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Engineering

Working Beyond Expectations

Water Cycle Management Plan

To accompany the Stage 1 and 2 Development Application for the Bonnyrigg Estate Masterplan

Property:
Humphries Road, Bonnyrigg

Applicant:
NSW Land and Housing Corporation

Date:
8th November 2021

Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	Preliminary Issue	26th August 2020	BS	ND
B	Client Comments	19th October 2020	BS	ND
C	Council Comments	24th September 2021	JY	ND
D	2nd Council Comments	8th November 2021	JY	ND

Executive Summary

ADW Johnson has been commissioned by the NSW Land and Housing Corporation to prepare a Water Cycle Management Plan (WCMP) for a proposed renewal/replacement of the existing NSW Bonnyrigg Housing Estate as a part of the Bonnyrigg Living Communities Project (BLCP). The preparation of this management plan has been undertaken to accompany a Development Application required for the proposed subdivision.

The proposed development had an initial masterplan which was completed in 2008. A number of stages have already been constructed/approved for construction based on this masterplan. An updated proposed concept masterplan has been prepared for Stages 8–18 of the development, covering the remaining site area, broken into the east and west precincts. This WCMP has been competed to supersede the previous detention and water quality strategy was prepared by Arcadis dated December 2019, as well as relate to the current masterplan.

The stormwater detention provided by the development includes an underground stormwater tank and an aboveground basin. The detention infrastructure helps to limit the post-development critical peak discharges leaving the site to less than that of pre-development for all storm events up to the 1% AEP. Furthermore, the detention infrastructure improves the existing stormwater situation between Humphries Road and Green Valley Creek.

The effect of this development on the stormwater situation between Humphries Road and Green Valley Creek has been verified by 2D flood modelling which generally shows a reduction in velocities, velocity depth and flood level depth.

A treatment train process of GPTs, biofiltration and stormwater filter cartridges have been designed to effectively reduce the nutrients and gross pollutants from stormwater runoff from the proposed development prior to discharge into the downstream stormwater infrastructure and ultimately Green Valley Creek.

The WCMP for the proposed development meets the objectives and requirements outlined in Fairfield City Councils Stormwater Management Policy (September 2017).

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1.0 Introduction

ADW Johnson has been commissioned by the NSW Land and Housing Corporation (LAHC) to prepare a Water Cycle Management Plan (WCMP) for a proposed renewal/replacement of the existing NSW Bonnyrigg Housing Estate as a part of the Bonnyrigg Living Communities Project (BLCP).

An initial masterplan was completed in 2008. A number of stages have already been constructed/approved for construction based on this masterplan. An updated proposed concept masterplan has been prepared for Stages 8–18 of the development, covering the remaining site area, broken into the east and west precincts.

A detention and water quality strategy was prepared by Arcadis dated December 2019 (hereafter referred to as: The Stormwater Strategy by Arcadis) as part of the updated masterplan documentation. This stormwater strategy outlined both water quality and detention strategies along with a review of existing drainage infrastructure.

Based on this masterplan, a concept subdivision layout has been prepared for the Eastern Precinct. This report has been prepared to accompany a Development Application for a 222 lot residential subdivision of the eastern precinct in two (2) stages.

This report documents the proposed stormwater system required to efficiently and effectively capture and convey the stormwater from the proposed development and upstream catchments, and ensure that there are no adverse effects from the proposed development on water quality to the receiving waters or additional flooding of downstream properties or infrastructure.

2.0 Site Description

The Bonnyrigg Housing Estate is located in Bonnyrigg and is bound by Edensor Road to the north, Humphries Road to the east, Cabramatta Road West/ Elizabeth Drive to the south and Bonnyrigg Avenue to the west. Stage 1 and Stage 2 are located at the north eastern end of the site. The development is within the Fairfield City Council Local Government Area (LGA).

The current site is an existing housing estate complete with existing roads, services, and associated infrastructure. The existing estate contains a mix of privately owned residential dwellings and existing social housing. **Figure 1.0** below shows the existing site with the proposed site outline for Stage 1 and Stage 2.

Immediately to the west of the site are recently constructed social housing dwellings, a recently constructed park and an area of demolished housing which is DA approved for new social housing dwellings.

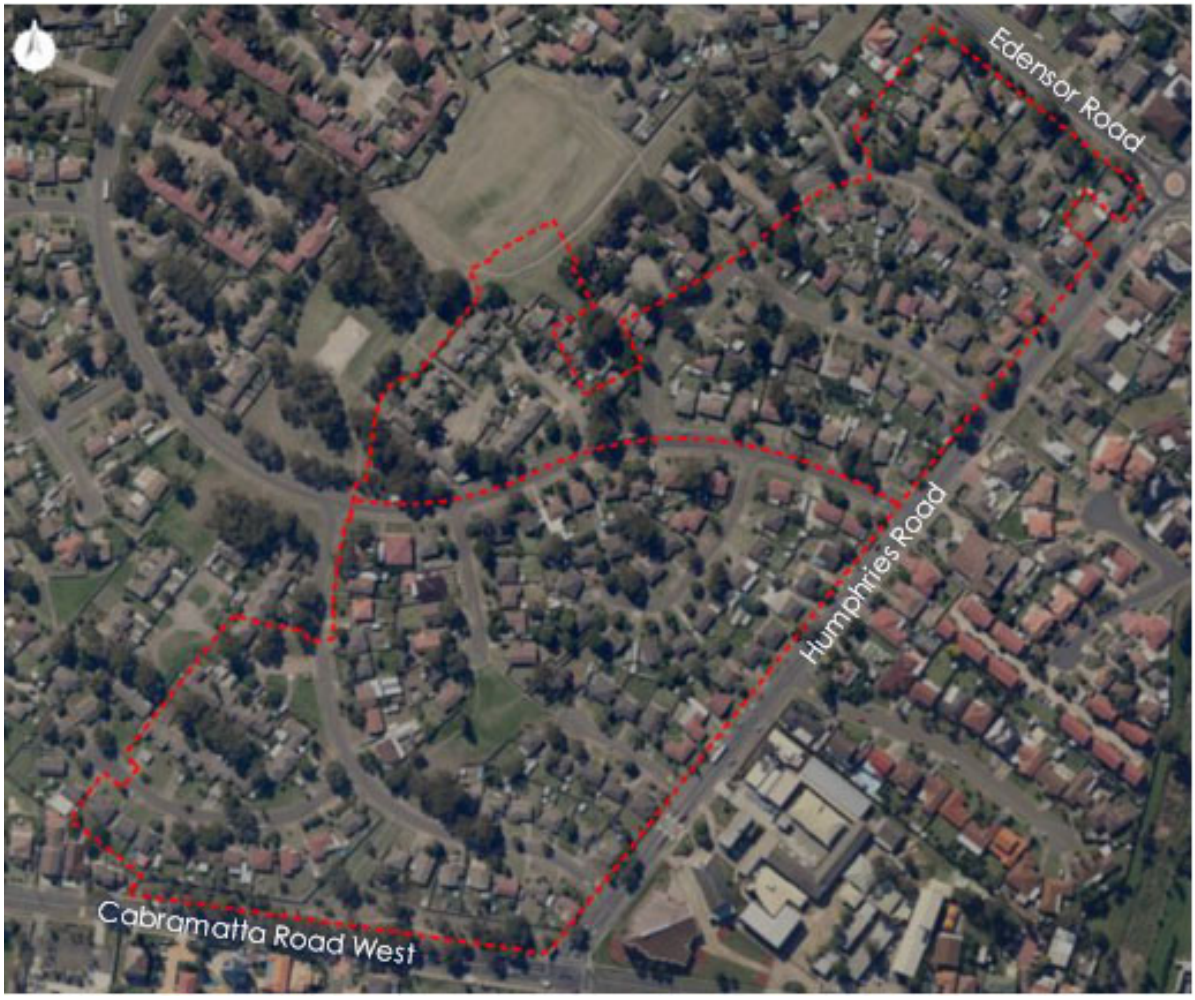

Figure 1.0: Bonnyrigg Estate Site

2.1 TOPOGRAPHY AND EXISTING STORMWATER INFRASTRUCTURE

The site, as shown in **Figure 1.0** above, is an existing housing estate. As such, the existing development has a high percentage impervious when compared to a greenfield site. The existing catchment area for this site is approximately 19.4ha which includes some stages of development that are already developed, some stages which are currently under development and some which still contain existing dwellings.

The subject site grades towards Humphries Road and ultimately discharges to Green Valley Creek. As a result of the existing stormwater infrastructure within Humphries Road, there are three (3) main discharge locations for the existing development. Based on Dial Before You Dig (DBYD) information, it appears that the existing stormwater infrastructure located in Edensor Road and Cabramatta Road West conveys stormwater past Humphries Road and therefore is not included within this study. Furthermore, it appears that there is not any existing stormwater detention or treatment devices within or downstream of the existing development.

Refer to **Exhibit 1** for the existing site catchments and downstream stormwater infrastructure.

2.2 BACKGROUND INFORMATION

As part of the updated masterplan documentation a stormwater report '*BONNYRIGG LIVING COMMUNITIES – DETENTION AND WATER QUALITY STRATEGY' was prepared* by Arcadis in December 2019. This previous report by Arcadis outlined the strategy to accommodate the stormwater quality and quantity requirements for the proposed renewal/replacement of the existing NSW Bonnyrigg Housing Estate. The existing report also completed an assessment of the existing receiving stormwater infrastructure.

The existing report integrated both detention storage and water quality treatments utilising both an underground detention tank and detention/water quality basins. With the proposed subdivision remaining relatively similar to the masterplan, this approach will be used as a base for the proposed development. This report updates the proposed stormwater strategy to account for the updated catchments, updated percentage impervious and more detailed stormwater modelling. Therefore, this WCMP will supersede all previous stormwater strategies for this eastern catchment of the proposed development.

3.0 Proposed Development

The proposed Development Application seeks consent to renew/replace the existing NSW Bonnyrigg Housing Estate by creating a new integrated community.

The Development Application seeks approval for a 222 lot residential subdivision of the existing site in two (2) stages including:

- Site preparation works, including tree removal, demolition of roads, services and earthworks across the site;
- The provision and augmentation of utilities and services infrastructure across the site;
- The construction of internal roads and internal infrastructure;
- The consolidation of existing lots and subdivision of the site to reflect the revised road layout, open space;
- Construction of on-site stormwater detention and treatment devices.

An image of the DA layout and the proposed road reconfiguration is provided at **Figure 2.0** below.

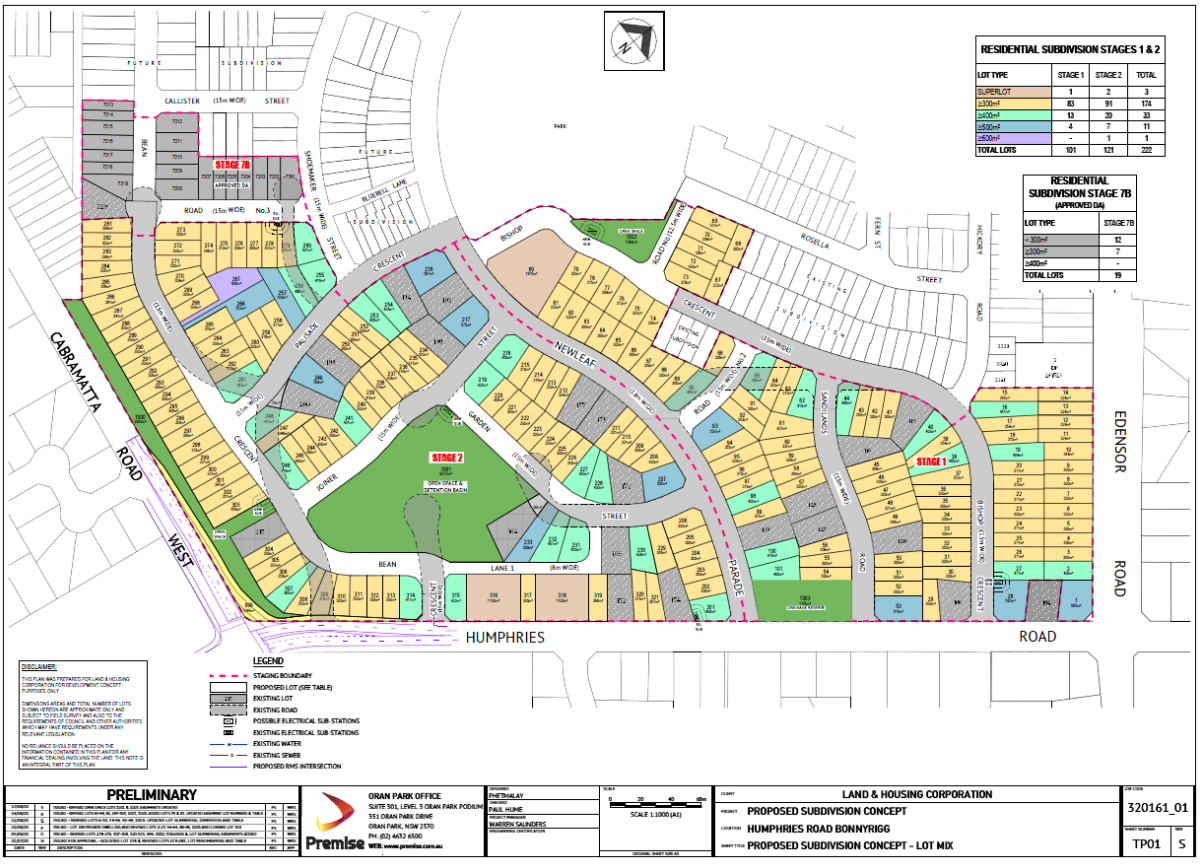

Figure 2.0: Stage 1 and Stage 2 DA Lot Layout

4.0 Objectives

The proposed development is to comply with the following Fairfield City Council documents:

- Stormwater Management Policy – September 2017.

All stormwater modelling within this report has been completed in accordance with the aforementioned document.

4.1 CONCEPT STORMWATER DESIGN

A concept stormwater design is required to demonstrate that stormwater runoff can be effectively and efficiently conveyed from the proposed development and upstream catchments to the existing stormwater infrastructure and receiving waters. The stormwater design is required to consider adjacent properties and ensure the existing stormwater situation is being improved.

4.2 STORMWATER QUANTITY

To ensure that there is no adverse impact on downstream properties or infrastructure, onsite detention is to be utilised to limit peak flows leaving the site.

The detention is to be sized to comply with Section 4 – On Site Detention Systems of Fairfield City Council's Stormwater Management Policy 2017.

The performance criteria for onsite detention systems within this policy is stated as:

- Maximum PSD of 140L/sec/ha for the 9 hour 100-year ARI for the total site; and
- Maximum PSD of the pre-developed site discharge for the 5, 15, 30, 60, 90, 120 and 540 minute duration storms for the 5 and 100 year ARIs for the total site.

Further to the above requirements, the stormwater detention modelling has been completed ensuring the post development flows do not exceed the pre development flows.

4.3 STORMWATER QUALITY

The stormwater drainage system must effectively remove the nutrients and gross pollutants from the site prior to the runoff entering the existing downstream waterways as outlined in Section 6 – Water Quality Improvement of Fairfield City Council's Stormwater Management Policy 2017.

The stormwater design for the proposed development is to adopt Water Sensitive Design (WSUD) principles throughout the development to promote sustainable and integrated land and water resource management.

The guidelines for stormwater quality treatment objectives are expressed as mean annual reductions of pollutant loads. The target objectives were obtained from Section 6.2 of Council's stormwater management policy and are shown in **Table 4.3.1** overleaf.

Table 4.3.1: Stormwater Treatment Objectives

Pollutant	Stormwater Treatment Objectives
Gross Pollutants	90% reduction
Total suspended solids (TSS)	80% reduction
Total phosphorus (TP)	55% reduction
Total nitrogen (TN)	40% reduction

4.4 EROSION AND SEDIMENTATION CONTROL

Erosion and sedimentation control measures need to be implemented during any construction activities on the proposed development to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the construction site to downstream drainage.

4.5 OVERLAND FLOODING

The proposed development is to ensure that there is no adverse impact on downstream properties or infrastructure through overland flooding. The development is to ensure the detention of the proposed development is sufficient to ensure that the flood level difference, velocity difference and velocity depth difference for the post development scenario is equal to or improved when compared to the pre developed scenario.

5.0 Concept Stormwater Design

A stormwater drainage concept plan has been prepared to demonstrate how the stormwater runoff for the proposed development and the upstream catchments is captured and transported to the existing stormwater infrastructure in Humphries Road and ultimately to Green Valley Creek. Refer to **Exhibit 2** for the proposed overall stormwater catchments and proposed stormwater layout.

The site has been separated into three (3) catchments corresponding to the three (3) discharge locations downstream of Humphries Road. All three (3) of the catchments ultimately flow to Green Valley Creek to the south east of the site. It is proposed to utilise the existing drainage system in Humphries Road and downstream of Humphries Road to convey the discharge from the site to Green Valley Creek downstream.

The proposed stormwater system contains a combination of conventional pit and pipe networks, detention facilities and WSUD elements to effectively convey stormwater runoff from the site and upstream catchments to the receiving infrastructure.

Due to the topography of the site and the proposed reconfiguration of the roads and lots, the size of the catchments contributing flows to each of the three (3) discharge locations have been altered from the current state. Based on this, the area of Catchment No. 3 has been reduced and the peak flows leaving the site following redevelopment will be less than the existing flows without any detention.

Due to the reconfiguration of contributing catchments and the increase in impervious area Catchments No. 1 and No. 2 will require detention. The detention has been designed as a combination of a detention basin and a detention tank.

Each of the catchments will incorporate water quality infrastructure to remove nutrients and sediments from the stormwater prior to the runoff leaving the site.

As a part of the analysis of the existing stormwater situation, stormwater modelling was completed which indicated that the existing stormwater infrastructure within Humphries Road and downstream of Humphries Road is currently over capacity at each of the three (3) outlets. At each of the low points in Humphries Road, it was evident that in both the minor (5 year ARI) and major (100 year ARI) storm events there is overland flow crossing Humphries Road. The proposed stormwater management for the site has been designed to ensure that the existing conditions are improved as a result of the works. The results have been verified via 2D flood modelling.

Details of the stormwater design for each of the three (3) catchments are shown below.

5.1 CATCHMENT 1

Catchment 1 relates to the contributing catchment to Outlet 1 and stormwater pipe reaches O1R1 to O1R7 as shown on **Exhibit 2**. A further breakdown of the stormwater catchments for Outlet 1 can be seen in **Exhibit 3**.

Catchment 1 receiving infrastructure currently consists of a pit and pipe stormwater network located in Humphries Road as well as within the existing Our Lady of Mt Carmel School site.

The details of this network are as follows:

- O1R1 – 600mm pipe;
- O1R2 – 0.6m x 0.75m box culvert;
- O1R3 – 375mm pipe;
- O1R4 – 525mm pipe;
- O1R5 – 600mm pipe;
- O1R6 – 600mm pipe;
- O1R7 – 600mm pipe.

O1R7 of the above network currently conveys a stormwater catchment of approximately 7.76ha through Our Lady of Mt Carmel School to Green Valley Creek. The proposed design will utilise the abovementioned network to convey a stormwater catchment of approximately 8.51ha to the same discharge location.

In order to alleviate the additional peak flow created via the increased stormwater catchment and percentage impervious of the catchment, it is proposed to utilise an aboveground stormwater basin to detain the post developed peak flow to less than the pre developed peak flow. The design, as can be seen in **Exhibit 6** and **Exhibit 7**, will have two (2) stormwater inlets into the detention infrastructure. The detention infrastructure will be located within the proposed park and will incorporate landscape features to achieve an astatically pleasing outcome.

The two (2) detention infrastructure inlets will incorporate individual Rocla CDS GPT's to remove gross pollutants and suspended solid prior to discharge to the underground detention tank. The eastern and western inlet will have a splitter pit to allow the diversion of higher flows downstream of the proposed GPT's. The low flows will be directed from the GPT's to the biofiltration area for further treatment.

Catchment 1 has a small bypass area which is not able to be conveyed to the abovementioned stormwater detention/water quality system. This small bypass area has been accounted for in Catchment 1 overall detention modelling and has included Ecosol street pit inserts where possible to provide a small percentage of water quality treatment.

Other options were explored during the design process including:

- Having an underground tank with water quality cartridges;
- Having a deeper basin which is fenced off; and
- Having a larger aboveground basin which takes up the majority of the park area.

These alternatives were not selected as the preferred solution due to higher maintenance burdens and operating cost as per our discussions with Council.

After consultation with Fairfield City Council, it was determined that the above ground detention basin would be required to be designed and built to Dams Safety NSW requirements. As part of the proposed Construction Certificate design for the development, it is expected that the proposed basin will be designed to Dams Safety NSW requirements and the plans would be reviewed/approved by Dams Safety NSW prior to construction. It is noted that Fairfield City Council will not accept handover of the basin until this has been completed.

5.2 CATCHMENT 2

Catchment 2 relates to the contributing catchment to Outlet 2 and stormwater pipe reaches O2R1 to O2R4 as shown on **Exhibit 2**. A further breakdown of the stormwater catchments for Outlet 2 can be seen in **Exhibit 4**.

Catchment 2 receiving infrastructure currently consists of a pit and pipe stormwater network located in Humphries Road as well as along an access handle through another social housing estate.
The details of this network are as follows:

- O2R1 – 375mm pipe;
- O2R2 – 375mm pipe;
- O2R3 – 675mm pipe;
- O2R4 – 750mm pipe.

O2R4 of the above network currently conveys a stormwater catchment of approximately 7.46ha along the access handle through another social housing estate to Green Valley Creek. The proposed design will utilise the abovementioned network to convey a stormwater catchment of approximately 8.03ha to the same discharge location.

In order to alleviate the additional peak flow created via the increased stormwater catchment and percentage impervious of the catchment, it is proposed to utilise an underground stormwater tank to detain the post developed peak flow to less than the pre developed peak flow. The design, as can be seen in **Exhibit 8**, will have three (3) stormwater inlets into the detention infrastructure. The detention infrastructure will be located within the proposed open space lot.

The eastern and western inlets will incorporate individual Rocla CDS GPT's to remove gross pollutants and suspended solids prior to discharge to the underground detention tank. The northern inlet is from an interallotment drainage line and does not require a GPT. The eastern and western lines will each have a splitter pit upstream of the GPT to allow the diversion of higher flows downstream of the proposed stormwater infrastructure. The underground tank will contain 30 Ocean Protect water quality filter cartridges or approved equivalent which will treat the stormwater and allow the proposed development to meet Council's required water quality targets.

Catchment 2 has a small bypass area which is not able to be conveyed to the abovementioned stormwater detention/water quality system. This small bypass area has been accounted for in Catchment 2 overall detention modelling and overall water quality modelling.

Another option explored during the design process was replacing the water quality cartridges with an Ocean Protect Jellyfish and providing a smaller underground tank for detention. This alternative was not selected as the preferred solution due to higher maintenance burdens and operating cost.

5.3 CATCHMENT 3

Catchment 3 relates to the contributing catchment to Outlet 3 and stormwater pipe reaches O3R1 to O3R4 as shown on **Exhibit 2**. A further breakdown of the stormwater catchments for Outlet 3 can be seen in **Exhibit 5**.

Catchment 3 receiving infrastructure currently consists of a pit and pipe stormwater network located in Humphries Road as well as through private property to Henshaw Close. The details of this network are as follows:

- O3R1 – 450mm pipe;
- O3R2 – 525mm pipe;
- O3R3 – 600mm pipe;
- O3R4 – 600mm pipe.

O3R4 of the above network currently conveys a stormwater catchment of approximately 4.2ha through the private property to Green Valley Creek. The proposed design will utilise the abovementioned network to convey a stormwater catchment of approximately 2.16ha.

As can be seen from the above pre and post development catchment areas, there is a decrease in area of approximately 2.04ha. Although there is an increase in percentage impervious for the Catchment 3, the significant decrease in the catchment area ensures that the post development flows are less than the pre development flows, therefore no stormwater detention is required.

After consultation with Fairfield City Council, it was determined that there is insufficient room in the verge of Bishop Street for a GPT or a Jellyfish device to be installed and they would be extremely difficult to maintain. As such Catchment 3 will have no water quality treatment which is as per the existing conditions. It is noted that the catchment has decreased significantly and therefore the water quality of Catchment 3 has consequently increased when compared to current conditions.

6.0 Stormwater Quantity

The proposed stormwater system needs to protect downstream properties and infrastructure from increased stormwater flows as a result of the development. To ensure there are no adverse impacts on the downstream properties and infrastructure the stormwater system will be designed to ensure that the post-development critical peak flows leaving the site are less than the existing flows for all design storms up to the 1% AEP storm event.

As the development of the site will result in an increased impervious area, on-site detention will be required to reduce the peak flows back to existing conditions.

The quantity of required storage to reduce the post developed discharge from the site to less than or equal to the existing discharge for various storm events was analysed using the 'DRAINS' software, which uses the runoff routing method.

6.1 MODEL PARAMETERS AND RAINFALL DATA

The model parameters adopted for analysis of stormwater runoff are in accordance with the Fairfield City Council Stormwater Management Policy, which are outlined in **Table 6.1.1** below.

Table 6.1.1: DRAINS Model Parameters

Parameter Description	Value
Soil type – normal	4.0
Paved (impervious) area depression storage	1mm
Supplementary area depression storage	5mm
Antecedent moisture conditions for all ARIs	4mm
Sag Pit blockage factor (major systems)	50%
On grade pit blockage factor	30%
Inlet pit capacity	Max 100l/s for on grade pits
Minimum pit freeboard	150mm

Rainfall data for the site was sourced from the Bureau of Meteorology. A screenshot of the DRAINS model is contained in **Appendix A**.

The stormwater quantity analysis was initially completed using overall catchments as per **Exhibit 2**, however after a refined stormwater pit and pipe network within individual subcatchments was completed by JWP, the calculated flows from JWP were mimicked by amending the time of concentration for the larger catchments in the drains model.

6.2 CATCHMENT 1

6.2.1 Catchment Data

The catchment data for the existing site was based upon the detail survey and current site conditions, whilst the data for the developed site was based upon Council's guidelines and the proposed development layout.

The predeveloped catchments are detailed in **Exhibit 1**, whilst the catchment parameters are detailed in **Table 6.2.1.1** overleaf.

Table 6.2.1.1: Outlet 1 Pre-Developed Catchment Data

Catchment	Area (Ha)	Impervious %
E1.1	1.28	50%
E1.2	0.23	95%
E1.3	2.85	80%
E1.4	0.65	75%
E1.5	0.45	60%
E1.6	0.74	80%
E1.7	0.56	60%
E1.8	0.32	80%
E1.9	0.28	75%
E1.10	0.37	95%
E1.11	0.03	95%

The post-developed catchments were split into lots, roads and open space corresponding to the two (2) basin inlets and catchments bypassing the proposed detention infrastructure. The post-developed catchments for Outlet 1 are detailed in **Exhibit 3**, whilst the catchment parameters are detailed in **Table 6.2.1.2** below.

Table 6.2.1.2: Post-Developed Catchment Parameters

Catchment	Sub Catchment	Total Area (ha)	% Impervious
Western Inlet	Lots	3.82	77
	Road	1.33	95
	Open Space	0.46	5
Eastern Inlet	Lots	0.57	77
	Road	0.20	95
	Open Space	0.46	5
Bypass	Lots	0.86	77
	Road	0.36	95
	Open Space	0.05	5

6.2.2 Proposed Stormwater Management

The Drains modelling included the stormwater infrastructure as outlined in **Section 5.1** of this report. The details of the detention basin can be seen in **Table 6.2.2.1** and are shown further in **Exhibit 6** and **Exhibit 7**.

Table 6.2.2.1: Stormwater Basin and Tank Details

Basin Parameter	Detail
Basin Base Area	3,150m²
Maximum Basin Ponding Depth (minor storm)	0.17m
Maximum Basin Ponding Depth (major storm)	0.33m
Basin Emergency Weir Level	RL 36.1m
Basin Invert Level at Outlet	RL 35.7m
Basin Crest Level at Outlet	RL 36.3m
Outlet Controls	2 x 375mm diameter pipe - IL RL 34.8m
	Weir – 11m length - IL RL 36.1m

6.2.3 Results

In accordance with Council's requirements and best practice, modelling was undertaken to demonstrate compliance of post-development flows being less than or equal to the pre development flows as well as meeting Council's objectives as outlined in Section 4.2 of this report.

Based upon the modelling completed, it was apparent that the requirement of post developed flows being less than or equal to pre developed flows was more conservative than Council's requirements outlined in Section 4.2 of the report. As such, only the results of the pre to post developed flows was considered. The results of the DRAINS modelling are detailed in **Table 6.2.3.1** below.

Table 6.2.3.1 – Outlet 1 Results

		Pre-developed			*Post-developed*		
Storm event	**Reach**	**Pipe Flow (m^3/s)**	**Overland Flow (m^3/s)**	**Combined (m^3/s)**	**Pipe Flow (m^3/s)**	**Overland Flow (m^3/s)**	**Combined (m^3/s)**
Minor (5yr ARI)	**O1 R1**	0.51	2.13	2.64	0.67	1.47	2.14
	O1 R2	0.56	1.65	2.21	0.73	1.07	1.80
	O1 R3	0.13	1.77	1.90	0.13	1.20	1.33
	O1 R4	0.32	0.00	0.32	0.35	0.00	0.35
	O1 R5	0.32	0.00	0.32	0.35	0.00	0.35
	O1 R6	0.53	1.55	2.08	0.58	1.06	1.64
	O1 R7	0.64	1.76	2.40	0.66	1.33	1.99
Major (100yr ARI)	**O3 R1**	0.50	3.45	3.95	0.68	2.93	3.61
	O3 R2	0.56	2.96	3.52	0.76	2.49	3.25
	O3 R3	0.13	3.13	3.26	0.13	2.64	2.77
	O3 R4	0.32	0.00	0.32	0.35	0.00	0.35
	O1 R5	0.32	0.00	0.32	0.35	0.00	0.35
	O1 R6	0.53	2.97	3.50	0.58	2.62	3.20
	O1 R7	0.54	3.28	3.82	0.56	3.00	3.56

As outlined in **Section 5.1** of the report, O1R7 is the critical downstream infrastructure for Catchment 1.

From the results, it can be seen that in the both the minor and major storm events the post development peak discharge leaving the catchment is less than the current peak flows.

A review of the overland flows also indicates the current situation in Humphries Road with aboveground flows will be improved with the proposed stormwater management.

6.3 CATCHMENT 2

6.3.1 Catchment Data

The catchment data for the existing site was based upon the detail survey and current site conditions, whilst the data for the developed site was based upon Council's guidelines and the proposed development layout.

The predeveloped catchments are detailed in **Exhibit 1**, whilst the catchment parameters are detailed in **Table 6.3.1.1** below.

Table 6.3.1.1: Outlet 2 Pre-Developed Catchment Data

Catchment	Area (Ha)	Impervious %
E2.1	2.67	50%
E2.2	1.14	60%
E2.3	1.01	80%
E2.4	1.11	75%
E2.5	0.29	95%
E2.6	0.46	75%
E2.7	0.40	75%
E2.8	0.38	95%

The post-developed catchments were split into lots, roads and open space corresponding to the three (3) basin inlets and catchments bypassing the proposed detention infrastructure. The post-developed catchments for Outlet 2 are detailed in **Exhibit 4**, whilst the catchment parameters are detailed in **Table 6.3.1.2** below.

Table 6.3.1.2: Outlet 2 Post-Developed Catchment Data

Catchment	Sub Catchment	Total Area (ha)	% Impervious
Newleaf Parade Inlet (Splitter Pit)	Lots	2.21	77
	Road	1.18	95
	Open Space	0.83	5
Sandilands Road Inlet (Splitter Pit)	Lots	2.15	77
	Road	0.82	95
IAD Line	Lots	0.09	77
Bypass	Bypass inlet A	0.54	77
	Bypass inlet B	0.21	30
	Humphries road Bypass Tank	0.38	95

6.3.2 Proposed Stormwater Management

The Drains modelling included the underground stormwater tank as outlined in **Section 5.2** of this report. The details of the detention tank/basin can be seen in **Table 6.3.2.1** and are shown further in **Exhibit 8**.

Table 6.3.2.1: Stormwater Tank Details

Basin Parameter	Detail
Underground Tank Dimensions	50m (L) x 20m (W) x 1.9m (H)
Underground Tank Invert Level	RL 33.35m (RL 33.5m for false floor)
Underground Tank Weir Level	RL 34.27m
Underground Tank Roof Level	RL 35.4m
Outlet Controls	1200mm Opening – IL RL 33.35m
Water RL Level - Minor Storm	RL 35.13m
Water RL Level - Major Storm	RL 35.4m
Total Storage in Major Storm	1,080 m³ at RL 35.4m

6.3.3 Results

In accordance with Council's requirements and best practice, modelling was undertaken to demonstrate compliance of post-development flows being less than or equal to the pre development flows as well as meeting Council's objectives as outlined in Section 4.2 of this report.

Based upon the modelling completed it was apparent that the requirement of post developed flows being less than or equal to pre developed flows was more conservative than Council's requirements outlined in Section 4.2 of the report. As such only the results of the pre to post developed flows was considered. The results of the DRAINS modelling are detailed in **Table 6.3.2.1** below.

Table 6.3.2.1: Outlet 2 Results

		Pre-developed			*Post-developed*		
Storm event	**Reach**	**Pipe Flow (m^3/s)**	**Overland Flow (m^3/s)**	**Combined (m^3/s)**	**Pipe Flow (m^3/s)**	**Overland Flow (m^3/s)**	**Combined (m^3/s)**
Minor (5yr ARI)	**O2 R1**	0.09	0.05	0.14	-	-	-
	O2 R2	0.20	0.10	0.29	0.11	0.09	0.20
	O2 R3	0.45	1.44	1.89	0.71	0.36	1.07
	O2 R4	0.87	1.42	2.29	0.90	0.08	0.98
Major (100yr ARI)	**O2 R1**	0.11	0.12	0.23	-	-	-
	O2 R2	0.26	0.20	0.45	0.12	0.18	0.30
	O2 R3	0.52	2.45	2.97	0.64	1.57	2.21
	O2 R4	1.02	2.62	3.64	0.97	1.12	2.09

As outlined in **Section 5.2** of the report, O2R4 is the critical downstream infrastructure for Catchment 2. From the results, it can be seen that in both the minor and major storm events the post development peak discharge leaving the catchment is less than the current peak flows.

A review of the overland flows also indicates the current situation in Humphries Road and downstream flow paths with aboveground flows will be improved with the proposed stormwater management.

6.4 CATCHMENT 3

6.4.1 Catchment Data

The catchment data for the existing site was based upon the detail survey and current site conditions, whilst the data for the developed site was based upon Council's guidelines and the proposed development layout.

The predeveloped catchments are detailed in **Exhibit 1**, whilst the catchment parameters are detailed in **Table 6.4.1.1** below.

Table 6.4.1.1: Outlet 3 Pre-Developed Catchment Parameters

Catchment	Area (Ha)	Impervious %
E3.1	1.77	75%
E3.2	0.79	75%
E3.3	1.13	80%
E3.4	0.17	75%
E3.5	0.18	95%
E3.6	0.16	95%

The post-developed catchment was split into lots, roads and open space and catchments bypassing. As discussed in **Section 5.3** of this report, no detention is required for Outlet 3 as the catchment has significantly decreased in area. The post-developed catchments for Outlet 3 are detailed in **Exhibit 5**, whilst the catchment parameters are detailed in **Table 6.4.1.2** below.

Table 6.4.1.2: Outlet 3 Post-Developed Catchment Parameters

Catchment	Area (Ha)	Impervious %
3.1	0.40	80%
3.2	0.02	20%
3.3	0.17	80%
3.4	1.24	75%
3.5	0.18	95%
3.6	0.16	95%

6.4.2 Proposed Stormwater Management

As previously mentioned in **Section 5.3** of the report, as a result of the change of catchments, even though the percentage impervious increased, the pre and post development flows at Outlet 3 are significantly less. Therefore, no detention infrastructure is proposed.

6.4.3 Results

In accordance with Council's requirements and best practice, modelling was undertaken to demonstrate compliance of post-development flows being less than or equal to the pre development flows as well as meeting Council's objectives as outlined in Section 4.2 of this report.

Based upon the modelling completed, it was apparent that the requirement of post developed flows being less than or equal to pre developed flows was more conservative than Council's requirements outlined in Section 4.2 of the report. As such, only the results of the pre to post developed flows was considered. The results of the DRAINS modelling are detailed in **Table 6.4.2.1** below.

Table 6.4.2.1: Outlet 3 Results

		Pre-developed			*Post-developed*		
Storm event	**Reach**	**Pipe Flow (m^3/s)**	**Overland Flow (m^3/s)**	**Combined (m^3/s)**	**Pipe Flow (m^3/s)**	**Overland Flow (m^3/s)**	**Combined (m^3/s)**
Minor (5yr ARI)	**O3 R1**	0.17	0.22	0.39	0.01	0.00	0.01
	O3 R2	0.29	0.60	0.90	0.33	0.11	0.45
	O3 R3	0.46	0.00	0.46	0.34	0.00	0.34
	O3 R4	0.74	0.58	1.32	0.43	0.06	0.49
Major (100yr ARI)	**O3 R1**	0.20	0.44	0.64	0.15	0.12	0.27
	O3 R2	0.30	1.29	1.59	0.45	0.33	0.78
	O3 R3	0.45	0.00	0.45	0.53	0.00	0.53
	O3 R4	0.78	1.35	2.13	0.72	0.29	1.00

As outlined in **Section 5.3** of the report, O3R4 is the critical downstream infrastructure for Catchment 3. From the results, it can be seen that in the both the minor and major storm events the post development peak discharge leaving the catchment is less than the current peak flows.

A review of the overland flows also indicates the current situation in Humphries Road and downstream flow paths with aboveground flows will be improved with the proposed stormwater management.

7.0 Overland Flooding

The proposed stormwater system, as detailed in **Section 5**, and outlined in **Section 6,** is to provide detention to allow pre development flows to be achieved. The stormwater systems is to be designed to ensure that there is no adverse impact on downstream properties or infrastructure through overland flooding. The development is to ensure the detention of the proposed development is sufficient to ensure that the flood level difference, velocity difference and velocity depth difference for the post development scenario is equal to or improved when compared to the pre developed scenario.

7.1 MODELLING

The software used for the 2D overland flooding analysis is TUFLOW. This program is well regarded as industry best practice for analysis of 2D flooding and was the software recommended by Council to analyse the overland flows downstream of the development.

CSSE was commissioned to complete the 2D overland flooding analysis. The Fairfield City Council's Central Overland Flood Study TUFLOW hydraulic model was utilised to complete an analysis of the existing overland flood scenario, the post developed overland flood scenario and the difference between the two (2) scenarios.

Below is a summary from CSSE of the modelling done for the existing overland flood scenario and the post developed overland flood scenario.

- Existing Flood Assessment: In order to understand the potential flood impacts associated with the proposed development, it was first necessary to confirm flood behaviour for existing (i.e. pre-development) conditions. To ensure the flood model was providing a reliable description of existing flood behaviour we made some updates to Council's existing model in the vicinity of the development area. This included:

    - The building footprints around the site were updated to better reflect present day conditions;
    - Field survey provided by ADW Johnson on 1st September 2021 was incorporated into the hydraulic model;
    - The existing stormwater network in the vicinity of the development area was not captured in the original TUFLOW model. Therefore, the TUFLOW model was updated to include a representation of all Council owned stormwater assets as a dynamically linked 1-Dimensional (1D) network. This stormwater information was provided by Fairfield City Council as GIS layers. However, the GIS layers did not provide invert elevations. Therefore, inverts were defined based on either a 1% pipe gradient or a minimum cover assumption (pipe diameter + 0.6m cover).

    The model was run for a suite of durations for the 1% AEP event and an envelope of the 15 minute, 90 minute and 120 minute durations were adopted as "critical durations" for this assessment (i.e. these durations produced the highest flood levels for various locations around the site).

- Post-Development Flood Assessment: The model that was used to define existing flood behaviour was then updated to include a representation of the proposed development. This included modifications to the roughness representation around the site as well as the representation of the proposed stormwater network, digital elevation model and stormwater basins. Basin 2 (comprising an underground storage tank), was represented as a 1D storage node with the storage characteristics defined based on information provided by ADW Johnson by email on 15th September 2021.

  As this is a precinct level assessment, individual buildings were not explicitly represented across the proposed development area. However, a representation of the likely roughness and imperviousness were represented on a "lot-scale" basis. This assumed the same lot-based Manning's roughness as existing conditions, however, we catered for an increase in impervious surfaces (and, therefore, reduced infiltration potential). In this regard, we assumed that 70% of each lot would be occupied by building roof area.

  The updated post-development model was used to simulate flood behaviour for the 1% AEP flood for each of the critical storm durations.

7.2 RESULTS

The results of the existing overland flood scenario, the post developed overland flood scenario and the difference between the two (2) scenarios was provided to Fairfield City Council directly from CSSE. This report is mainly focuses on the difference between the two (2) scenarios to see the impacts of the proposed development.

The flood impact as a result of the development for the 1% AEP event is shown in **Exhibit 9, Exhibit 10** and **Exhibit 11** as the flood level difference, velocity difference and velocity depth difference respectively.

As can be seen in **Exhibit 9**, from Humphries Road downstream of the development to Green Valley Creek, the flood level differences between the existing scenario and the post development scenario decrease between 10mm and greater than 100mm. Furthermore, there are areas that were previously wet but are now dry due to the stormwater detention infrastructure installed as part of the development.

Exhibit 10 shows that from Humphries Road downstream of the development to Green Valley Creek, the flood velocity differences between the existing scenario and the post development scenario decrease between 0.05m/s and greater than 0.3m/s. There are a few small localised areas where the velocity has increased in the order of 0.05m/s to 0.2m/s, however in these areas there has been a decrease in flood level as per **Exhibit 9**.

Further to the above results, **Exhibit 11** highlights a decrease in velocity depth of 0.05m^2/s to 0.1m^2/s from Humphries Road downstream of the development to Green Valley Creek. These results show that even in the areas where there was a decrease in flood level and an increase in velocity, the velocity depth in those areas is equal to or better than the existing scenario.

The above results prove that there is no adverse impact on downstream properties or infrastructure through overland flooding as a result of this development.

8.0 Stormwater Quality

The proposed stormwater system, as detailed in **Section 5**, uses a combination of pit and pipe networks and water quality devices to convey stormwater runoff from the site. It is intended to use a combination of treatment devices within the drainage system to remove nutrients and sediments from the stormwater prior to the runoff leaving the site.

8.1 MODELLING

The software used for the water quality modelling is MUSIC Version 6.2. This program is well regarded as industry best practice for analysis of the effectiveness of treatment mechanisms on the quality of stormwater runoff from a development site of this size.

MUSIC-link for Blacktown City Council has been used for the modeling for this site, as detailed in the Fairfield City Council stormwater management policy. Using Blacktown City Council's MUSIC-link enables the simplification of the development and assessment of MUSIC models. It also enables the model to adopt all of Fairfield City Councils preferred parameters such as rainfall, evapotranspiration data, lowland soil characteristics and pollutant generation rates.

The MUSIC model parameters were adopted using the MUSIC-LINK feature, whilst treatment node parameters were based upon a combination of Council's guidelines and information provided by individual device providers.

8.1.1 Source Nodes

The source nodes were set up to represent each sub catchment within each catchment. Each of the subcatchment source nodes are given different pollution generation parameters based on the type of subcatchment. The pollution generation parameters have been provided by MUSIC -link.

8.2 CATCHMENT 1

8.2.1 Catchment Data

The catchment data is as per **Section 6.2** of the report.

8.2.2 Treatment Device

Outlet 1 utilises a combination of Rocla CDS GPT's, an above ground biofiltration basin and Ecosol litter baskets to achieve Council's water quality requirements. The majority of the stormwater catchment is directed to the biofiltration basin via GPT's, however only the low flows are treated by the biofilter area. The bypass catchment for Outlet 1 receives some water quality treatment by the litter baskets which are placed in the street pits in Lane 1.

8.2.3 Results

The MUSIC model was set up and run using the parameters mentioned above. A summary of the modelling results can be seen in **Table 8.2.3.1** overleaf.

Table 8.2.3.1: Basin 1 MUSIC Results

Pollutant	Source Load	Residual Load	Modelled Reduction (%)	Target (%)
Gross Pollutants (kg/yr)	1250	90.3	92.7	90
Total Suspended Solids (kg/yr)	10600	1900	82.1	80
Total Phosphorus (kg/yr)	17.6	6.65	62.2	55
Total Nitrogen (kg/yr)	105	62.6	40.2	40

From the results, it can be seen that the proposed treatment train exceeds the stormwater quality requirements outlined in Council's stormwater management policy.

8.3 CATCHMENT 2

8.3.1 Catchment Data

The catchment data is as per **Section 6.3** of the report.

8.3.2 Treatment Device

Outlet 2 utilises a combination of Rocla CDS GPT's and an underground tank with Ocean Protect stormwater filter cartridges to achieve Council's water quality requirements. The majority of the stormwater catchment is directed to the underground tank via the GPT's, however only the low flows are treated by the stormwater filter cartridges within the tank through the use of splitter pits. The bypass catchment for Outlet 2 is untreated, however the stormwater treatment which occurs within the underground tank overcompensates for the bypass flows to ensure the total catchment achieves Council's water quality targets.

8.3.3 Results

The MUSIC model was set up and run using the parameters mentioned above. A summary of the modelling results can be seen in **Table 8.3.3.1** below.

Table 8.3.3.1: Outlet 2 MUSIC results

Pollutant	Source Load	Residual Load	Modelled Reduction (%)	Target (%)
Gross Pollutants (kg/yr)	1230	119	90.4	90
Total Suspended Solids (kg/yr)	10600	1620	84.7	80
Total Phosphorus (kg/yr)	17.6	4.63	73.8	55
Total Nitrogen (kg/yr)	104	60.1	42	40

From the results, it can be seen that the proposed treatment train exceeds the stormwater quality requirements outlined in Council's stormwater management policy.

8.4 CATCHMENT 3

As discussed in **Section 5.3** of this report, after consultation with Fairfield City Council, it was determined that a GPT or a Jellyfish device are not required for Catchment 3. As such Catchment 3 will have no water quality treatment which is as per the existing conditions. It is noted that the catchment has decreased significantly and therefore the water quality of Catchment 3 has consequently increased when compared to current conditions.

9.0 Erosion and Sedimentation Control

Erosion and sedimentation control measures need to be implemented during any construction on the proposed development to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the construction site to downstream waterways. It is expected that an Erosion and Sedimentation Control Plan will be completed as part of the CC documentation.

10.0 Conclusion

The proposed stormwater system has been designed to satisfy Council's stormwater requirements without adversely impacting downstream properties and infrastructure.

The stormwater detention provided by the proposed infrastructure will allow the limiting of the post-development critical peak discharges leaving the site to less than that of pre-development for all storm events up to the 100 year ARI, thereby not increasing the risk of flood inundation to existing downstream development and not increasing the demand on the downstream stormwater infrastructure. The amount of overland flow on the roads downstream of the site has been reduced for all three catchments.

The overland flow situation between Humphries Road and Green Valley Creek has been verified by 2D flood modelling which generally shows a reduction in velocities, velocity depth and flood level depth.

A treatment train process of GPT's, biofiltration and stormwater filter cartridges have been designed to effectively reduce the nutrients and gross pollutants from stormwater runoff from the proposed development to meet Council's water quality requirements.

An erosion and sedimentation control plan will be implemented to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the development site to the receiving waters during construction.

Exhibits

300241-SWMP-001

LEGEND

- EXISTING LOT BOUNDARY
- EXISTING CONTOURS
- EXISTING KERB
- ex sw — EXISTING STORMWATER
- EXISTING LINTEL
- OUTLET 1 EXISTING CATCHMENT
- OUTLET 2 EXISTING CATCHMENT
- OUTLET 3 EXISTING CATCHMENT

E 1.1
E 1.2
E 1.3
E 1.4
E 1.5
E 1.6
E 1.7
E 1.8
E 1.9
E 1.10
E 1.11
E 2.1
E 2.2
E 2.3
E 2.4
E 2.5
E 2.6
E 2.7
E 2.8
E 3.1
E 3.2
E 3.3
E 3.4
E 3.5
E 3.6

CABRAMATTA ROAD WEST
LAYCOCK PLACE
PALISADE CRESCENT
JOINER PLACE
NEWLEAF
GARDEN PLACE
MASON PLACE
PARADE
SANDILANDS ROAD
BISHOP CRESCENT
EDENSOR ROAD
HUMPHRIES ROAD

BASED ON DBYD STORMWATER IS PIPED PAST HUMPHRIES ROAD

O1R1 O1R2 O1R3 O1R4 O1R5 O1R6 O1R7
O2R1 O2R2 O2R3 O2R4
O3R1 O3R2 O3R3 O3R4

ex sw

EXISTING SCHOOL
EXISTING SOCIAL HOUSING
HENSHAW CLOSE
TO GREEN VALLEY CREEK

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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drawing title:
EXHIBIT 1
EXISTING CATCHMENT PLAN

location: HUMPHRIES ROAD, BONNYRIGG
council: FAIRFIELD CITY COUNCIL
dwg ref: 300241-SWMP- 001
client: NSW Land & Housing Corporation

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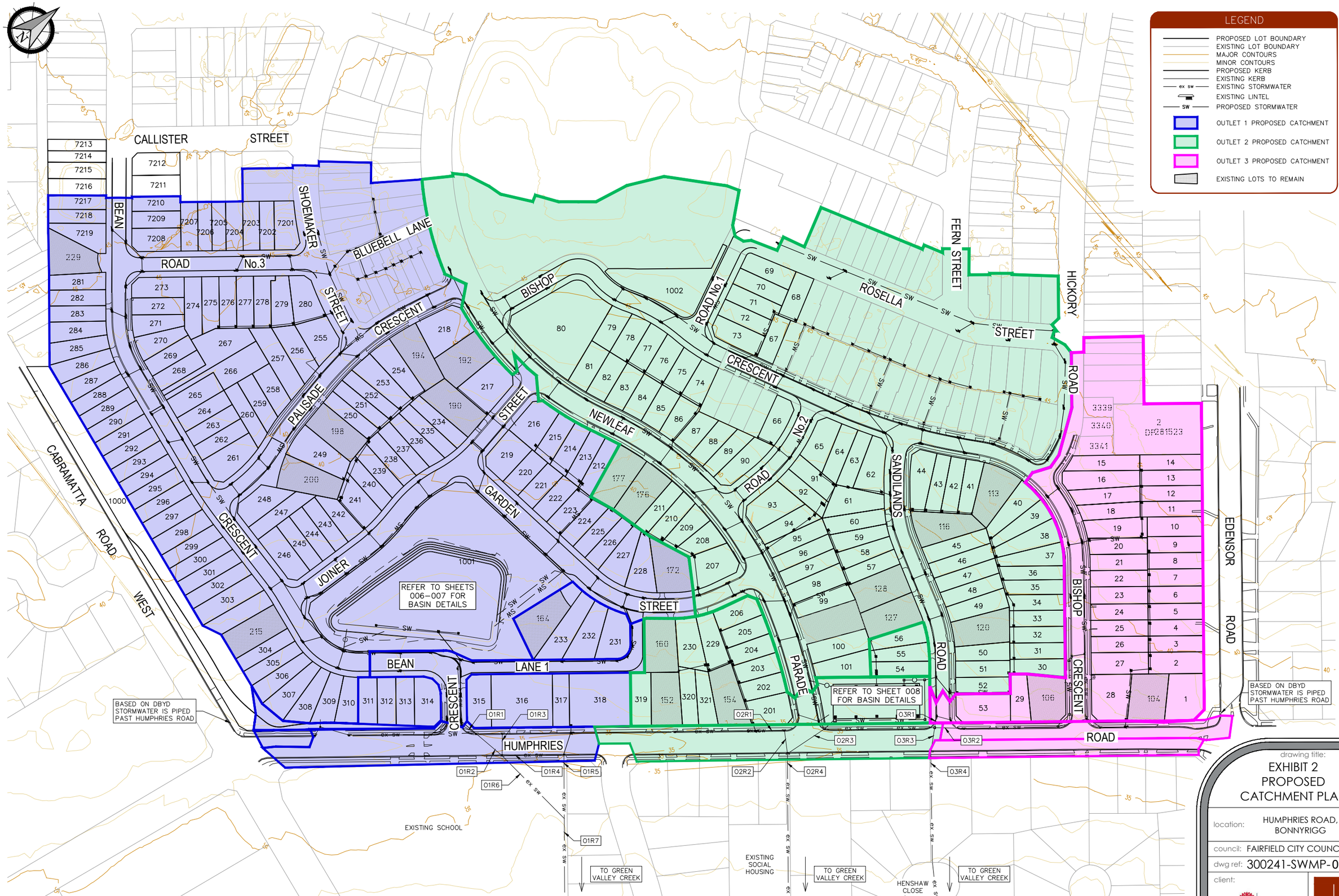

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drawing title:
EXHIBIT 2 PROPOSED CATCHMENT PLAN

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-002

client: NSW Land & Housing Corporation

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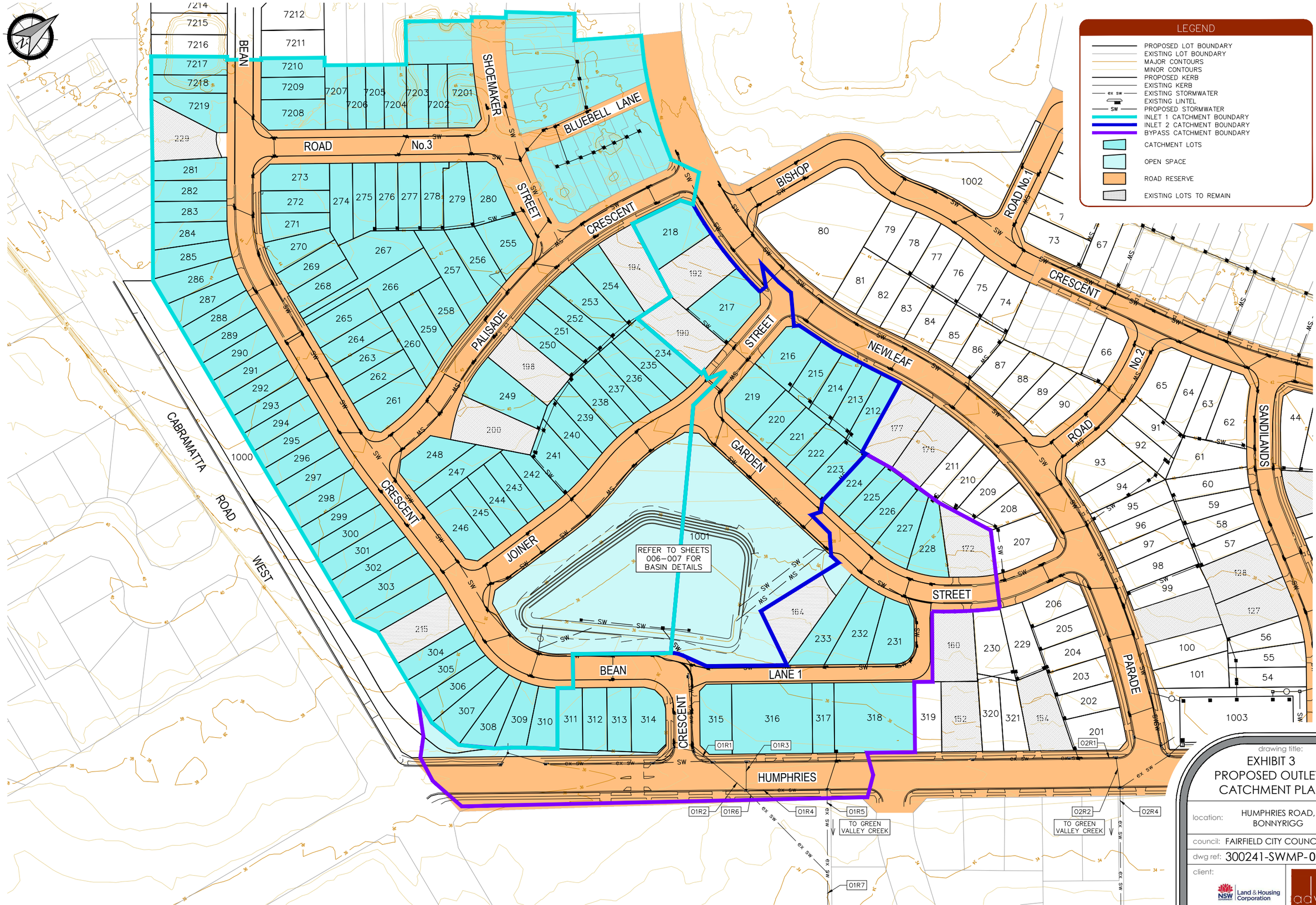
300241-SWMP-003



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drawing title:
EXHIBIT 3
PROPOSED OUTLET 1 CATCHMENT PLAN

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-003

client: NSW Land & Housing Corporation

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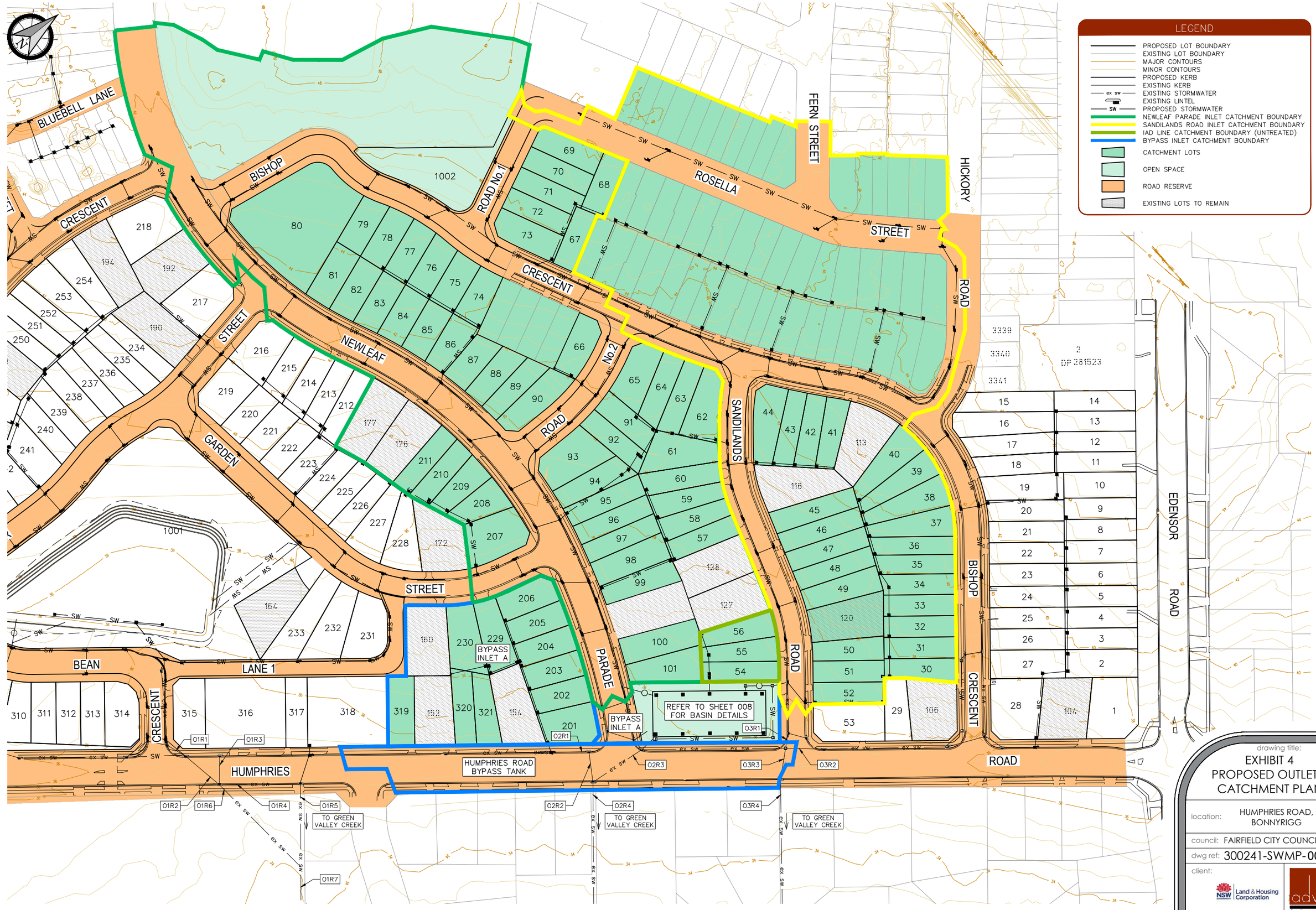

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drawing title:
EXHIBIT 4
PROPOSED OUTLET 2 CATCHMENT PLAN

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-004

client: NSW Land & Housing Corporation

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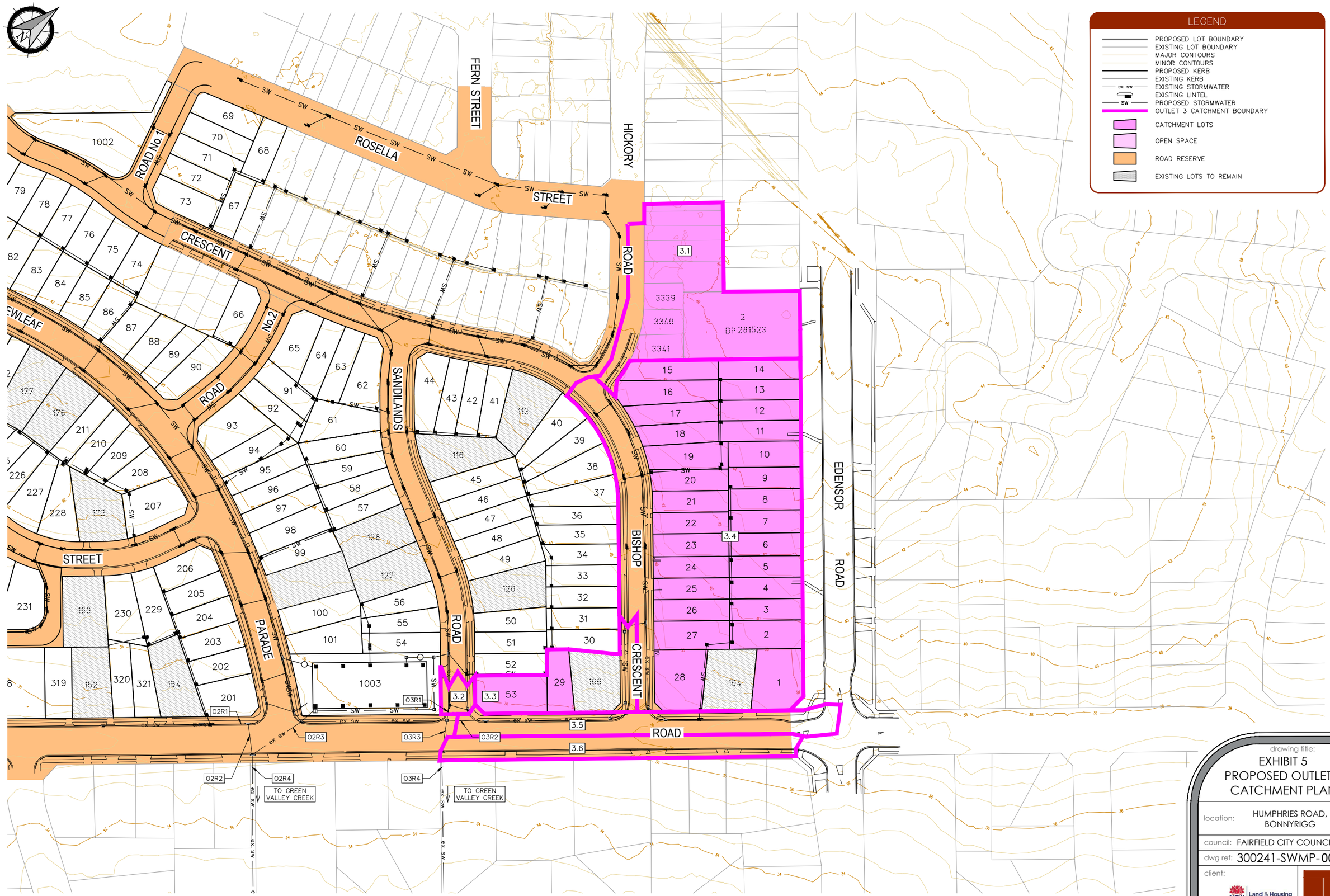

drawing title:
EXHIBIT 5
PROPOSED OUTLET 3 CATCHMENT PLAN

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-005

client: NSW Land & Housing Corporation

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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This plan includes coloured information. If you have a black and white copy you do not have all of the information. This note is coloured RED.

300241-SWMP-006

LEGEND

- PROPOSED LOT BOUNDARY
- EXISTING LOTS TO REMAIN
- MAJOR CONTOUR
- MINOR CONTOUR
- EXTENTS OF BATTER
- ROAD PAVEMENT
- PROPOSED STORMWATER
- ex sw EXISTING STORMWATER
- PROPOSED SW PIT
- LINTEL
- BIOFILTRATION MEDIA

JOINER STREET

BEAN CRESCENT

LANE 1

TIERED SANDSTONE RETAINING WALL SEATING

SANDSTONE LOG RETAINING WALL

SANDSTONE LOG RETAINING WALL

BIOFILTRATION FILTER AREA 255m² SURFACE RL 35.9

BIOFILTRATION FILTER AREA 215m² SURFACE RL 35.8

900 x 900 GSIP

900 x 900 GSIP

1200 x 1200 GSIP

OUTLET IL34.8

HEADWALL INLET IL35.9

HEADWALL INLET IL35.85

HEADWALL INLET IL36.0

HEADWALL INLET IL35.8

PROPOSED GPT CDS 1518 SURFACE RL 37.5 IL 35.94

PROPOSED GPT CDS 1009 SURFACE RL 38.1 IL 36.5

HIGH FLOW BYPASS OF GPT

HIGH FLOW BYPASS OF GPT

INLET 2

IL36.6

IL36.55

IL35.97

IL34.1

SPLITTER PIT

INTERNAL WEIR FOR FLOW TO ø600 PIPE IL36.57

REINFORCED CONCRETE MAINTENANCE ACCESS PATH. DETAILS TO BE PROVIDED AS PART OF CC DESIGN

INDICATIVE BASIN WEIR AND MAINTENANCE ACCESS

EXISTING STORMWATER TO BE REMOVED

ø450 ø900 ø450 ø450 ø600 ø600 ø600 ø600 ø600 ø375 ø375 2xø375 ø150 ø150 ø525 ø300 ø600 ø600 ø600 ø600

A 007 B 007 A 007 B 007

BASIN 1 DETAIL PLAN

SCALE 1:200

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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drawing title:

EXHIBIT 6
BASIN 1 DETAIL PLAN

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-006

client: NSW Land & Housing Corporation

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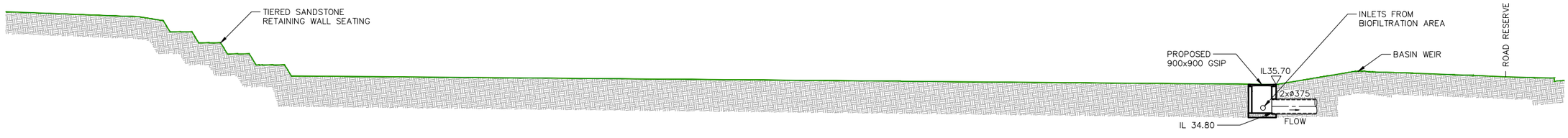

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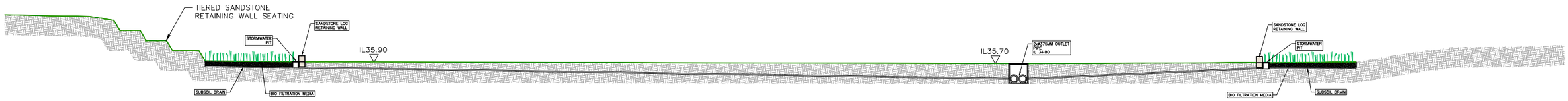

SECTION B
NOT TO SCALE 006

working beyond expectations

drawing title:

EXHIBIT 7
BASIN 1 SECTIONS

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-007

client: NSW Land & Housing Corporation

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
E	08.11.2021	2nd COUNCIL COMMENTS	CR	JY	DATUM: N/A CONTOUR INTERVAL: N/A	A1 1:100 — 0 2.5 5.0m — A3 1:200	

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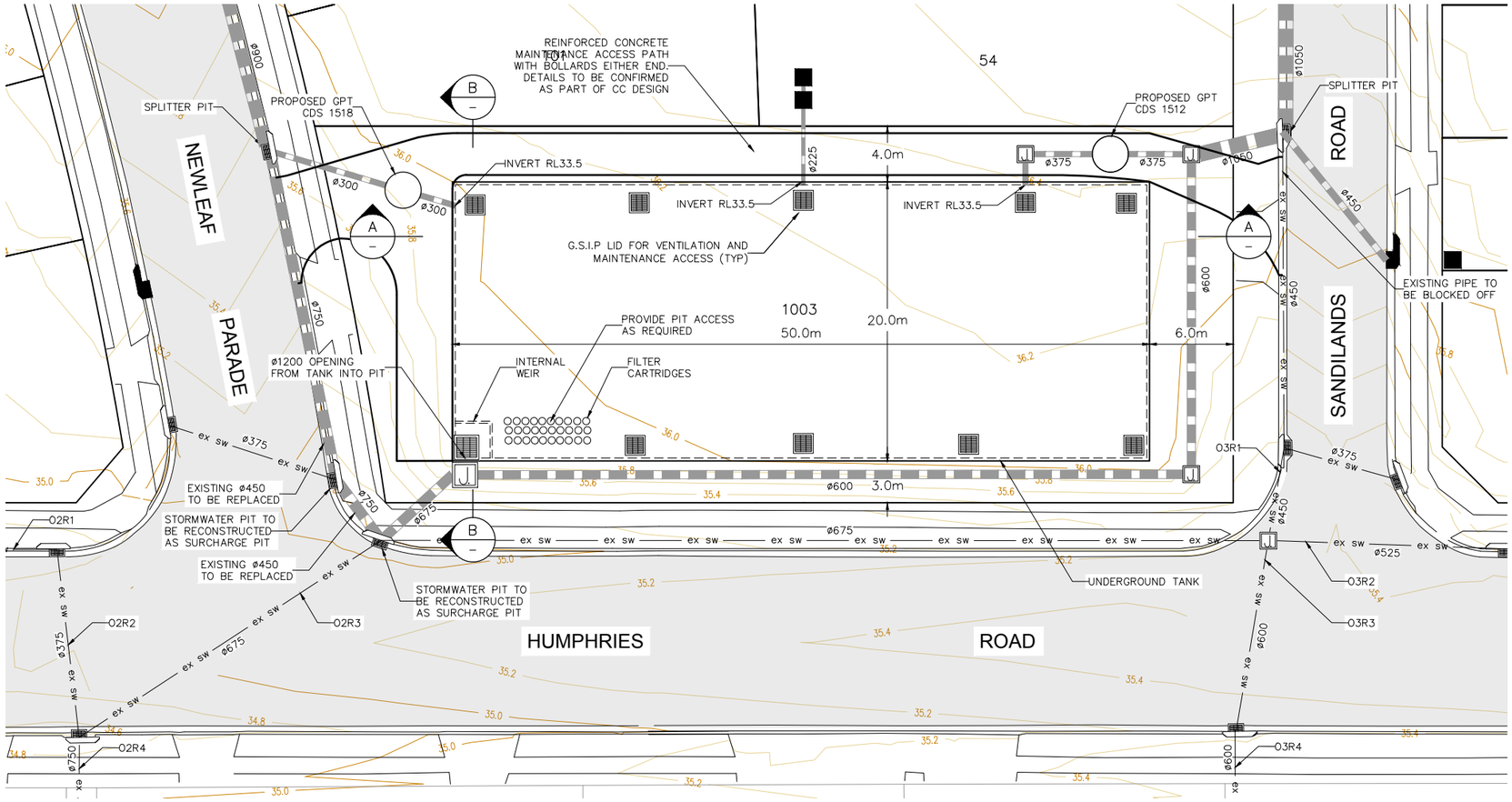
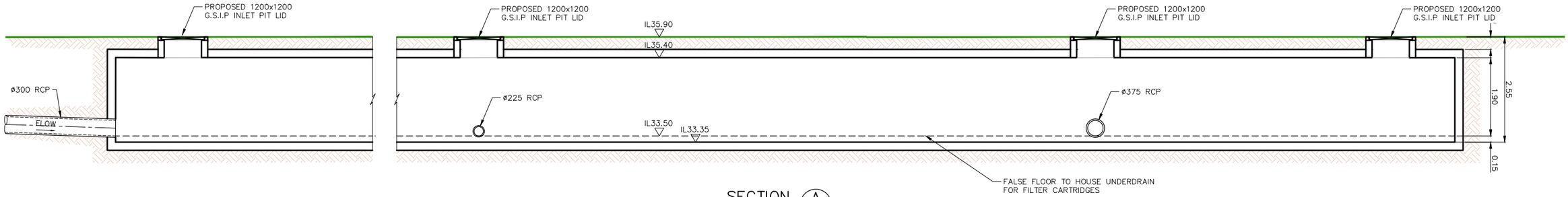
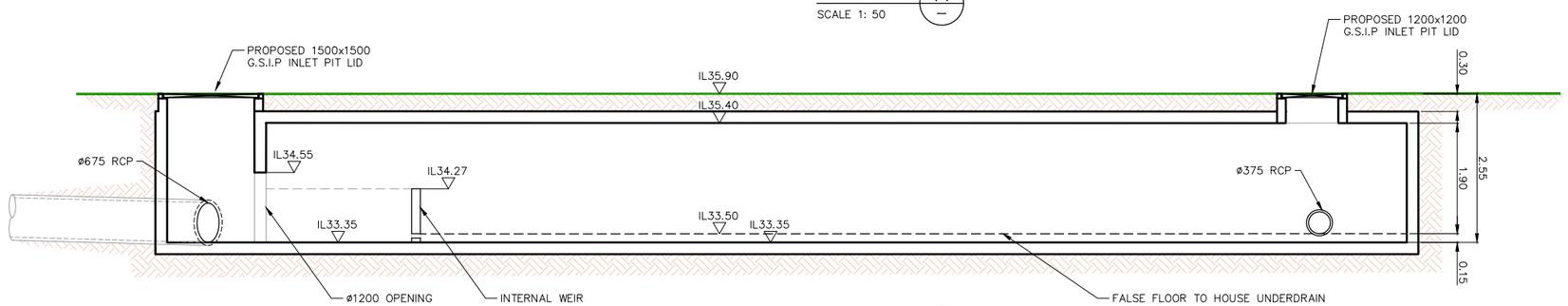


BASIN 2 DETAIL PLAN
SCALE 1:200

LEGEND
- PROPOSED LOT BOUNDARY
- EXISTING LOTS TO REMAIN
- MAJOR CONTOUR
- MINOR CONTOUR
- ROAD PAVEMENT
- PROPOSED STORMWATER
- EXISTING STORMWATER
- PROPOSED SW PIT
- LINTEL



SECTION A
SCALE 1:50



SECTION B
SCALE 1:50

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
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drawing title:
EXHIBIT 8
BASIN 2
DETAIL PLAN & SECTIONS

location: HUMPHRIES ROAD, BONNYRIGG
council: FAIRFIELD CITY COUNCIL
dwg ref: 300241-SWMP-008
client: NSW Land & Housing Corporation

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300241-SWMP-009

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
E	08.11.2021	2nd COUNCIL COMMENTS	CR	JY	DATUM: N/A CONTOUR INTERVAL:		

drawing title:
EXHIBIT 9
FLOOD VELOCITY DIFFERENCE 1% AEP

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-009

client: NSW Land & Housing Corporation

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ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
E	08.11.2021	2nd COUNCIL COMMENTS	CR	JY	DATUM: N/A CONTOUR INTERVAL:		

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drawing title:
EXHIBIT 10
VxD DIFFERENCE
1% AEP

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP-010

client: NSW Land & Housing Corporation

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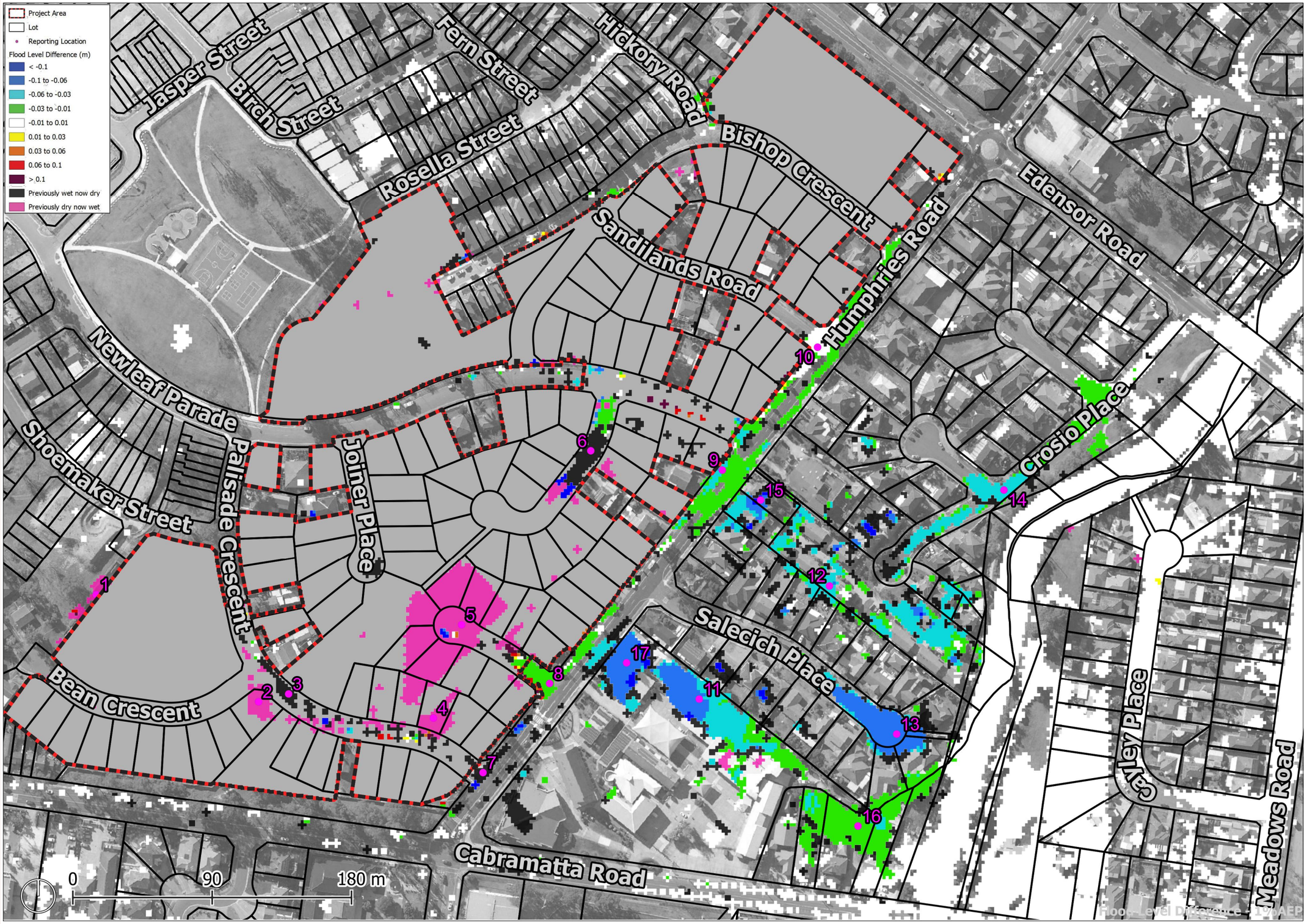

Flood Level Difference - 1% AEP

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
E	08.11.2021	2nd COUNCIL COMMENTS	CR	JY	DATUM: N/A CONTOUR INTERVAL:		

drawing title:
EXHIBIT 11
FLOOD LEVEL
DIFFERENCE 1% AEP

location: HUMPHRIES ROAD, BONNYRIGG

council: FAIRFIELD CITY COUNCIL

dwg ref: 300241-SWMP- 011

client: NSW Land & Housing Corporation

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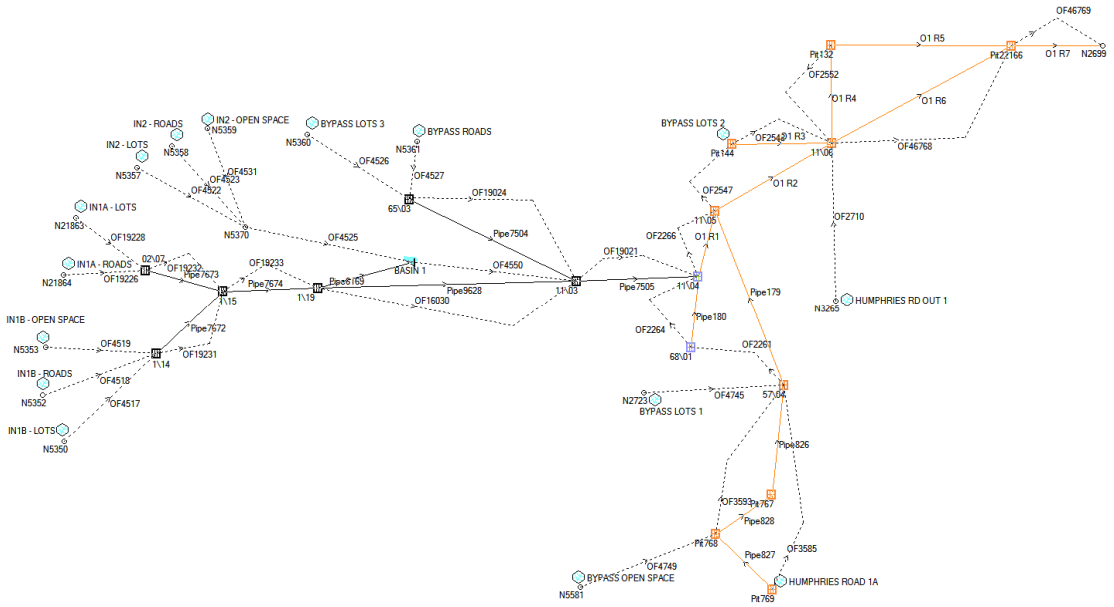
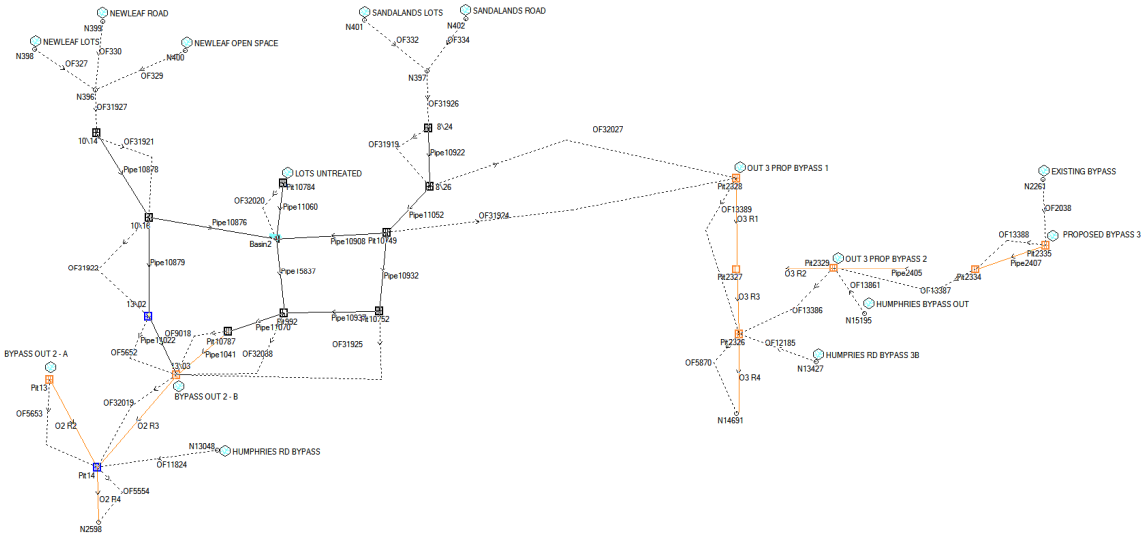
Appendix A

DRAINS MODEL

Outlet 1



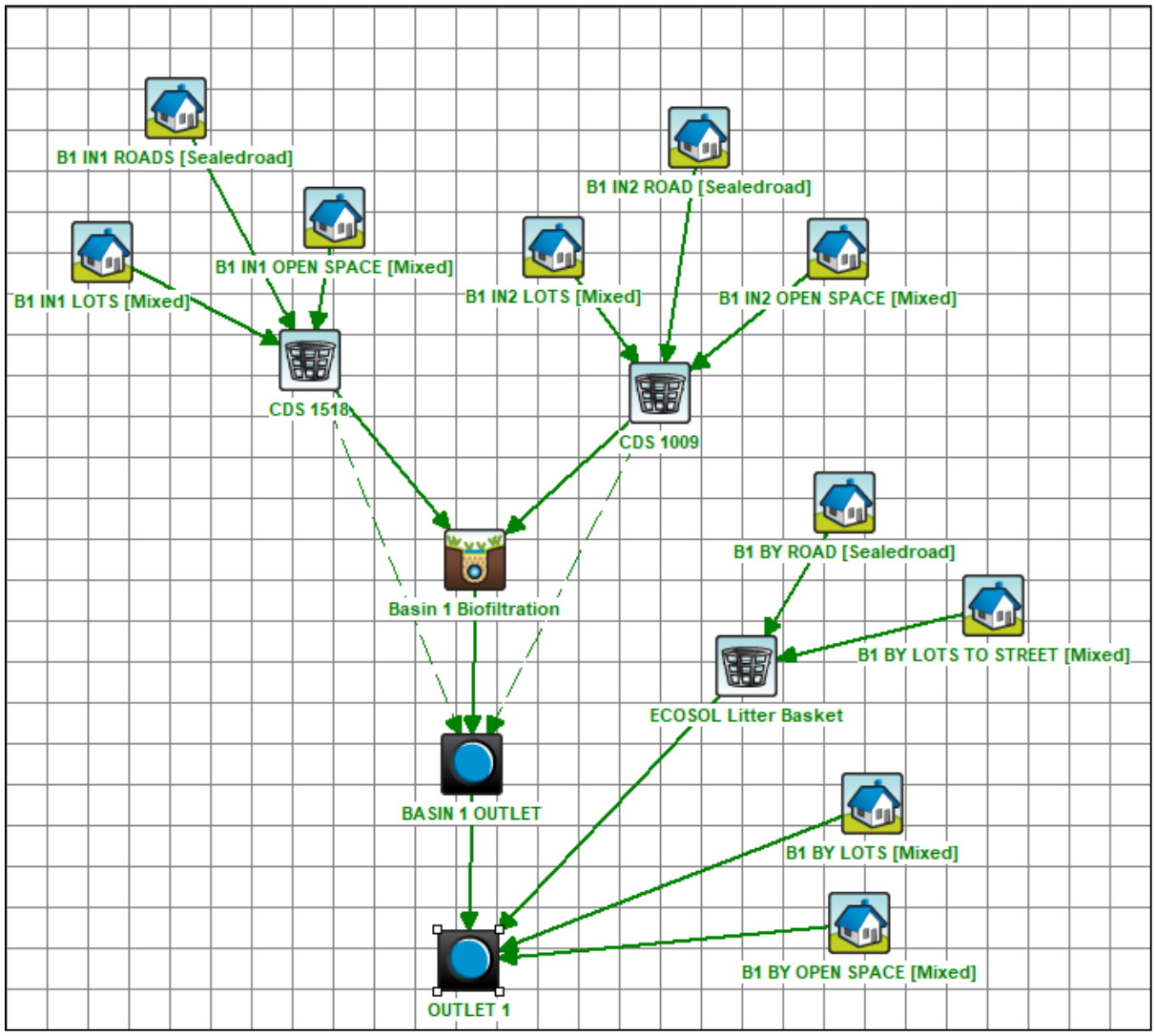
Outlet 2 and 3



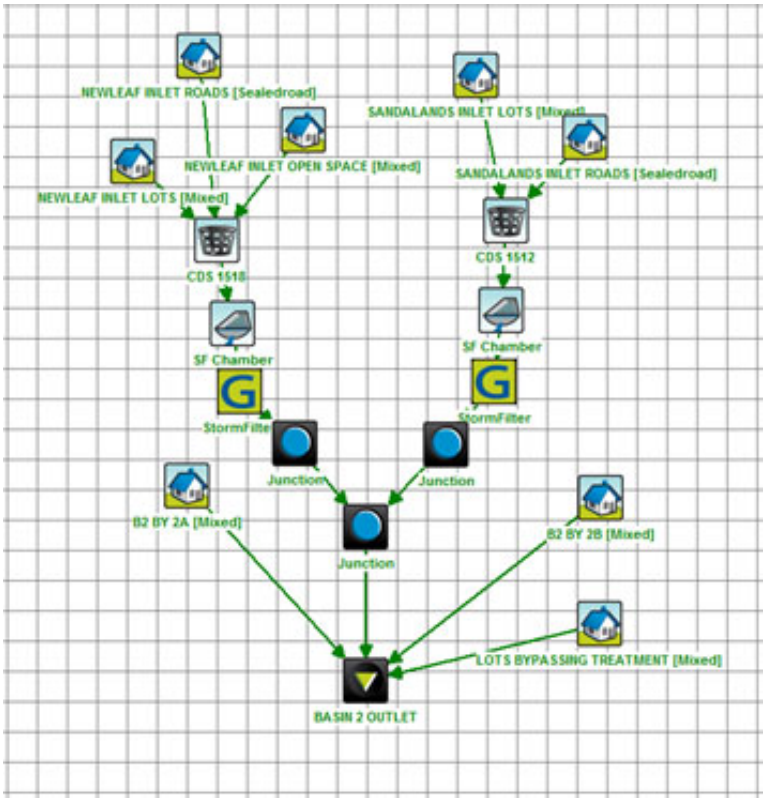
Appendix B

MUSIC MODEL

Outlet 1



Outlet 2


NEWLEAF INLET ROADS [Sealedroad]
SANDALANDS INLET LOTS [Mixed]
NEWLEAF INLET OPEN SPACE [Mixed]
SANDALANDS INLET ROADS [Sealedroad]
NEWLEAF INLET LOTS [Mixed]
CDS 1512
CDS 1518
SF Chamber
SF Chamber
StormFilter
StormFilter
Junction
Junction
B2 BY 2A [Mixed]
B2 BY 2B [Mixed]
Junction
LOTS BYPASSING TREATMENT [Mixed]
BASIN 2 OUTLET