Proposed Rural Residential Subdivision

STORMWATER DRAINAGE STRATEGY

Lot 42 DP585862, Lot 52 DP1239772 & Lot 101 DP 1158364

31 Chichester Dam Road, Dungog

13 September 2022

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Document Control

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A	13.09.2022	DA Issue	Simon Bugeja	Kevin Urane

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 Bendolba Downs Pty Ltd to prepare a Stormwater Management Plan & Report in accordance with the stormwater quantity and quality requirements of the Dungog Shire 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 Chichester Dam Road known as Lot 42 DP585862, Lot 52 DP1239772 and Lot 101 DP1158364 located within the Dungog Shire 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:

- Dungog Shire Council Development Control Plan (DCP) 2004.
- "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 Chichester Dam Road, Bendolba, NSW, and is Lot 42 DP585862, Lot 52 DP1239772 and Lot 101 DP1158364 with a total area of approximately 6.102 hectares. The site is bounded by Chichester Dam Road to the west side.

The site has average natural surface slope from North-Western corner to the South-Eastern corner at approximately 12%, and level from RL91.1m AHD on north-western corner to RL 60.9m AHD in the south-eastern corner of the site.

1.3 Proposed Development

The proposed site is for a residential subdivision, with 5 lots over the developable footprint. The concept subdivision lot layout has been prepared by High Definition Design and is shown in Figure 2 Appendix A.

1.4 Drainage Catchment

The site generally drains towards the southern boundaries. Stormwater runoff from the sites finished surface will be towards the east of the site boundary. This site is contained in two catchments, the first catchment (5.5093ha) as shown in Figure 3 of Appendix B drains towards each lot into the water tanks and the second catchment (0.593ha) as shown Figure 3 of Appendix B drains towards to the swale on the side of the proposed 20m wide road reserve and into the proposed basin.

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 Dungog Shire 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 High Definition Design.
  A copy of the plan is shown in Appendix A.
- Dungog Shire Council – Development Control Plan 2004 (amended 19 Feb 2013)
- Dungog Local Environmental Plan 2014

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.
- Requirements of minimum capacity for rainwater tanks

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);
- Grass Lined Swales;
- Stormwater bioretention basins; and
- Proprietary water quality improvement devices for runoff water treatment.

1.7.3 Flooding Criteria

Dungog Shire Council Local Environmental Plan 2014, Part 6 Additional Local Provisions, "6.3 flooding planning", States:

a) Flood planning required of 1 in 100 year ARI in flood event plus 0.5 metre freeboard.
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 grass line swales at the low point of their respective lots and discharge into bio-filter beds.
- Road reserve will drain to the swales aside, into the basin. The quality and quantity of the water flow are managed.
- Output of the collected stormwater from drainage pipe/overland flow system to grass lined swales for primary treatment prior to the discharge into the proposed combined detention and bioretention basins for further treatment.

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.

3.1.1Stormwater 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.

The models discussed in this report included the Horton/ILSAX model for the Basin retention modelling and a RAFTS hydrological routing routine model for the rural residential lot catchment. Both models were used within the DRAINS software package.

For the existing state the development site was formed to be two catchments. One being the proposed 20 wide road reserve arrangement and the other being the rural residential lots and proposed internal access road, Figure 3 of 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 of 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 12 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	= -32.327^0 S	
Longitude	= 151.727^0 E	
Skewness	= 0.06	
2-year ARI,	1 hour intensity	= 27.20 mm/hr
	12 hour intensity	= 5.72 mm/hr
	72 hour intensity	= 1.92 mm/hr
50-year ARI,	1 hour intensity	= 65.00 mm/hr
	12 hour intensity	= 13.50 mm/hr
	72 hour intensity	= 4.72 mm/hr

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**
Pervious Area Initial Loss (mm)	5
Pervious Area Continuing Loss (mm/h)	6
Impervious Area Initial Loss (mm)	0
Impervious Area Continuing Loss (mm/h)	0
Storage Multiplier, Bx	1.0

3.1.1.4 Model Catchment Data

Full DRAINS model Catchment data is provided in Appendix D. Surface roughness values, n*, used in the DRAINS models are summarised in Table 2 and Table 2.1.

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

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

Table 2.1: Roughness parameter values, adopted in the RAFTS DRAINS model for the rural residential lots

	Model - surface type	Manning 'n*' value
Pre-dev	Pervious and Impervious Areas	0.1
Post-dev	Pervious and Impervious Areas	0.1

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) **Due to existing dwelling and hardstand areas on proposed lot 101*	1.08%
Existing site area (Pre-development for Basin site)	0%
Residential Development area (Post-development) **Area limited to 1000m2 per lot*	9.07%
Road Reserve Areas	70%

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 Dungog Shire 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 road type. The pollutant generation characteristics of the land use/zoning and surface type are shown in Table 6 below.

3.2.1.2 Time Step

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

3.2.1.3 Hydrology

MUSIC hydrology parameters used are summarised below in Table 5.

Table 5: MUSIC Rainfall-Runoff Parameters

Parameter	Land Use Catchment			
	Residential	Roof	Main Road	Internal Road
Impervious Area Properties				
Land Use Area (ha)	4.759	0.50	0.593	0.25
Impervious Area (%)	20	100	70	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	200	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

3.2.1.4 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 6.

Table 6: 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

4.1.1.1 Northern Detention Basin

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 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 for residential are shown below in Table 7.

Table 7: Estimated Pre and Post-Developed Peak Discharge (Road Reserve and Basin)

ARI (years)	Allowable Pre-Developed Peak Discharge (m^3/s)	Undetained Post-Developed Peak Discharge (m^3/s)
1	0.039	0.087
2	0.053	0.100
5	0.105	0.153
10	0.152	0.199
20	0.195	0.240
50	0.245	0.286
100	0.287	0.333

The Post Developed flows with the road structure in place are shown in Table 8.

Table 8: Estimated Pre and Post-Developed Peak Discharge (Road Reserve and Basin)

ARI (years)	Allowable Pre-Developed Peak Discharge with Bypass (m^3/s)	Post-Developed Peak Discharge (m^3/s)	Pre-Post Development Discharge (% Change)	Basin Depth (m)
1	0.039	0.036	-8.3 %	0.29
2	0.053	0.040	-32.5 %	0.32
5	0.105	0.050	-110.0%	0.45
10	0.152	0.065	-133.8%	0.52
20	0.195	0.107	-82.2 %	0.57
50	0.245	0.154	-59.1 %	0.61
100	0.287	0.194	-47.9 %	0.64

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

As modelled this basin is without a spillway to show the capacity of the basin. Due to the natural topography of the area where the basin is proposed the flows above the 100 year would spill over the basin wall and flow naturally towards Chichester Dam Road's existing swale. As modelled the area discharging into the basin is a relatively small area of 0.593ha and as such the basin capacity is sufficient not only for the 100 year ARI storm event but also the 500 year ARI. During the construction certificate detail design the basin model will be adjusted to suit the pre-development conditions closer.

As modelled the depth of water in basin was modelled in Drains for the 100 year ARI storm event was found to be 0.64m with a max required volume of 160m^3, therefore the modelled detention volume of 300m^3 will be sufficient to 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 E.

4.1.1.2 Rural Residential Lots and Internal Road

The remainder of the site was modelled using a RAFTS routing module within the DRAINS software. A pre-developed and post-developed model was created to represent each lot due to the larger lot size and assumed 1000m^2 hardstand allocation for each lot. The following table represents the pre and post discharge from the network of lots. Once the critical storms were selected for each ARI event, pre and post development hydrographs were plotted to calculate volume difference between states.

Table 9: Estimated Pre and Post-Developed Peak Discharge (Rural Residential Lots and Internal Road)

ARI (years)	Pre-Developed Peak Discharge (m^3/s)	Post-Developed Peak Discharge (m^3/s)	Pre-Post Volume Difference (m^3)	+25% for outlet condition changes (m^3)
1	0.348	0.440	48.7	61
2	0.433	0.533	49.4	62
5	0.715	0.830	62.2	78
10	0.888	1.080	64.4	81
20	1.120	1.350	75.8	95
50	1.460	1.760	75.4	95
100	1.750	2.080	73.1	92

The above table shows that a detention basin of approximately 95m^3 would also be required on the southern side of lot 105 to limit the post development flows back to the pre-developed flows.

In lieu of this additional basin (cost and maintenance) the individual lots could install rainwater tanks with a capacity of 19m3 (19,000L) or more per lot to detain 100% of the post development flows to pre-development flows.

Though the above flows also include additional runoff from the internal sealed road the extra capacity from the proposed individual rainwater tanks would ultimately offset this additional discharge.

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). 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	2430	5.26	39.1

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
- Grass lined swales
- 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 Bioretention Basin

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

Table 9: Bioretention Basin Treatment Parameters

Parameter	Northern Basin	Southern Basin
Inlet Properties		
Low Flow By-pass (m^3/s)	0.0	0.0
High Flow Bypass (m^3/s)	100.0	100.0
Storage Properties		
Extended Detention Depth (m)	0.30	0.80
Surface Area (m^2)	50	125
Filter and Media Properties		
Filter Area (m^2)	50	10
Unlined Filter Media Perimeter (m)	28	25
Saturated Hydraulic Conductivity (mm/hr)	180	200
Filter Depth (m)	0.8	0.8
TN Content of Filter Media (mg/kg)	800	800
Orthophosphate Content of Filter Media (mg/kg)	50.0	50.0
Infiltration Properties		
Exfiltration Rate (mm/hr)	0.00	0.00
Lining Properties		
Is Base Lined?	No	No
Vegetation Properties		
Vegetation with Effective Nutrient Removal Plants?	Yes	Yes
Outlet Properties		
Overflow Weir Width (m)	5.0	5.0
Underdrain Present?	Yes	Yes
Submerged Zone with Carbon Present?	No	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). Appendix C shows the node layout used in the MUSIC modelling.

Table 10: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	134	2.18	18.0

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 11: MUSIC Model Treatment Train Effectiveness Results

Pollutant	Export Value		Treatment Train Effectiveness
	Post Development	**Post Development with treatment measures**	
TSS (kg/yr)	2430	134	94.5%
TP (kg/yr)	5.26	2.18	58.6%
TN (kg/yr)	39.1	18.0	54.1%

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 Dungog Shire Council's Manual of Engineering Standards.

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 plans 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 5 of 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.
- 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 or within grass line swales within the existing watercourses/lots, or piped as required, toward southern side of the site towards Chichester Dam Road, 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.

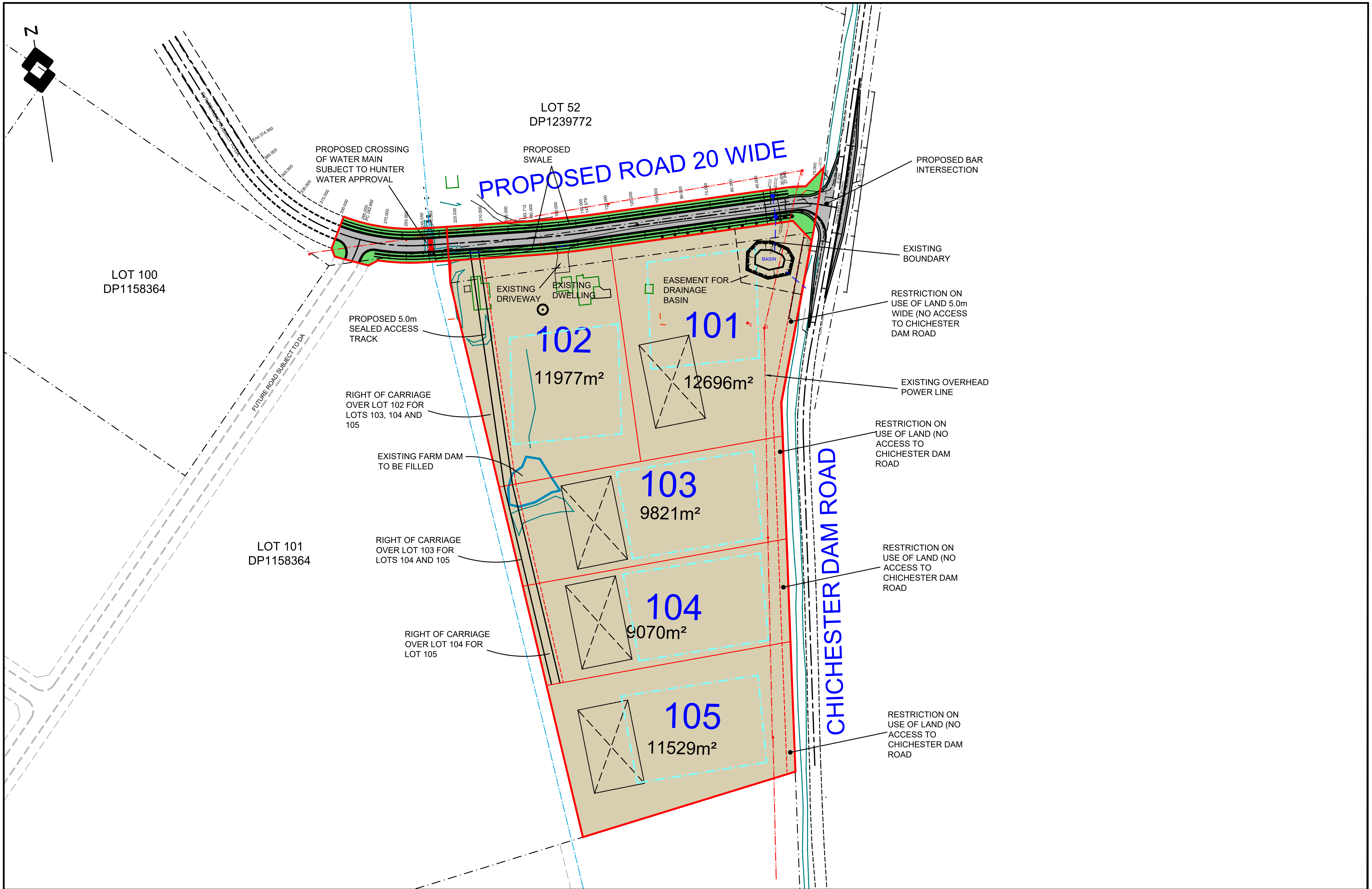
As illustrated by Figure 4 in Appendix B, there is sufficient area within the site to provide stormwater drainage management measures to negate the impact of the proposed development.

7. REFERENCES

- Dungog Shire Council – Development Control Plan 2004 (amended 19 Feb 2013)
- Dungog Local Environmental Plan 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 Lot 42 DP585862, Lot 52 DP1239772 and Lot 101 DP1158364
39 CHICHESTER DAM ROAD
DUNGOG
PLAN SHEET

CLIENT: BENDOLBA DOWNS PTY LTD

High Definition Design Pty Ltd

KEVIN URANE 0412009891

NOTE:

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION AND LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

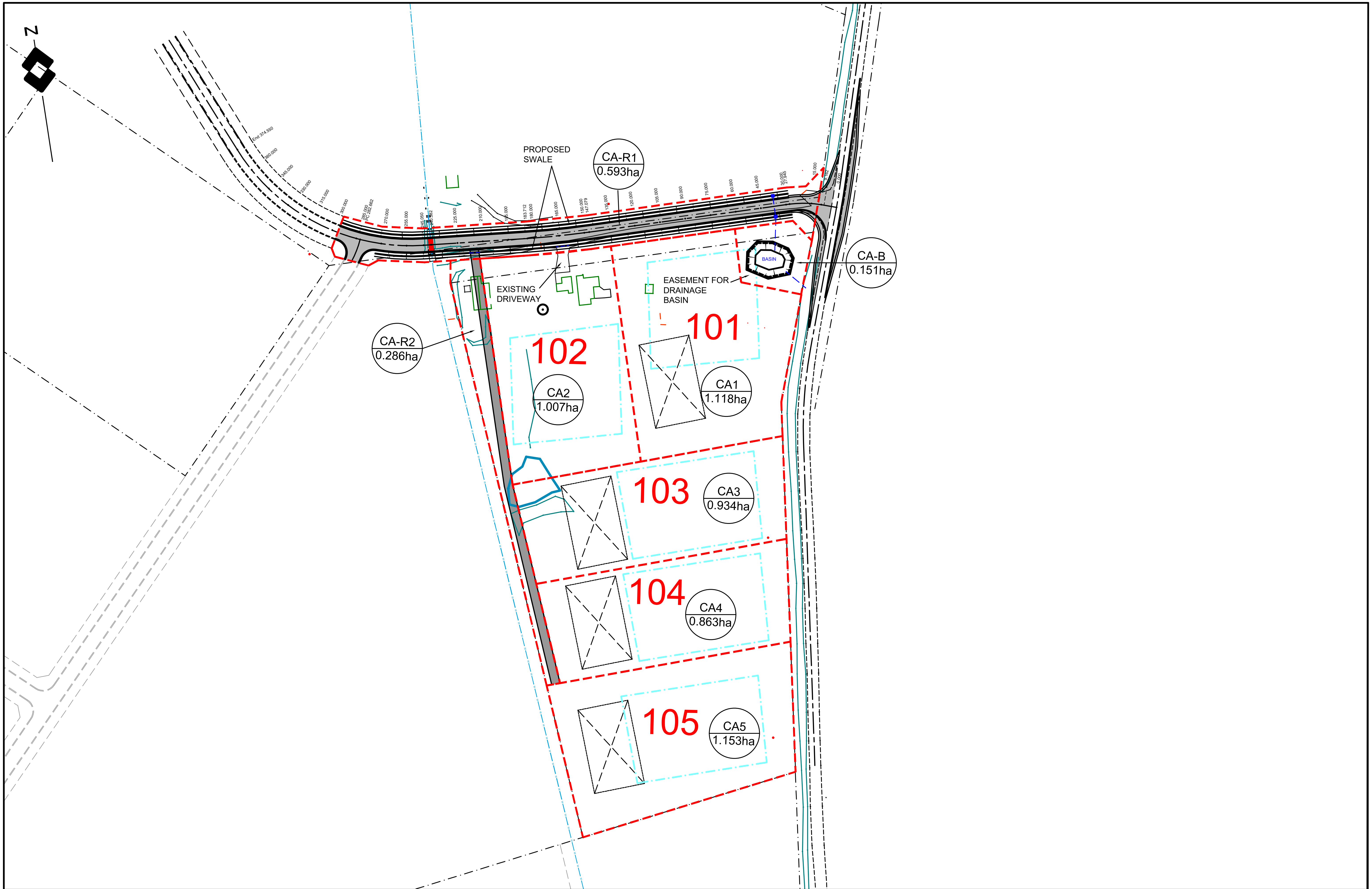
0 10 20 30 40 50m
1:500

Date: 12.10.20 Scale: 1:500 A1 Designed: KU
Cad Ref: HD350 DA1 Civils

No	Amendment	Drawn	Date
2	DESIGN CONTOUR, REGRADE DETAIL AND SUBSOIL	KU	22.01.21
1	CC	KU	12.10.20

Project No: HD1
Drawing No: CC03
Revision: 2

Appendix B: Stormwater Management Plans



TITLE: PROPOSED SUBDIVISION Lot 42 DP585862, Lot 52 DP1239772 and Lot 101 DP1158364
39 CHICHESTER DAM ROAD
DUNGOG
CATCHMENT PLAN

CLIENT: BENDOLBA DOWNS PTY LTD

KEVIN URANE 0412009891

High Definition Design Pty Ltd

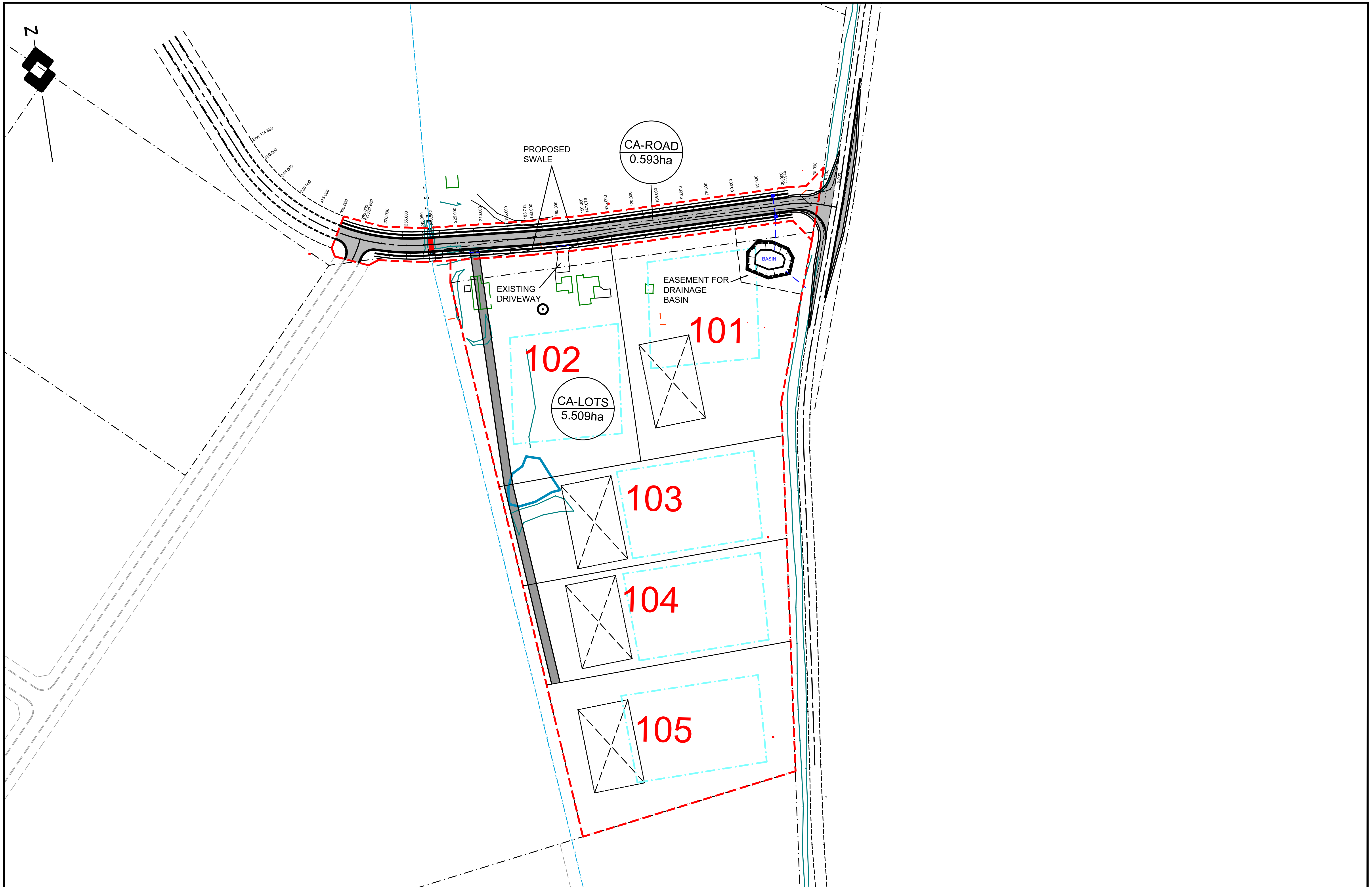
NOTE:
ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION AND LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

0 10 20 30 40 50m
1:500

Date: 12.10.20 Scale: 1:500 A1 Designed: KU
Cad Ref: HD350 DA1 Civils

No	Amendment	Drawn	Date
2	DESIGN CONTOUR, REGRADE DETAIL AND SUBSOIL	KU	22.01.21
1	CC	KU	12.10.20

Project No: HD1
Drawing No: CC10
Revision: 2



TITLE: PROPOSED SUBDIVISION Lot 42 DP585862, Lot 52 DP1239772 and Lot 101 DP1158364
39 CHICHESTER DAM ROAD
DUNGOG
EXISTING CATCHMENT PLAN

CLIENT: BENDOLBA DOWNS PTY LTD

KEVIN URANE 0412009891

High Definition Design Pty Ltd

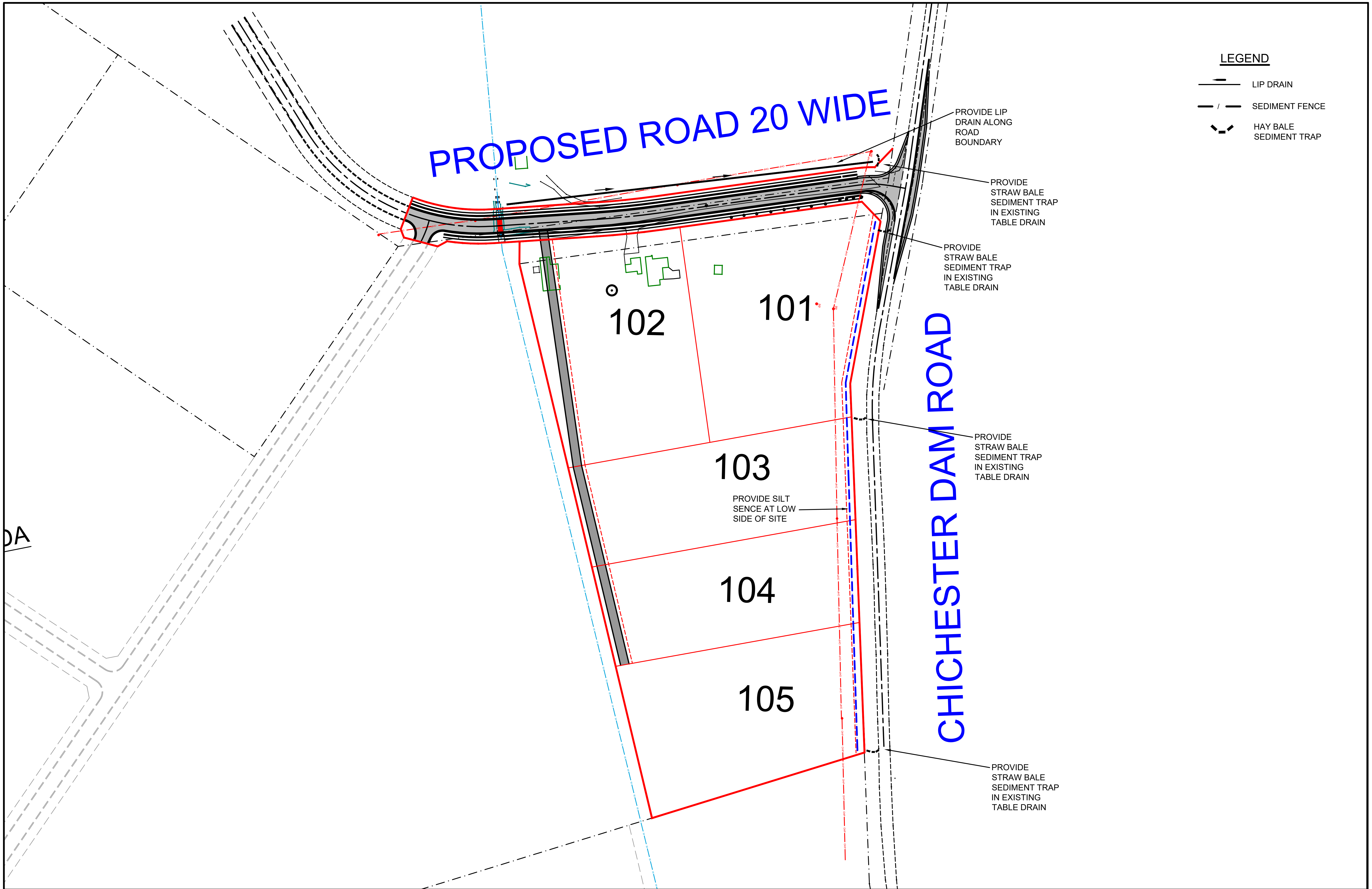
NOTE:
ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION AND LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

0 10 20 30 40 50m
1:500

Date: 12.10.20 Scale: 1:500 A1 Designed: KU
Cad Ref: HD350 DA1 Civils

No	Amendment	Drawn	Date
2	DESIGN CONTOUR, REGRADE DETAIL AND SUBSOIL	KU	22.01.21
1	CC	KU	12.10.20

Project No: HD1
Drawing No: CC09
Revision: 2



TITLE: PROPOSED SUBDIVISION Lot 42 DP585862, Lot 52 DP1239772 and Lot 101 DP1158364
39 CHICHESTER DAM ROAD
DUNGOG
EROSION AND SEDIMENTATION CONTROL PLAN

CLIENT: BENDOLBA DOWNS PTY LTD

High Definition Design Pty Ltd

KEVIN URANE 0412009891

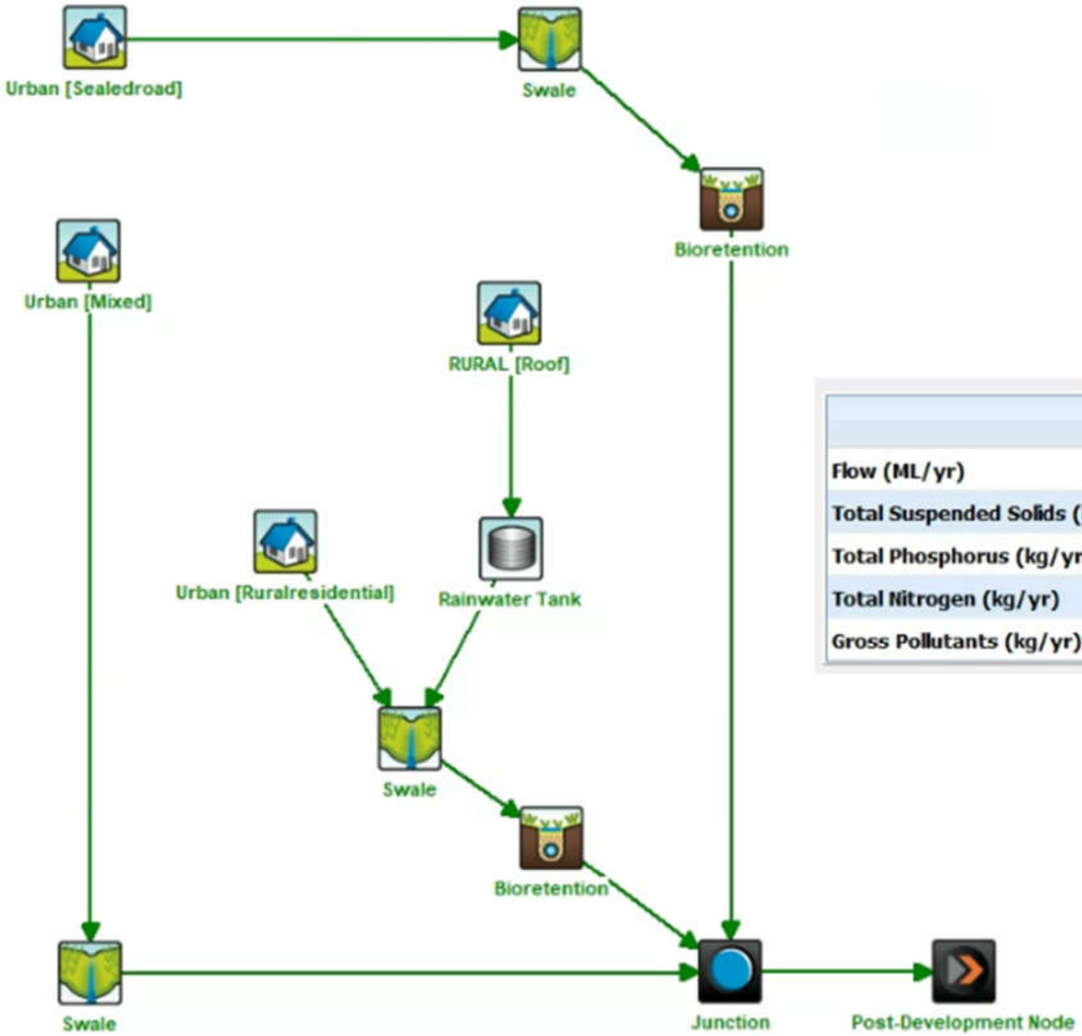
NOTE:
ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION AND LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

Date: 11.09.22 Scale: 1:1000 A1 Designed: KU
Cad Ref: HD350 DA1 Civils

No	Amendment	Drawn	Date
1	DA ISSUE	KU	11.09.22

Project No: HD1
Drawing No: C07
Revision: 1

Appendix C: MUSIC Modelling



	Sources	Residual Load	% Reduction
Flow (ML/yr)	20.3	18	11.7
Total Suspended Solids (kg/yr)	2430	134	94.5
Total Phosphorus (kg/yr)	5.26	2.18	58.6
Total Nitrogen (kg/yr)	39.1	18	54.1
Gross Pollutants (kg/yr)	282	0	100

Figure 7: MUSIC Note Layout and Results

Appendix D: DRAINS Data Spreadsheets

Pre-Developed Site Data

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 Safe Pond Depth (m)	Major Safe Pond Depth (m)
Lot 102	Node							0		381147.094	6417383		1367966		No					
Lot 101	Node							0		381068.703	6417413		1367970		No					
Lot 103	Node							0		381161.365	6417346		1367971		No					
Lot 104	Node							0		381173.678	6417285		1367972		No					
Lot 105	Node							0		381178.539	6417227		1367973		No					
Road Rese	Node							0		381063.506	6417233		1368913		No					
Dummy	Node							0		381160.159	6417145		1370780		No					
out	Node							0		381157.826	6417116		1370783		No					

SUB-CATCHMENT DETAILS								
Name	Pit or Node	Total Area	Imperviou Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Cat 102	Lot 102	1.2696	0	9	0.1	0	1	Dungog RAFTS
Cat 101	Lot 101	1.1977	5	10	0.1	0	1	Dungog RAFTS
Cat 103	Lot 103	0.9821	0	7.6	0.1	0	1	Dungog RAFTS
Cat 104	Lot 104	0.907	0	8.9	0.1	0	1	Dungog RAFTS
Cat 105	Lot 105	1.1529	0	9.5	0.1	0	1	Dungog RAFTS
Cat-Road	Road Rese	0.25	0	8	0.1	0	1	Dungog RAFTS

OVERFLOW ROUTE DETAILS																	
Name	From	To	Length (m)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Dept Major Stoi (m)	SafeDepth Minor Storms (m)	Safe DxV (sq.m/sec)	Bed Slope (%)	D/S Area Contributing %		id	U/S IL (m)	D/S IL (m)	
OF2	Lot 102	Lot 103	140				4 m wide pa	1	1	0.3	2.86	100		1571556	78	74	140
OF1	Lot 101	Lot 102	135				4 m wide pa	1	1	0.3	4.44	100		1568874	84	78	135
OF3	Lot 103	Lot 104	90				4 m wide pa	1	1	0.3	6.67	100		1571557	74	68	90
OF4	Lot 104	Lot 105	130				4 m wide pa	1	1	0.3	4.62	100		1571558	68	62	130
OF5	Lot 105	Dummy	100				4 m wide pa	1	1	0.3	2	100		1571560	62	60	100
OF6	Road Rese	Dummy	80				4 m wide pa	1	1	0.3	10	100		1571561	68	60	80
OF7	Dummy	out	20				4 m wide pa	1	1	0.3	5	100		1571562	60	59	20

This model has no pipes with non-return valves

Post-Developed Site Data

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 Safe Pond Depth (m)	Major Safe Pond Depth (m)
Lot 102	Node							0		381147.1	6417383		1367966		No					
Lot 101	Node							0		381068.7	6417413		1367970		No					
Lot 103	Node							0		381161.4	6417346		1367971		No					
Lot 104	Node							0		381173.7	6417285		1367972		No					
Lot 105	Node							0		381178.5	6417227		1367973		No					
Road Rese	Node							0		381063.5	6417233		1368913		No					
Dummy	Node							0		381160.2	6417145		1370780		No					
out	Node							0		381157.8	6417116		1370783		No					

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area	Imperviou Area	Avg Slope(%)	Mannings n	Time lag (mins)	Rainfall Multiplier	Hydrological Model
Cat 102	Lot 102	1.2696	8	9	0.1	0	1	Dungog RAFTS
Cat 101	Lot 101	1.1977	8.4	10	0.1	0	1	Dungog RAFTS
Cat 103	Lot 103	0.9821	10.2	7.6	0.1	0	1	Dungog RAFTS
Cat 104	Lot 104	0.907	11	8.9	0.1	0	1	Dungog RAFTS
Cat 105	Lot 105	1.1529	8.7	9.5	0.1	0	1	Dungog RAFTS
Cat-Road	Road Rese	0.25	80	8	0.1	0	1	Dungog RAFTS

OVERFLOW ROUTE DETAILS

Name	From	To	Length (m)	Spill Level (m)	Crest Length (m)	Weir Coeff. C	Cross Section	Safe Dept Major Stoı (m)	SafeDeptł Minor Sto (m)	Safe DxV (sq.m/sec	Bed Slope (%)	D/S Area Contributing %		id	U/S IL (m)	D/S IL (m)	
OF2	Lot 102	Lot 103	140				4 m wide pa	1	1	0.3	2.86	100		1571556	78	74	140
OF1	Lot 101	Lot 102	135				4 m wide pa	1	1	0.3	4.44	100		1568874	84	78	135
OF3	Lot 103	Lot 104	90				4 m wide pa	1	1	0.3	6.67	100		1571557	74	68	90
OF4	Lot 104	Lot 105	130				4 m wide pa	1	1	0.3	4.62	100		1571558	68	62	130
OF5	Lot 105	Dummy	100				4 m wide pa	1	1	0.3	2	100		1571560	62	60	100
OF6	Road Rese	Dummy	80				4 m wide pa	1	1	0.3	10	100		1571561	68	60	80
OF7	Dummy	out	20				4 m wide pa	1	1	0.3	5	100		1571562	60	59	20

This model has no pipes with non-return valves

Basin DRAINS Data

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 Safe Pond Depth (m)	Major Safe Pond Depth (m)
Node 1	Node							0		381257.6	6417480		1410107		No					
Dummy	Node					77		0		381203.4	6417466		1392853		No					
Out	Node					76		0		381209.6	6417447		1394898		No					

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length	id
Basin	76.2	1.44		None						381188.7	6417489	No			1392823
	76.999	1.44													
	77	156													
	77.8	402													
	78	480													

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 FlowFactor	Rainfall Multiplier
Cat Road F	Basin	0.5927	70	30	0	5	7	2										0				1
Basin Pre	Node 1	0.5927	0	100	0	5	7	2										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)
Pipe25259	Dummy	Out	20	76.2	75.6	3	Concrete,	375	375	0.013	New	1	Out	0					

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cove	Cover (m)	
Pipe25259	Concrete,	375	0.6	-0.01	Unsafe

This model has no pipes with non-return valves

Appendix E: DRAINS Results Spreadsheets for Pre and Post Development

Pre-Developed Site - 10 year storm:

DRAINS results prepared from Version 2022.012

PIT / NODE DETAILS				Version 8			
Name	Max HGL	Max Pond HGL	Max Surfa Flow Arriv (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboarc (m)	Overflow (cu.m/s)	Constraint
Lot 102	78.03		0.368				
Lot 101	84.02		0.266				
Lot 103	74.03		0.557				
Lot 104	68.04		0.723				
Lot 105	62.06		0.908				
Road Rese	68.01		0.057				
Dummy	60.05		1.056				

SUB-CATCHMENT DETAILS		
Name	Max Flow (cu.m/s)	Due to Storm
Cat 102	0.187	10% AEP, 30 min burst, Storm 8
Cat 101	0.22	10% AEP, 30 min burst, Storm 8
Cat 103	0.142	10% AEP, 30 min burst, Storm 8
Cat 104	0.141	10% AEP, 30 min burst, Storm 8
Cat 105	0.176	10% AEP, 30 min burst, Storm 8
Cat-Road	0.048	10% AEP, 20 min burst, Storm 4

OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Widtl	Max V	Due to Storm
OF2	0.398	0.539	2.886	0.047	0.07	12	2.16	10% AEP, 30 min burst, Storm 8
OF1	0.219	0.399	2.884	0.039	0.14	12	6.6	10% AEP, 30 min burst, Storm 8
OF3	0.538	0.678	2.739	0.044	0.11	12	3.43	10% AEP, 30 min burst, Storm 8
OF4	0.677	0.848	2.804	0.057	0.11	12	2.65	10% AEP, 30 min burst, Storm 8
OF5	0.847	0.847	2.932	0.06	0.1	12	1.85	10% AEP, 30 min burst, Storm 8
OF6	0.046	0.046	2.647	0.045	0.14	12	20.64	10% AEP, 30 min burst, Storm 8
OF7	0.888	0.888	2.776	0.051	0.12	12	2.77	10% AEP, 30 min burst, Storm 8

Run Log for HD 350 Stormwater Report RAFTS Pre run at 10:34:32 on 13/9/2022 using version 2022.012

Flows were safe in all overflow routes.

Pre-Developed Site - 100 year storm:

DRAINS results prepared from Version 2022.012

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfa Flow Arriv (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboarc (m)	Overflow (cu.m/s)	Constraint
Lot 102	78.05		0.696				
Lot 101	84.03		0.493				
Lot 103	74.05		1.043				
Lot 104	68.06		1.351				
Lot 105	62.08		1.697				
Road Rese	68.01		0.106				
Dummy	60.07		1.979				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat 102	0.373	1% AEP, 25 min burst, Storm 1
Cat 101	0.434	1% AEP, 20 min burst, Storm 8
Cat 103	0.283	1% AEP, 25 min burst, Storm 1
Cat 104	0.28	1% AEP, 25 min burst, Storm 5
Cat 105	0.349	1% AEP, 25 min burst, Storm 1
Cat-Road	0.092	1% AEP, 20 min burst, Storm 8

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Widtl	Max V	Due to Storm
OF2	0.781	1.056	2.886	0.061	0.13	12	2.12	1% AEP, 25 min burst, Storm 6
OF1	0.414	0.784	2.884	0.05	0.1	12	2.86	1% AEP, 25 min burst, Storm 6
OF3	1.054	1.329	2.739	0.057	0.16	12	3.2	1% AEP, 25 min burst, Storm 1
OF4	1.328	1.67	2.804	0.081	0.18	12	2.83	1% AEP, 25 min burst, Storm 1
OF5	1.67	1.67	2.932	0.083	0.18	12	2.21	1% AEP, 25 min burst, Storm 1
OF6	0.091	0.09	2.647	0.064	0.18	12	18.29	1% AEP, 20 min burst, Storm 8
OF7	1.751	1.751	2.776	0.068	0.2	12	3.11	1% AEP, 25 min burst, Storm 1

Run Log for HD 350 Stormwater Report RAFTS Pre run at 10:35:10 on 13/9/2022 using version 2022.012

Flows were safe in all overflow routes.

Post-Developed Site - 10 year storm:

DRAINS results prepared from Version 2022.012

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfa Flow Arriv (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboarc (m)	Overflow (cu.m/s)	Constraint
Lot 102	78.04		0.436				
Lot 101	84.02		0.292				
Lot 103	74.03		0.676				
Lot 104	68.04		0.88				
Lot 105	62.06		1.104				
Road Rese	68.01		0.115				
Dummy	60.05		1.254				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat 102	0.242	10% AEP, 30 min burst, Storm 8
Cat 101	0.236	10% AEP, 30 min burst, Storm 8
Cat 103	0.193	10% AEP, 30 min burst, Storm 8
Cat 104	0.191	10% AEP, 30 min burst, Storm 4
Cat 105	0.227	10% AEP, 30 min burst, Storm 8
Cat-Road	0.106	10% AEP, 5 min burst, Storm 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Widtl	Max V	Due to Storm
OF2	0.465	0.652	2.886	0.051	0.08	12	2.11	10% AEP, 30 min burst, Storm 4
OF1	0.235	0.469	2.884	0.041	0.12	12	5.4	10% AEP, 30 min burst, Storm 8
OF3	0.651	0.825	2.739	0.047	0.12	12	3.26	10% AEP, 30 min burst, Storm 4
OF4	0.825	1.041	2.804	0.063	0.13	12	2.65	10% AEP, 30 min burst, Storm 4
OF5	1.04	1.04	2.932	0.066	0.12	12	1.93	10% AEP, 30 min burst, Storm 4
OF6	0.105	0.106	2.647	0.026	0.2	12	17.98	10% AEP, 5 min burst, Storm 1
OF7	1.078	1.078	2.776	0.055	0.14	12	2.82	10% AEP, 30 min burst, Storm 4

Run Log for HD 350 Stormwater Report RAFTS run at 10:39:36 on 13/9/2022 using version 2022.012

Flows were safe in all overflow routes.

Post-Developed Site - 100 year storm:

DRAINS results prepared from Version 2022.012

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfa Flow Arriv (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboarc (m)	Overflow (cu.m/s)	Constraint
Lot 102	78.05		0.806				
Lot 101	84.03		0.538				
Lot 103	74.05		1.273				
Lot 104	68.06		1.671				
Lot 105	62.09		2.105				
Road Rese	68.01		0.184				
Dummy	60.07		2.406				

SUB-CATCHMENT DETAILS

Name	Max Flow (cu.m/s)	Due to Storm
Cat 102	0.46	1% AEP, 25 min burst, Storm 1
Cat 101	0.453	1% AEP, 25 min burst, Storm 1
Cat 103	0.368	1% AEP, 25 min burst, Storm 1
Cat 104	0.358	1% AEP, 25 min burst, Storm 3
Cat 105	0.435	1% AEP, 25 min burst, Storm 1
Cat-Road	0.174	1% AEP, 5 min burst, Storm 1

OVERFLOW ROUTE DETAILS

Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Widtl	Max V	Due to Storm
OF2	0.904	1.261	2.886	0.066	0.15	12	2.22	1% AEP, 25 min burst, Storm 1
OF1	0.451	0.906	2.884	0.053	0.12	12	2.77	1% AEP, 25 min burst, Storm 1
OF3	1.261	1.595	2.739	0.063	0.19	12	3.26	1% AEP, 25 min burst, Storm 1
OF4	1.594	2.01	2.804	0.089	0.21	12	2.95	1% AEP, 25 min burst, Storm 1
OF5	2.01	2.01	2.932	0.091	0.21	12	2.4	1% AEP, 25 min burst, Storm 1
OF6	0.174	0.175	2.647	0.039	0.24	12	16.47	1% AEP, 5 min burst, Storm 1
OF7	2.085	2.085	2.776	0.072	0.23	12	3.26	1% AEP, 25 min burst, Storm 1

Run Log for HD 350 Stormwater Report RAFTS run at 10:40:37 on 13/9/2022 using version 2022.012

Flows were safe in all overflow routes.

Basin Layout Results - 10 year storm:

DRAINS results prepared from Version 2022.012

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfa Flow Arriv (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboarc (m)	Overflow (cu.m/s)	Constraint
Dummy	76.32		0				
Out	75.72		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
Cat Road F	0.199	0.155	0.044	5	7	2	10% AEP, 15 min burst, Storm 5
Basin Pre	0.152	0	0.152	5	7	2	10% AEP, 10 min burst, Storm 4

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
Pipe25259	0.065	2.18	76.317	75.717	10% AEP, 1 hour burst, Storm 10

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 Widtl	Max V	Due to Storm
Pit Top	0.009	0.009						10% AEP, 1 hour burst, Storm 10
Orifice	0.055	0.055						10% AEP, 1 hour burst, Storm 10

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	77.52	119.7	0.065	0	0.065

Run Log for HD 350 Stormwater Report run at 23:35:49 on 12/9/2022 using version 2022.012

Basin Layout Results - 100 year storm:

DRAINS results prepared from Version 2022.012

PIT / NODE DETAILS Version 8

Name	Max HGL	Max Pond HGL	Max Surfa Flow Arriv (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboarc (m)	Overflow (cu.m/s)	Constraint
Dummy	76.42		0				
Out	75.82		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
Cat Road F	0.333	0.277	0.057	5	7	2	1% AEP, 5 min burst, Storm 1
Basin Pre	0.287	0	0.287	5	7	2	1% AEP, 10 min burst, Storm 7

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
Pipe25259	0.194	2.91	76.418	75.818	1% AEP, 25 min burst, Storm 7

CHANNEL DETAILS

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

OVERFLOW ROUTE DETAILS

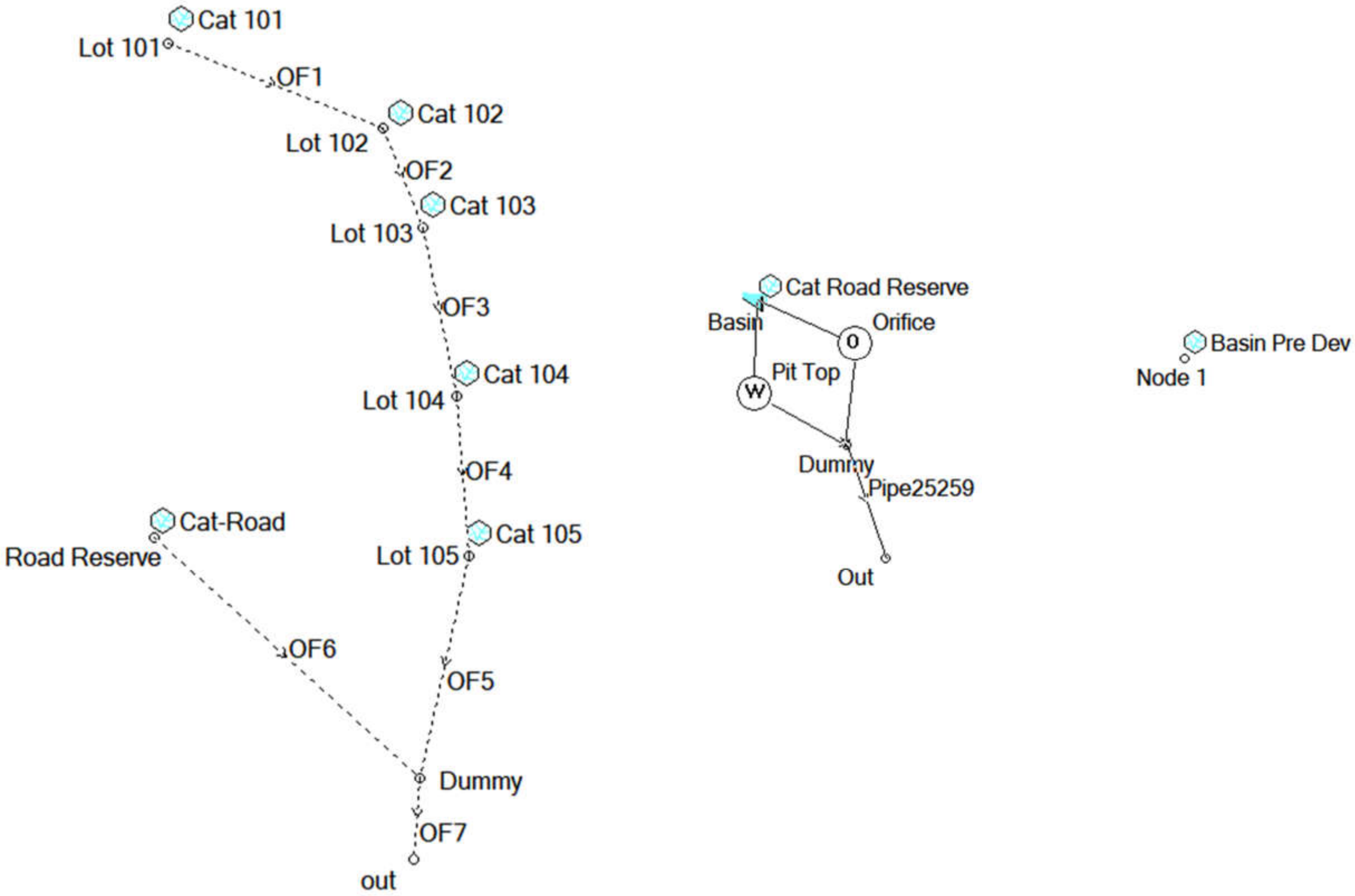
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Widtl	Max V	Due to Storm
Pit Top	0.131	0.131						1% AEP, 25 min burst, Storm 7
Orifice	0.062	0.062						1% AEP, 25 min burst, Storm 7

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin	77.64	157.6	0.194	0	0.194

Run Log for HD 350 Stormwater Report run at 23:35:49 on 12/9/2022 using version 2022.012

Appendix F: DRAINS Model Node Layout


Cat 101
Lot 101
OF1
Cat 102
Lot 102
OF2
Cat 103
Lot 103
OF3
Cat 104
Lot 104
OF4
Cat-Road
Road Reserve
Cat 105
Lot 105
OF6
OF5
Dummy
OF7
out
Cat Road Reserve
Basin
Orifice
Pit Top
Dummy
Pipe25259
Out
Basin Pre Dev
Node 1