Proposed Residential Subdivision

STORMWATER DRAINAGE STRATEGY

Lot 101 DP1233753

65 Owlpen Lane Farley

25 MAY 2022

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Contents

List of Acronyms

AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARQ	Australian Runoff Quality, Engineers Australia, 2006
AR&R	Australian Rainfall and Runoff, Institution of Engineers, Australia, 1987
BASIX	Building Sustainability Index
BOM	Bureau of Meteorology
CC	Construction Certificate
DA	Development Application
DLWC	Department of Land and Water Conservation
FFL	Finished Floor Level
FPL	Flood Planning Level
IAD	Interallotment drainage
IFD	Intensity Frequency Duration
LGA	Local Government Area
MCC	Local Government Area
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
RL	Reduced Level
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids

1. INTRODUCTION

1.1 Background

High Definition Design Pty Ltd was commissioned by Brad Hill Pty Ltd to prepare a Stormwater Management Plan & Report in accordance with the stormwater quantity and quality requirements of the Maitland City Council's Development Control Plan and the Engineering Guidelines for Subdivisions and Development Standards to support the Development Application for the proposed development at the 65 Owlpen lane Farley known as Lot 101 DP 1233753 located within the Maitland City Council area, the site location is shown in Figure 1 Appendix A.

The scope of this report includes an identification of the stormwater management requirements for the proposed development and in order to devise a stormwater management strategy.

The report describes the principles and operation of the proposed stormwater system as well as the primary components of the drainage system. As the assessment and evaluation are required under the conditions of consent, the final stormwater system layout may need to be revised in the future during the application for a Construction Certificate.

The following information and documents were used in this investigation:

- Concept plan reference by Mertiri, 200220 Sheet 02 Rev 1 dated 22 November 2021.
- Maitland City Council Development Control Plan (DCP) 2011.
- Maitland City Council, Manual of Engineering Standards, adopted April 2014.
- "Australian Runoff Quality – A Guide to Water Sensitive Urban Drainage", Engineers Australia (2006).
- "Australian Rainfall and Runoff – A Guide to Flood Estimation", Institute of Engineers Australia (1987).

The increase in impervious areas and alteration of the natural topography due to land development has the potential to increase and concentrate peak storm flows. This has the potential to impact on flow regimes and cause erosion of the downstream drainage network and associated waterways.

To avoid any adverse impact on the downstream drainage systems, the site's stormwater management system must be designed to ensure the safe conveyance of flows throughout the site and within the capacity of the downstream trunk drainage systems in a healthy environmental state for Ecological Sustainable Development.

1.2 Site Description

The site is located at Owlpen Lane, Farley, NSW, and is Lot 101, DP1233753 with a total area of approximately 5.681 hectares. The site is bounded by Owlpen Lane to the west side, residential land to the East and South, and open drainage channel to the North.

The site has average natural surface slope from West to the South-Eastern corner at approximately 7%, and level from RL30.0m AHD on western side to RL 11.0m AHD in the south eastern corner of the site.

1.3 Proposed Development

The proposed site is for a residential subdivision, with 69 lots over the developable footprint. The concept subdivision lot layout has been prepared by Metiri Pty Ltd and is shown in Figure 2 Appendix A.

1.4 Drainage Catchment

The site generally drains towards the south-eastern boundaries. Stormwater runoff from the sites finished surface will be towards the south of the sites boundary, and then conveys to the existing Swamp Creek downstream to the south-east of the site. This site is divided into 2 catchments, the western catchment (0.400ha) as shown in Figure 4 of Appendix B drains towards the neighbouring site DA19/707. The remainder of the site (5.681ha) is captured and detained by the proposed sites Basin. Both sites are wholly owned by the same owner.

1.5 Objective and Target of Work

This plan of work has been undertaken to provide the following information in support of the Development Application:

- Documentation of the requirements of Maitland City Council for this development site.
- Identify the impacts of this proposed residential development on existing waterways and downstream properties.
- Provide stormwater controls that ensure the proposed development does not adversely impact on the quantity of stormwater flows within, adjacent and downstream of the site.
- Provide concept dimensions of the proposed stormwater management services in accordance with the adopted approach by council.

1.6 Available Data

The following information was utilised in the preparation of this strategy:

- An indicative lot layout plan provided by Metiri.
  A copy of the plan is shown in Appendix A.
- Maitland City Council - Manual of Engineering Standards, 2014.

- Flood study, “Hunter River Floodplain Risk Management” of Maitland City Council Release Area as per council website (referenced on 1/5/2022).

1.7 Strategy Purposes / Criteria

1.7.1 Stormwater Runoff Quantity Criteria

Stormwater flow management and design criteria of quantity include:

- The adoption of a major / minor flow approach to the design of the local stormwater management system.
- Delivery of major flows through the site to the stormwater system in a safe manner and to avoid impacting on the site and downstream properties.
- Limiting the discharges rates of the proposed to development pre-development discharge rates.

1.7.2 Stormwater Runoff quality Criteria

Stormwater runoff from the development area should be treated prior to discharging to a public Stormwater system consistent with normal practice criteria for new developments, and with consideration to opportunities for integration with developed site features and topography

The design methodology for Stormwater Runoff Quality typically contains stormwater quality treatment devices based on identified opportunities for stormwater quality management referencing the development site and catchment.

Stormwater quality management for the proposed site could include a treatment train of structures consisting of:

- Water harvester for reducing runoff volumes;
- Gross pollutant trap (GPT);
- Stormwater bioretention basins;
- Proprietary water quality improvement devices for runoff water treatment.

1.7.3 Flooding Criteria

Maitland City Council Development Control Plan 2011, Part C Design guidelines, “C.10 Subdivision, Section 4. Design Element- EC.3 Hazards, Flooding”, States:

a) All lots Within new residential subdivisions shall have safe access available in a 1 in 100 year flood event.

b) All new residential lots are to be wholly above Council’s adopted flood standard (the 1% AEP or 1 in 100 flood event). In exceptional circumstances, and where lot sizes have been increased to provide sufficient flood free area for erection of a dwelling and associated structures, parts of the lot may be permitted below the adopted flood standard.

Hence, all the proposed lots should be designed at or above the 1 in 100 year flood event level, with all residences to be above the flood planning level with the 0.5 m freeboard for residential development

2. STORMWATER DRAINGE MANAGEMENT STRATEGY

The stormwater drainage management plan involves:

- Roof areas of residences will drain to rainwater tanks/harvesters within each lot for re-use. Water Tanks will overflow through a piped connection to IAD or street drainage system.
- Output of the collected stormwater from drainage pipe system to gross pollutant traps (GPT's) for primary treatment prior to the discharge into the proposed combined detention and bioretention basins for further treatment.
- Capture of stormwater from lot and road reserve areas by a convectional pit and pipe drainage network located in the street or in IAD easements where required.
- Discharge from the catchment's outlets will be conveyed over land towards the existing waterways, or piped where required, generally similar to the discharge from the undeveloped catchments.
- A basin with-in the proposed subdivision, in accordance with Maitland City Council's Development Control Plan, Part F- Urban Release Areas-Farley Urban Release Area.

Details of the proposed local drainage system will be determined at the time of Construction Certificate application, to Council's standard requirements.

3. METHODOLEGYT

3.1 Stormwater Runoff Quantity

The hydrological modelling software has been used for flowrates estimation of the existing and post-development in order to demonstrate the magnitude of the local catchment discharge.

3.1.1 Stormwater Flow Model

The post-development release is compared to the pre-developed discharge, and if higher, detention is usually warranted in accordance with Council's standard requirements.

3.1.1.1 Catchment Plan and Model Data

Surface runoff flowrates from the proposed site were modelled in two differing scenarios (the pre-developed state and post-developed catchment) using the DRAINS – Urban Drainage Model.

The Horton/ILSAX model was used within the DRAINS software package for both scenarios.

For the existing state the development site was formed to be one catchment. Figure 3 Appendix B shows the location of the Post-developed catchment boundaries, including redirection of stormwater where flow is conveyed via the developments internal road drainage system. DRAINS model data is included in Appendix E.

The methodology for stormwater quantity comprised quantitative analysis of available data to estimate existing and future flow behaviour from the development site. The analysis involved examination of surface hydrology to identify runoff characteristics from the proposed site and determination if stormwater mitigation devices are required to negate the impact of site development on existing flowrates from the site.

This involved the following steps:

- Estimate the existing peak stormwater flowrates at the downstream drainage outlets of the site using the DRAINS drainage software package.
- Revise the existing scenario in the DRAINS drainage model to include the additional impervious areas that will arise due to development of the site. This resulted in the developed DRAINS drainage model.
- The critical storm was then selected for each ARI, based on the peak discharge from the site. The hydrographs of these 'critical' storms were plotted to enable comparison of the existing state storm event to the developed state storm event

3.1.1.2 Rainfall Data

Rainfall for the 1 year, 2 year , 5year ,10 year , 20 year , 50 year and 100 year ARI design events, and storm durations from 5 minutes to 4.5 hours for each, were modelled in order to identify the critical storm duration (producing the highest peak flowrate) for each ARI from the site. The required rainfall Intensity Frequency Duration (IFD) rainfall data was obtained from the tables supplied in Australian Rainfall and Runoff, and the BOM website, and is reproduced below.

Latitude	= -32.73^0 S	
Longitude	= 151.51^0 E	
Skewness	= 0.06	
2-year ARI,	1 hour intensity	= 29.60 mm/hr
	12 hour intensity	= 6.08 mm/hr
	72 hour intensity	= 1.93 mm/hr
50-year ARI,	1 hour intensity	= 57.52 mm/hr
	12 hour intensity	= 12.83 mm/hr
	72 hour intensity	= 3.90 mm/hr
F_2	= 4.32	
F_{50}	= 15.95	

3.1.1.3 DRAINS Model Parameters

Table 1 summarises the catchment storage and loss parameter values adopted in the DRAINS models for both the pre-developed and post-developed models.

Table 1: Storage and loss parameter values adopted in the DRAINS hydrological models

Parameter	Value
Paved depression storage (mm)	1
Grassed depression storage (mm)	5
Soil type	3

3.1.1.4 Model Catchment Data

Full DRAINS model Catchment data is provided in Appendix E. Surface roughness values, n*, used in the DRAINS models are summarised in Table 2.

Table 2: Roughness parameter values, n, adopted in the DRAINS models*

	Model - surface type	Surface roughness 'n*' value
Pre-dev	Pervious areas	0.15
Post-dev	Pervious areas	0.011
	Impervious areas	0.21

Catchment impervious area percentage values used in the DRAINS models are summarised in Table 3.

Table 3: Impervious area percentage values adopted in the DRAINS models

Model - type	Impervious Area Percentage
Existing site area (Pre-development)	0%
Residential Development area, including road reserve (Post-development)	61%

3.2 Stormwater Runoff Quality

The methodology for Stormwater Runoff Quality typically involves selection of stormwater quality treatment devices based on identified opportunities for stormwater quality management referencing the development site and catchment conditions, and normal best practice.

The performance of the stormwater management plan was undertaken using the MUSIC stormwater water quality model. MUSIC is a continuous simulation water quality model. The pollutants considered in the water quality modelling were total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN) which are typical components of urbanised stormwater runoff.

MUSIC input parameters include:

- Rainfall and potential evapotranspiration data
- Catchment area and percentage impervious
- Hydrologic parameters
- Statistical pollutant generation parameters

MUSIC outputs include:

- Average annual pollutant export loads
- Treatment train effectiveness expressed in terms of pollutant reduction.

Input parameters used for modelling were derived from BOM Climate Data, parameter values in the *MUSIC User Manual* and the publication *Using MUSIC in Sydney's Drinking Water Catchment, A Sydney Catchment Authority Standard* (Published by Sydney Catchment Authority, Penrith, December 2012).

The treatment criteria of stormwater quality of Maitland City Council are summaries in Table 4:

Table 4: Stormwater Treatment Objectives

Pollutant	**Stormwater Treatment Objective**
Total Suspended Solids (TSS)	80% retention of average annual load
Total Phosphorus (TP)	45% retention of average annual load
Total Nitrogen (TN)	45% retention of average annual load

3.2.1 MUISIC Parameters

3.2.1.1 Land Use Type

The post-developed land use was modelled using both the residential land use/zoning and surface type. The pollutant generation characteristics of the land use/zoning and surface type are shown in Table 6 below.

3.2.1.2 Rainfall and Evapotranspiration

The rainfall data used for the modelling was from Williamtown weather station (061078). The rainfall data used in the analysis was from the year 2000. The average annual rainfall during this period was 961mm.

Monthly average areal potential evapotranspiration (PET) values from MUSIC's default values for Newcastle were used in the modelling. Evapotranspiration values are given in Table 5. The estimated total annual areal PET is 1407 mm.

Table 5:Monthly Average Areal PET Values

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PET (mm/month)	188	148	148	96	66	53	56	72	100	138	162	180

3.2.1.3 Time Step

The model was run with a time step of 6 minutes.

3.2.1.4 Hydrology

MUSIC hydrology parameters used are summarised below in Table 6.

Table 6: MUSIC Rainfall-Runoff Parameters

Parameter	Land Use Catchment			
	Residential	**Roof**	**Basin**	**Road**
Impervious Area Properties				
Land Use Area (ha)	1.65	1.11	0.430	1.20
Impervious Area (%)	20	100	0	70
Rainfall Threshold (mm/day)	1.0	1.0	1.0	1.0
Pervious Area Properties				
Soil Storage Capacity (mm)	120	120	120	120
Initial Storage (% of Capacity)	25	25	25	25
Field Capacity (mm)	80	80	70	80
Infiltration Capacity Exponent - a	200	200	180	200
Infiltration Capacity Exponent - b	1.0	1.0	1.0	1.0
Groundwater Properties				
Initial Depth (mm)	10	10	10	10
Daily Recharge Rate (%)	25	25	25	25
Daily Baseflow Rate (%)	5	5	5	5
Daily Deep Seepage Rate (%)	0	0	0	0

3.2.1.5 Event Mean Concentrations

The MUSIC model requires pollutant generation parameters for baseflow and stormflow conditions. Baseflow is derived from the groundwater store, which is recharged from the previous soil store. Stormflow is generally generated from the impervious area, and under some conditions the pervious area as well.

The pollutant parameters for the adopted land use types were determined from the *Using* MUSIC in Sydney's Drinking Water Catchment, A Sydney Catchment Authority Standard (Published by Sydney Catchment Authority, Penrith, December 2012), and are provided in Table 7.

Table 7: Adopted Land Use Baseflow and Stormflow Concentration Parameters

Land Use and Flow Type	Total Suspended Solids (TSS) ($\log_{10}$ mg/L)		Total Phosphorus (TP) ($\log_{10}$ mg/L)		Total Nitrogen (TP) ($\log_{10}$ mg/L)	
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev
Baseflow Residential Roof	1.10	0.17	-0.82	0.19	0.32	0.12
Stormflow Residential Roof	1.20	0.17	-0.85	0.19	0.11	0.12
Stormflow Road	1.20	0.17	-0.85	0.19	0.11	0.12
Stormflow Basin	1.10	0.17	-0.82	0.19	0.32	0.12

4. MODEL RESULTS

4.1 Stormwater Runoff Quantity

4.1.1 DRINS Model Results

The pre and post-developed site conditions were modelled to establish the peak rate of discharge for each critical storm event from the 1 year to 100 year ARI events. The stormwater water plan is shown in Appendix B. The pre-developed flow rates were calculated using the Probabilistic Rational Method, the results are shown in Table 1 as allowable pre-developed peak discharge. The time of concentration for the per developed catchments was estimated using the Kinematic Wave Equation. Estimated peak rates of discharge for each pre-developed using the rational method and post-developed undetained storm event are shown below in Table 8.

Table 8: Estimated Pre and Post-Developed Peak Discharge

ARI (years)	Allowable Pre-Developed Peak Discharge (m^3/s)	Undetained Post-Developed Peak Discharge (m^3/s)
1	0.066	0.685
2	0.132	0.797
5	0.423	1.298
10	0.662	1.638
20	0.948	1.976
50	1.365	2.436
100	1.732	2.817

The incorporation of an outlet control structure configuration will reduce post-developed flowrates to less than, or equal to the pre-developed flowrates for all storm events up to and including the 100 year ARI event. The Post Developed flows with the outlet control structure in place are shown in Table 9.

Table 9: Estimated Pre and Post-Developed Peak Discharge

ARI (years)	Allowable Pre-Developed Peak Discharge with Bypass (m^3/s)	Post-Developed Peak Discharge (m^3/s)	Basin Top Water Level (RL)
1	0.066	0.046	12.13
2	0.132	0.052	12.30
5	0.423	0.254	12.62
10	0.662	0.482	12.67
20	0.948	0.666	12.71
50	1.365	0.958	12.80
100	1.732	1.217	12.87

The DRAINS model for each year has been attached to the report for assessment.

The retention basin calculations do not account for reduced runoff due to the presence of rainwater harvesting tanks. A noticeable reduction in peak runoff during larger storms (such as the 100 year ARI) would likely occur due to such tanks.

In accordance with Council's stormwater retention basin requirements, a spillway must be incorporated within the basin embankment. The spillway must be able to convey the 100-year ARI flood event.

Using the Manning Equation for Uniform Open Channel Flow a spillway width of 5m, with 1:5 side slopes the height of the basin spillway is 0.5m. The depth of water in basin was modelled in Drains for the 100 year ARI storm event was found to be 1.47m with a max volume of 1895m^3, therefore the detention volume 1895m^3 will be required and the proposed spillway can adequately handle the discharge generated by the 100 year ARI storm event.

The summary DRAINS Output is provided for the 1, 2, 5, 10, 20 and the 100-year ARI in Appendix F.

4.2 Stormwater Runoff Quality

4.2.1 MUSIC Results – Post Development land Use (No Treatment)

The modelled average annual pollutant loads leaving the site in its post development land use, without any treatment measures, is shown in Table 10. Pollutant load estimates are provided for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). Figure 7 Appendix C shows the node layout used in the MUSIC modelling.

Table 10: MUSIC Model Results for the Site's Post Development Land Use (No Treatment)

Land Use	Average Annual Pollutant Load (kg/yr)		
	Total Suspended Solids (TSS)	Total Phosphorous (TP)	Total Nitrogen (TN)
Catchment	4125	8.33	58.9

Standard engineering practice is to ensure that runoff from the proposed new impervious area of the development is treated to meet the established criteria previously documented in Table 4, and this is the basis for evaluation of the treatment train effectiveness as documented below.

4.2.2 MUSIC Results – Post Development land Use (With Treatment)

The MUSIC model results for the post development land use, with treatment measures, is documented below, enabling the evaluation of the treatment train effectiveness.

4.2.2.1 Treatment Device

Treatment devices modelled in MUSIC for the treatment of runoff from the developments impervious surface areas include:

- Rainwater Tanks
- Gross Pollutant Traps (GPTs)
- Bioretention Basins

4.2.2.1.1 Rainwater Tanks

The rainwater tank node was included immediately following the roof area node, using the default rainwater tank treatment node within MUSIC. Rainwater tanks for all proposed lots within catchment was modelled as one MUSIC treatment node.

Rainwater tank treatment node data included:

- Stored water would be utilised by internal reused on each lot;
- Rainwater tank volume is 3000L per lot; (Water NSW Table 5.3)
- Daily usage demand (consisting of internal and external) of 0.62kL/day per lot. (Water NSW Table 5.4)

4.2.2.1.2 Gross Pollutant Traps

The GPT node was included downstream of the development area and prior to the proposed bioretention basins. A GPT node was created by using the Sydney Catchment Authority Standard parameter in MUSIC Modelling.

4.2.2.1.3 Bioretention Basin

The proposed bioretention basin node was included in the MUSIC model immediately downstream of the proposed GPT node. The MUSIC model parameters used for the bioretention basin node are shown below in Table 11.

Table 11: Bioretention Basin Treatment Parameters

Parameter	Value
Inlet Properties	
Low Flow By-pass (m^3/s)	0.0
High Flow Bypass (m^3/s)	100.0
Storage Properties	
Extended Detention Depth (m)	0.15
Surface Area (m^2)	260
Filter and Media Properties	
Filter Area (m^2)	260
Unlined Filter Media Perimeter (m)	136
Saturated Hydraulic Conductivity (mm/hr)	200
Filter Depth (m)	0.5
TN Content of Filter Media (mg/kg)	800
Orthophosphate Content of Filter Media (mg/kg)	50.0

Infiltration Properties	
Exfiltration Rate (mm/hr)	0.00
Lining Properties	
Is Base Lined?	No
Vegetation Properties	
Vegetation with Effective Nutrient Removal Plants?	Yes
Outlet Properties	
Overflow Weir Width (m)	5.0
Underdrain Present?	Yes
Submerged Zone with Carbon Present?	No

4.2.2.2 Modelling Results

The modelled average annual pollutant loads leaving the site in its post development land use, utilising treatment measures, is shown in Table 12. Pollutant load estimates are provided for total suspended solids (TSS), total phosphorus (TP) and total nitrogen (TN). Figure 7 Appendix C shows the node layout used in the MUSIC modelling.

Table 12:MUSIC Model Results for the Site's Post Development Land Use (with Treatment)

Land Use	**Average Annual Pollutant Load (kg/yr)**		
	Total Suspended Solids (TSS)	**Total Phosphorus (TP)**	**Total Nitrogen (TN)**
Post Development	785	4.98	41.1

The results above show that the pollutant export for the post development land use with treatment measures is significantly lower than the post development land use with no treatment measures.

The treatment train effectiveness, expressed as a percentage reduction in post development land use pollutant loads generated by the modelled sources, is summarised in Table 13.

Table 13: MUSIC Model Treatment Train Effectiveness Results

Pollutant	Export Value		Treatment Train Effectiveness
	Post Development	Post Development with treatment measures	
TSS (kg/yr)	5950	785	86.8%
TP (kg/yr)	12.2	4.98	59.1%
TN (kg/yr)	82.1	41.1	50.0%

The treatment train effectiveness results above indicate that the pollutant reduction performance is in accordance with the requirements of the Australian Runoff Quality pollutant removal criteria and Maitland City Council's Manual of Engineering Standards, Section 8.2.

4.3 Flooding

Following the stormwater modelling process, and the inclusion of any required stormwater detention measures and/or stormwater flow conveyance structures, proposed lots are reviewed against localised 100 year ARI stormwater flood levels to confirm that the lots are at or above the 1 in 100 year flood event level, enabling all dwellings to be above the flood planning level, which is the 1 in 100 year flood level plus 500mm freeboard for residential development.

Maitland City Council's LEP 2011, Flood Planning Map, shows that the subject site is in a mapped flood zone as shown Figure 8 and 9 Appendix D. Therefore, the site is subject to any flooding limitans.

- All lots to be 500mm above the 1 in 100 year flood

5. SOIL AND WATER MANGEMENT DURING CONSTRUCTION

Soil and water management devices to minimise land disturbance during the subdivision construction phase are to be provided in accordance with the publication *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

A detailed erosion and sedimentation control plan are to be undertaken during the detailed design stage of the proposed development. The erosion and sedimentation control plan should generally contain the following range of management practices for effective soil and water management during a land disturbance phase:

- Minimise the area of soil disturbed and exposed to erosion by phasing works so that land disturbance is confined to minimum areas.
- Erect barrier fencing to minimise disturbance by preventing vehicular and pedestrian access to restricted areas.
- Limit access for plant etc. to current construction area to limit amount of disturbed area.
- Conserve topsoil for site rehabilitation/revegetation when site works are complete.
- Installation of sediment filters, such as silt fences, straw bales, or turf strips downstream of disturbed areas.
- Control water flow from the top of, and through the development area. In particular, divert upslope runoff around works and limit slope length to 80 metres on disturbed lands if rainfall is expected.
- Where appropriate, reduce the effects of wind erosion by controlling on-site traffic movement and watering bare soil areas.

  Provision of shaker humps / pads near construction entry and exit locations to remove excess soil materials from vehicle tyres and underbodies.
- Rehabilitate disturbed lands quickly.
- Ensure that all erosion and sediment control measures are kept in a properly functioning condition until all site disturbance works are completed and the site is rehabilitated.

6. SUMMARY AND CONCLUSIONS

At Source Management

Stormwater Flow Management (stormwater runoff quantity and quality)

The strategy for management of stormwater runoff from the development is depicted on Figure 3 and 4 Appendix B, and comprises:

- Capture of stormwater from lot and road reserve areas by a conventional pit and pipe drainage network located in the street or in interalotment drainage easements where required.
- Conveyance of captured stormwater within the drainage pipe network to gross pollutant traps (GPT's) for primary treatment prior to discharge into the proposed combined detention and bioretention basins.
- The detention basins will provide attenuation of developed stormwater flowrates to existing flowrate conditions for the development site.
- The bioretention basins will provide secondary/tertiary treatment and polishing of the stormwater runoff from the development site prior to discharge downstream.
- Discharge from the major catchment outlets will be conveyed over land within the existing watercourses, or piped as required, toward southern side of the site towards Swamp Creek, generally similar to the discharge from the undeveloped catchments.

MUSIC modelling has demonstrated that the proposed treatment devices will treat developed stormwater runoff to meet requirements outlined in Manual of Engineering Standard 2014 Section 8.2 Stormwater Quality, and on this basis it is considered that no further water quality controls will be required within the proposed subdivision development.

Details of the proposed local drainage system will be determined at the time of Construction Certificate application, to Council's standard requirements.

area within the site to provide stormwater drainage management measures to negate the impact of As illustrated by Figure 4 Appendix B, there is sufficient the proposed development.

The catchment area outside our site to the south is not considered as part of this current application as the flow from the lot will not be going to the proposed basin. The neighbouring lot is also being developed and an application is being or will be submitted.

Flooding

From a review of Maitland City Council's Floodplain Risk Management Study and Plan 2015, Flood Planning Map, it is considered that the subject site is in a mapped flood zone. Therefore, the site is subject to any flooding limitations.

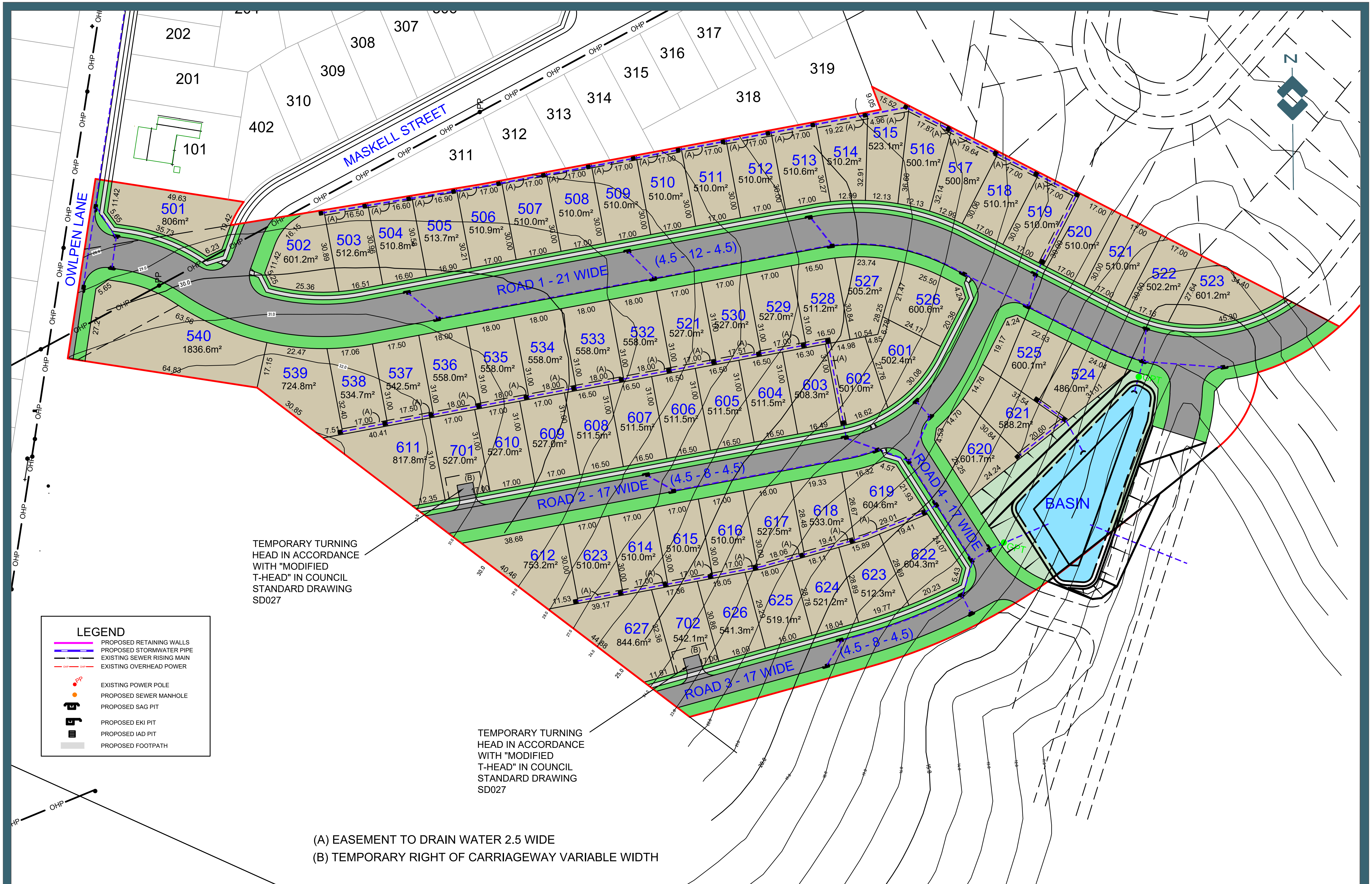
The site's levels, including any site regrading that may be proposed, should be reviewed in the CC phase of the development to confirm that developable areas are at or above the 1 in 100 year flood level, enabling future habitable dwellings to be located at or above the flood planning level.

7. REFERENCES

- Maitland City Councils Manual of Engineering Standards, 2014.
- Australian Rainfall and Runoff, Institution of Engineers, Australia, 1987.
- Australian Runoff Quality, Engineers Australia, 2006.
- Using MUSIC in Sydney's Drinking Water Catchment, A Sydney Catchment Authority Standard, Sydney Catchment Authority, Penrith, December 2012.

Appendix A: Site location and Subdivision Plan

Figure 1: Proposed Site Location



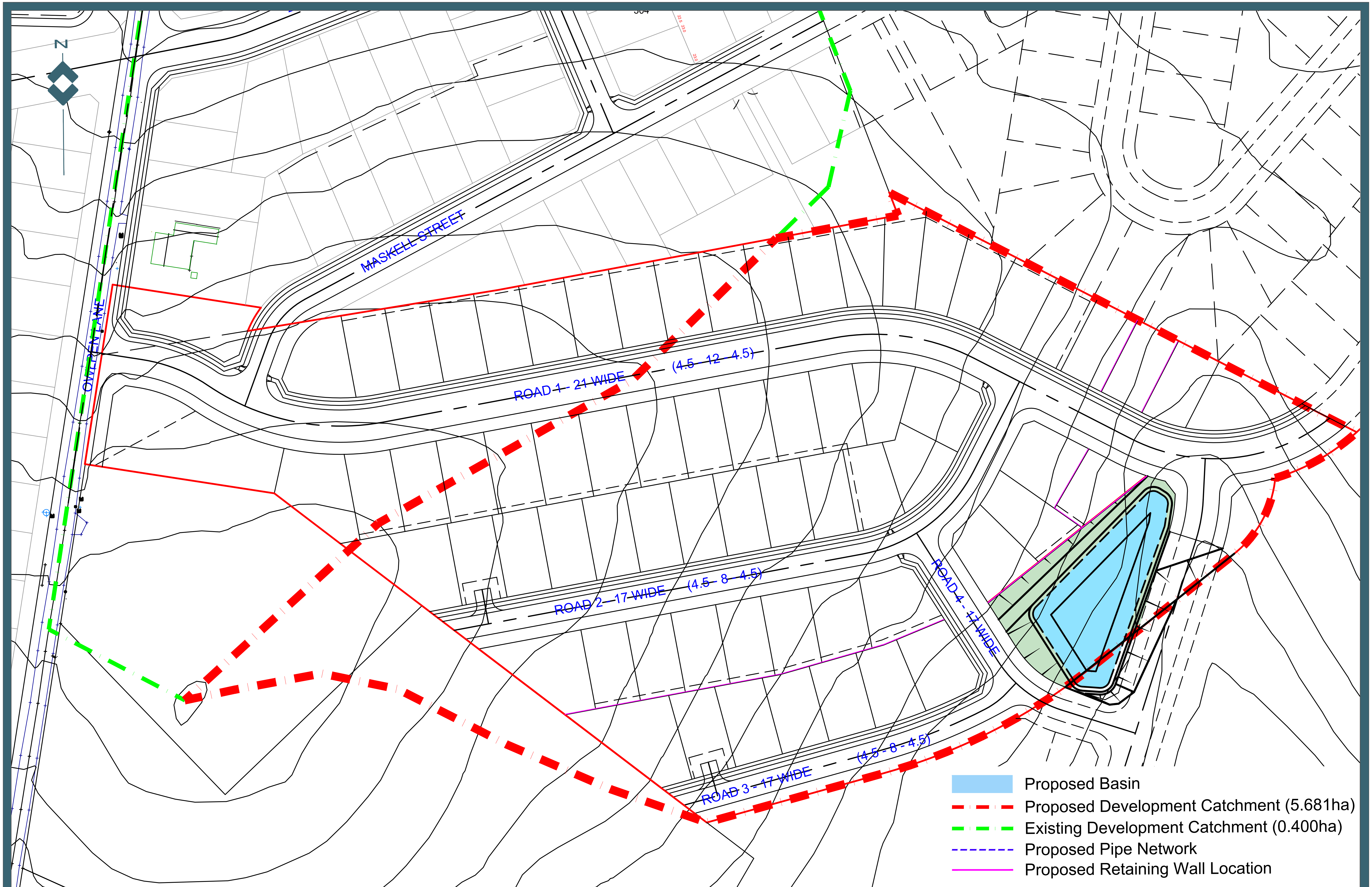
TITLE: PROPOSED SUBDIVISION OF LOT 101 DP1233753 AND LOT 400 DP UNREGISTERED
65 OWL PEN LANE, FARLEY

FIGURE 2: SUBDIVISION PLAN

High Definition Design Pty Ltd
KEVIN URANE 0412009891

Date: 19.05.22	Scale: 1:1250 A3	Designed: KU		Project No	HD351
Cad Ref: HD351 r1					
1	CLIENT ISSUE	KU	19.05.22	Drawing No FIG02	Revision 1
No	Amendment	Drawn	Date		

Appendix B: Stormwater Management Plans



TITLE: PROPOSED SUBDIVISION OF LOT 101 DP1233753
65 OWL PEN LANE, FARLEY

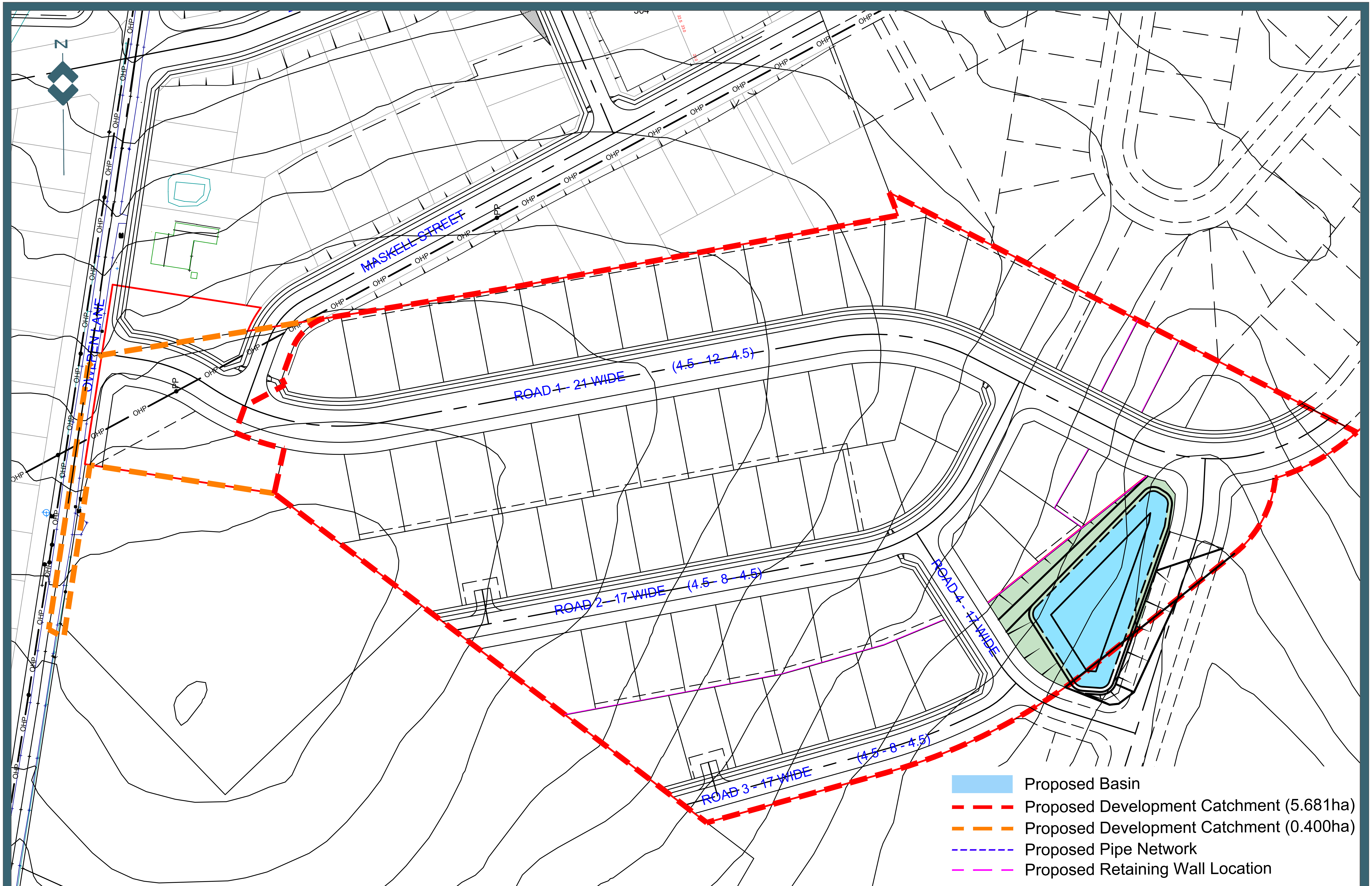
FIGURE 3: EXISTING CATCHMENT PLAN

High Definition Design Pty Ltd
KEVIN URANE 0412009891

Date: 02.05.22 Scale: 1:2000 A3 Designed: SB
Cad Ref: HD351 r1

No	Amendment	Drawn	Date
1	STORMWATER MANAGEMENT PLAN	SB	02.05.22

Project No: HD351
Drawing No: FIG03
Revision: 1



TITLE: PROPOSED SUBDIVISION OF LOT 101 DP1233753
65 OWL PEN LANE, FARLEY

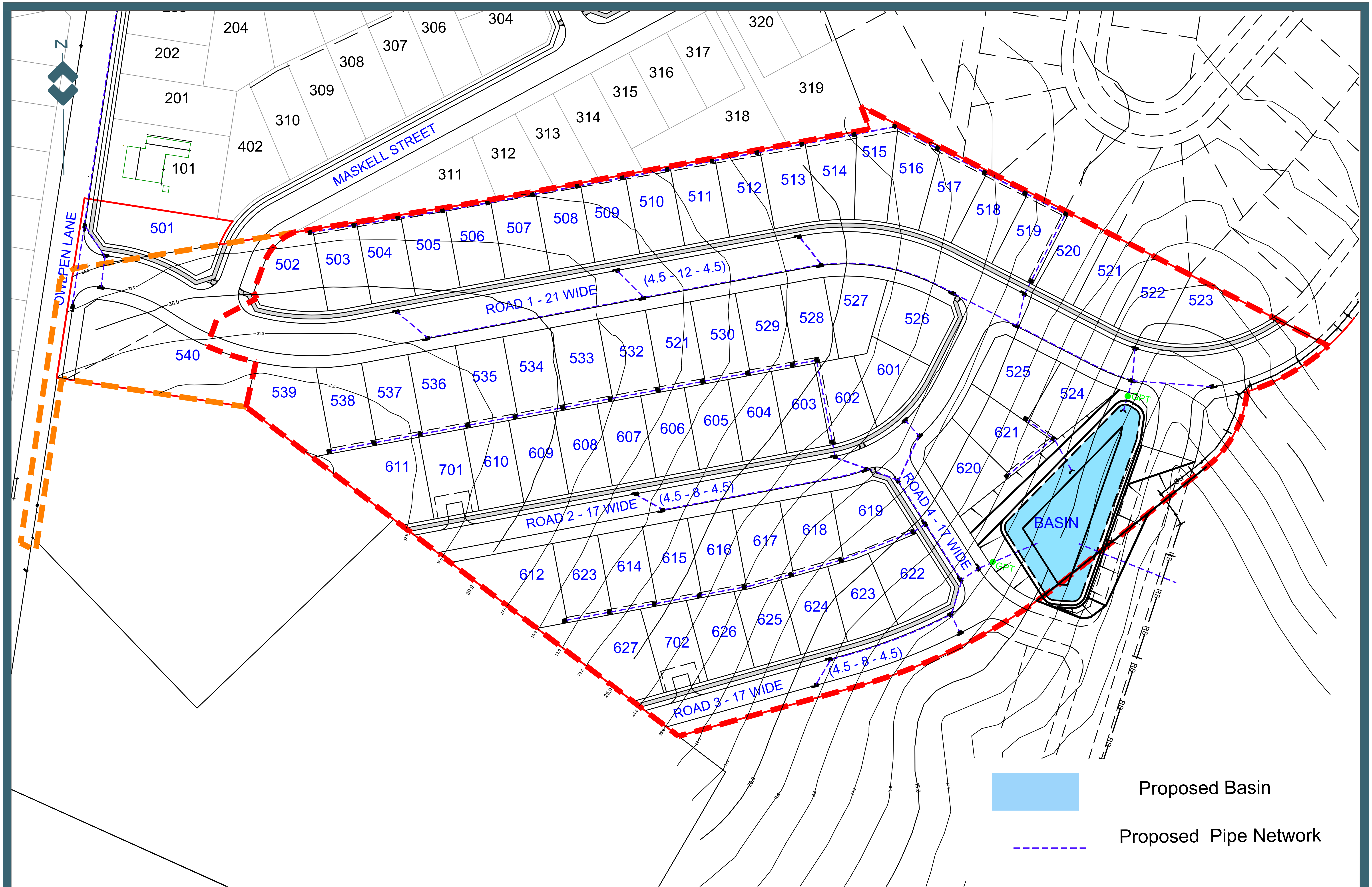
FIGURE 4: DEVELOPED CATCHMENT PLAN

High Definition Design Pty Ltd
KEVIN URANE 0412009891

Date: 02.05.22 Scale: 1:2000 A3 Designed: SB
Cad Ref: HD351 r1

No	Amendment	Drawn	Date
1	STORMWATER MANAGEMENT PLAN	SB	02.05.22

Project No: HD351
Drawing No: FIG04
Revision: 1



TITLE: PROPOSED SUBDIVISION OF LOT 101 DP1233753
OWL PEN LANE, FARLEY

FIGURE 5: STORMWATER MANAGEMENT PLAN

KEVIN URANE 0412009891

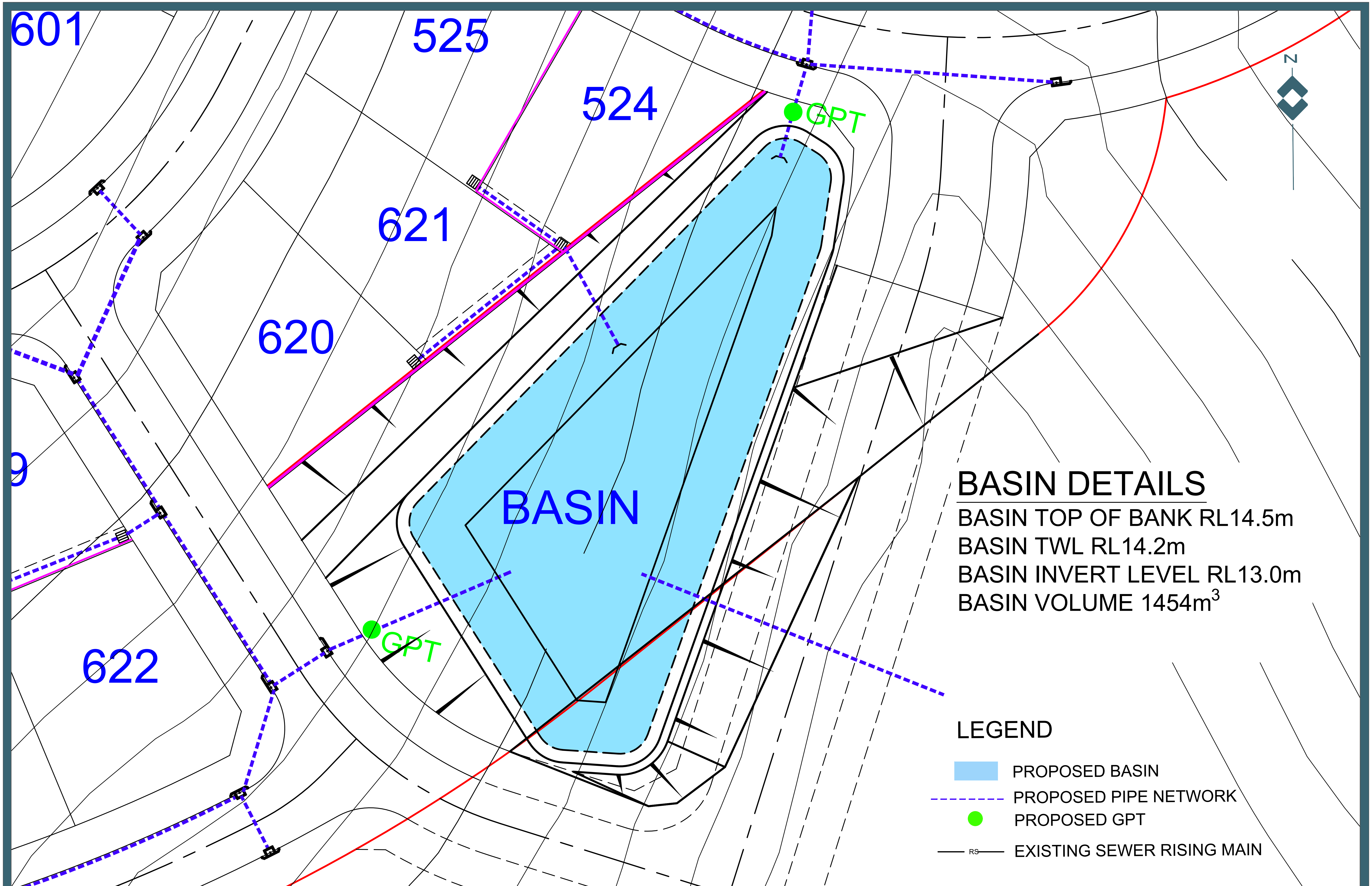
High Definition Design Pty Ltd

Date: 02.05.22 Scale: 1:2000 A3 Designed: SB
Cad Ref: HD351 r1

Project No: HD351

No	Amendment	Drawn	Date
1	STORMWATER MANAGEMENT PLAN	SB	02.05.22

Drawing No: FIG05
Revision: 1



TITLE: PROPOSED SUBDIVISION OF LOT 101 DP1233753
OWL PEN LANE, FARLEY

FIGURE 6: DETENTION BASIN LAYOUT PLAN

High Definition Design Pty Ltd
KEVIN URANE 0412009891

Date: 02.05.22 Scale: 1:2000 A3 Designed: SB
Cad Ref: HD351 r1

No	Amendment	Drawn	Date
1	STORMWATER MANAGEMENT PLAN	SB	02.05.22

Project No: HD351
Drawing No: FIG06
Revision: 1

Appendix C: MUSIC Modelling

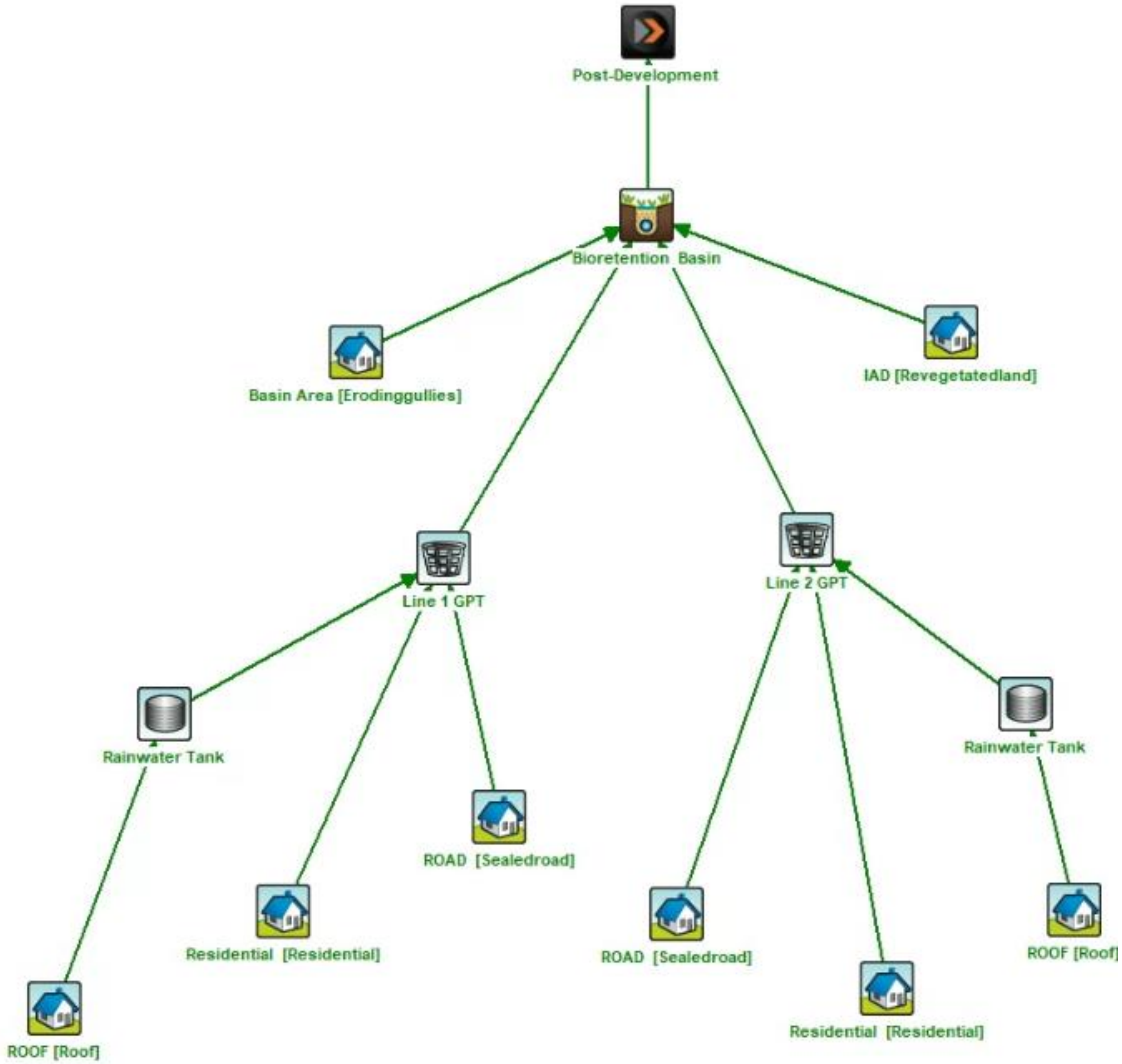


Figure 7: MUSIC Note Layout

Appendix D: Floodplain Risk Management Study

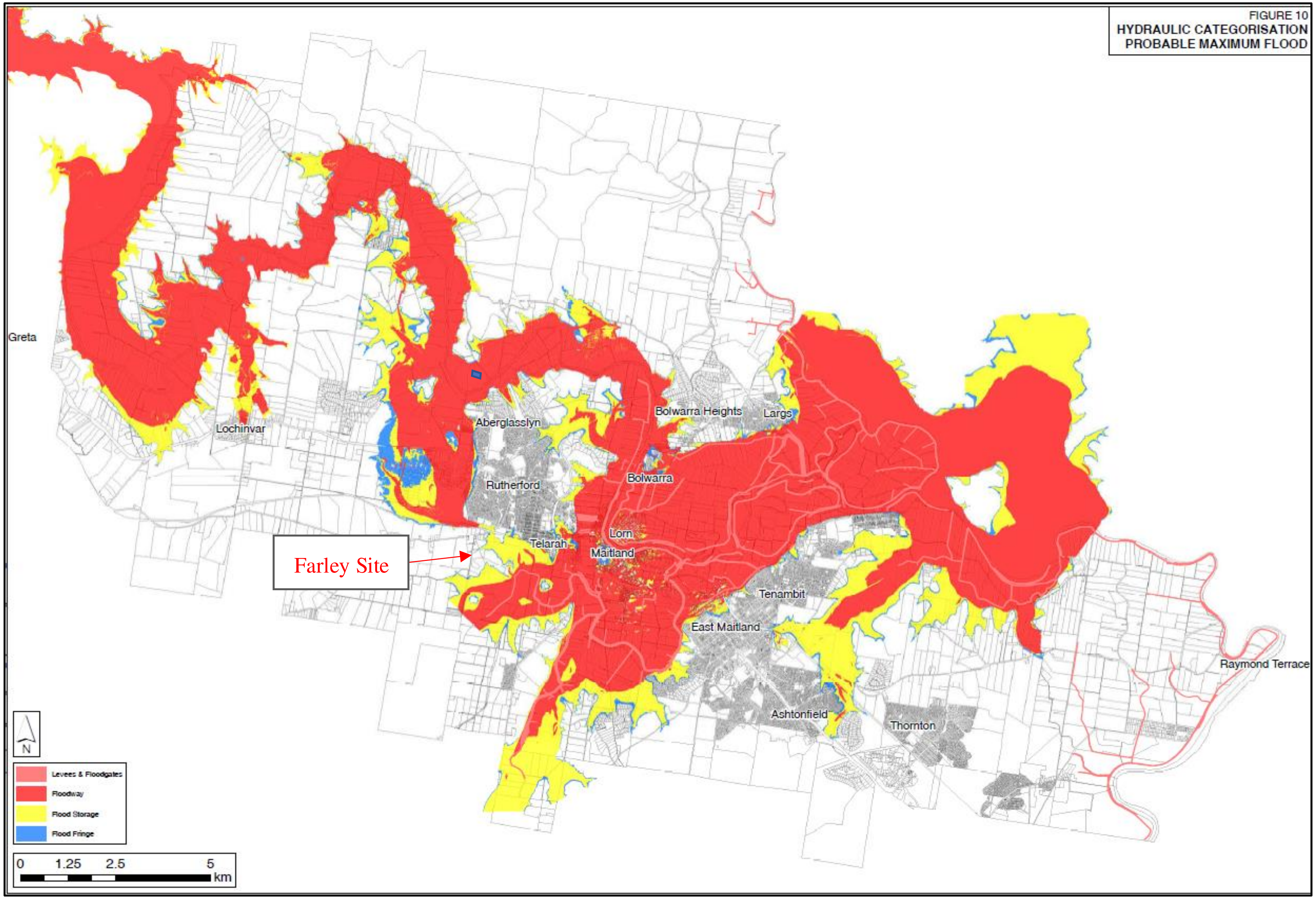


Figure 8: Probable Maximum Flood

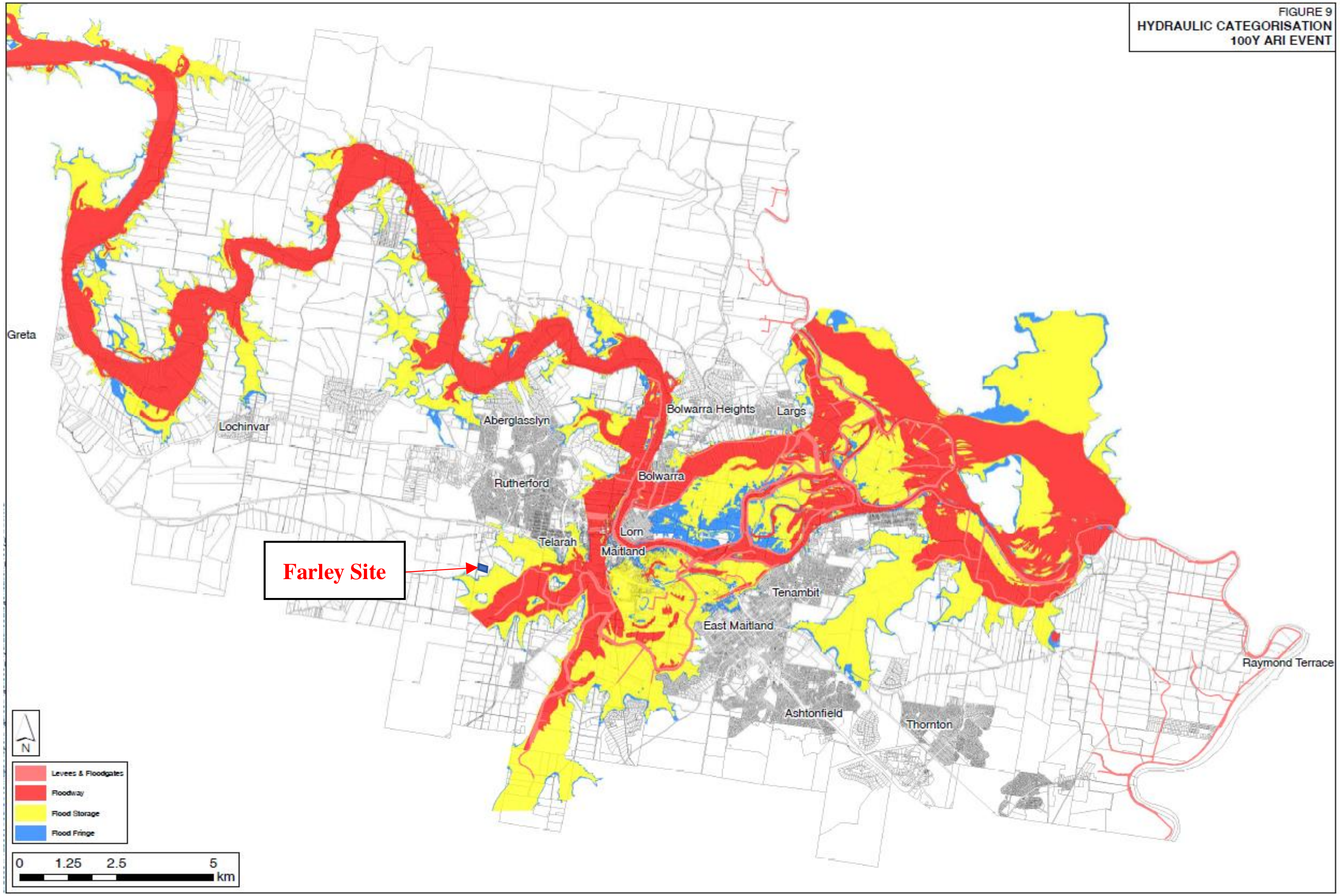


Figure 9: 1% ARI Evert

Appendix E: DRAINS Data Spreadsheets

PIT / NODE DETAILS — Version 15

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down lid	id	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Saf Pond Dep (m)	Major Safe Pond Depth (m)
Pre-Dev. Node	Node					100		0		800.803	-256.678		5		No					
Post-Dev. Node	Node					30		0		777.79	-270.379		1059		No					
Outlet Pit	Node					12.5		0		803.793	-271.048		4825		No					
Downstream Node	Node					12		0		810.674	-270.921		8098		No					
N1	Node					11.145		0		814.556	-271.147		21292		No					

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Typ	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length	id
Basin	11.4	950		None						789.105	-271.176	No			4620
	12.7	1550													
	13	1850													

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter FlowFacto	Rainfall Multiplier
Pre-Dev Cat	Pre-Dev. Node	5.681	0	100	0	0	0	0	0	300	0	0	6.9	0	0	0.15	0	0				1
Post-Dev Cat	Post-Dev. Node	5.681	61	39	0	0	0	0	300	300	0	8	8	0	0.011	0.21	0	0				1

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	Rl (m)	Chg (m)	RL (m)	etc (m)
Pipe83	Post-Dev. Node	Basin	220	25	11.4	6.18	Concrete, u	900	900	0.013	NewFixed	1	Post-Dev.	0					
Pipe85	Outlet Pit	Downstre	10	10.4	10.3	1	Concrete, u	375	375	0.013	New	1	Outlet Pit	0					
Pipe120	Downstream Node	N1	3	10.3	10.27	1	Concrete, u	375	375	0.013	New	1	Downstre	0					

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of (m)	Chg (m)	Bottom Elev (m)	Height of (m)	Chg (m)	Bottom Elev (m)	Height of (m)	etc etc

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Widt (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cove	Cover (m)	
Pipe83	Concrete, under roa	900	0.45	-0.97	Unsafe
Pipe85	Concrete, under roa	375	0.45	1.29	
Pipe120	Concrete, under roa	375	0.45	0.46	

This model has no pipes with non-return valves

Appendix F: DRAINS Results Spreadsheets for post- development and pre-development

10 year storm:

DRAINS results prepared from Version 2021.031								
PIT / NODE DETAILS				Version 8				
Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint	
Post-Dev. Node	25.42		1.959					
Outlet Pit	11.61		0					
Downstream Node	10.86		0					
N1	10.63		0					
SUB-CATCHMENT DETAILS								
Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm	
Pre-Dev Cat	0.662	0	0.662	0	27.46	0	10% AEP, 30 min burst, Storm 5	
Post-Dev Cat	1.599	1.513	0.086	4.01	23.52	0	10% AEP, 5 min burst, Storm 1	
PIPE DETAILS								
Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm			
Pipe83	1.637	5.65	25.418	12.671	10% AEP, 5 min burst, Storm 1			
Pipe85	0.482	4.37	11.61	10.857	10% AEP, 1.5 hour burst, Storm 8			
Pipe120	0.482	4.36	10.857	10.645	10% AEP, 1.5 hour burst, Storm 8			
CHANNEL DETAILS								
Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm			
OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
W1								
W	0.435	0.435						10% AEP, 1.5 hour burst, Storm 8
Orific	0.061	0.061						10% AEP, 1.5 hour burst, Storm 1
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level			
Basin	12.67	1564.5	0.496	0	0.496			
Run Log for HD351 Strategy Report Drains Model.drn run at 10:05:28 on 4/5/2022 using version 2021.031								

100 year storm:

DRAINS results prepared from Version 2021.031

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Version 8 Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Post-Dev. Node	25.57		3.558				
Outlet Pit	12.87		0				
Downstream Node	12.07		0				
N1	10.63		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre-Dev Cat	1.732	0	1.732	0	21.49	0	1% AEP, 25 min burst, Storm 6
Post-Dev Cat	2.749	2.484	0.265	3.29	19.29	0	1% AEP, 5 min burst, Storm 1

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Pipe83	2.816	6.62	25.57	12.873	1% AEP, 5 min burst, Storm 1
Pipe85	0.687	6.22	12.866	12.07	1% AEP, 20 min burst, Storm 1
Pipe120	1.217	11.02	12.07	10.645	1% AEP, 45 min burst, Storm 6

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
W1	0.72	0.72						1% AEP, 45 min burst, Storm 6
W	0.959	0.959						1% AEP, 20 min burst, Storm 1
Orific	0.062	0.062						1% AEP, 20 min burst, Storm 8

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	12.87	1892	1.741	0	1.741

Run Log for HD351 Strategy Report Drains Model.drn run at 10:05:28 on 4/5/2022 using version 2021.031