN HYDRB	2.1	0.147	0.010	2.7325	
1440 minute winter	BASIN HYDRB	Hydro-Brake®	OUTFALL	1.9				266.2

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.80%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	SW1	10	77.788	0.113	42.2	0.1283	0.0000	OK
15 minute summer	SW2	10	77.354	0.129	42.0	0.1460	0.0000	OK
15 minute summer	SW3	10	77.094	0.119	41.8	0.1340	0.0000	OK
30 minute summer	PP1	20	77.185	0.085	23.9	4.4488	0.0000	OK
15 minute summer	PP2	12	77.355	0.054	15.0	2.2631	0.0000	OK
15 minute summer	SW4	11	76.567	0.192	105.7	0.2172	0.0000	OK
15 minute summer	SW5	11	76.227	0.202	105.9	0.2288	0.0000	OK
15 minute summer	SW6	11	76.151	0.401	148.7	0.4532	0.0000	OK
15 minute summer	SW7	11	76.114	0.414	148.2	0.4687	0.0000	OK
15 minute summer	SW8	11	76.050	0.411	147.4	0.4651	0.0000	OK
30 minute summer	PP3	20	76.563	0.063	18.6	3.2709	0.0000	OK
15 minute summer	PP4	12	76.752	0.052	14.4	1.8825	0.0000	OK
15 minute summer	SW9	11	75.984	0.407	225.7	0.4600	0.0000	OK
15 minute summer	SW10	10	75.742	0.292	236.4	0.3307	0.0000	OK
30 minute summer	PP5	21	77.812	0.062	45.7	13.5065	0.0000	OK
30 minute summer	SW11	19	77.059	0.109	41.5	0.1236	0.0000	OK
15 minute summer	SW12	11	76.721	0.130	76.3	0.1476	0.0000	OK
1440 minute winter	BASIN	1410	75.742	0.742	20.4	547.9421	0.0000	SURCHARGED
1440 minute winter	BASIN HYDRB	1410	75.742	0.814	4.4	0.9204	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	74.200	0.000	1.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	SW1	1.000	SW2	42.0	1.928	0.456	0.3150	
15 minute summer	SW2	1.001	SW3	41.8	1.867	0.516	0.2318	
15 minute summer	SW3	1.002	SW4	41.4	2.063	0.476	0.3255	
30 minute summer	PP1	2.000	SW4	16.5	1.658	0.566	0.1857	
15 minute summer	PP2	3.000	SW4	10.7	1.909	0.259	0.0735	
15 minute summer	SW4	1.003	SW5	105.9	1.804	0.465	1.5849	
15 minute summer	SW5	1.004	SW6	106.3	1.647	0.392	0.8876	
15 minute summer	SW6	1.005	SW7	148.2	1.038	0.593	1.2587	
15 minute summer	SW7	1.006	SW8	147.4	0.968	0.900	3.5694	
15 minute summer	SW8	1.007	SW9	147.9	1.021	0.903	3.6144	
30 minute summer	PP3	5.000	SW9	13.6	1.994	0.333	0.0870	
15 minute summer	PP4	4.000	SW9	11.4	1.971	0.258	0.1268	
15 minute summer	SW9	1.008	SW10	225.4	1.839	1.137	4.3303	
15 minute summer	SW10	1.009	BASIN	240.6	3.710	0.486	1.3022	
30 minute summer	PP5	6.000	SW11	27.3	1.752	0.095	0.2002	
30 minute summer	SW11	6.001	SW12	41.2	1.635	0.262	0.4727	
15 minute summer	SW12	6.002	BASIN	75.7	2.651	0.368	1.2104	
1440 minute winter	BASIN	1.010	BASIN HYDRB	4.4	0.150	0.021	2.7325	
1440 minute winter	BASIN HYDRB	Hydro-Brake®	OUTFALL	1.9				277.4

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.80%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	77.818	0.143	59.0	0.1613	0.0000	OK
15 minute summer	SW2	10	77.390	0.165	58.8	0.1866	0.0000	OK
15 minute summer	SW3	11	77.126	0.151	58.4	0.1711	0.0000	OK
30 minute summer	PP1	20	77.203	0.103	33.5	6.5451	0.0000	OK
30 minute summer	PP2	20	77.365	0.065	19.3	3.1018	0.0000	OK
15 minute summer	SW4	11	76.838	0.463	146.8	0.5239	0.0000	SURCHARGED
15 minute summer	SW5	11	76.654	0.629	143.4	0.7112	0.0000	SURCHARGED
15 minute summer	SW6	11	76.554	0.804	201.1	0.9096	0.0000	SURCHARGED
15 minute summer	SW7	11	76.480	0.780	199.6	0.8824	0.0000	SURCHARGED
15 minute summer	SW8	11	76.345	0.706	198.3	0.7984	0.0000	SURCHARGED
15 minute summer	PP3	12	76.576	0.076	28.3	4.6174	0.0000	OK
15 minute summer	PP4	12	76.762	0.062	20.2	2.6451	0.0000	OK
15 minute summer	SW9	11	76.207	0.630	306.4	0.7128	0.0000	SURCHARGED
1440 minute winter	SW10	1440	76.029	0.579	20.3	0.6546	0.0000	SURCHARGED
30 minute summer	PP5	20	77.827	0.077	64.0	17.4021	0.0000	OK
30 minute summer	SW11	19	77.091	0.141	62.8	0.1592	0.0000	OK
15 minute summer	SW12	11	76.755	0.164	111.5	0.1857	0.0000	OK
1440 minute winter	BASIN	1440	76.029	1.029	28.4	807.4728	0.0000	SURCHARGED
1440 minute winter	BASIN HYDRB	1440	76.029	1.101	5.0	1.2450	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	74.200	0.000	1.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	58.8	2.033	0.638	0.4171	
15 minute summer	SW2	1.001	SW3	58.4	1.976	0.721	0.3060	
15 minute summer	SW3	1.002	SW4	57.9	2.212	0.666	0.5525	
30 minute summer	PP1	2.000	SW4	21.9	1.754	0.748	0.2320	
30 minute summer	PP2	3.000	SW4	15.8	2.067	0.382	0.1153	
15 minute summer	SW4	1.003	SW5	143.4	1.847	0.629	2.9782	
15 minute summer	SW5	1.004	SW6	144.3	1.686	0.533	1.2064	
15 minute summer	SW6	1.005	SW7	199.6	1.260	0.799	1.3217	
15 minute summer	SW7	1.006	SW8	198.3	1.252	1.211	3.7138	
15 minute summer	SW8	1.007	SW9	199.1	1.257	1.216	3.7847	
15 minute summer	PP3	5.000	SW9	20.2	2.098	0.497	0.1598	
15 minute summer	PP4	4.000	SW9	15.8	1.978	0.359	0.1664	
15 minute summer	SW9	1.008	SW10	302.2	1.995	1.524	4.8420	
1440 minute winter	SW10	1.009	BASIN	20.3	1.251	0.041	3.0530	
30 minute summer	PP5	6.000	SW11	42.1	1.937	0.146	0.2770	
30 minute summer	SW11	6.001	SW12	62.5	1.843	0.398	0.6472	
15 minute summer	SW12	6.002	BASIN	110.4	2.901	0.537	1.6141	
1440 minute winter	BASIN	1.010	BASIN HYDRB	5.0	0.154	0.024	2.7325	
1440 minute winter	BASIN HYDRB	Hydro-Brake®	OUTFALL	2.0				311.6