STORMWATER MANAGEMENT REPORT

for

PROPOSED
RESIDENTIAL SUBDIVISION

'DURNESS STATION'
VINEY CREEK ROAD
NORTH SHEARWATER

LOT 1, 2, 3 & 4 IN DP 1154170

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1.0 INTRODUCTION

This report has been prepared to support a proposal for a fresh Development Application for the first three Precincts of the North Shearwater residential project. While mostly covering the same footprint, the current proposal consists of generally smaller 'standard' residential lots consistent with the Council LEP, and also makes other adjustments for DPI Water, RFS and MidCoast Water Services requirements.

This June 2020 revision has been updated in response to discussions with Council and the RFS, and address several design changes made as a result of these discussions.

The site of the proposed development is part of Lots 1, 2, 3 & 4 in DP 1154170 and is located off Viney Creek Road, Tea Gardens.

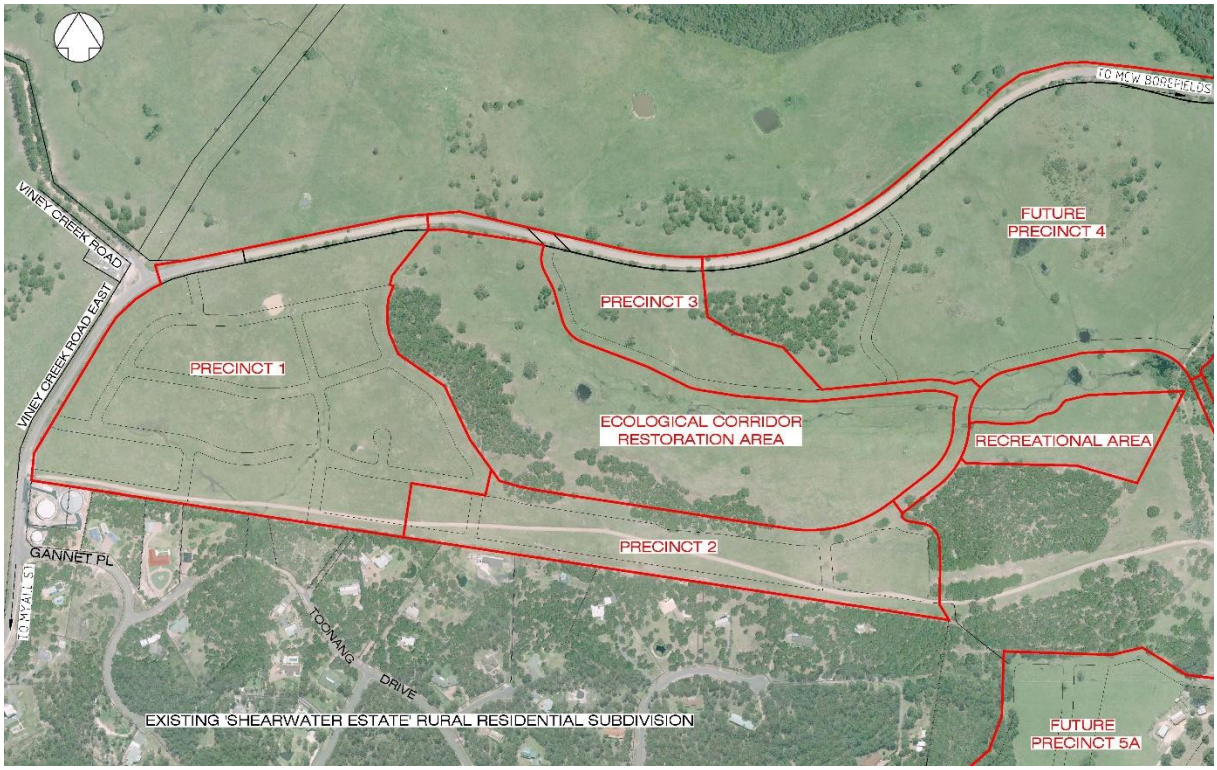

Figure 1: Locality Diagram

2.0 BACKGROUND INFORMATION

The site is currently part of a larger rural property known as Durness Station, which has a long history of agricultural grazing including cell grazing. Part of the property between Viney Creek Road and the Myall River has been slated for residential development (and environmental rehabilitation), and a rezoning process has been undertaken with Council to direct this development.

An earlier DA for the Precinct 1 area has previously been submitted and approved by Council. That proposal was deemed unviable due to a range of factors including changes to bushfire regulations, inconsistencies between the Council LEP and DCP, MidCoast Water Services servicing requirements and the low relative lot yield. An alternate layout is now proposed.

The areas of proposed development are mostly cleared, and the current DA also includes the first stage of a large area of rehabilitation and riparian offset in the E2 wildlife and riparian corridor area.

It is understood a previous water management study would have been prepared for the site for the original DA, but this has not been provided to Tattersall Lander.

3.0 SITE CONTEXT

The site is a rural property, sections of which were recently rezoned to include R2 residential and E2 environmental lands. A section of remnant RU2 lands still remains in the centre of the rezoned areas. The current landuse is as an active grazing property, employing 'cell grazing' techniques which including active fertilising and pasture improvement and controlled periodic intensive grazing.

The topography is best described as varying from very steep to undulating. The Precinct 1 area drains south into a public drainage reserve through the Shearwater rural-residential estate. Precinct 2 currently drains directly into numerous private rural-residential lots in the Shearwater Estate and then back onto the subject site before flowing to the Myall River. Precinct 3 drains into an existing gully that runs to the east through further stages of this development and on to the Myall River.

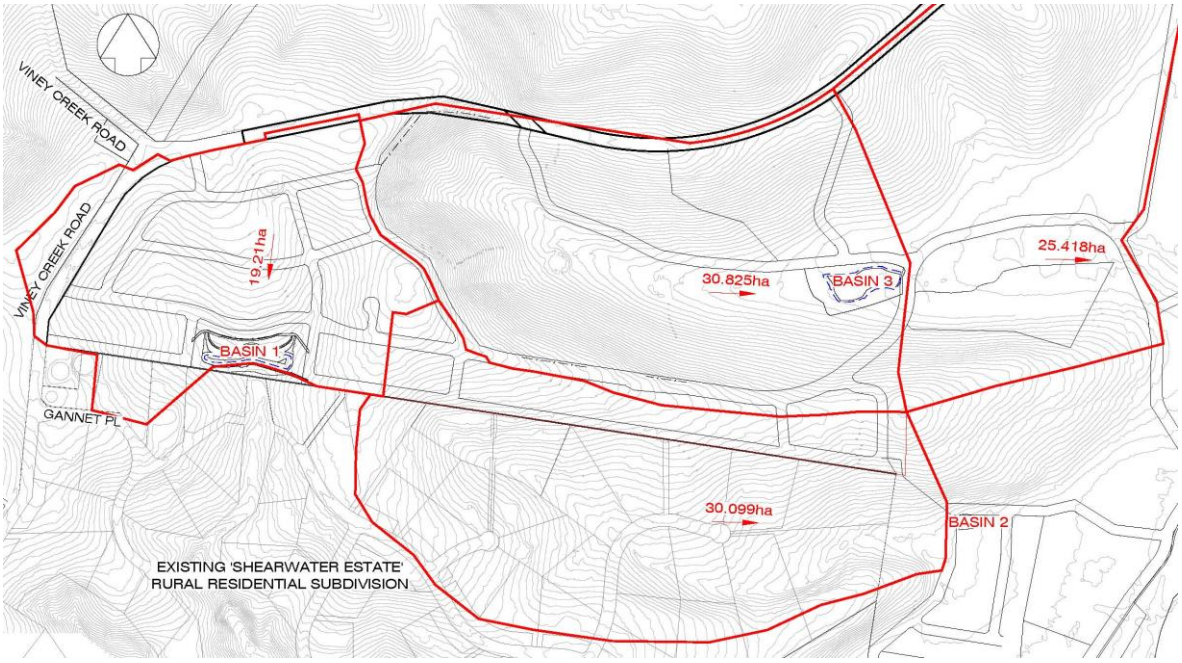

Figure 2: Existing Catchment Diagram

(Contour interval = 1 metre, contours generated from NSW Gov. Spatial Services LiDAR data)

4.0 PROPOSED DEVELOPMENT

The proposal is for the development of residential lands known as Precinct 1, Precinct 2 and Precinct 3 of the North Shearwater project. In total 226 residential lots will be created in these precincts, along with various public roads, drainage reserves, public conservation reserves and a large public recreational reserve. Precinct 1 will be constructed and released in 5 separate releases (Precincts 1A to 1E).

In Precinct 1 stormwater control is proposed via a constructed basin and biofiltration system in the central low point of that catchment, consistent with the previous DA.

Precinct 2 will be constructed as a single release. Stormwater runoff will be intercepted before it enters the adjoining Shearwater Estate properties by the southern perimeter road and diverted down into the future Precinct 5A footprint, where temporary dispersion measures will be installed (future extension during Stage 5 will see this stormwater ultimately conveyed to the Myall River). The northern portion of Precinct 2 (catchment essentially limited to the collector road and verges) will shed directly to the E2 lands. Water quality requirements will be addressed as much as possible given the significant site constraints, by the use of roadside swales, and will also be offset by landuse changes and water management devices in the E2 rehabilitation area.

Precinct 3 will also be constructed as a single release. Stormwater runoff will follow natural flowpaths into and along the E2 riparian corridor. This area of the site is similarly tightly constrained by existing slopes, riparian zones and required bushfire APZs. Water quality requirements will be addressed as much as possible by the use of roadside swales and will also be offset by landuse changes and water management devices in the E2 rehabilitation area. An online detention basin will provide both ecological habitat diversity and some detention for peak flow attenuation.

Layout and staging plans can be seen in Appendix A.

5.0 WATER QUALITY TARGETS

The Water Sensitive Design section of the Council Development Control Plan states that a water quality treatment train for this development should meet the pollution reduction targets in
Table 1 below:

Table 1: Stormwater Quality Targets

Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	Neutral or Beneficial Effect
Total Phosphorus (TP)	Neutral or Beneficial Effect
Total Nitrogen (TN)	Neutral or Beneficial Effect

6.0 CONSTRAINTS, OPPORTUNITIES & BEST PLANNING PRACTICES

Best-planning practices have been considered throughout the planning process. The steep and rocky nature of the existing site, bushfire APZ restrictions and Riparian Zones under the Water Management Act combine to present some significant challenges to WSD implementation.

Within Precinct 1, the current proposal is mostly consistent with the previously approved DA proposal, but some modification/improvements have been introduced. These improvements include provision of high flow bypasses to the biofiltration measures, provision of roadside swales (where appropriate) and significant increase in active rehabilitation of the E2 lands. The ‘token’ street scale biofiltration measures in the original DA have been removed, as their previous configuration presented significant constraints to provision of sewer services, and they offered no real benefit as any water treated by them was then being ‘shandied’ in with untreated flows and then re-treated in the larger downstream biofiltration measures. Gross Pollutant Traps were also removed at Council’s request.

In this August 2020 revision of the proposal, roadside swales have also been removed from Precinct 1 and some locations in Precincts 2 and 3 at the request of

Council, where grades >10% were considered too steep from a maintenance perspective.

7.0 SOIL AND WATER MANAGEMENT

A critical time for increase pollutant loads is during construction, and with this in mind, current practice recommends guidelines from Landcom's "Blue Book". Erosion and sediment control measures should be designed and specified in accordance with the "Blue Book" guidelines, and to Council satisfaction, and be inspected and maintained during the construction phase. This will assist in ensuring adherence to pollutant prevention objectives, particularly the removal of suspended solids (sediment).

As each construction stage will be in excess of 2,500sq.m, it is expected that a detailed Soil and Water Management Plan will need to be prepared for each construction stage prior to release of the Construction Certificate. This would typically include calculations of likely soil loss during construction, instructions on preferred construction sequence and limiting land disturbance, and calculations for the provision and sizing of a temporary sedimentation basin to cover the period of civil works. On this site, the permanent detention basins would appear to be the logical place to also site the temporary construction basins.

The five-staged release of Precinct 1 presents some challenges here, with one basin location being needed for sediment control and progressively for water quality and detention purposes. Additionally, finalisation of bio-filtration devices should ideally be deferred until after the majority of the catchment is 'mature' – i.e. at least 80% of dwellings are completed. This presents an opportunity where the biofiltration area may be temporarily utilised as a construction sediment basin.

As such, delayed final commissioning of the permanent basin may be one practical solution, pending discussions/agreement with Council on some environmental, engineering and legal issues. These issues may include ownership and maintenance of a structure used for both temporary private sediment control and public peak flow control, deferment of water quality treatment benefits, engineering design of temporary works interacting with permanent infrastructure etc.

Physically, a construction basin within the proposed biofilter area would be achieved by shaping the biofilter area, including excavating to the ultimate drainage layer base, and that void being used as a construction sediment basin. The drainage layers, filter layer and vegetation works can be finalised with subsequent Precinct 2 or 3

construction works (depending on Precinct 1 housing progression), or installed by Council using a developer bond if the timing does not line up with the construction of one of these stages.

The adjacent detention basin area should be constructed to its final format in the first stage of construction to provide the necessary flow attenuation to protect downstream properties from larger storm events.

Basins for Precinct 2 and 3 are isolated to those precincts, so there is no issue with using the basin locations initially for construction purposes before finalising in their long term format, other than the fact the basin will only be available for sediment control for the civil works process, not the subsequent dwelling construction process. The Precinct 3 basin will ultimately be an online basin in a catchment that includes all the upstream E2 restoration corridor, but will need to be designed in an offline configuration during construction, to minimise size and chemical treatment costs.

It is noted that where benched lots have been provided, they have been designed with level building pads (rather than nominal sloping grades). While this may make the initial building site boggier if wet conditions are encountered during dwelling construction, it also removes any need for additional earthworks by the builders, coordinates retaining wall construction and will further help reduce sediment transportation due to the flat grades.

8.0 INTEGRATED WATER CYCLE MANAGEMENT

All created lots will be serviced with reticulated water and sewer from the MidCoast Water Services network. MidCoast Water Services have previously investigated recycled water reticulation and determined it was not feasible in the Tea Gardens area.

In line with BASIX and WSD principles, runoff from future dwelling roof areas is to be directed into rainwater tanks for reuse within the dwelling (toilet and laundry) and external use.

9.0 STORMWATER MANAGEMENT - HYDROLOGY

The nature of urban development is that it significantly increases the amount of impervious surface in a catchment, which in turn can decrease runoff times and create higher peak flow rates. It is important with new developments that measures are put in place to prevent increases in runoff from the site and resulting downstream flash flooding.

The overall North Shearwater development has two distinct catchments. Precinct 1 drains south into a public reserve in Shearwater Estate which in turn flows down across Toonang Drive, and the future Parry's Cove (formerly Riverside) residential development. The Toonang Drive culverts have known capacity issues however Council has recently upgraded the main culvert to attempt to mitigate the Toonang Road flooding issues. Managing peak discharges in this catchment is important to ensure there are no negative impacts on these downstream properties and structures. The proposed Precinct 1 basin is similar to the basin proposed in the original DA, although it is now slightly larger to reflect the increased densities now proposed and has been modified to act as a wet basin rather than a dry basin, removing the need for regular mowing maintenance and also providing additional habitat variety. The proposed permanent water depth ranges from 0.5m-1.0m deep, and a maximum batter below and near the waterline is 1:6. The previously proposed Gross Pollutant Traps have been replaced by shallow sediment forebays based on Lake Macquarie Council's standard drawing EGSD-422 to provide easier maintenance by Council's existing local works crews. A low flow outlet has been included to help reduce the discharge rate of smaller regular events, making them less peaky and providing a more stable riparian environment downstream.

Precincts 2 and 3 will ultimately drain into the Myall River in combination with Precincts 4 and 5. With no downstream properties between these lands and the river, and in recognition of the greatly delayed flood peak in the Myall River system, peak flow attenuation is not necessary for these precincts in relation to the impacts on other properties. None-the-less, the Precinct 3 basin has been designed with a detention capacity component to ensure local flood impacts are minimised internally on the future Precinct 4 residential lands and downstream riparian corridor, and also to allow appropriate sizing of the collector road culvert to ensure public safety in the 100yr

event. Again, a low flow outlet has been included to try and replicate a more natural regular storm flow regime.

The Precinct 2 basin is a temporary structure that will be relocated in future Precinct 5 works. It is essentially a sediment trap and energy dissipater and has not been designed for peak flow attenuation.

An XP-Storm hydrological and hydraulic routing model has been prepared to quantify the effectiveness of the proposed measures. The effect of rainwater tanks has not been included in the calculations, although it is noted that some councils are now allowing some of the volume of dwelling rainwater tanks to be counted towards overall onsite detention capacities (20% in LMCC, and up to 100% in NCC).

Rainfall was simulated utilising the Laurenson Method with (ARR87) IFD data sourced from the Council. Minimal infiltrations rates were conservatively set, assuming design storm bursts are occurring following earlier rainfall events. A range of storms were run to determine the critical duration for each catchment (generally found to be either the 1hr or 2hr storm). Sample discharge hydrographs are shown on the following pages.

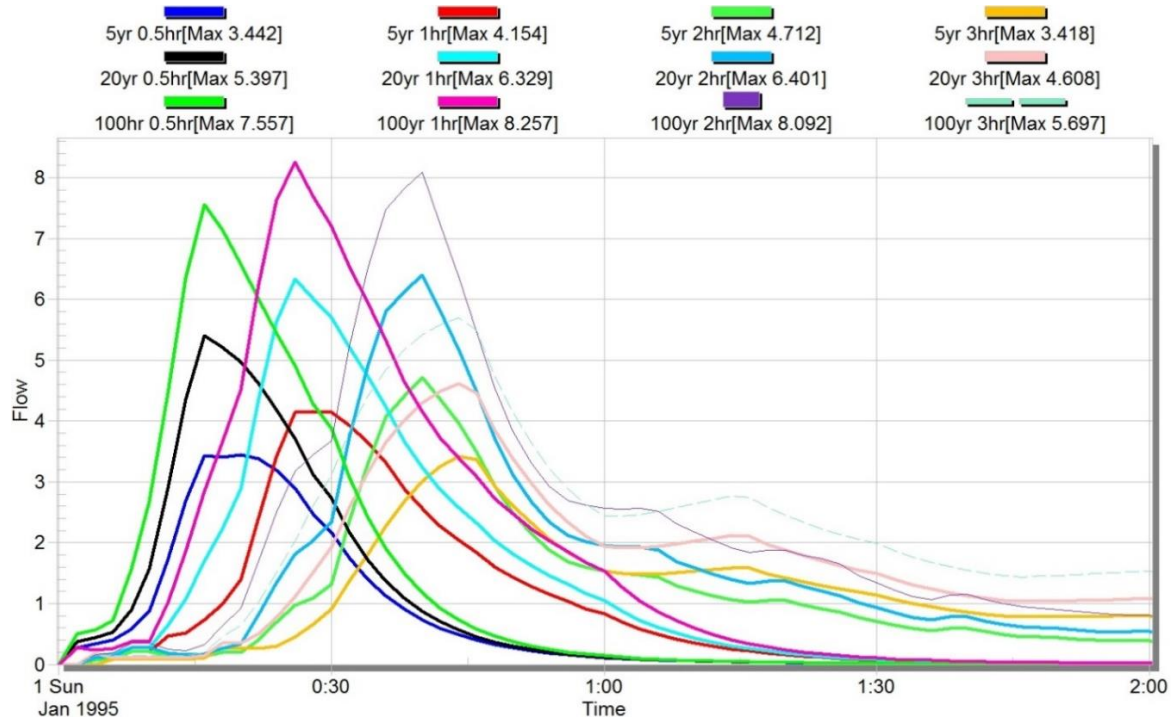

Figure 3: Basin 1 Pre-Development Hydrograph

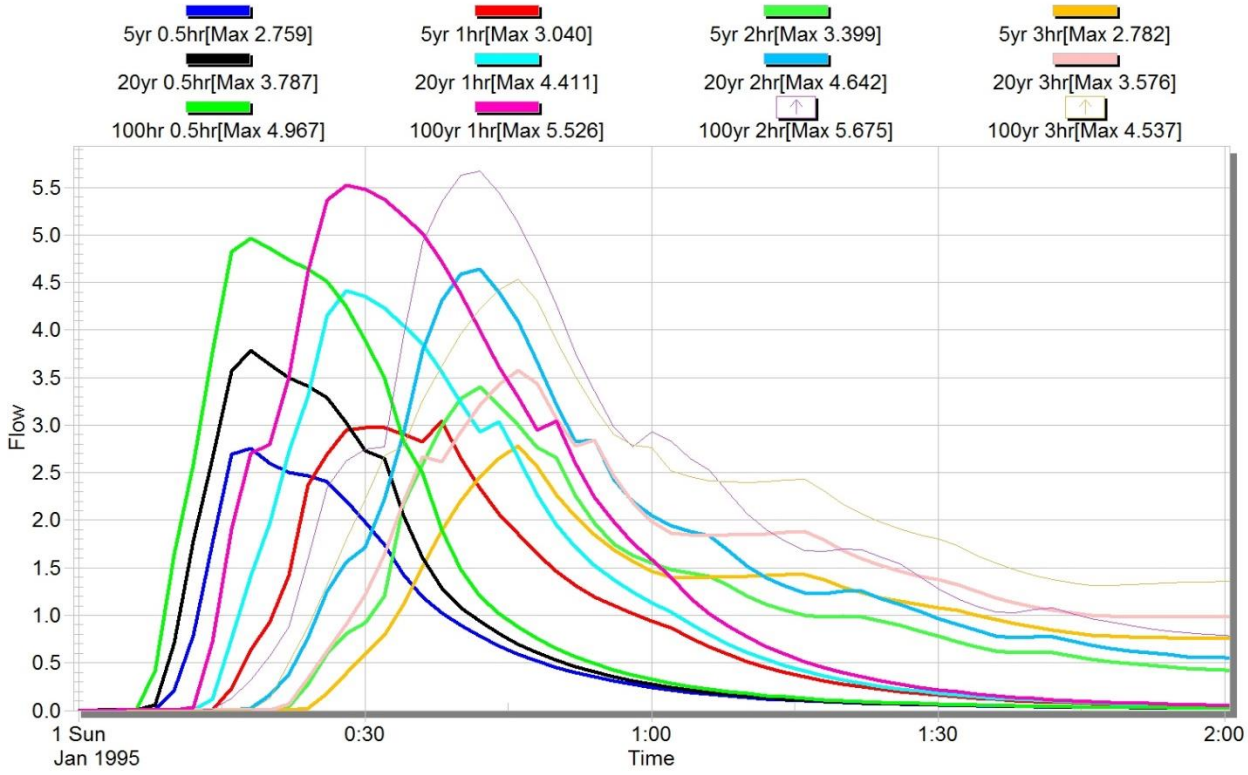

Figure 4: Basin 1 Post-Development Hydrograph

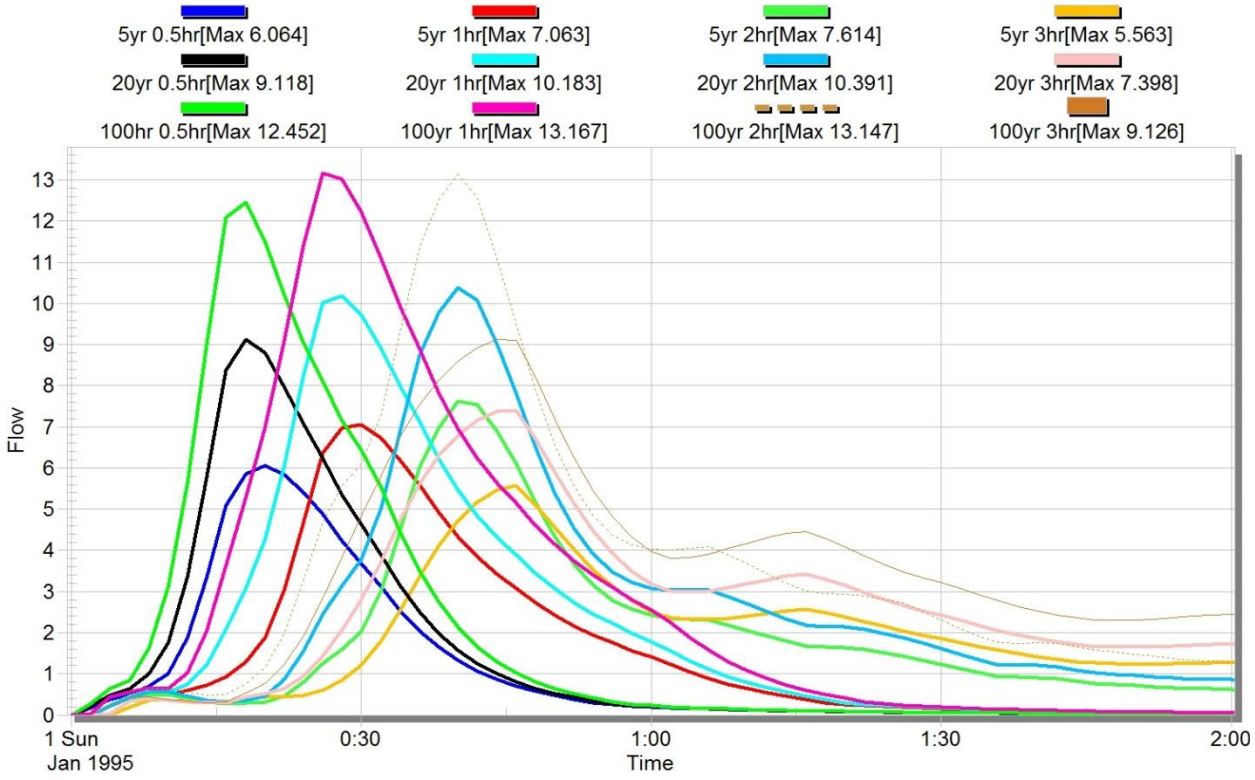

Figure 5: Basin 3 Pre-Development Hydrograph

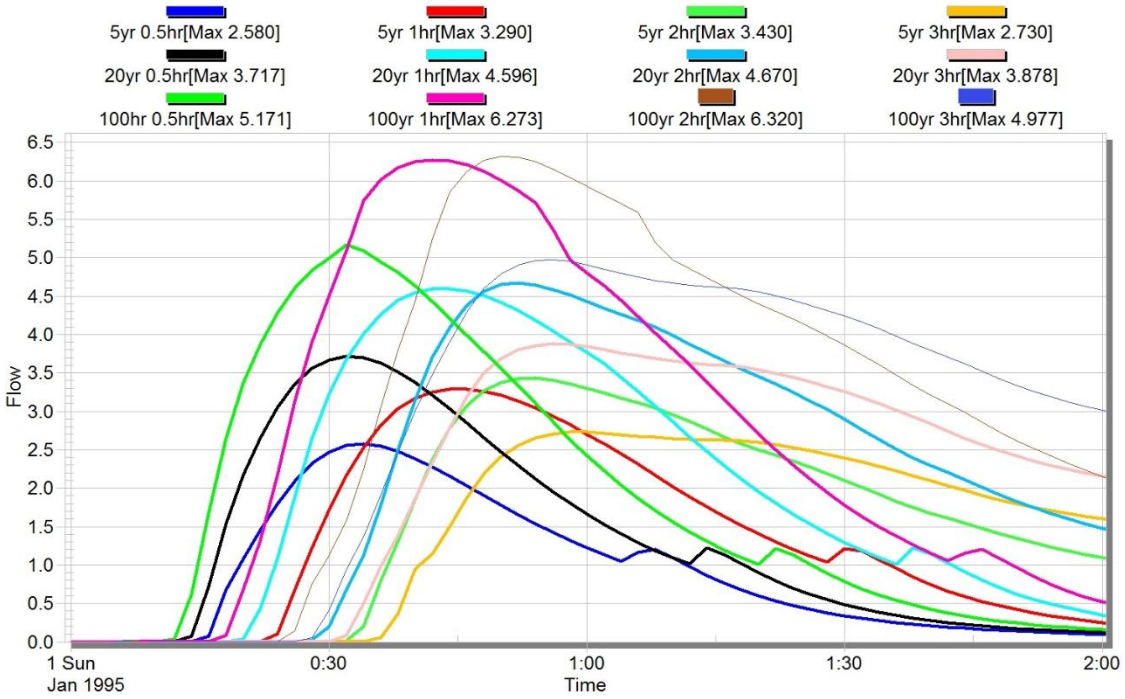

Figure 6: Basin 3 Post-Development Hydrograph

As a check, a simplified 2D rainfall-on-grid model was set up and run to confirm the 1D model results being achieved. This type of model has the advantage that catchment extents, slopes and flow paths do not need to be approximated by the modeller, but rather are determined organically from the DTM. The check model included a 2m grid size, DTM from LiDAR data and was run for a 100yr 2hr storm event. The resulting peak Precinct 1 and Precinct 3 hydrographs and Depth/Velocity outputs can be seen below. They provide a close comparison of the equivalent 1D results considering the completely different modelling methods, and provide some reassurance of the 1D results.

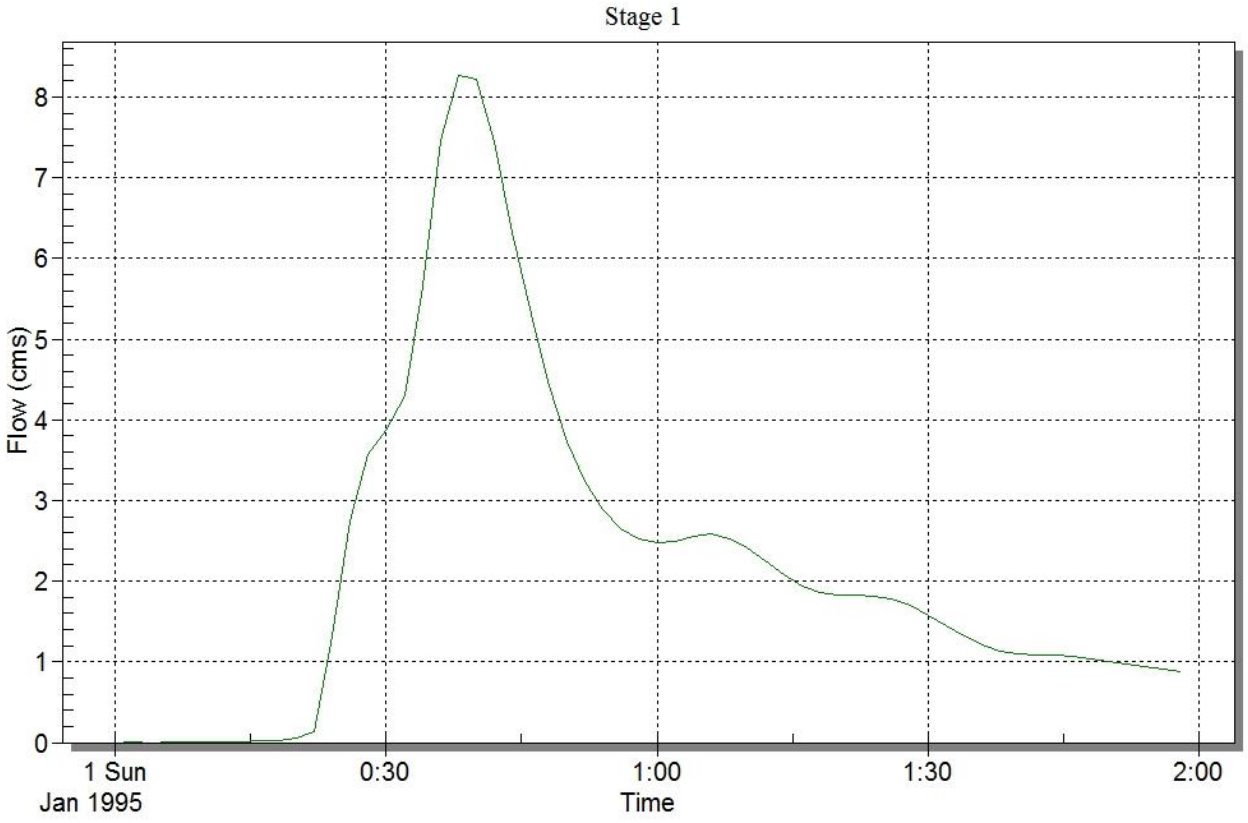

Figure 7: Basin 1 Pre-Development 2D Hydrograph

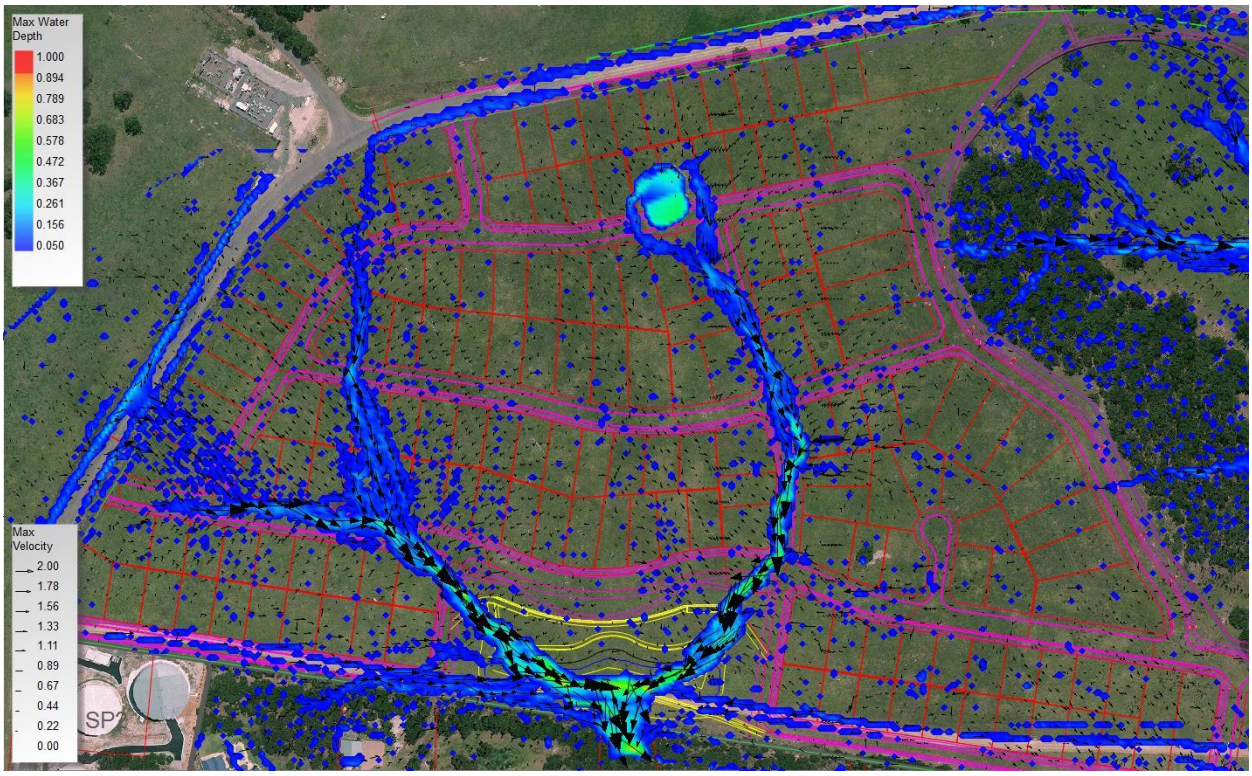

Figure 8: Basin 1 Pre-Development 2D Peak Flow/Velocity Mapping

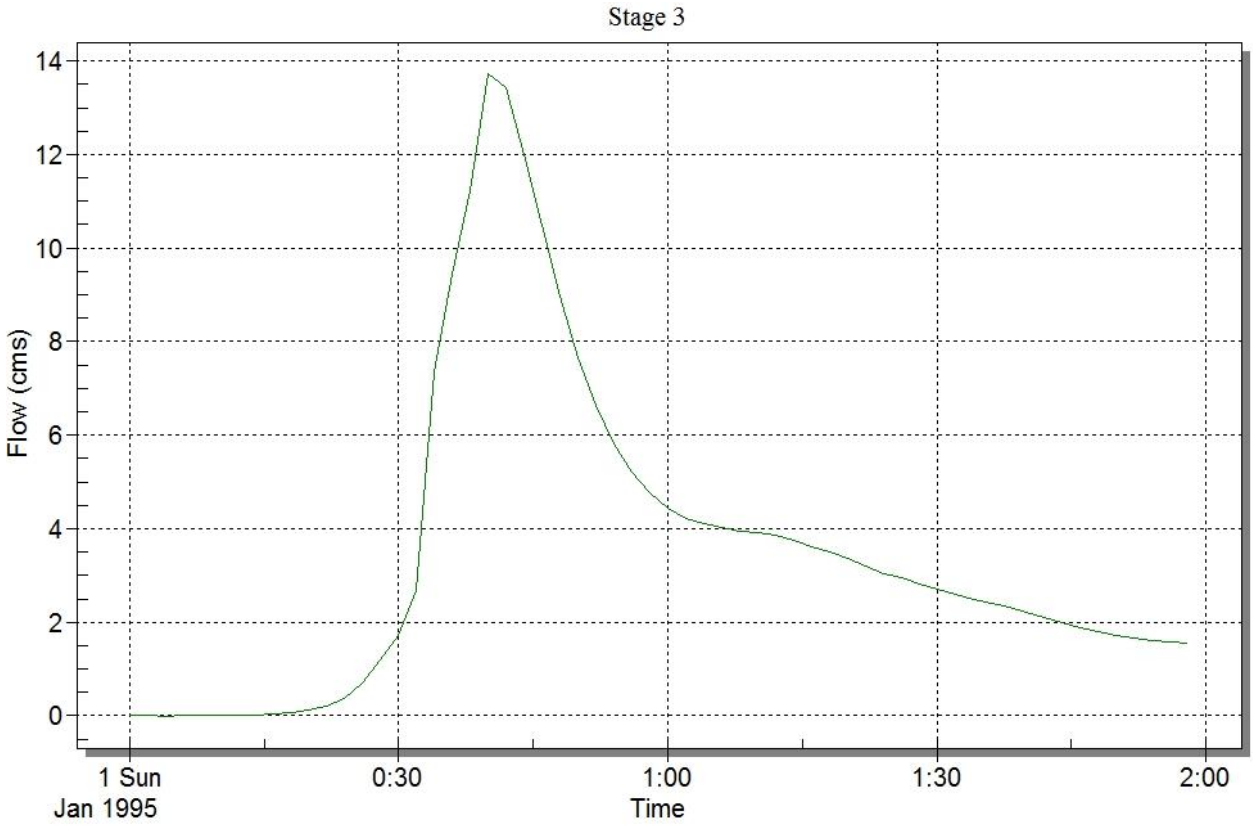

Figure 9: Basin 3 Pre-Development 2D Hydrograph

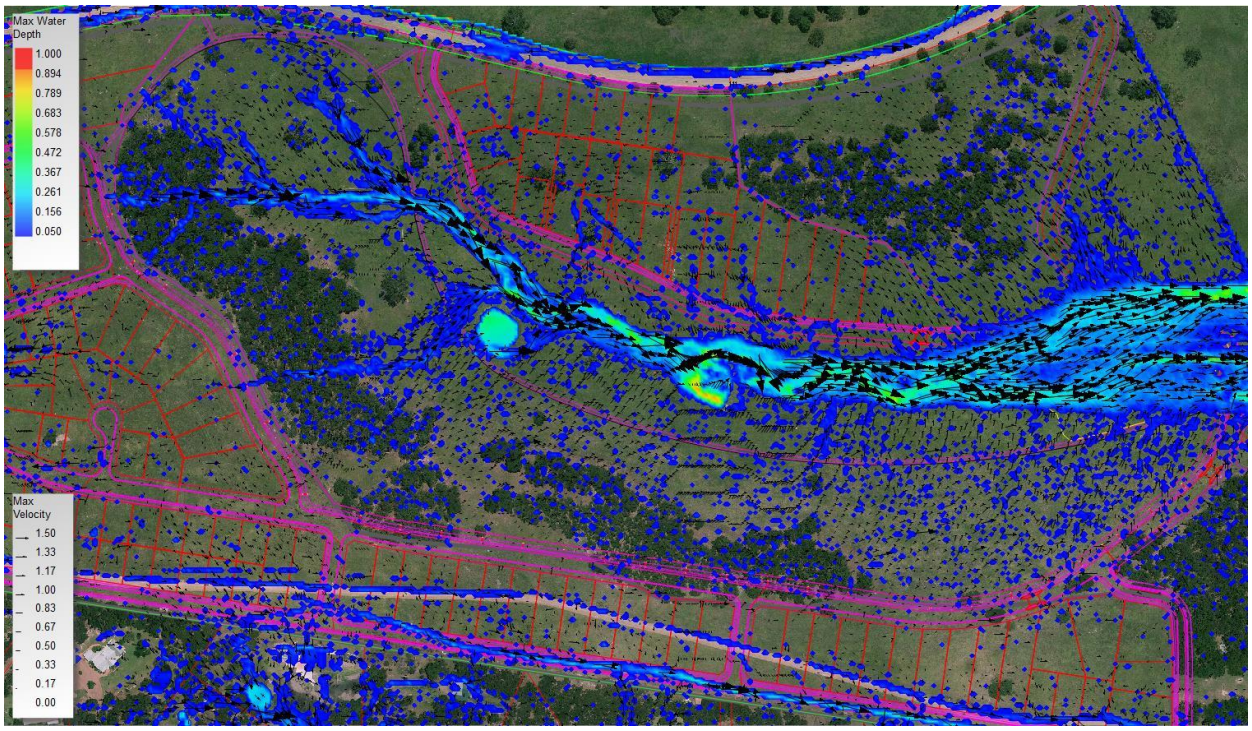

Figure 10: Basin 3 Pre-Development 2D Peak Flow/Velocity Mapping

A brief summary of each catchment can be seen below in Table 4, illustrating that the 5yr, 20yr and 100yr post-development peak discharge rates are lower than the existing site conditions, ensuring no negative downstream flooding impact as a result of the proposed development.

Table 2: Hydraulic Model Summary

Catchment	Precinct 1	Precinct 3
Catchment Area (ha)	19.21	30.825
Pre-developed Imperviousness (%)	10%	10%
Post-developed Imperviousness (%)	60%	60%
Provided Basin Total Detention Volume (m^3)	4,750	8,850
5yr Pre / Post Development Discharge (m^3/s)	4.71 / 3.40	7.61 / 3.43
20yr Pre / Post Development Discharge (m^3/s)	6.40 / 4.64	10.39 / 4.67
100yr Pre/Post Development Discharge (m^3/s)	8.26 / 5.68	13.16 / 6.32

10.0 STORMWATER MANAGEMENT – WATER QUALITY MODEL

10.1 BACKGROUND

The quality of stormwater runoff generated by a development site is important to ensure the preservation of the downstream environments. Generally, an increased proportion of impervious area associated with development will lead to a subsequent increase in the quantities of suspended solids, phosphorus and nitrogen entering potential storm water runoff if treatment measures are not put in place. The aim of this study was to determine what measures need to be undertaken as part of this development to meet the water quality objectives set out in

Table 1 in Section 5 of this report.

10.2 MUSIC MODELLING

MUSIC is the Model for Urban Stormwater Improvement Conceptualisation, developed by the Cooperative Research Centre for Catchment Hydrology. MUSIC provides the ability to model both quality and quantity of runoff generated by catchments. Therefore MUSIC can simulate annual stormwater volumes, and expected annual pollutant loadings.

MUSIC is designed to model stormwater runoff systems in urban catchments. It is used to simulate a range of temporal and spatial scales. Catchment modelling can be performed for areas up to 100 km^2, with times steps from 6 minutes to 24 hours to match the range of spatial scale. This enables long term modelling of continuous historical rainfall data from pluviograph sources, and reflects the ability to account for temporal variation in data for an annual rainfall series directly.

MUSIC also has the ability to model a number of treatment devices, and measure their effectiveness in terms of the quantity and quality of runoff downstream. This allows determination of the degree of reduction in annual pollutant loadings.

It is important to note that the MUSIC simulation relies heavily on input variables and it is usually recommended that MUSIC models be calibrated to local conditions wherever possible. When calibration is not possible default values can be used, or variables can be sourced from values recommended for stormwater modelling in the NSW MUSIC modelling Guidelines, which are in turn sourced from a technical report

prepared for the DECC by the Co-operative Research Centre titled "*Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures*" (Fletcher et al, 2004).

10.2.1 CLIMATE / RAINFALL

To accurately model a site of this size, continuous rainfall record spanning at least five years with a six minute timestep is required. Rainfall data was obtained from the Bureau of Meteorology in the form of a historic pluviograph record from the Williamstown rainfall gauge. It is situated approximately 34km from the site and is of similar elevation and temporal pattern.

The rainfall record was analysed, and the ten years of data between the dates of 1/1/1997 and 31/12/2006 was chosen. This was based on advice received for a peer-reviewed MUSIC model carried out by Tattersall Lander on another development in the Tea Gardens area. This data produced a mean annual rainfall of 1131mm. It was noted that the long term average rainfall (obtained from the Bureau of Meteorology) for Nelson Bay (approximately 13km from the site) is 1348mm. The ten year pluviograph data was scaled appropriately to bring the mean annual rainfall in line with this long term average (again based on advice received for the previous model). For the purpose of this report, all rainfall events in the nominated ten year period have been modelled.

10.2.2 EVAPORATION

To accurately model the outcome of water quality treatment measures, monthly potential evapotranspiration (PET) data is required. Monthly average areal potential evapotranspiration values were read from maps in the 'Climate Atlas of Australia, Evapotranspiration' (BoM, 2001), and are displayed below in Table 3:

Table 3: Monthly Areal Potential Evapotranspiration Figures

Month	Potential Evapotranspiration (mm)
January	180
February	135
March	135
April	90
May	70
June	50
July	50
August	70
September	95
October	135
November	150
December	175
Total	**1335**

10.2.3 NODE PARAMETERS

The MUSIC model was used to simulate the pollutant export generated during a ten year period of average rainfall. Geotechnical investigations indicate that the predominant soil types on site are Silty Clays and Clays. Rainfall-runoff parameters for Clay soils were adopted from Section 3.6.4.3 of the Draft NSW MUSIC Modelling Guidelines (2010) and typical pollutant concentrations derived from Fletcher et al. The adopted parameters can be seen in Figure 11 and Table 4 below.

Note that a Rainfall Threshold of 1.50 mm/day was adopted for the “Sealed Road” node and 0.30 mm/day was adopted for the “Roof” node per Table 3.6 in the Draft NSW MUSIC Modelling Guidelines (2010). A Rainfall Threshold of 1.00 mm/day adopted for all other nodes.

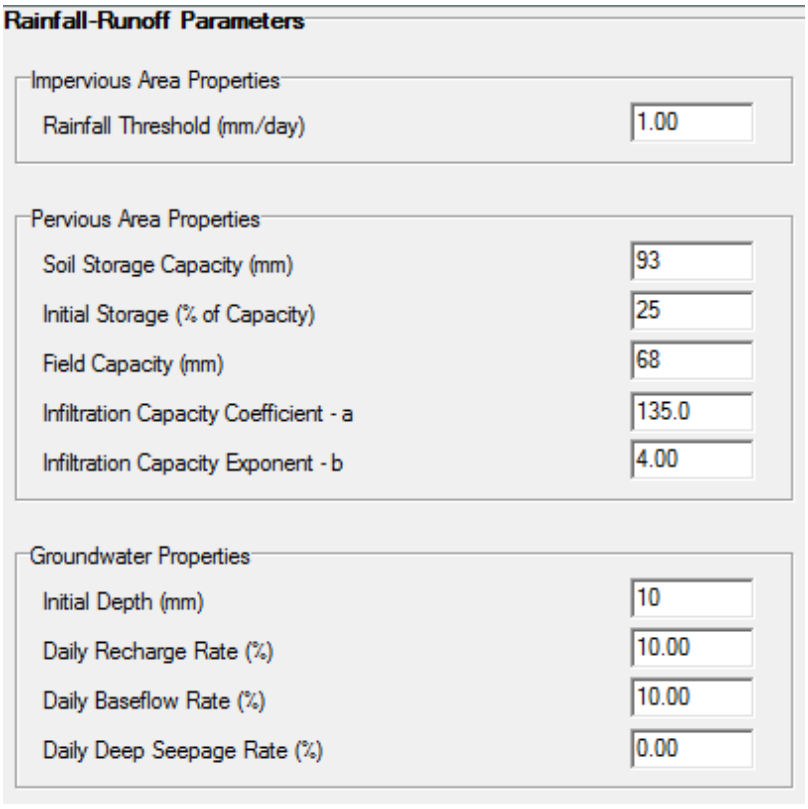

Figure 11: Adopted Rainfall-Runoff MUSIC Parameters

Table 4: Adopted MUSIC Pollutant Generation Parameters

	Agricultural	Rural	Residential	Roof	Road
Baseflow TSS Mean (mg/L)	20	14	16	-	16
Stormflow TSS Mean (mg/L)	140	90	140	20	270
Baseflow TP Mean (mg/L)	0.09	0.06	0.14	-	0.14
Stormflow TP Mean (mg/L)	0.6	0.22	0.25	0.13	0.5
Baseflow TN Mean (mg/L)	1.1	0.9	1.3	-	1.3
Stormflow TN Mean (mg/L)	3	2	2	2	2.2

10.2.4 EXISTING FLOW & POLLUTANT ANALYSIS

The overall development has two distinct catchments – Precinct 1 drains south into a public reserve in Shearwater Estate, while Precincts 2 and 3 will ultimately drain into the Myall River in combination with Precincts 4 and 5.

The existing site was modelled to simulate the current pollutant loads from the site. Cleared areas of the site were modelled as an 'Agricultural' node to reflect the cleared and open nature of the site and in acknowledgement of the active commercial grazing operations. Treed areas within the development footprint were modelled as 'Rural', as cattle grazing still occurs in these areas which would result in increased pollutant loads compared to an idealised 'Forest'.

* Note: It is acknowledged that the use of an Agricultural landuse is a position Council is not necessarily comfortable with. In this case the site is farmed fairly intensively as a grazing property, and the following is offered as justification of the adopted position.

As previously discussed with Council, the source of pollutant-generating parameters for MUSIC modelling is *Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures*, 2004, by Fletcher et al. This document does not provide definitions of what it defines as Agricultural and Rural (or any other) landuses. Further, the *Draft NSW MUSIC Modelling Guidelines,* 2010 by BMT WBM allocate an Agricultural landuse to grazing lands (other than horses), and the 2015 NSW MUSIC Modelling Guidelines

recommend an Agricultural landuse to RU2 lands (which is the former zoning of this site, and the nature of current site activities is still consistent with this).

Strong precedence also exists for this position - MUSIC modelling done by Martens & Associates (and peer reviewed by BMT WBM and the PAC expert panel) for the SEPP Major Projects application on the adjacent Riverside project applied agricultural landuse to the grazing areas on that site. Other Tattersall Lander reports peer reviewed by BMT WBM have also confirmed this approach as using the best information currently available.

In the context of this water quality assessment however, the real significance is to reflect the change of landuse because of the large areas of rehabilitated lands. Post-development areas of urban development will increase pollutant loads and the method for representing this post-development landuse is generally accepted. The significant distinction with this project is the conversion of large sections of farming lands back to a 'natural' state via active rehabilitation (16.7ha area in this DA, and more in future precincts). It is appropriate to reflect the improvement this will have on runoff water quality to offset some of the increases from the urban areas. This is achieved in this report by using an 'Agricultural' pre-developed landuse, and a 'Rural' post-developed landuse. Similar results would have been seen if a 'Rural' pre-developed landuse and a 'Forest' post-developed landuse had been used, but the NSW MUSIC modelling guidelines do not allow revegetated areas to be modelled as Forest, as a conservative assumption that the benefits will take some time to be fully realised as the rehabilitated areas mature to forest, whereas the conversion of residential lands to a mature 'urban' catchment may happen much faster.

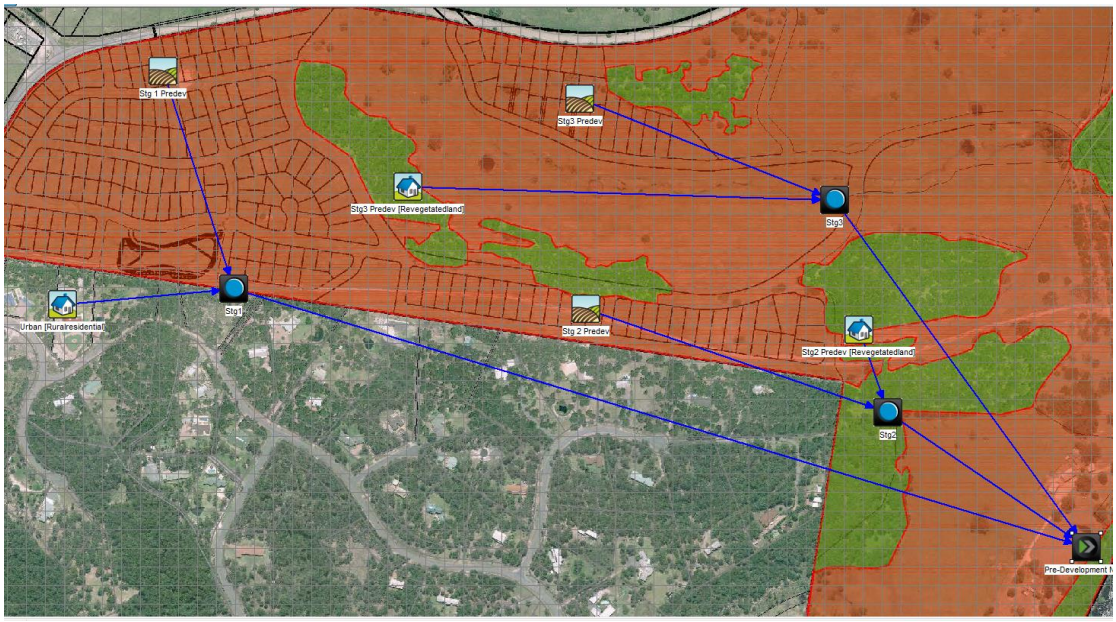

Figure 12: Existing State MUSIC Model

Table 5: Receiving Node Pre-Development Analysis

Precinct 1	**TSS (kg/yr)**	17,500
	TP (kg/yr)	68.7
	TN (kg/yr)	330
	GP (kg/yr)	581
Precinct 2 (R2 footprint only*)	**TSS (kg/yr)**	6,910
	TP (kg/yr)	28.2
	TN (kg/yr)	137
	GP (kg/yr	207
Precinct 3 (R2 footprint only*)	**TSS (kg/yr)**	3,620
	TP (kg/yr)	14.6
	TN (kg/yr)	71.5
	GP (kg/yr	0

* Note – despite each overall drainage catchment including surrounding adjacent lands, Council has requested analysis to be done of the proposed R2 development land only, so no water quality benefits as a result of the land use change and restoration of the E2 lands are included in these results.

10.2.5 PROPOSED DEVELOPMENT FLOW & POLLUTANT ANALYSIS

The proposed development was modelled to determine expected pollutant loads and the effectiveness of the proposed water treatment measures. The catchment was broken up into different areas depending on the surface type, including;

- Roofs areas (assumed at 300sq.m per lot), and modelled as “Roof” nodes with 100% impervious area;
- Drainage reserve (Stage 1) modelled as “Rural”
- All road areas (measured directly off design plans) were modelled as “Sealed Road” nodes with 100% impervious area;
- Remaining urban pervious area (reserves, road verges, residential yards etc) were modelled as residential nodes with 10% DCIA to account for any additional sheds, paths, paved courtyards etc that may be connected to site drainage;
- E2 restoration lands, including retained vegetation and remediation areas were modelled as a separate “Rural” node.

Modelled treatment nodes include;

Precinct 1;

- Rainwater tanks, average size 3kl. Captured water from these tanks has been modelled for reuse in toilet, laundry and external uses only. Tank water reuse rates were adopted for a dwelling with 3 occupants from Table 3-12 in the 2010 Draft NSW Music Modelling Guidelines - an internal water reuse rate of 0.36kL/day/dwelling and external reuse rate of 112kL/yr/dwelling. With each lot provided a legal drainage point at the lowest point on the site, it has been assumed that 100% of the roof areas will be connected to the tanks,

- Biofiltration measures have been incorporated into the main basin in Precinct 1. Features include a 0.35m average detention depth, 0.4m filter depth, 1405sq.m filter area and sediment forebay/energy dissipater/high flow bypass arrangement,

  Note - Roadside swales previously proposed have been removed at Council request, as some grades exceeded 5%. It is debatable whether swales at >5% offer zero water quality benefit, but with the proposed biofilter providing sufficient treatment, additional WSD devices were considered an unnecessary

maintenance burden and have been replaced by hard engineering concrete kerbs and pipes.

Precinct 2;

- Rainwater tanks per Precinct 1,

- Roadside swales on all roads <10% grade, 200mm deep with 1m base width. The design includes regular (30m spacing) inlet pits to segment the swales into shorter sections connected to the parallel pipe drainage network – i.e. the swales are for treatment only, rather than flow conveyance. Swales were modelled at half the pit spacing (15m), and a calculated equivalent width to allow them to be grouped together for each catchment. It is noted that swales are included in the design up to a maximum 10% slope with approval from Council Engineering, who confirm that this should not be an ongoing maintenance issue. However, all swales over 5% slope (approximately half the swales in this stage) have been excluded from the MUSIC modelling on Council Natural Systems instruction that they will not accept MUSIC results which show that a swale can provide treatment beyond the 5% threshold.

Precinct 3;

- Rainwater tanks per Precinct 1,

- Roadside swales on southern side of southern perimeter road <10% grade, 200mm deep, with 1m base width. The swales will have regular (30m spacing) bunded check dams to segment the swales into shorter sections and provide regular minor discharges into the adjacent E2 lands. Swales were modelled at half the check dam spacing (15m), and a calculated equivalent width to allow them to be grouped together for each catchment.

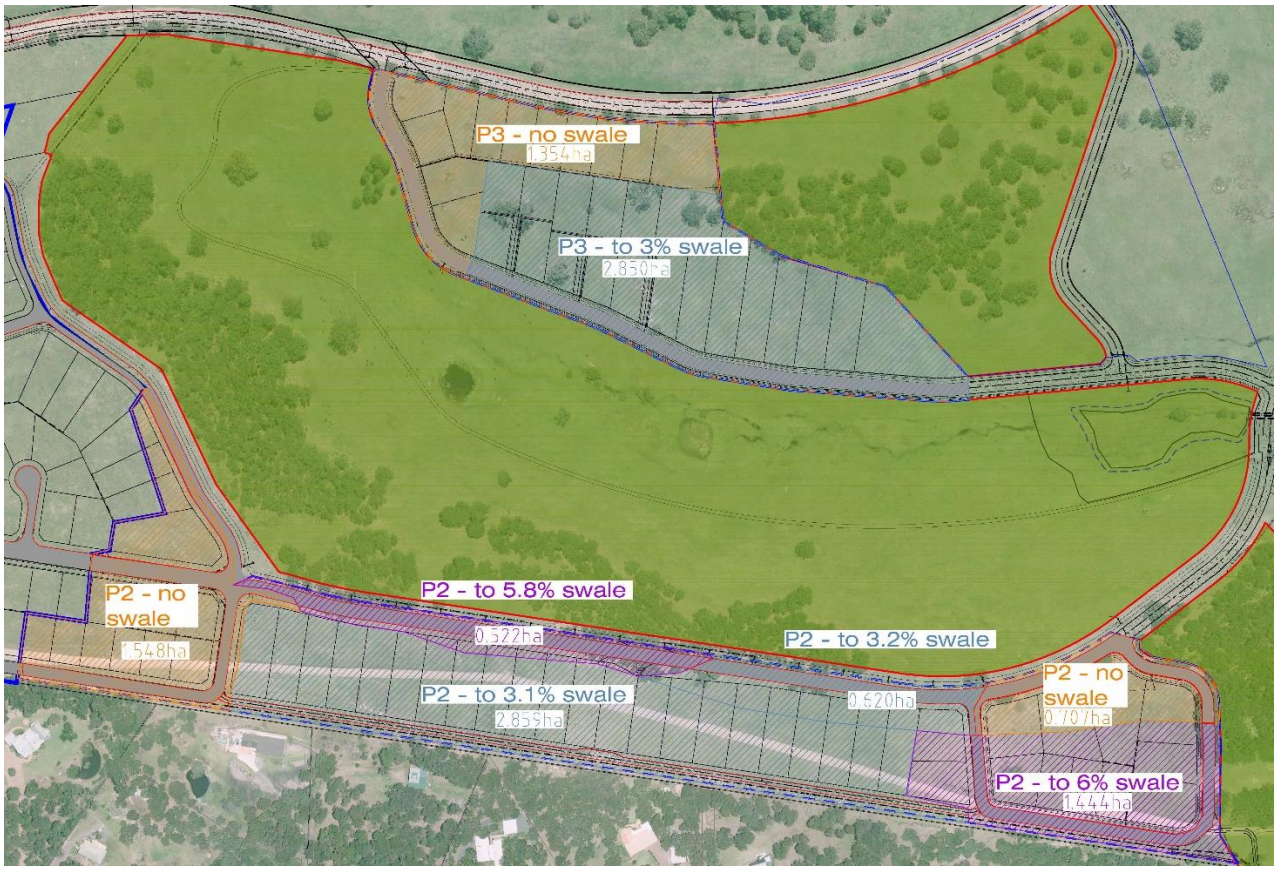

Figure 13: Precinct 2 / 3 Detailed Catchment Breakdown

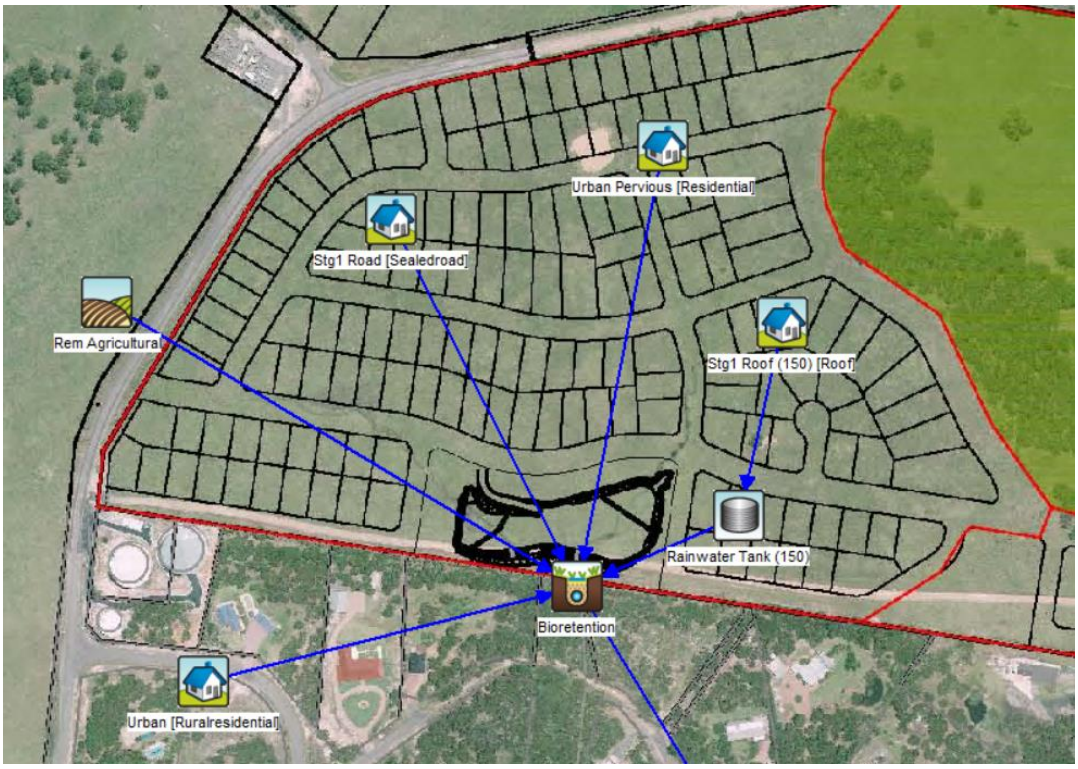

Figure 14: Precinct 1 Proposed Development MUSIC Model

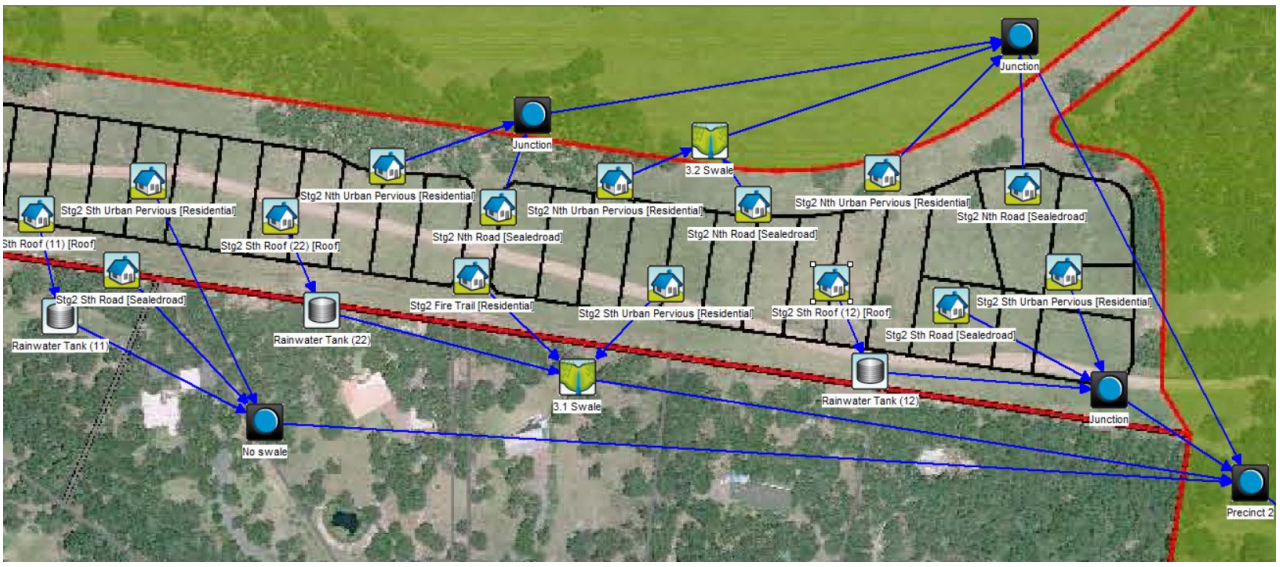

Figure 15: Precinct 2 Proposed Development MUSIC Model

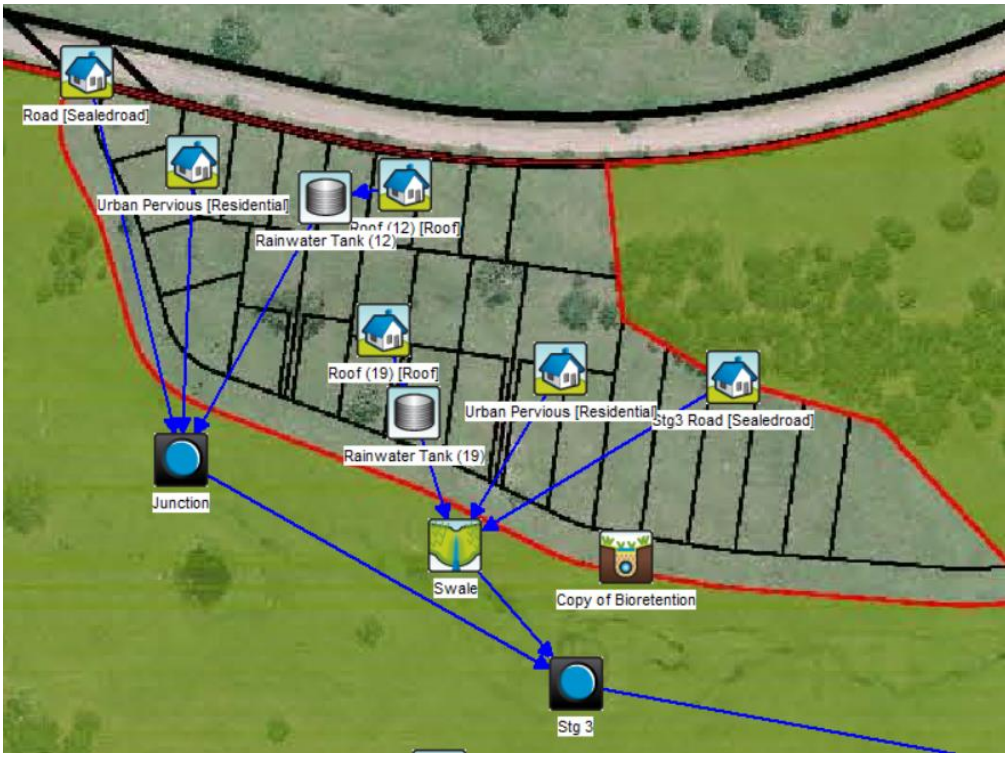

Figure 16: Precinct 3 Proposed Development MUSIC Model

An analysis of the Post-Development Receiving Node reveals the following:

Table 6: Receiving Node Post-Development Analysis

Precinct 1	**TSS (kg/yr)**	4,850
	TP (kg/yr)	18.1
	TN (kg/yr)	179
	GP (kg/yr)	35.4
Precinct 2 (R2 footprint only)	**TSS (kg/yr)**	7,870
	TP (kg/yr)	16.0
	TN (kg/yr)	119
	GP (kg/yr	447
Precinct 3 (R2 footprint only)	**TSS (kg/yr)**	2,890
	TP (kg/yr)	6.98
	TN (kg/yr)	65.0
	GP (kg/yr	140

10.2.6 COMPARISON OF POLLUTANT RESULTS

Pre and post development pollutant loads are compared in the table below to ensure that the Stormwater Quality Targets have been met.

Table 7: Comparison of Pre- and Post-Development Pollutant Loads

		Pre-Developed	Post-Developed	NoBE Compliant
Precinct 1	**TSS (kg/yr)**	17,500	4,850	Yes
	TP (kg/yr)	68.7	18.1	Yes
	TN (kg/yr)	330	179	Yes
	GP (kg/yr)	581	35.4	Yes
Precinct 2 (R2 footprint only)	**TSS (kg/yr)**	6,910	7,870	No
	TP (kg/yr)	28.2	16.0	Yes
	TN (kg/yr)	137	119	Yes
	GP (kg/yr	207	447	No
Precinct 3 (R2 footprint only)	**TSS (kg/yr)**	3,620	2,890	Yes
	TP (kg/yr)	14.6	6.98	Yes
	TN (kg/yr)	71.5	65.0	Yes
	GP (kg/yr	0	140	No

* NoBE = Neutral or Beneficial Effect

Discussion;

This is an unusual project, where the development areas are perched on steep lands above a large environmental / drainage corridor zoned for environmental use and requiring significant rehabilitation. There are numerous additional works being proposed within this E2 corridor that will provide additional water quality benefits, but are difficult to quantify accurately within the structure of the DCP and the MUSIC modelling guidelines and so are not represented in the results listed above. They will, however, provide an additional treatment effect, which should more than make up the shortcomings of the in-precinct measures.

The proposed rehabilitation plan shown in Appendix B has the support of Council's ecologist and is considered a significantly better ecological outcome. Additional unquantified water quality improvements would also occur as a result;

- **Additional reforestation works -** Under the planning agreement from the original rezoning, restoration of the E2 lands from the current pasture grasses was limited to not much more than simply fencing off the area and allowing natural revegetation to occur. It is considered this will result in a poor end outcome. The land has been grazed for so long there is negligible native seedbank left and natural regeneration would likely be a failed process, more likely to create a weed infested area that would then disperse seeds to surroundings lands and downstream environments. Evidence of this can be seen onsite in the areas previously fenced out and planted in coordination with Council along sections of creek line – while the individual plantings have generally performed well, the understory is still complete kikuyu/weed coverage and no supplementary 'natural' regeneration has occurred at all.

  Additional to the dedication of these significant land areas to Council (over 16ha in this current DA, and further dedications in future DAs), the current proposal is offering something significantly more – large scale active plantings, with 30 separate species and including upper, middle and lower stratum species to create the complete forest structure. Some species have also been selected specifically to create preferred koala habitat.

  In addition to the improved ecological outcome, it is considered that the proposed active replanting / reforestation will provide an additional water quality benefit compared to the minimum required under the planning agreement.

- **Stream bank stabilisation –** Additional bank restoration works are proposed to stabilise the existing creek and to repair damaged areas that are currently scouring and contributing to downstream pollution,

- **Contour banks -** The aim of the contour banks is to hold more water up on the hillslope and encourage better reforestation outcomes, as well as slow runoff rates to reduce the existing creek bank erosion issues. The contour banks are essentially swales holding back the runoff and allowing absorption of nutrients by the vegetation, as well as the dual effect of reducing runoff velocities – allowing sediment to drop out on the hillside and reducing new erosion scour potential.

- **Perimeter road swales > 5% –** At Council's instruction, all swales > 5% slope have been excluded from the MUSIC modelling. Council's position means that while a swale at 5% may remove, say, 75% of TSS, that changes to 0% removal at 5.1%. As such, effects of several long sections of vegetated swale (310m @ 5.8% and 140m @ 6%) have not been included in the reported results. It is expected that these sections of swale will provide some additional unquantified treatment value.

- **Perimeter road vegetated buffers –** Where grades are considered too steep (>10%), swales have been replaced with rock lined, lomandra planted shoulders. While not modelled in MUSIC due to lack of guidance on applicable slopes, it is expected these vegetated shoulders will provide some additional unquantified treatment value.

- **Basin 3 –** Basin 3 has been included in the design as a detention structure and from an ecological viewpoint to provide some variety of habitat in the E2 corridor. It will actually also provide many of the benefits of a constructed wetland, but because it is online with no high-flow bypass, and because it is accepting residential flows after they have been filtered through the E2 catchment, it is not something that can be accurately modelled in MUSIC. Additionally, DPI water will also not approve a water quality structure in the Riparian Zone, but they have approved this basin as a detention structure.

  Despite these issues, the basin will act essentially as a constructed wetland and will provide additional water quality benefits that are not included in the MUSIC modelling results reported above.

Note - Re-suspension is not considered a significant issue because in the chosen position in the valley the grades have actually flattened out significantly, and the design of the outlet actually means that the peak 100 year flow velocities are around 0.5m/s across the basin (and even lower near the outlet), as illustrated below.

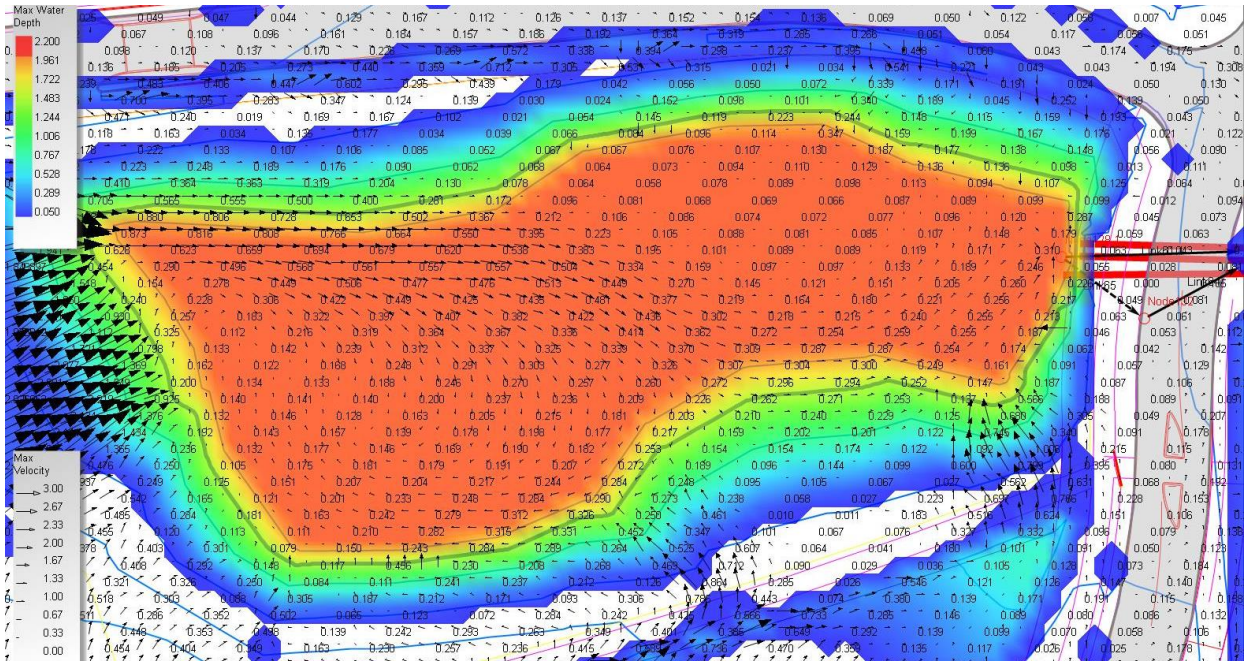

Figure 17: Basin 3 100yr maximum depths and flow velocities

Note - Additional Precinct 2 Raingarden Option - The possibility of including an additional raingarden in the lower section of the E2 corridor (adjacent to Basin 3) was discussed with Council staff, as the only realistic option to try to provide additional treatment on the site. Detailed investigation shows that this would only end up treating 0.707ha of additional lands (9% of the Precinct 2 catchment), as shown in Figure 12. The pros and cons of this option were discussed with Council staff, and it was ultimately advised that should not be pursued as there would be limited gains relative to the additional upfront and ongoing maintenance costs.

Note - Additional On-Lot Biofilter Option – There are sections of Precincts 2 and 3 that will not receive any treatment, due to the various constraints of the site. While the impact of this is generally offset by treatment of other areas, the possibility of including additional on-lot biofiltration for these otherwise untreated lots was discussed with Council staff and concluded that it should not be pursued as there would be limited gains relative to the upfront costs and compliance issues related to ongoing private maintenance.

11.0 COSTS

All stormwater infrastructure will be installed at the developer's expense and will be handed over to Council as public assets.

Is it expected that the finalisation of the biofiltration component of the basin in Precinct 1 will be deferred until 80% of the housing construction in the catchment has been completed. Council may wish to hold a bond for these works to ensure all finalisation and establishment costs are borne by the developer and available at the appropriate time.

Council have previously confirmed that they believe adequately sized and designed biofiltration basins are the most cost-effective method for achieving adequate water quality treatment of urban runoff. Council are now in ownership of numerous biofiltration assets and would have a reasonable understanding of the typical ongoing maintenance costs of operating these assets in local conditions. As such, detailed assessment of ongoing maintenance costs has not been prepared as it would not provide better information than what Council already has.

While some concerns have been raised about the cost of maintaining the swale and buffer sections of vegetation around the E2 lands, various alternative treatment options were discussed with various sections of Council (meeting at Council's Forster office 9/3/2020) and it was concluded that the adopted approach provides the best overall maintenance cost outcome when balanced with the costs associated with the adjacent E2 reserve.

12.0 OPERATION AND MAINTENANCE PLAN

12.1 BIOFILTERS

The biofilter systems are installed in a public drainage reserve and it is expected that all maintenance tasks on this system would fall under the general works routinely conducted by Council maintenance staff. Council are in possession of numerous biofilter assets of similar design and should have suitably skilled and educated staff to inspect and maintain the system without further instruction. Their experience in maintaining these assets within the local environmental conditions would generally take precedence over generic guidelines otherwise available.

As a general comment, regular maintenance is required to ensure water treatment measures continue to operate in an effective way. These tasks should be performed every three months or after heavy storm events, and can be done as part of regular maintenance by Council maintenance staff.

The maintenance schedule in Appendix C has been prepared as a typical template to direct maintenance staff undertaking routine maintenance and is based on Raingardens and Bioretention Tree Pits Maintenance Plan Example, prepared by the Facility for Advancing Water Biofiltration, Monash University. Relevant sections have been reproduced and/or modified for the specific site conditions. However, Council most probably already have adequately trained and skilled staff and settled biofiltration maintenance regimes and should defer to these.

The biofilter has been designed with two shallow concrete sediment forebays to provide scour protection to the biofilter. Low flows are captured in the structure and distributed into the biofilter through a series of slots cut into the integral kerbing, while high flows should bypass the forebay and flow straight into the detention basin. These forebays will require periodic inspection and cleaning. Access has been designed to allow backhoe entrance for this purpose. These forebays are designed to contain up to two years average sediment deposition. It is recommended that this be inspected every six months and after major rainfall events, and cleaned as necessary. This may need to be more frequent in the initial stages following subdivision release, depending on the pace of dwelling construction. If higher than expected sedimentation has

occurred, investigation into the upstream catchment should be undertaken to try to determine the source of the sediment.

All biofilter maintenance activities will need to commence as soon as biofilters are planted and brought online and continue for the life of the development.

Note: On top of the cleaning as described above, the sediment forebays are a specific feature that needs to be monitored and reviewed to determine if they are performing as designed. An inspection from a suitably qualified person should be undertaken following and, if possible, during regular rainfall events in the first year of operation. If too much water is bypassing the biofilters, water is not distributing evenly through the outlets or too much sediment is entering the biofilters, minor remedial design changes may be able to be made to correct these issues.

12.2 DETENTION BASINS

12.2.1 PRECINCT 1 BASIN

The Precinct 1 basin has been designed with two shallow sediment forebays that will require periodic inspection and cleaning as detailed above.

Basin discharges are controlled by a low-flow orifice outlet from the basin (protected by a maxi-mesh debris screen), a grated outlet pit, an outlet headwall and finally a reinforced turf spillway. It is expected all these outlets will be low-maintenance (to a point), but visual inspection and potential manual clearing of any built-up debris from any of the outlet structures should be undertaken in conjunction with the above-mentioned sediment forebay inspections.

12.2.2 PRECINCT 2 BASIN

The Precinct 2 basin is a ‘temporary’ basin that will be relocated and incorporated into the future Precinct 5 design. It is designed essentially as a coarse sediment collection device, and there will be adequate storage volume below the permanent water level to store up to ten years of accumulated sediment. If Precinct 5

construction has not commenced by this time, mechanical cleaning out may be required to reinstate capacity. A concrete service road has been provided for this purpose. Inspection is recommended annually and after large rainfall events.

12.2.3 PRECINCT 3 BASIN

The Precinct 3 basin is online on a second order stream that includes the E2 restoration area. Once the catchment is mature and stabilised, minimal sedimentation in the basin is expected, and a storage volume in excess of ten years of accumulated sediment will be provided below the permanent water level. Inspection annually and after large rainfall events is recommended, and periodic cleaning out may be required (via excavator with access from adjacent public roads if necessary).

Basin discharges are controlled by a low-flow orifice outlet from the basin (protected by a maxi-mesh debris screen), a grated outlet pit, and an outlet headwall. It is expected all these outlets will be low-maintenance (to a point), but visual inspection and potential manual clearing of any built-up debris from any of the outlet structures should be undertaken annually and after large rainfall events.

12.3 SWALES / BUFFER STRIPS

The swales and buffer strips adjacent to the E2 perimeter roads should be have fully established vegetation by the time they are dedicated to Council. The best protection from weed infestation will be to maintain a thick coverage of lomandra plantings. Weed growth is inevitable on this residential / environmental interface, but it is considered easier to deal with weeds in this roadside environment with easy access, rather than let the weed seeds get further into the E2 lands where access will be much more difficult. Periodic inspection and spraying will be required, at least bi-annually and focussed on spring and summer when weed growth can be at its highest. It is also recommended to reinstate plantings if plants die and densities are not being maintained.

13.0 CONCLUSIONS

The current development application proposes to address water quality and quantity objectives of the DCP via a combination of the following measures;

- Construction of three detention basins,
- Construction of an offline end of pipe biofiltration rain garden in Precinct 1,
- Construction of roadside swales where grades allow on perimeter roads,
- Provision of vegetated buffer strips adjacent to E2 where grades do not allow swale construction,
- Installation of a 3kL (average) rainwater tanks with all future dwellings,
- Removal of existing farming practices and active rehabilitation of significant areas of rezoned E2 land, including significant replanting efforts and large scale contour banks.

It is expected that the development will have a positive overall impact on both the stormwater pollutant levels and peak flowrates leaving the site, compared to the existing situation. From a stormwater quality and quantity perspective, approval is recommended.

14.0 REFERENCES

Draft NSW MUSIC Modelling Guidelines, 2010, BMT WBM

Music Version 5.0 User Manual, 2011, eWater

Policy 11: Land Development Guidelines, Section 13 Water Sensitive Urban Design, 2007, Gold Coast Council

Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures, 2004, Fletcher et al

WSUD Engineering Procedures: Stormwater, 2005, Melbourne Water

APPENDIX A: PROPOSED LAYOUT & DETAIL PLANS

PROPOSED RESIDENTIAL SUBDIVISION

'DURNESS STATION', LOT 1, 2, 3 & 4 DP 1154170

VINEY CREEK ROAD, NORTH SHEARWATER

DEVELOPMENT APPLICATION,
ROAD & DRAINAGE DESIGN PLANS

LOCALITY SKETCH

Schedule of Drawings

Sheet	File Number	Description	Revision
1	21800037	COVER SHEET, LOCALITY SKETCH & SCHEDULE OF DRAWINGS	B
2	21800038	OVERALL SITE PLAN	B
3	21800039	PRECINCT 1 SUBDIVISION LAYOUT	B
4	21800040	PRECINCT 2 & 3 SUBDIVISION LAYOUT	B
5	21800041	PRECINCT 1 DETAIL PLAN	B
6	21800042	PRECINCT 2 & 3 DETAIL PLAN	B
7	21800043	RU2 RECREATIONAL AREA DETAIL PLAN	B
8	21800044	PRECINCT 1 TREE REMOVAL PLAN	B
9	21800045	PRECINCT 2 & 3 TREE REMOVAL PLAN	B
10	21800046	PRECINCT 1 PRECINCT RELEASE PLAN	B
11	21800047	DETAILS PLAN - ROAD TYPICALS	B
12	21800048	DETAILS PLAN - SERVICES ALLOCATIONS & VINEY CREEK RD LANDSCAPE BUFFER	B
13	21800049	ROAD LONGITUDINAL SECTIONS	B
14	21800050	ROAD LONGITUDINAL SECTIONS	B
15	21800051	ROAD LONGITUDINAL SECTIONS	B
16	21800052	ROAD LONGITUDINAL SECTIONS	B
17	21800053	ROAD LONGITUDINAL SECTIONS	B
18	21800054	RIPARIAN CORRIDOR PATHWAY & STG 2-5 SERVICE ROAD LONGITUDINAL SECTIONS	B
19	21800055	PRECINCT 1 BASIN PLAN	B
20	21800056	PRECINCT 1 BASIN SECTIONS	B
21	21800057	PRECINCT 1 BASIN DETAILS	B
22	21800058	PRECINCT 2 BASIN PLAN	B
23	21800059	PRECINCT 3 BASIN PLAN	B
24	21800060	PRECINCT 3 BASIN SECTIONS	B
25	21800061	CATCHMENT PLAN	B
26	21800062	PRECINCT 1 CUT-FILL PLAN	B
27	21800063	PRECINCT 2 & 3 CUT-FILL PLAN	B
28	21800064	OVERALL SHARED PATHWAYS PLAN	B
29	21800065	PRECINCT 1 CONCEPT SOIL & WATER MANAGEMENT PLAN	B
30	21800066	PRECINCT 2 & 3 CONCEPT SOIL & WATER MANAGEMENT PLAN	B
31	21800067	CONCEPT SOIL & WATER MANAGEMENT NOTES	B
32	21800068	OVERALL CONCEPT ELECTRICAL SERVICING PLAN	B

Designed By TATTERSALL LANDER PTY LTD
DEVELOPMENT CONSULTANTS IN ENGINEERING, SURVEYING & PLANNING
PO Box 580 RAYMOND TERRACE Phone (02) 4987 1500

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*

* Denote the original signature and date when revision was issued.

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OVERALL SITE PLAN
DURNESS STATION RESIDENTIAL SUBDIVISION
LOT 1, 2, 3 & 4 DP 1154170
VINEY CREEK ROAD, NORTH SHEARWATER

COUNCIL: MIDCOAST	REFERENCE: 21800038
PARISH: COWEAMBAH	SHEET SIZE: A3
SCALE: 1:600 on A3	SHEET No.: 2
DATE : Plotted 4/8/20 11:18AM	
CLIENT: WOLIN PTY LTD	JOB No.: 205532
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg	

LEGEND

- EXISTING CONTOURS (1m INTERVAL)
- EXISTING OVERHEAD POWER
- EXISTING WATERMAIN
- EXISTING TELSTRA
- TABLE DRAIN
- PROPOSED RETAINING WALL (1.2m MAX HEIGHT)
- EXISTING HABITAT TREE

BENCHING NOTES:

1. PROPOSED BENCHING DEPENDANT ON IN-SITU ROCK RIPABILITY AT EACH LOCATION - TO BE CONFIRMED DURING CONSTRUCTION. END RESULT MAY BE REVISED BENCHING LEVELS, OR NO BENCHING AT ALL.
2. MAX RETAINING WALL HEIGHT = 1.2m. ALL WALLS TO STRUCTURAL ENGINEERS DETAILS.
3. ALL FILLING TO BE CERTIFIED LEVEL 1 IN ACCORDANCE WITH AS 3798.

VINEY CREEK ROAD

VINEY CREEK ROAD EAST

PIPED ROAD STORMWATER TO BE DISCHARGED VIA LEVEL SPREADER ONTO RURAL LANDS

NOMINATED FILL BORROW AREA (IF NECCESARY)

ESTATE ENTRY SIGNAGE

SAW CUT EXISTING PAVEMENT AND FULL RECONSTRUCTION FROM CH370

5m RESTRICTION / POSITIVE COVENANT FOR LANDSCAPE MOUND - SEE DETAIL SHEET 12

ROAD 1 · ROAD 2 · ROAD 3 · ROAD 4 · ROAD 5 · ROAD 6 · ROAD 7 · ROAD 8 · ROAD 9

TEMPORARY TURNING HEAD

SHARED PATHWAY (UPPER)

SHARED PATHWAY (LOWER)

JOINS SHEET 6

ELECTRICAL KIOSK

EXISTING OVERHEAD POWER (TO BE REMOVED)

SEE SHEET 19-21 FOR BASIN DETAILS

MCW RESERVOIR SITE

FUTURE TRUNK WATERMAIN

PROPOSED LEAD IN VACUUM SEWER MAIN

NOTE - EXISTING FENCE UP TO 3m OFF BOUNDARY - TO BE RELOCATED DURING ROAD CONSTRUCTION

4m WIDE SEALED FIRE TRAIL

DIAL BEFORE YOU DIG www.1100.com.au

0 m 25 m 50 m 75 m 100 m

(A) - PROP. EASEMENT FOR DRAINAGE OF SEWAGE (3 WIDE & VARIABLE)
(B) - PROP. EASEMENT FOR DRAINAGE OF WATER (1 WIDE)

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*

* Denote the original signature and date when revision was issued.

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PLAN OF PROPOSED RESIDENTIAL SUBDIVISION
PRECINCT 1 DETAIL PLAN
LOT 1, 2, 3 & 4 DP 1154170
VINEY CREEK ROAD, NORTH SHEARWATER

COUNCIL: MIDCOAST	REFERENCE: 21800041
PARISH: COWEAMBAH	SHEET SIZE: A3
SCALE: 1:2000 on A3	SHEET No.: 5
DATE : Plotted 6/8/20 9:22AM	

CLIENT: WOLIN PTY LTD | JOB No.: 205532 | COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg

LEGEND

- EXISTING CONTOURS (1m INTERVAL)
- EXISTING OVERHEAD POWER
- EXISTING WATERMAIN
- EXISTING TELSTRA
- EXISTING DRAIN
- EXISTING HABITAT TREE

LIMIT OF PRECINCT 3 CONSTRUCTION. MAKE SMOOTH CONNECTION TO EXISTING ACCESS ROAD

NOMINATED FILL BORROW AREA (IF NECCESARY)

TEMPORARY TURNING HEAD

ROAD 1

FUTURE PRECINCT 4

ROAD 11 (FUTURE ROAD)

NOMINATED SOIL STOCKPILE AREA (IF NECCESARY)

FUTURE ROAD

LIMIT OF PRECINCT 3 CONSTRUCTION

ROCK ENERGY DISSIPATION & SCOUR PROTECTION

SEE SHEET 23-24 FOR BASIN DETAILS

JOINS SHEET 7

ROCK ENERGY DISSIPATION & SCOUR PROTECTION

ROAD 13

ELECTRICAL KIOSK

EXISTING UNFORMED ROAD (COUNCIL OWNED, TO BE ACQUIRED)

TYPE 'SO' CONCRETE DISH DRAIN ALONG TOE OF BATTER

(LOWER)

SHARED PATHWAY

CONCRETE 'V' DRAIN ALONG TOP OF BATTER

JOINS SHEET 5

ROAD 2

'RURAL STYLE' OPEN POST AND RAIL FENCE ALONG ROAD FRONTAGE

ELECTRICAL KIOSK

'RURAL STYLE' OPEN POST AND RAIL FENCE ALONG ROAD FRONTAGE

3m LOCALISED 2:1 BATTER

SHARED DRIVEWAY (IN EASEMENT)

TYPE 'SO' CONCRETE DISH DRAIN ALONG TOP OF BATTER

REINSTATE EXISTING GRAVEL DRIVEWAY ACCESS

EXISTING OVERHEAD POWER (TO BE REMOVED)

FIRE TRAIL

ROAD 10

REMOVABLE BOLLARD WITH RFS / COUNCIL ACCESSIBLE LOCK

4m WIDE SEALED FIRE TRAIL

PASSING BAY

FUTURE TRUNK WATERMAIN

REMOVABLE BOLLARD WITH RFS / COUNCIL ACCESSIBLE LOCK

SERVICES CORRIDOR - CONCRETE SERVICE ROAD, SEWER, STORMWATER & TRUNK WATERMAIN THROUGH E2 LAND TO PRECINCT 5 - SEE SHEET 22

NOTE - EXISTING FENCE UP TO 3m OFF BOUNDARY - TO BE RELOCATED DURING ROAD CONSTRUCTION

(A) - PROP. EASEMENT FOR DRAINAGE OF SEWAGE (3 WIDE & VARIABLE)
(B) - PROP. EASEMENT FOR DRAINAGE OF WATER (1 WIDE)

0 m 25 m 50 m 75 m 100 m

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*

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PLAN OF PROPOSED RESIDENTIAL SUBDIVISION
PRECINCT 2 & 3 DETAIL PLAN
LOT 1, 2, 3 & 4 DP 1154170
VINEY CREEK ROAD, NORTH SHEARWATER

COUNCIL: MIDCOAST	REFERENCE: 21800042
PARISH: COWEAMBAH	SHEET SIZE: A3
SCALE: 1:2000 on A3	SHEET No.: 6
DATE : Plotted 6/8/20 9:10AM	

CLIENT: WOLIN PTY LTD | JOB No.: 205532 | COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg

LEGEND

- EXISTING CONTOURS (1m INTERVAL)
- EXISTING OVERHEAD POWER
- EXISTING WATERMAIN
- EXISTING TELSTRA
- EXISTING DRAIN
- EXISTING HABITAT TREE

FUTURE PRECINCT 4 RESIDENTIAL LAND

FUTURE COLLECTOR ROAD (PRECINCT 4 CONSTRUCTION)

PROPSED 60.0m (MIN) RIPARIAN CORRIDOR

PATHWAY

1:3 BATTER

FUTURE COLLECTOR ROAD (PRECINCT 5 CONSTRUCTION)

1:6 BATTER

FUTURE CARPARK (WITH PRECINCT 5 CONSTRUCTION)

SPORTING FIELD

80.0

130.0

RU2

LIMIT OF PRECINCT 3 CONSTRUCTION

JOINS SHEET 6

PRECINCT 3 BASIN

ROCK ENERGY DISSIPATION & SCOUR PROTECTION

SHARED

EXERCISE STATIONS

OFF-LEAD DOG AREA

PLAYGROUND

ROCK ENERGY DISSIPATION & SCOUR PROTECTION

1:6 BATTER

1:4 BATTER

FUTURE KIOSK/AMENITIES BUILDING (WITH PRECINCT 5 CONSTRUCTION)

BBQ AREA

TYPE 'SO' CONCRETE DISH DRAIN

APPROXIMATE S94 OFFSET AREA =24,300sq.m

0 m 12.5 m 25 m 37.5 m 50 m

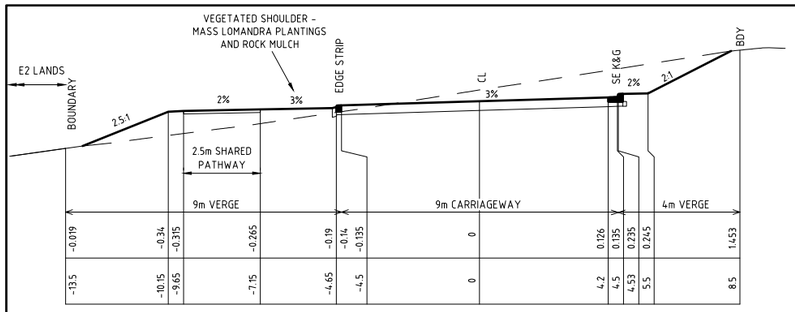
REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*

* Denote the original signature and date when revision was issued.

TATTERSALL LANDER PTY LTD
DEVELOPMENT CONSULTANTS
ENGINEERING, SURVEYING & PLANNING
2 Bourke St. P.O.Box 580
RAYMOND TERRACE 2324
Fax (02) 49871733 Phone (02) 49871500

CENTRAL RU2 AREA CONCEPT LAYOUT PLAN
PRECINCT 3 CONSTRUCTION
DURNESS STATION
VINEY CREEK RD, TEA GARDENS

COUNCIL: MIDCOAST	REFERENCE: 21800043
PARISH	SHEET SIZE: A3
SCALE: 1:2000 on A3	SHEET No.: 7
DATE : Plotted 6/8/20 9:14AM	
CLIENT:	JOB No.: 205532
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg	



TYPICAL SECTION - ROAD 2 Ch1230-Ch1455
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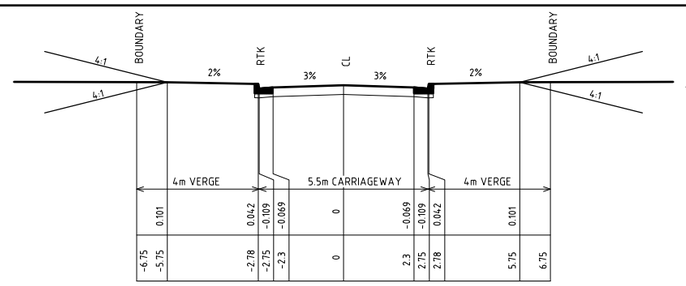

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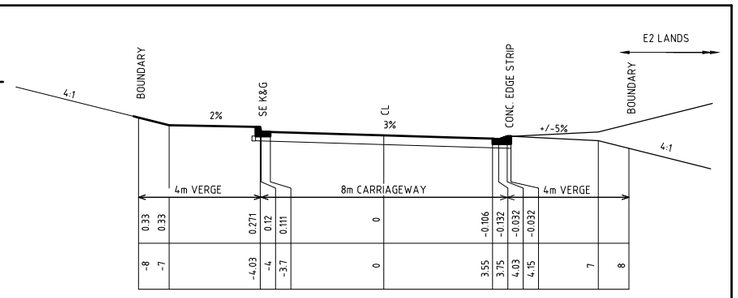

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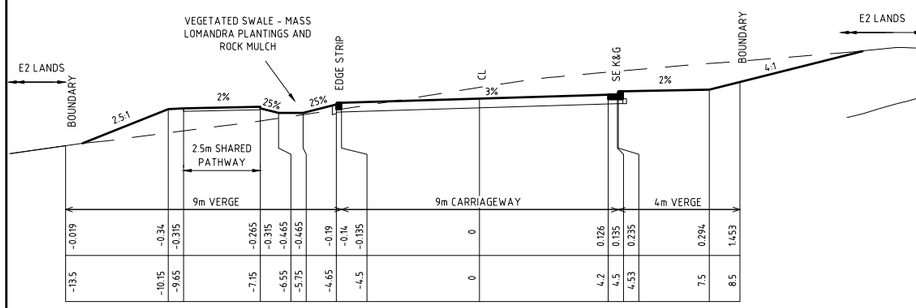

TYPICAL SECTION - ROAD 2 Ch630-Ch1230
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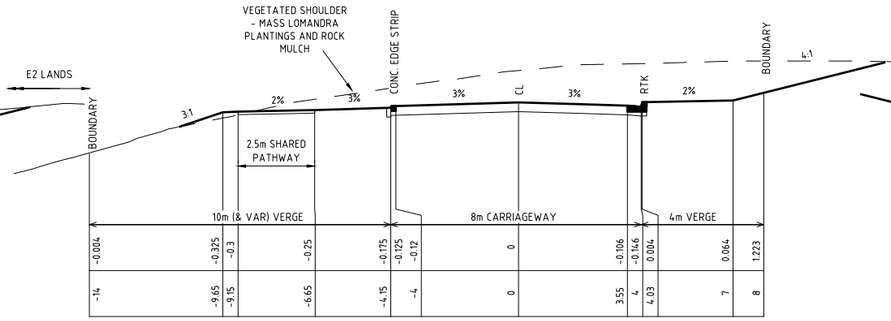

TYPICAL SECTION - ROAD 4 Ch480-Ch800
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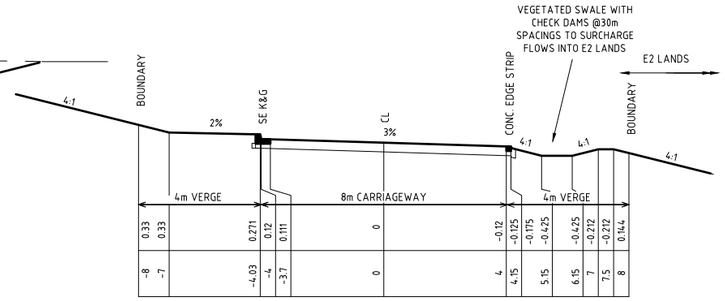

TYPICAL SECTION - ROAD 13 Ch150-700
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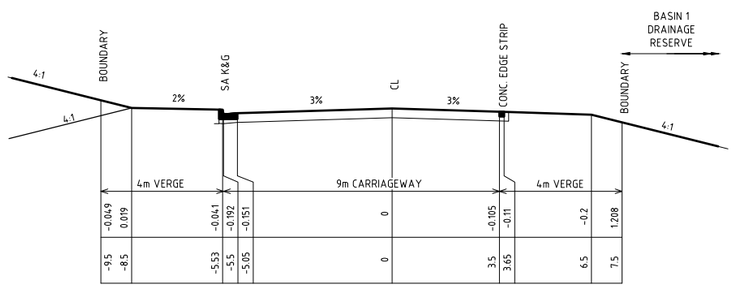

TYPICAL SECTION - ROAD 2 Ch210-Ch405
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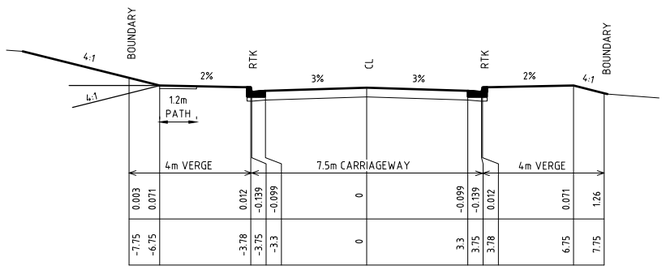
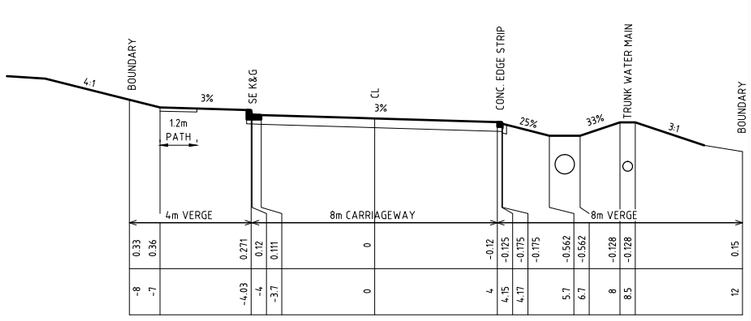


TYPICAL SECTION - ROAD 4 Ch0-Ch480, ROAD 5, ROAD 6 & ROAD 7 Ch112-Ch210
1:200 (NATURAL)



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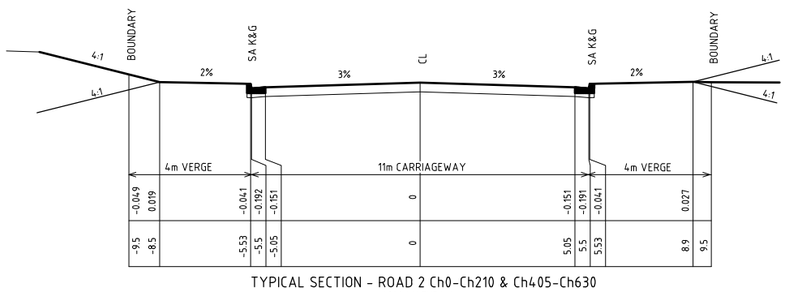

TYPICAL SECTION - ROAD 2 Ch0-Ch210 & Ch405-Ch630
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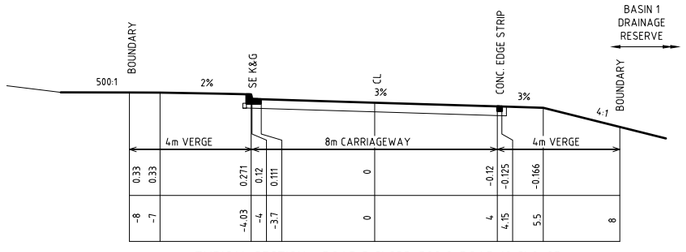
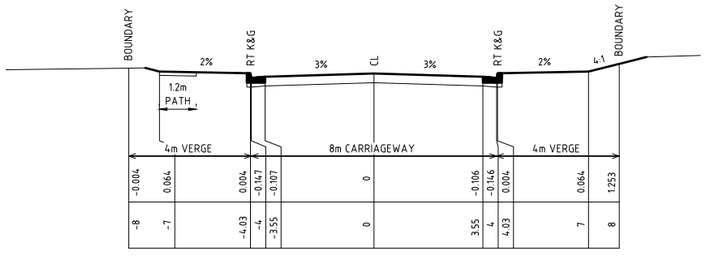
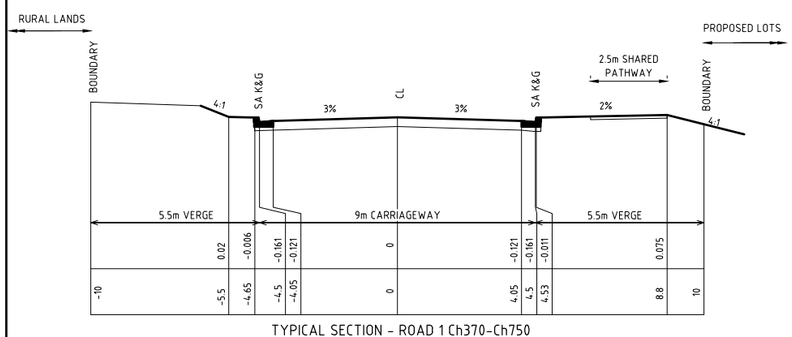


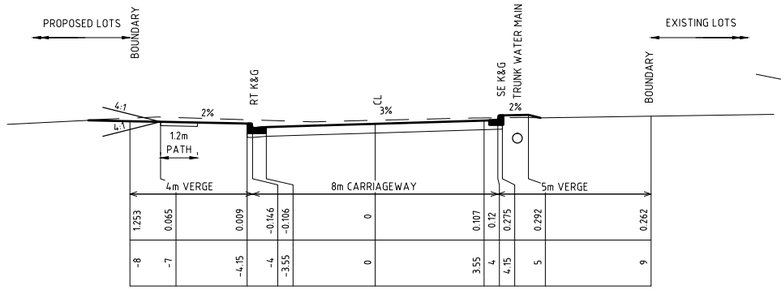
TYPICAL SECTION - ROAD 3 Ch233-300 & ROAD 10 Ch0-85
1:200 (NATURAL)



TYPICAL SECTION - ROAD 10 Ch0-69 & 236.8-386.4
1:200 (NATURAL)



TYPICAL SECTION - ROAD 1 Ch370-Ch750
1:200 (NATURAL)



TYPICAL SECTION - ROAD 3 Ch0-220
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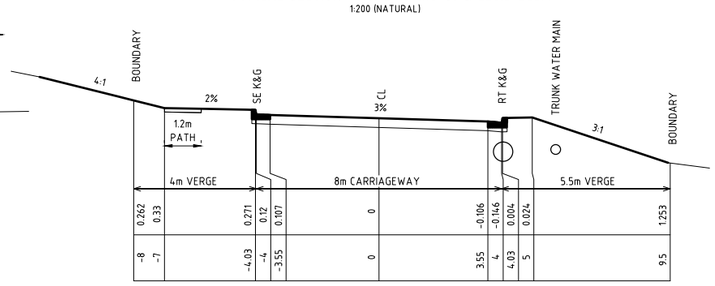

TYPICAL SECTION - ROAD 9 Ch95-305
1:200 (NATURAL)

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*

* Denote the original signature and date when revision was issued.

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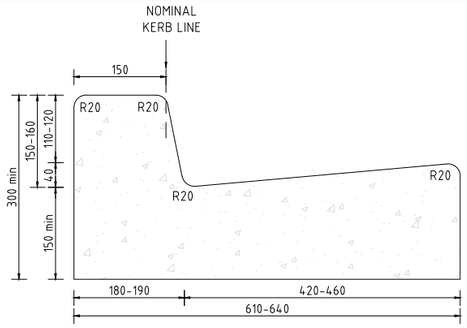
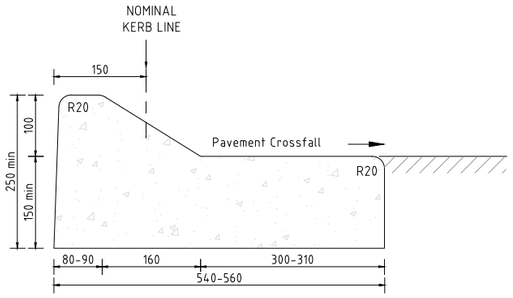
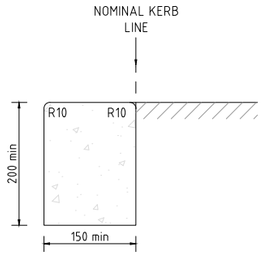
SCALE : AS SHOWN
SHEET No. :11
JOB No. : 2174.16
FILE : 21800047
DATE : Plotted 4/8/20 11:21AM
SHEET SIZE A3
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg



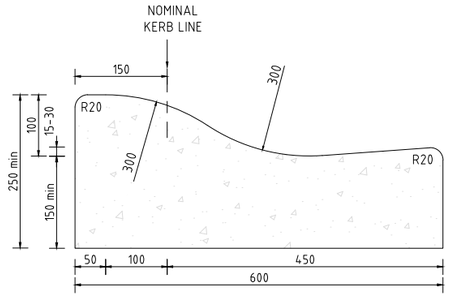
SA - KERB AND GUTTER
ALL DETAILS PER MCC ST0107



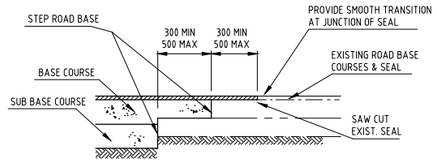
SE MOUNTABLE KERB & GUTTER
ALL DETAILS PER MCC ST0107



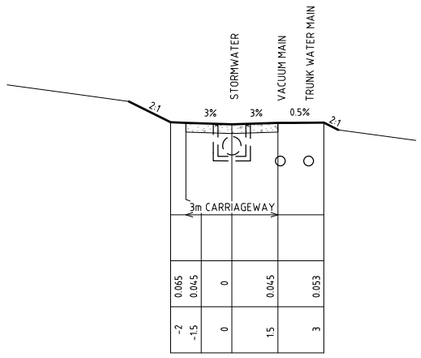
EDGE STRIP
ALL DETAILS PER MCC ST0107



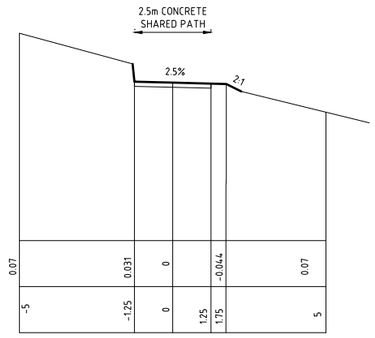
RT - ROLL TOP KERB AND GUTTER
ALL DETAILS PER MCC ST0107



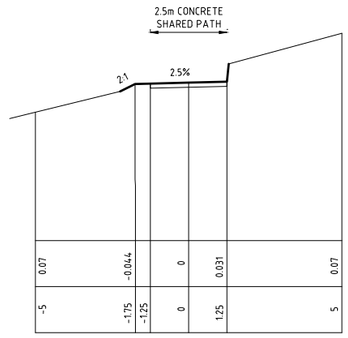
KEY JOINT DETAIL BETWEEN
NEW & EXISTING PAVEMENT
NOT TO SCALE



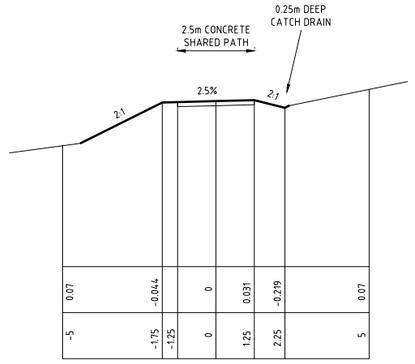
TYPICAL SECTION - PRECINCT 2-5 SERVICE ROAD (ROAD 14)
1:200 (NATURAL)



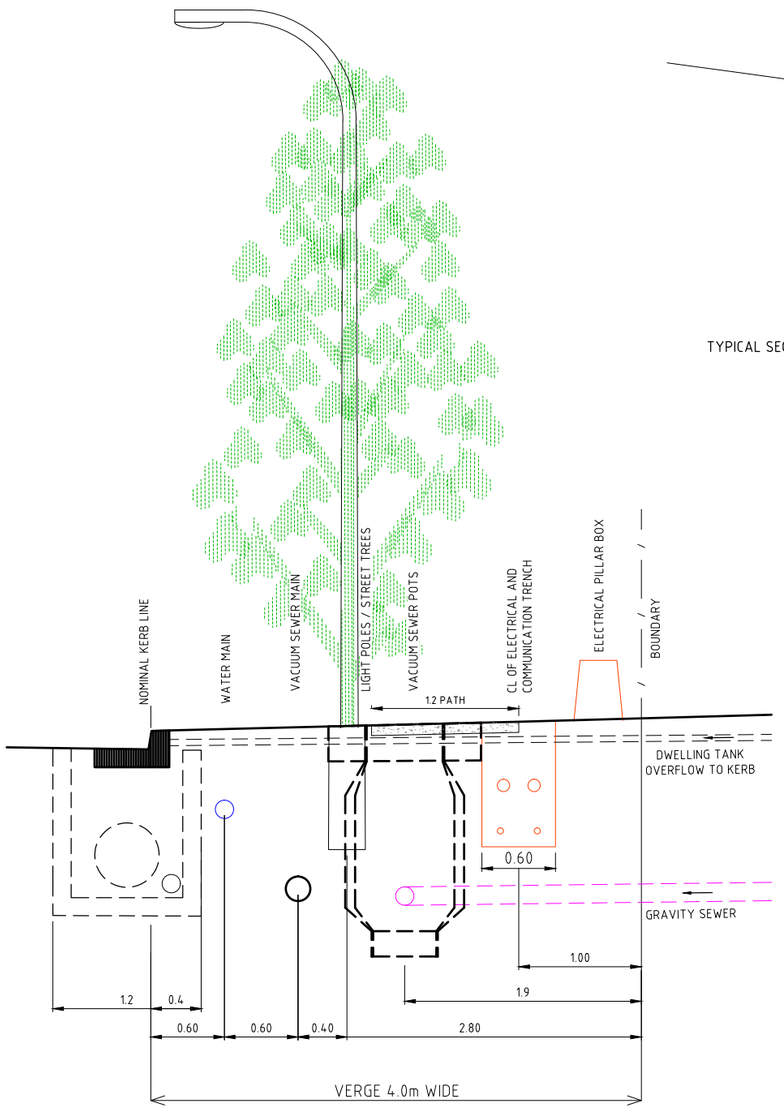
E2 SHARED PATHWAY (UPPER)
1:200 (NATURAL)



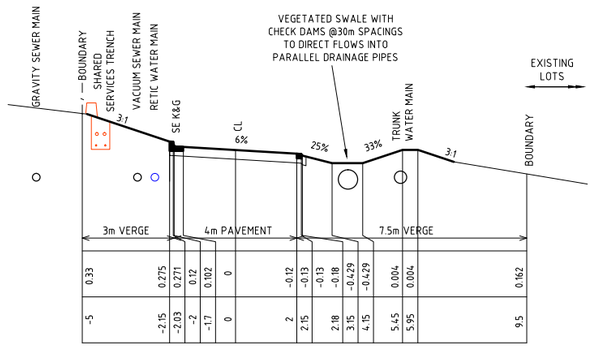
E2 SHARED PATHWAY (LOWER) - Ch 0-120
1:200 (NATURAL)



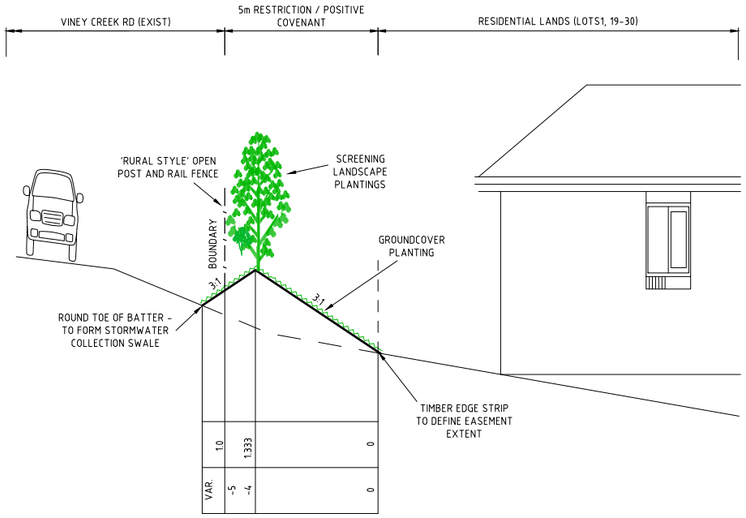
E2 SHARED PATHWAY (LOWER) - Ch 120-980
1:200 (NATURAL)



TYPICAL FOOTPATH ALLOCATION
1:50 (NATURAL)



TYPICAL SECTION - FIRE TRAIL
1:200 (NATURAL)



VINEY CREEK RD 5m LANDSCAPE EASEMENT
1:200(V) 1:100(H)

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*
*	Denote the original signature and date when revision was issued.					

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SCALE : AS SHOWN	SHEET No. :12	FILE : 21800048	SHEET SIZE A3
	JOB No. : 217416	DATE : Plotted 6/8/20 9:22AM	

COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg

ROAD 2
ROAD 3
ROAD 9
ELECTRICAL KIOSK
VARIABLE BATTER (1:6 TO 1:4)
CONCRETE SEDIMENT FOREBAY - SEE DETAIL SHEET 21
2.5m CONCRETE SHARED PATHWAY
1.2m HIGH ROCK WALL
PROPOSED BIOFILTER
BASE LEVEL = 48.1-48.2m AHD
STORAGE DEPTH = 0.3-0.4m
FILTER DEPTH = 0.4m
RIPRAP ENERGY DISSIPATOR
CONCRETE MAINTENANCE RAMP 3m WIDE, 1:6 MAXIMUM GRADE
HIGH FLOW BYPASS
1:4 BATTER
1:6 BATTER
PROPOSED "BASIN 1"
BASE LEVEL = 45.5-46.0m AHD
TPWL = 46.5m AHD
VOLUME AT TPWL = 710cu.m
SPILLWAY = 47.9m AHD
TEMP. STORAGE VOLUME= 4900cu.m
75mmØ LOW FLOW ORIFICE @46.5m AHD.
GRATED SECOND STAGE DISCHARGE @46.9m AHD.
SEE SHEET 21 FOR DETAILS
TPWL
0.9m HIGH ROCK WALL
SPILLWAY 47.9m AHD 10.0
TOP WALL 48.4m AHD
2x750mmØ RCP HIGH FLOW OUTLET PIPES
U/S INV=47.2m AHD
D/S INV = 45.5m AHD
FUTURE TRUNK WATERMAIN
PROPOSED VACUUM SEWER
PUBLIC RESERVE
RELOCATE EXISTING FENCE ONTO PROPERTY BOUNDARY
53
55
56
54
51
49
48
A
B

PRECINCT 1 BASIN DETAIL PLAN

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*
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SCALE : (1:500 for A3 Size Plot)
SHEET No. :19
FILE : 21800055
JOB No. : 217416
DATE : Plotted 4/8/20 11:22AM
SHEET SIZE A3
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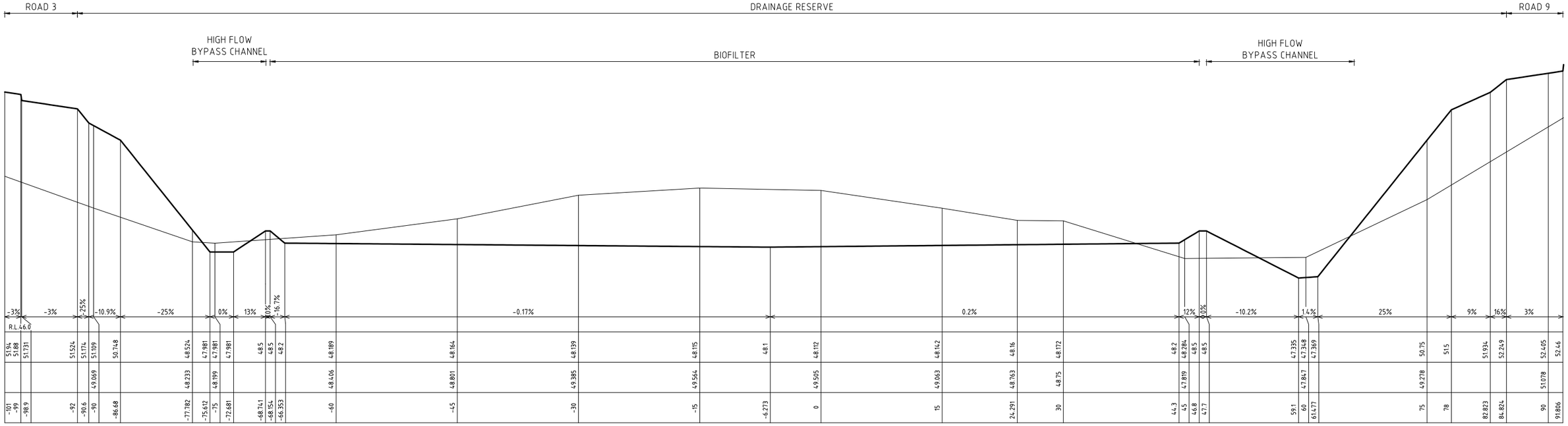
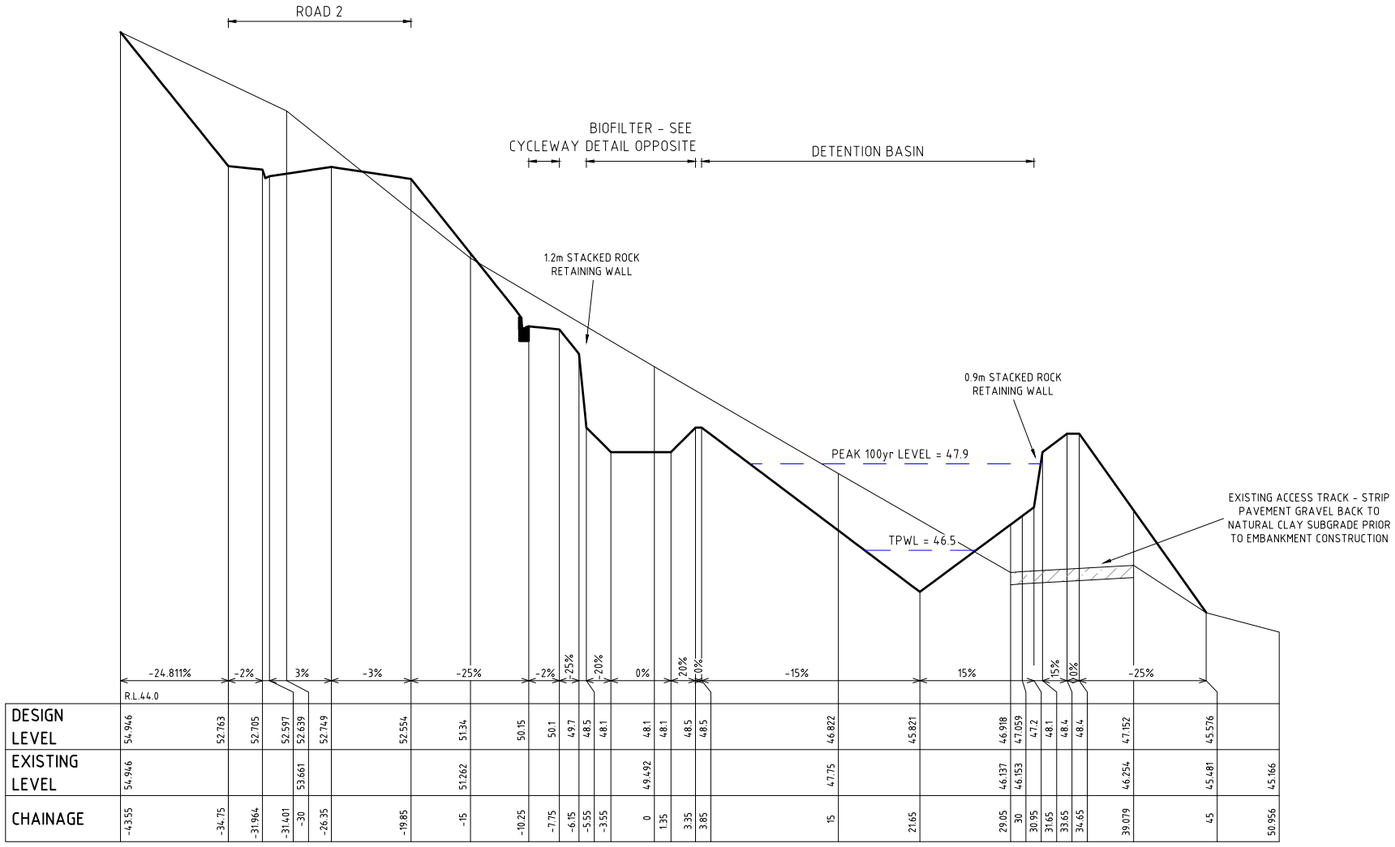


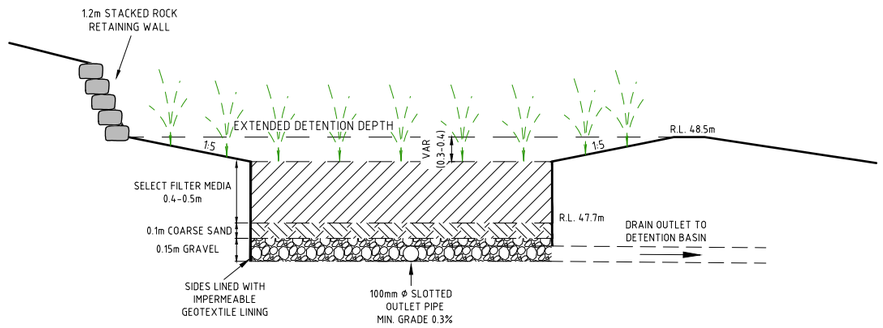
BASIN 1 SECTION A-A

H=1:500 V=1:100



BASIN 1 SECTION B-B

H=1:500 V=1:100



BIO-FILTER DETAIL

SCALE 1:40

PRECINCT 1 BASIN SECTIONS

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*

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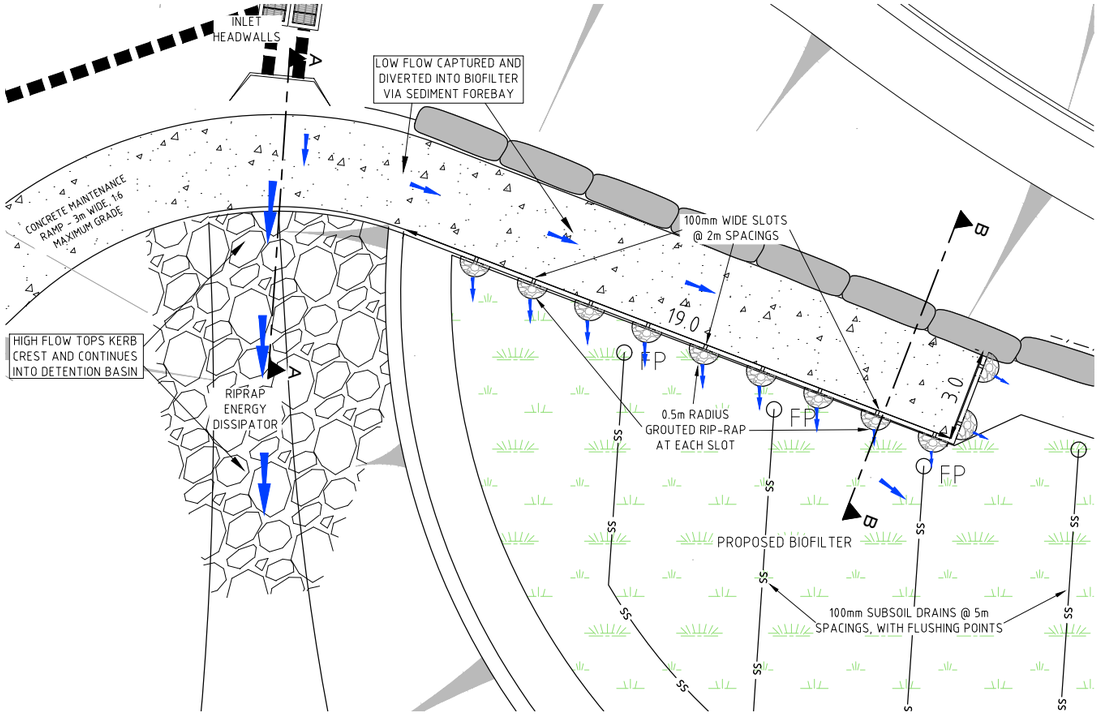
DEVELOPMENT CONSULTANTS

SCALE : AS SHOWN	SHEET No. :20	FILE : 21800056	SHEET SIZE A3
	JOB No. : 217416	DATE : Plotted 4/8/20 11:22AM	

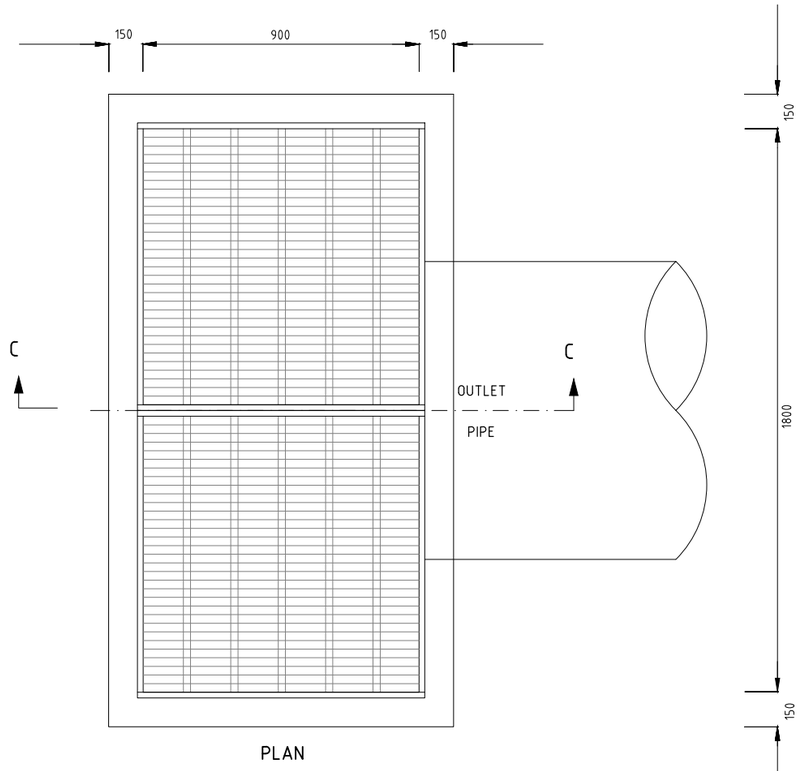
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg



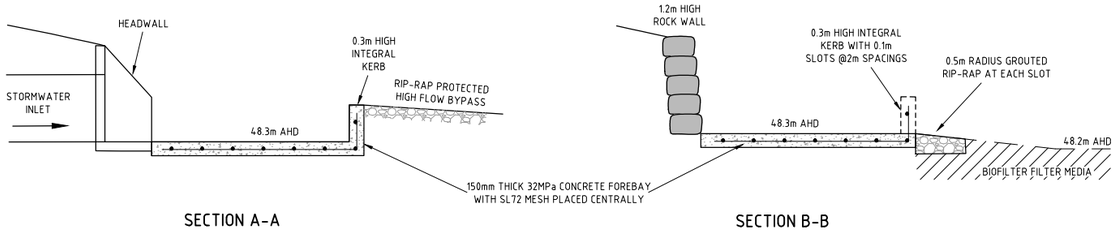
BASIN OUTLET STRUCTURE

NOT TO SCALE

ADOPTED FROM LAKE MACQUARIE CITY COUNCIL STANDARD EGSD-422



PLAN

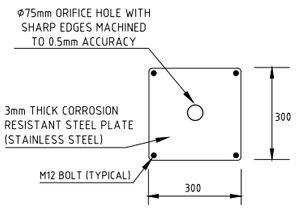


SECTION A-A

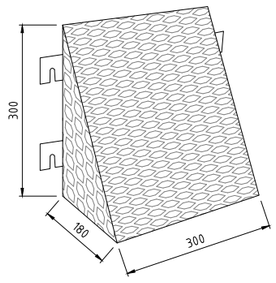
NOT TO SCALE

SECTION B-B

NOT TO SCALE



ORIFICE PLATE DETAILS

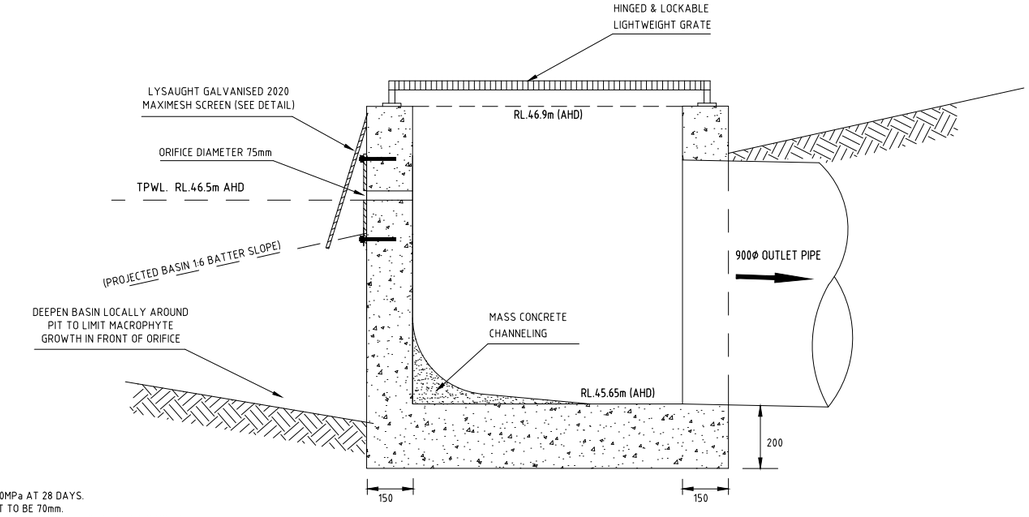


TYPICAL MAXIMESH SCREEN DETAIL

NOT TO SCALE

CONCRETE AND STEEL NOTES

1. COMPRESSIVE STRENGTH OF CONCRETE TO BE F'c 40MPa AT 28 DAYS.
2. MINIMUM COVER OF CONCRETE OVER REINFORCEMENT TO BE 70mm.
3. MAXIMESH SCREEN MUST BE PLACED SO THAT THE LONG AXIS OF THE OVAL SHAPED HOLES ARE HORIZONTAL WITH THE PROTRUDING LIP ANGLED UPWARDS & FACING DOWNSTREAM.
4. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS SPECIFIED OTHERWISE
5. ALL STEEL WORK TO BE HOT - DIPPED GALVANIZED AFTER FABRICATION.
6. ALL BOLTS/ANCHORS SET IN CONCRETE SHALL BE STAINLESS STEEL.
7. ALL WELDS TO BE 6mm FILLETS UNLESS SPECIFIED OTHERWISE.
8. MINIMUM BOLT SIZE TO BE M16.
9. MINIMUM THICKNESS OF CONCRETE WALLS TO BE 150mm.
10. ALL INTERNAL SURFACES TO BE STEEL FLOAT FINISH.



SECTION C-C

MODIFIED RM11A GRATED SURFACE INLET PIT BASIN OUTLET STRUCTURE

NOT TO SCALE

(ALL OTHER DETAILS PER RM.11 TYPE A)

PRECINCT 1 BASIN DETAILS

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*
*	Denote the original signature and date when revision was issued.					

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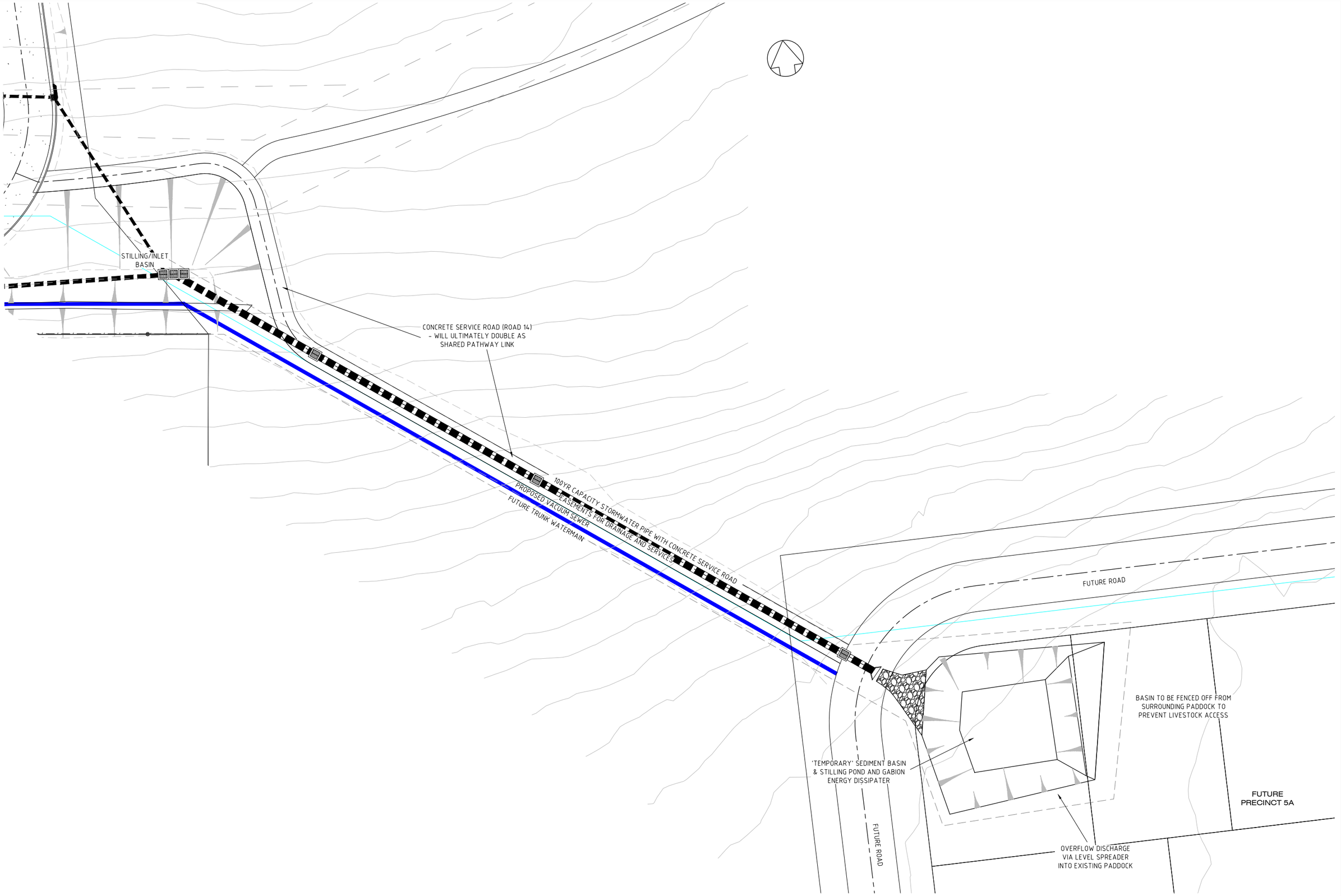
DEVELOPMENT CONSULTANTS

SCALE : AS SHOWN	SHEET No. :21	FILE : 21800057	SHEET SIZE A3
	JOB No. : 217416	DATE : Plotted 4/8/20 11:23AM	

COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg



PRECINCT 2 BASIN DETAIL PLAN

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*
*	Denote the original signature and date when revision was issued.					

TATTERSALL LANDER Pty Ltd
DEVELOPMENT CONSULTANTS

SCALE : 0 10 20m (1:1000 for A3 Size Plot)
SHEET No. :22
JOB No. : 217416
FILE : 21800058
DATE : Plotted 4/8/20 11:27AM
SHEET SIZE A3
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg

FUTURE
PRECINCT 4

ROAD 13

55540
57040
58540
60040
61540
63040
64540
65040.12
66040
67540
69040
70311.4
71618.3
1440.42
1455+0

VAR. BATTER
(1:6 TO 1:4)

100mmΦ LOW FLOW ORIFICE @7.4m AHD,
3x900mmΦ HIGH FLOW PIPES
U/S INV 7.7m AHD, D/S INV 7.3m AHD

1425+0
1410+0
1395+0
1380+0
1365+0
1350+0

ROAD 2

PROPOSED "BASIN 3"
BASE LEVEL = 6.8m AHD
TPWL = 7.4m AHD
VOLUME AT TPWL = 2150cu.m
MAX LEVEL = 9.0m AHD
TEMP STORAGE VOLUME = 8,850cu.m

TPWL

VAR. BATTER
(1:10 TO 1:6)

VAR. BATTER
(1:10 TO 1:4)

A
A
B
B

PRECINCT 3 BASIN DETAIL PLAN

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*
*	Denote the original signature and date when revision was issued.					

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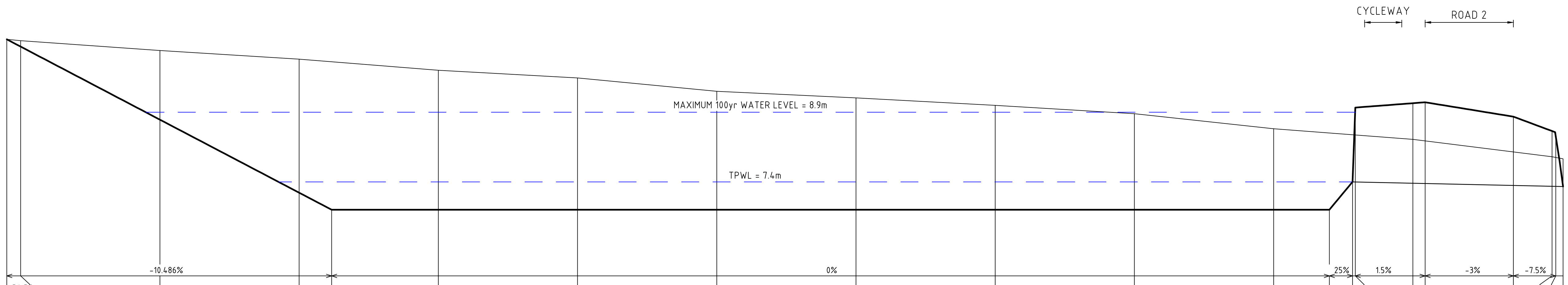
SCALE : 0 5 10m
(1:500for A3 Size Plot)

SHEET No. :23
JOB No. : 217416

FILE : 21800059
DATE : Plotted 4/8/20 11:27AM

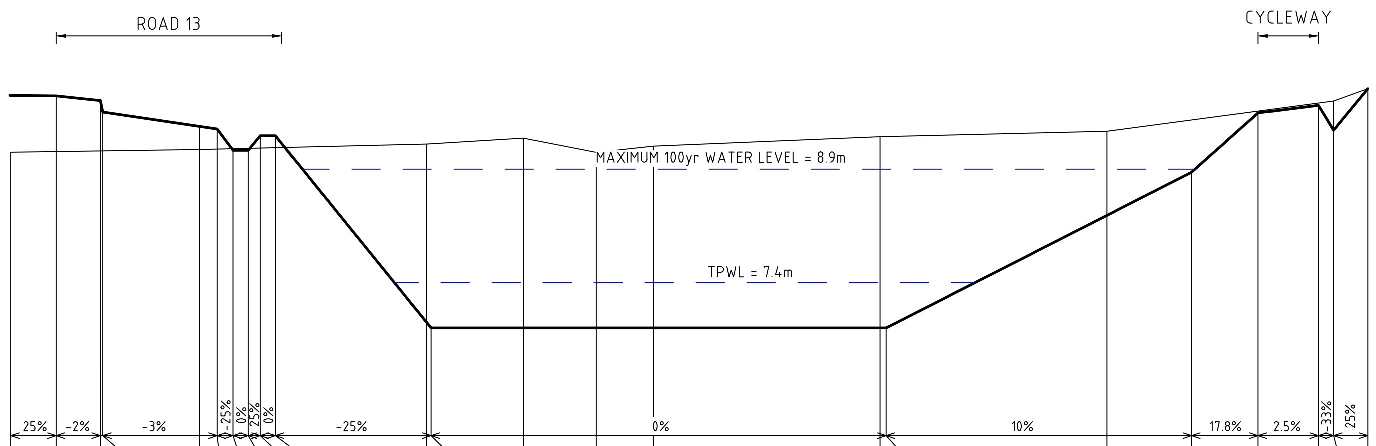
SHEET SIZE A3

COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg



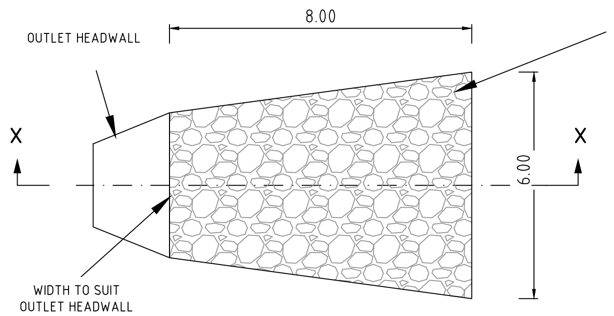
DESIGN LEVEL	10.47	10.313	8.74	7.167	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	7.401	9	9.094	9.114	8.805	8.494	8.464	7.3
EXISTING LEVEL	10.47	10.44	10.228	10.043		9.803	9.639	9.351	9.209	9.049	8.868	8.545				8.316			7.94		7.897
CHAINAGE	-91.5	-90	-75	-60	-56.5	-45	-30	-15	0	15	30	45	51	53.5	53.8	60	61.319	70.824	75	75.402	76.178

BASIN 3 SECTION A-A
H=1:500 V=1:100

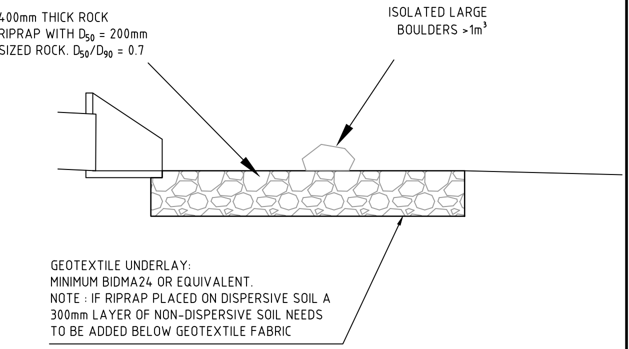


DESIGN LEVEL	9.125	9.87	9.808	9.657	9.466	9.432	9.15	9.15	9.342	9.342	6.874	6.8	6.8	6.8	6.8	6.8	6.8	8.289	8.86	9.644	9.744	9.415	9.966
EXISTING LEVEL	9.125				9.16						9.233		9.311	9.122	9.205	9.331		9.402				9.803	9.966
CHAINAGE	-42.5	-39.5	-36.579	-36.416	-30	-28.85	-27.8	-26.8	-26	-25	-15	-14.7	-8.598	-3.776	0	15	15.402	30	35.6	40	44	45	47.263

BASIN 3 SECTION B-B
H=1:500 V=1:100



PLAN



SECTION X-X

RIP RAP ENERGY DISSIPATION STRUCTURES

NOT TO SCALE

PRECINCT 3 BASIN DETAILS

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
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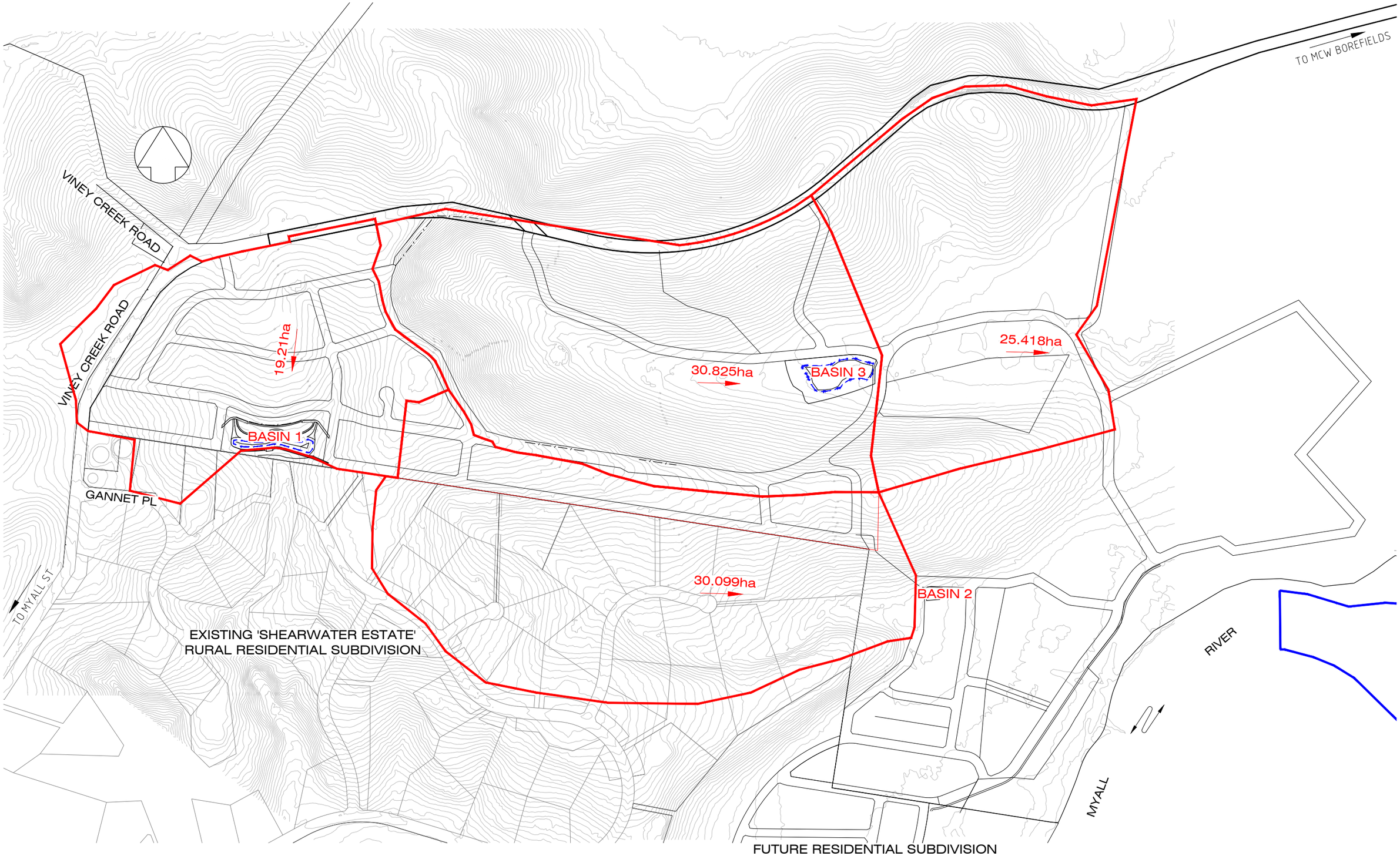
SCALE : AS SHOWN	SHEET No. :24	FILE : 21800060	SHEET SIZE A3
	JOB No. : 217416	DATE : Plotted 4/8/20 11:27AM	
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg			



REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
B	Revised per Council & RFS Comments	AV	AV	CG*	BL*	4/8/20*
A	Original Issue	AV	AV	CG*	BL*	18/4/18*

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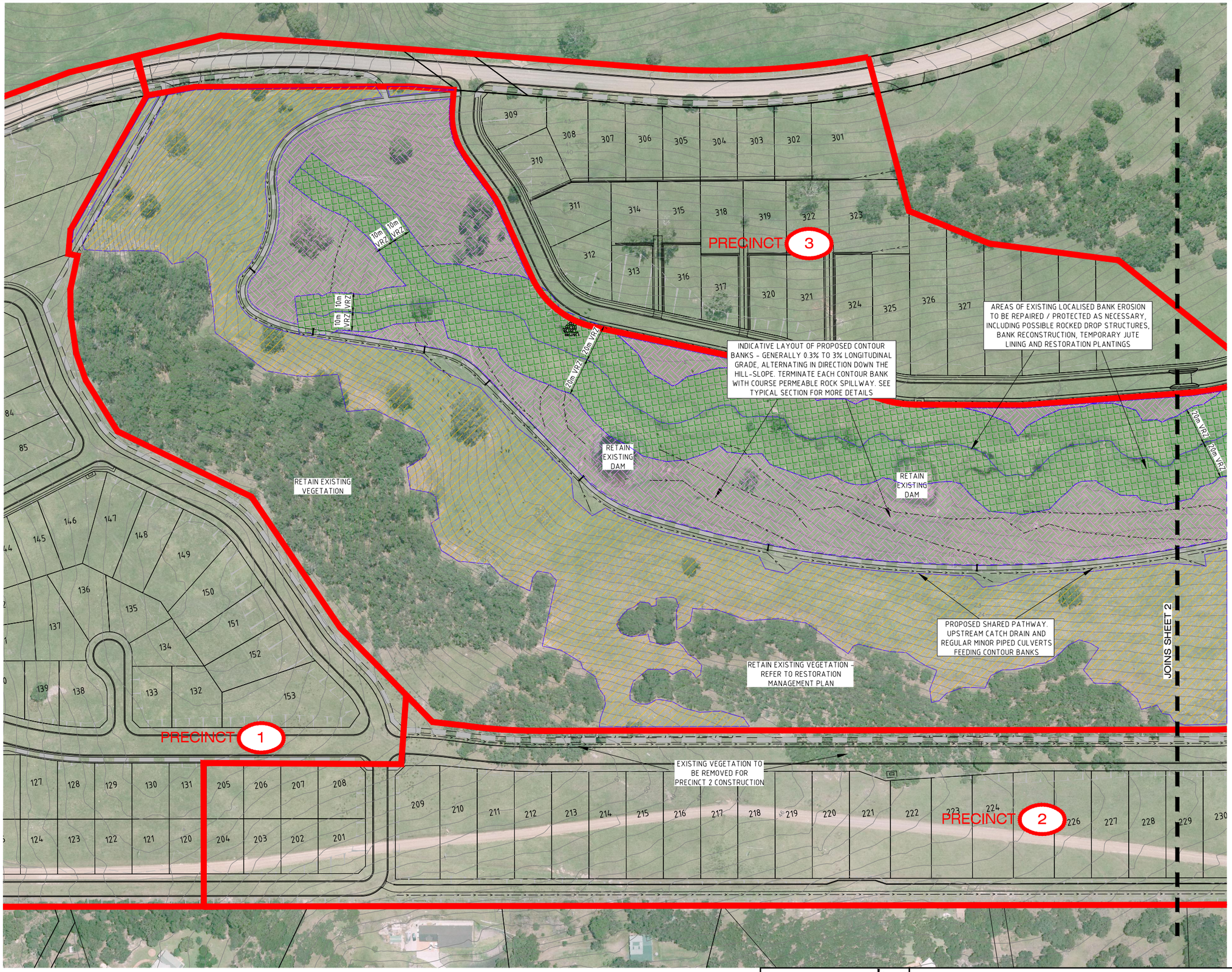
SCALE : 1:6000 on A3	SHEET No. :25	FILE : 21800061	SHEET SIZE A3
	JOB No. : 217416	DATE : Plotted 4/8/20 11:28AM	

COMPUTER FILE : S:\projects\North Shearwater\Dwg\Precinct1-3 DA Design Plans.dwg

APPENDIX B: PROPOSED E2 LANDS REHABILITATION PLANS



LEGEND	
REHABILITATION AREA TYPE 1	
REHABILITATION AREA TYPE 2	
REHABILITATION AREA TYPE 3	

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
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A	Original Issue	AV	AV	BF*	BL*	18/4/18*

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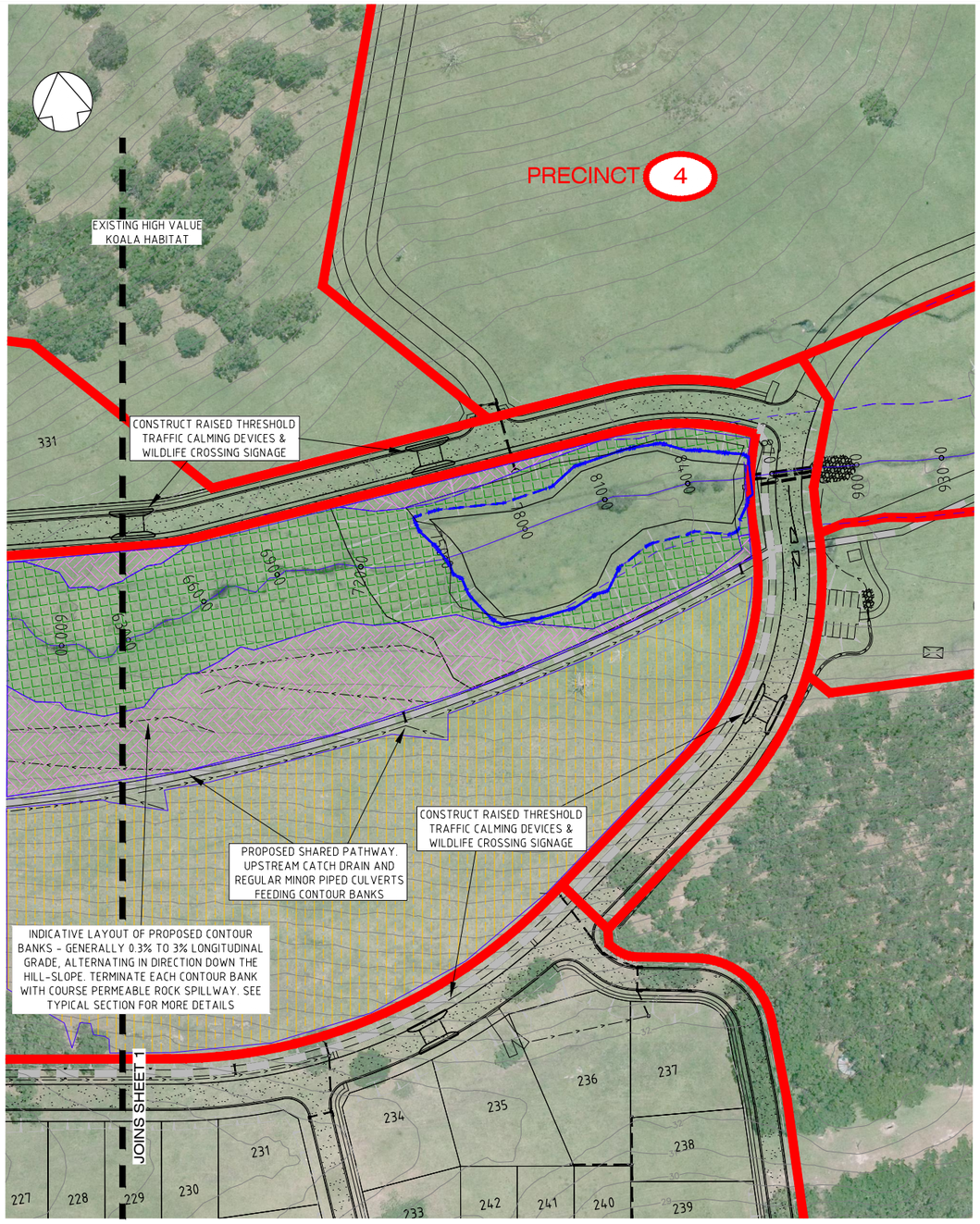
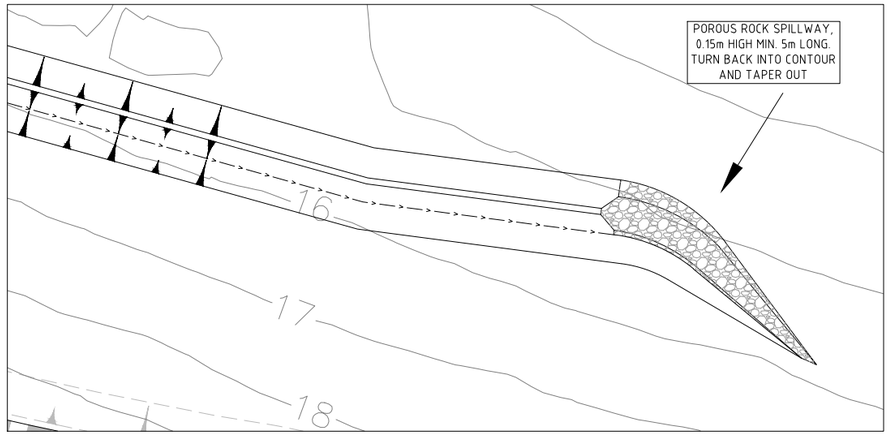
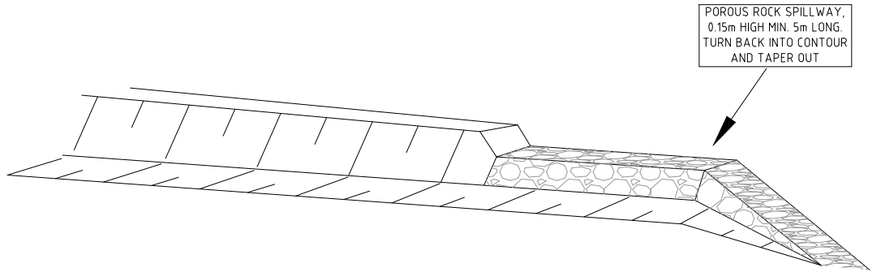
PRECINCT 3 RIPARIAN CORRIDOR REHABILITATION PLAN PHYSICAL WORKS SHEET 1 DURNESS STATION VINEY CREEK RD, TEA GARDENS

COUNCIL: MIDCOAST	REFERENCE: 21800076
PARISH:	SHEET SIZE: A3
SCALE: 1:2000 on A3	SHEET No.: 1 OF 3
DATE : Plotted 13:10 30/07/18	
CLIENT: WOLIN INVESTMENTS	JOB No.: 205532
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Restoration Plans.dwg	

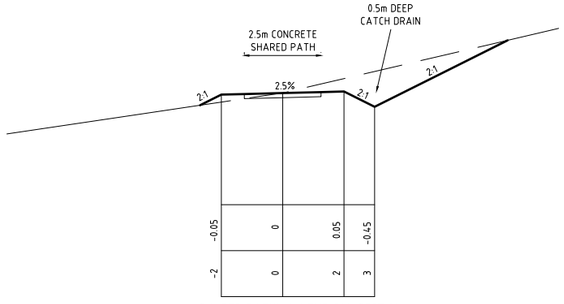




CONTOUR BANK LEVEL SPREADER TYPICAL DETAIL
1:500

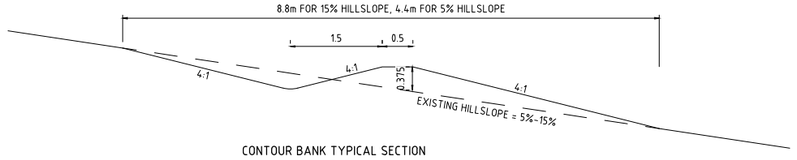


NOTES:
1. BUILD WITH TYPICAL GRADIENTS OF 0.3%-1%
2. AVOID REMOVING EXISTING TREES AND SHRUBS WHERE POSSIBLE
3. PROVIDE 'ROUND' BASE, RATHER THAN SHARP V-SHAPE
4. ENSURE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE
5. SEED IN ACCORDANCE WITH THE 'BLUE BOOK' TO PROVIDE INITIAL SCOUR PROTECTION WHILE REGENERATION PROCEEDS

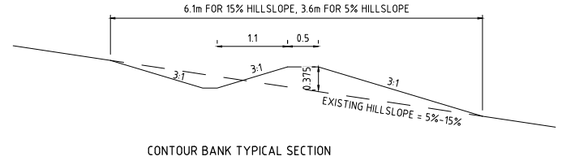


SHARED PATHWAY TYPICAL SECTION
1:50 (NATURAL)

LEGEND	
REHABILITATION AREA TYPE 1	
REHABILITATION AREA TYPE 2	
REHABILITATION AREA TYPE 3	



CONTOUR BANK TYPICAL SECTION
1:50 (NATURAL)



CONTOUR BANK TYPICAL SECTION
1:50 (NATURAL)

REV	DETAILS OF AMENDMENT	DESIGNED	DRAWN	CHECKED	APPROVED	DATE
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PRECINCT 3 RIPARIAN CORRIDOR REHABILITATION PLAN
PHYSICAL WORKS SHEET 2
DURNESS STATION
VINEY CREEK RD, TEA GARDENS

COUNCIL: MIDCOAST	REFERENCE: 21800077
PARISH	SHEET SIZE: A3
SCALE: 1:2000 on A3	SHEET No.: 2 OF 3
DATE : Plotted 13:10 30/07/18	
CLIENT: WOLIN INVESTMENTS	JOB No.: 205532
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Restoration Plans.dwg	

LEGEND	
REHABILITATION AREA TYPE 1	
REHABILITATION AREA TYPE 2	
REHABILITATION AREA TYPE 3	

PLANTING SCHEDULE AREA TYPE 1 - 5.38ha	
UPPER STRATUM	
SPECIES	DENSITY/ha
Corymbia maculata (Spotted Gum)	30
Eucalyptus siderophloia (Grey Ironbark)	50
Eucalyptus canaliculata (Grey Gum)	50
Eucalyptus tereticornis (Forest Red Gum)	60
Corymbia gummifera (Red Bloodwood)	25
Stratum Subtotal	215
MIDDLE STRATUM	
SPECIES	DENSITY/ha
Acacai myrtifolia (Myrtle Wattle)	20
Acacia ulicifolia (Prickly Moses)	20
Pultenaea retusa (Notched Bush-pea)	25
Pultenaea villosa (Hairy Bush-pea)	35
Xanthorrhoea macronema	20
Macrozamia communis (Burrawang)	10
Hibbertia diffusa (Wedge Guinea Flower)	20
Hibbertia linearis	30
Leucopogon juniperinus (Prickly Beard-heath)	30
Stratum Subtotal	210
PROSTRATE (LOWER) STRATUM	
SPECIES	DENSITY/ha
Dianella caerulea var. producta	100
Imperata cylindrica (Blady Grass)	100
Lomandra filiformis (Wattle Mat-rush)	80
Lomandra longifolia (Spiney-headed Mat-rush)	20
Lomandra multiflora (Many-flowered Mat-rush)	40
Stratum Subtotal	340
Total density =	765
TOTAL PLANTINGS = 4115	

PLANTING SCHEDULE AREA TYPE 2 - 2.97ha	
UPPER STRATUM	
SPECIES	DENSITY/ha
Corymbia maculata (Spotted Gum)	15
Eucalyptus siderophloia (Grey Ironbark)	30
Eucalyptus canaliculata (Grey Gum)	20
Eucalyptus tereticornis (Forest Red Gum)	40
Eucalyptus robusta (Swamp Mahogany)	40
Eucalyptus acmenoides (White Mahogany)	20
Corymbia gummifera (Red Bloodwood)	25
Angophora costata (Sydney Reg-gum	20
Stratum Subtotal	210
MIDDLE STRATUM	
SPECIES	DENSITY/ha
Acacai myrtifolia (Myrtle Wattle)	20
Acacia ulicifolia (Prickly Moses)	25
Pultenaea retusa (Notched Bush-pea)	30
Pultenaea villosa (Hairy Bush-pea)	20
Glochidion ferdinandi (Cheese tree)	20
Leucopogon juniperinus (Prickly Beard-heath)	20
Macrozamia communis (Burrawang)	10
Hibbertia diffusa (Wedge Guinea Flower)	10
Hibbertia linearis	30
Callistemon salignus (willow Bottlebrush)	20
Callistemon rigidus (Stiff Bottlebrush)	20
Stratum Subtotal	225
PROSTRATE (LOWER) STRATUM	
SPECIES	DENSITY/ha
Dianella caerulea var. producta	50
Imperata cylindrica (Blady Grass)	40
Lomandra filiformis (Wattle Mat-rush)	80
Lomandra longifolia (Spiney-headed Mat-rush)	30
Lomandra multiflora (Many-flowered Mat-rush)	30
Poa labillardierei (Tussock Grass)	30
Stratum Subtotal	260
Total density =	695
TOTAL PLANTINGS = 2065	

PLANTING SCHEDULE AREA TYPE 3 - 2.83ha	
UPPER STRATUM	
SPECIES	DENSITY/ha
Archontophoenix cunninghamiana (Bangalow Palm)	15
Eucalyptus siderophloia (Grey Ironbark)	30
Eucalyptus canaliculata (Grey Gum)	20
Eucalyptus microcorys (Tallowwood)	40
Eucalyptus robusta (Swamp Mahogany)	40
Eucalyptus acmenoides (White Mahogany)	20
Corymbia gummifera (Red Bloodwood)	25
Angophora costata (Sydney Reg-gum)	20
STRATUM SUBTOTAL	210
MIDDLE STRATUM	
SPECIES	DENSITY/ha
Acacai myrtifolia (Myrtle Wattle)	20
Acacia ulicifolia (Prickly Moses)	25
Pultenaea retusa (Notched Bush-pea)	30
Glochidion ferdinandi (Cheese tree)	20
Macrozamia communis (Burrawang)	20
Hibbertia linearis	30
Callistemon salignus (willow Bottlebrush)	20
Callistemon rigidus (Stiff Bottlebrush)	20
Stratum Subtotal	185
PROSTRATE (LOWER) STRATUM	
SPECIES	DENSITY/ha
Gahnia sieberiana (Red-fruit saw sedge)	50
Lomandra longifolia (Spiney-headed Mat-rush)	30
Lomandra multiflora (Many-flowered Mat-rush)	30
Poa labillardierei (Tussock Grass)	30
Stratum Subtotal	140
Total density =	535
TOTAL PLANTINGS = 1520	

NOTES

- PLANTS MAY BE TUBE STOCK OR LARGER, DEPENDING UPON AVAILABILITY.

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PLANTING SCHEDULE

VINEY CREEK RD, TEA GARDENS

COUNCIL: MIDCOAST	REFERENCE: 21800078
PARISH	SHEET SIZE: A3
SCALE: 1:2000 on A3	SHEET No.: 3 OF 3
DATE : Plotted 13:10 30/07/18	
CLIENT: WOLIN INVESTMENTS	JOB No.: 205532
COMPUTER FILE : S:\projects\North Shearwater\Dwg\Restoration Plans.dwg	

APPENDIX C: BIOFILTER MAINTENANCE TASKS

A. Filter Media Tasks

Sediment Deposition	Remove sediment build up from the surface of bioretention swales Frequency – 3 monthly after rain
Holes or scour	Infill any holes in the filter media. Check for erosion or scour and repair, provide energy dissipation (rocks & pebbles etc) if necessary Frequency – 3 monthly after rain
Filter media surface porosity	Inspect for the accumulation of an impermeable layer (such as oily or clayey sediment) that may have formed on the surface of the filter media. A symptom may be that water remains ponded in the swale for more than a few hours after a rain event. Repair minor accumulations by raking away any mulch on the surface and scarifying the surface of the filter media between plants Frequency – 3 monthly after rain
Litter Control	Check for litter (including organic litter) in and around bioretention swales. Remove both organic and anthropogenic litter to ensure flow paths and infiltration through the filter media are not hindered. Frequency – 3 monthly after rain

B. Horticultural Tasks

Pests and Diseases	Assess plants for disease, pest infection, stunted growth or senescent plants. Treat or replace as necessary. Reduced plant density reduces pollutant removal and infiltration performance Frequency – 3 monthly after rain
Maintain original plant densities	Inspect condition of all plants. Replace and dead plants immediately to maintain a minimum density of 4 plants per square metre Frequency – 3 monthly after rain
Drought / Extreme Heat	In periods of prolonged drought or extreme heat, the condition of plantings and site lawn coverage should to be monitored for signs of stress. Watering may be required to ensure plant survival Frequency – As required

Weeds	It is important to identify the presence of any rapidly spreading weeds as they occur. The presence of such weeds can reduce dominate species distributions and diminish aesthetics. Weed species can also compromise the systems long term performance. Inspect for and manually remove weed species. Application of herbicide should be limited to a wand or restrictive spot spraying due to the fact that the swales are directly connected to the stormwater system Frequency – 3 monthly after rain
Grassed buffer strip	Grassed buffer strips treat runoff as it flows off the roads, before it enters the bioretention swales. Maintaining a healthy grass cover is important, but the use of fertilisers should be kept to a minimum given their proximity to the drainage network
Lawn Fertiliser	Healthy site grass coverage is important for pollutant treatment, topsoil erosion control and aesthetics. However, if not correctly used, fertilisers can damage the downstream environment. A low Phosphorus fertiliser with restricted leaching properties such as a Fused Calcium Magnesium Phosphate or TNN Industries 'Formula 1', or equivalent is ideal. The application of fertiliser should be restricted to a maximum of twice a year

C. Drainage Tasks

Perforated Pipe	Ensure that perforated pipes are not blocked to prevent filter media and plants from becoming waterlogged. A small steady clear flow of water may be observed discharging from the perforated pipe at its connection into the downstream pit some hours after rainfall. Note that smaller rainfall events after dry weather may be completely absorbed by the filter media and not result in flow. Remote camera (eg CCTV) inspection of pipelines for blockage and structural integrity could be useful. Flushing of lines from the flushing points may be required. Frequency – 6 monthly after rain
High flow inlet pits, overflow pits and other stormwater junction pits	Ensure inflow areas and grates over pits are clear of litter and debris and in good and safe condition. A blocked grate would cause nuisance flooding of adjoining areas. Inspect for dislodged or damaged pit covers and ensure general structural integrity. Remove sediment from pits and entry sites (likely to be an irregular occurrence in mature catchment). Frequency – monthly and occasionally after rain