XAVIER
KNIGHT

26rd October 2023

Lot 2 Phillip Drive, South West Rocks
Stage 2 and 3 Stormwater Drainage Concept Design

This letter has been prepared by Xavier Knight on behalf of Rise Projects to support the Concept Development Application (DA) of Stages 2 and 3 for the development at Lot 2 Phillip Drive, South West Rocks.

Stage 1 of the development has been approved under DA2200404, dated 15 August 2023 and consisted of private road works, multi-dwelling houses and a commercial building. Refer to Appendix C for the Stage 1 approved engineering report and drawings.

This concept DA involves the Masterplan of Stages 2 and 3 of the development which includes:

- Stage 2: Four Residential Flat Buildings of a maximum height of 5 storeys.
- Stage 3: Five buildings of a mix of Residential, Serviced Apartments, shops and food and drink premises of a maximum of 6 storeys.

This letter presents an overview of the concept stormwater and water quality works for Stages 2 and 3 masterplan and takes into account the engineering design philosophy prepared for Stage 1 and approved under DA2200404.
After approval of this Concept DA, separate detailed DAs will be prepared for Stages 2 and 3 that will describe in more detail the engineering design of storm drainage, water quality and civil works.

Refer to Appendix A for the site and staging plans.

- **Stage 2 and 3 Stormwater Drainage.**

The Stage 2 stormwater drainage and Water Sensitive Urban Design (WSUD) has previously been considered in the approved Stage 1 DA2200404 and stub lines from the proposed pits in the Road MC01 have been provided to the stage 2 buildings as presented in Appendix C, Drawings C040 and C041.
The Stage 1 design had the stormwater drainage lines discharge into WSUD devices (two bioretention basins and an infiltration swale) running adjacent to proposed Road MC01.

As part of the stage 3 development, the site area north of Road MC01 will be developed, therefore, the bioretention basins and infiltration trench will be relocated and expanded to accommodate the new development.
The piped drainage from Stage 1 and 2 will be extended to drain into the relocated basins while new stormwater drainage piping will be proposed as part of the Stage 3 detailed design to drain into the WSUD devices. Refer to Appendix B for concept storm drainage and water quality design.

- **Groundwater and Basements**
"Final Groundwater Monitoring Report" has been prepared by Aquatic Science and Management (Dated May 2023) and detailed the performance of 8 groundwater monitoring bores and groundwater level and quality assessments. The locations and summary statistics of these groundwater wells are shown below:

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Figure 1 Groundwater well locations in relation to property boundary (*Aquatic Science and Management*)

Table 1 Summary statistics from logged groundwater levels (*Aquatic Science and Management*)

Site	*Position (East)*	*Position (North)*	*Elevation (Ground, mAHD)*	*Average Level (mAHD)*	*Median Level (mAHD)*	*Max Level (mAHD)*	*Range (m)*
GW1	505570	6582508	2.79	2.02	1.93	2.92	1.24
GW2	505587	6582471	3.76	2.59	2.47	3.66	1.53
GW3	505642	6582420	5.52	3.80	3.76	4.42	0.77*
GW4	505686	6582518	1.98	1.83	1.77	2.29	0.77
GW5	505792	6582515	1.75	1.10	1.05	1.78	1.01
GW6	505795	6582445	4.55	3.06	3.03	3.67	1.05
GW7	505786	6582400	6.27	3.89	3.79	4.43	0.76*
GW8	505873	6582438	5.23	3.17	3.09	3.71	0.88

*** Not likely to represent total range, piezometer dry at lower levels**

The proposed stage 2 and 3 developments are both proposed with basement carparking at an elevation of FFL 3.0mAHD.

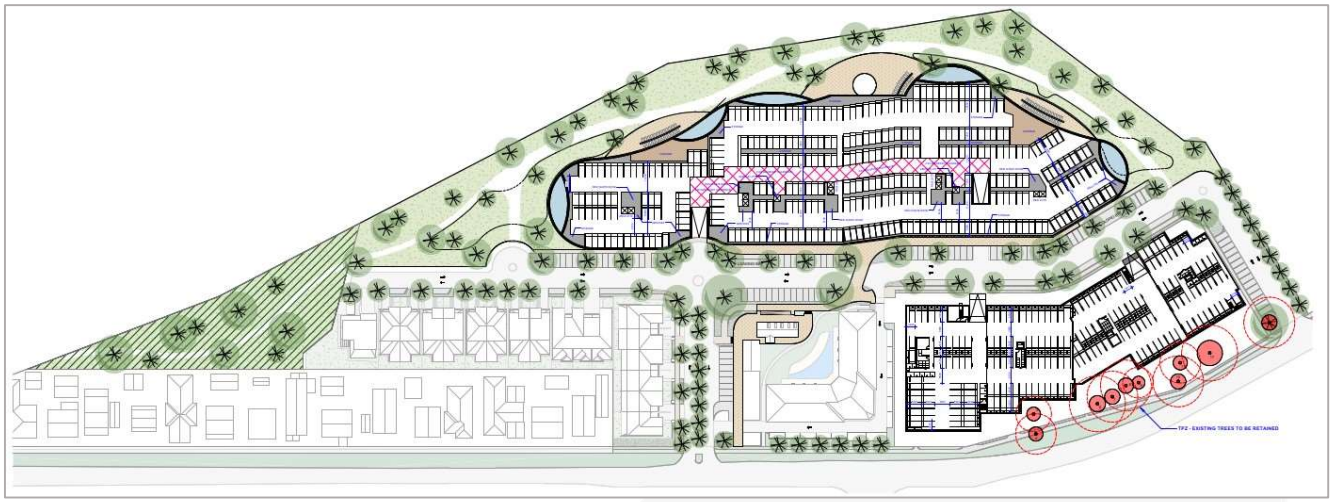


Figure 2 Stage 2 and 3 Basement Plan

The Stage 2 basement is monitored by the GW6, GW7 and GW8 monitoring wells, which have a median groundwater height of 3.03, 3.79 and 3.09 mAHD respectively. This would indicate that the basement may be intersecting with the groundwater table on the southern side of the stage 2 basement. Further modelling and assessment by a Geotech engineering may be required at the future detailed DA stage.

The stage 3 basement is monitored by the GW4 and GW5 monitoring wells, which have a median groundwater level of 1.77 and 1.05 mAHD respectively and therefore it is not expected that the basement carpark will have adverse effects on groundwater.

- **Infiltration and Groundwater Recharge**

The Stage 1 approved DA design utilised an infiltration trench connected to two bio-retention basins to recharge the groundwater with rainfall falling with the areas of Stages 1 and 2. This system will be expanded to accommodate the additional area from the Stage 3 development.

As highlighted in the Stage 1 DA Engineering Design Report section 4.3.3, the average daily rainfall on the development is 11mm and storage of 30% of the rainfall should be provided to ensure adequate groundwater recharge. Therefore, the total volume of rainfall to be stored in the infiltration trench and bioretention basins is equal to 11mm (average daily rainfall) * 30% (rainfall to be captured) * 5.3Ha (Total site and upstream catchment area) = 175 m^3

A 330m long infiltration trench is proposed along the northern site boundary. Two "Evertrench Small" cells will be utilised and will each be laid in a 0.6m wide trench and a 0.2m gravel bed will be laid under the arches with a void of 20%. The storage volume for a linear metre of an "Evertrench Small" is 0.08m^3 while that for the gravel layer is (0.6*0.2*20%) = 0.024, therefore; the total storage for a linear metre of the two-cell trench is 2*(0.08+0.024) = 0.208 m^3. For a 330m long trench, the storage volume = 68.6m^3. The bottom of the infiltration trench needs to be at least 0.5m above the groundwater level. It should be noted that the existing site will be filled as part of the development and future groundwater levels need to be assessed by a geotechnical engineer as part of the Detailed DA Design.

106.4 m^3 of storage volume is still required to accommodate 30% of the average daily rainfall event. This storage can be provided in the two bio-retention basins design to achieve the water quality targets. The bed areas of bioretention basins 1 and 2 are 200 m^2 and 100 m^2 respectively and both will have an extended detention depth of 0.4m, providing an additional storage area of 120m^3. This combined with the infiltration trench provides a total storage volume of 188.6 m^3 which is adequate to store the average daily rainfall.

A grassed swale is proposed over infiltration trench to handle larger flows. This approach is similar to the neighbouring "Saltwater" development, DA Approval No. T6-17-446 which sized the above ground channel to store the 5 Year ARI storm.

The proposed bed width is 5.0m and the allowed water depth is 0.5m while the side slopes shall be 1:4. The length of the swale will be equal to that of the infiltration trench which is 330m long. This will provide an additional storage volume of 1155 m^3. Combined with the Bio-Retention Basin and the infiltration trench, The total storage volume is 188.6+1155 = 1343.6 m^3. This is adequate to store the 5-year ARI storm for the development which has been calculated using DRAINS software to be 1300m^3. Any larger storm events will spill from the aboveground channel through weirs at the northern side of the channel to be detailed at the DA stage.

The bio retention basins, infiltration swale and overflow channel are proposed to be located along the site's northern boundary as there is ample space to accommodate them and to allow the channel to overflow without affecting the development.
As the development is being carried on waterfront land, the WSUD devices shall remain clear of the 40m buffer outline from the wetland edge to ensure compliance with the requirements of the Riparian Corridor Matrix set by the NSW Department of Planning and Environment.

Table 2 Riparian Corridor Matrix *(NSW Department of Planning and Environment)*

Stream order	VRZ	RC offsetting for non-RC uses	Cycleways and paths	Detention Basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	●	●	●	●	●	●	●		
2nd	20m	●	●	●	●	●		●		
3rd	30m	●	●	●		●			●	●
4th +	40m	●	●	●		●			●	●

- **Water Quality**

Similar to the Stage 1 DA Design, the stage 2 and 3 water quality design criteria will be achieved by scaling up the two proposed bioretention basins and infiltration swale and relocating them to the northern landscaped area.
The Stage 1 DA Design Report included two bioretention basins in addition to an infiltration trench to achieve water quality targets for Stages 1 and 2 of the development.

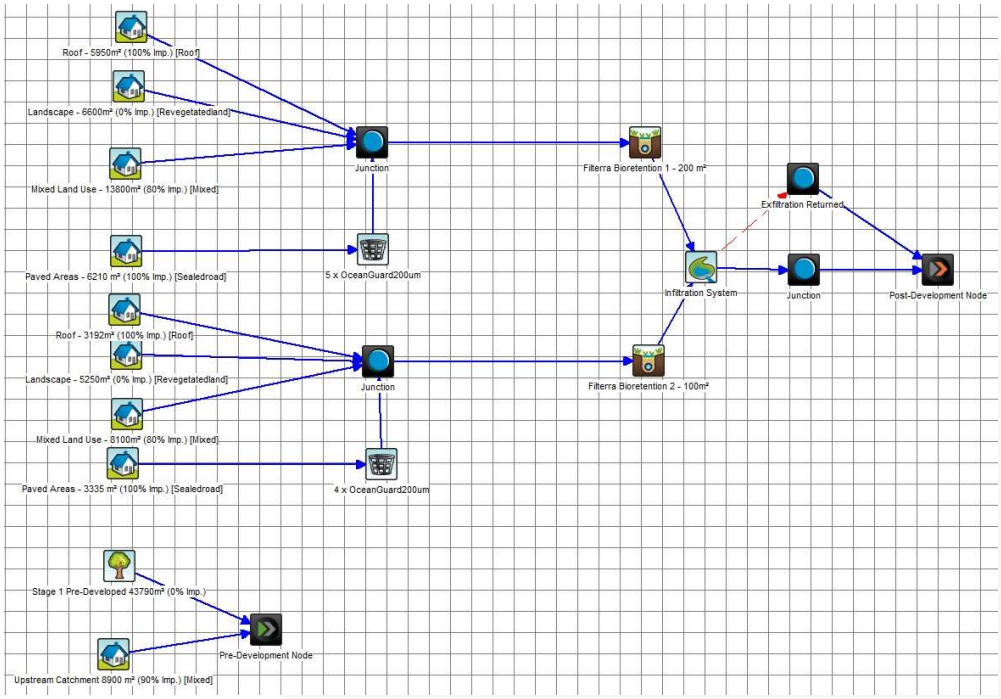


Figure 3 MUSIC Treatment Train

The resultant pollutant loads, concentrations and treatment train results are shown in the tables below:

Table 3 Pre and Post Pollutant Load Comparison

	Inflow	
	Pre	Post
Flow (ML/yr)	40.8	65.2
Total Suspended Solids (kg/yr)	4.32E3	500
Total Phosphorus (kg/yr)	7.55	2.64
Total Nitrogen (kg/yr)	46.2	45.0
Gross Pollutants (kg/yr)	307	0.00

Table 4 Post Pollutant Concentrations

Pollutant	Mean Concentration (mg/L)
TSS	8.730
TN	0.700
TP	0.065

Table 5 Treatment Train Effectiveness

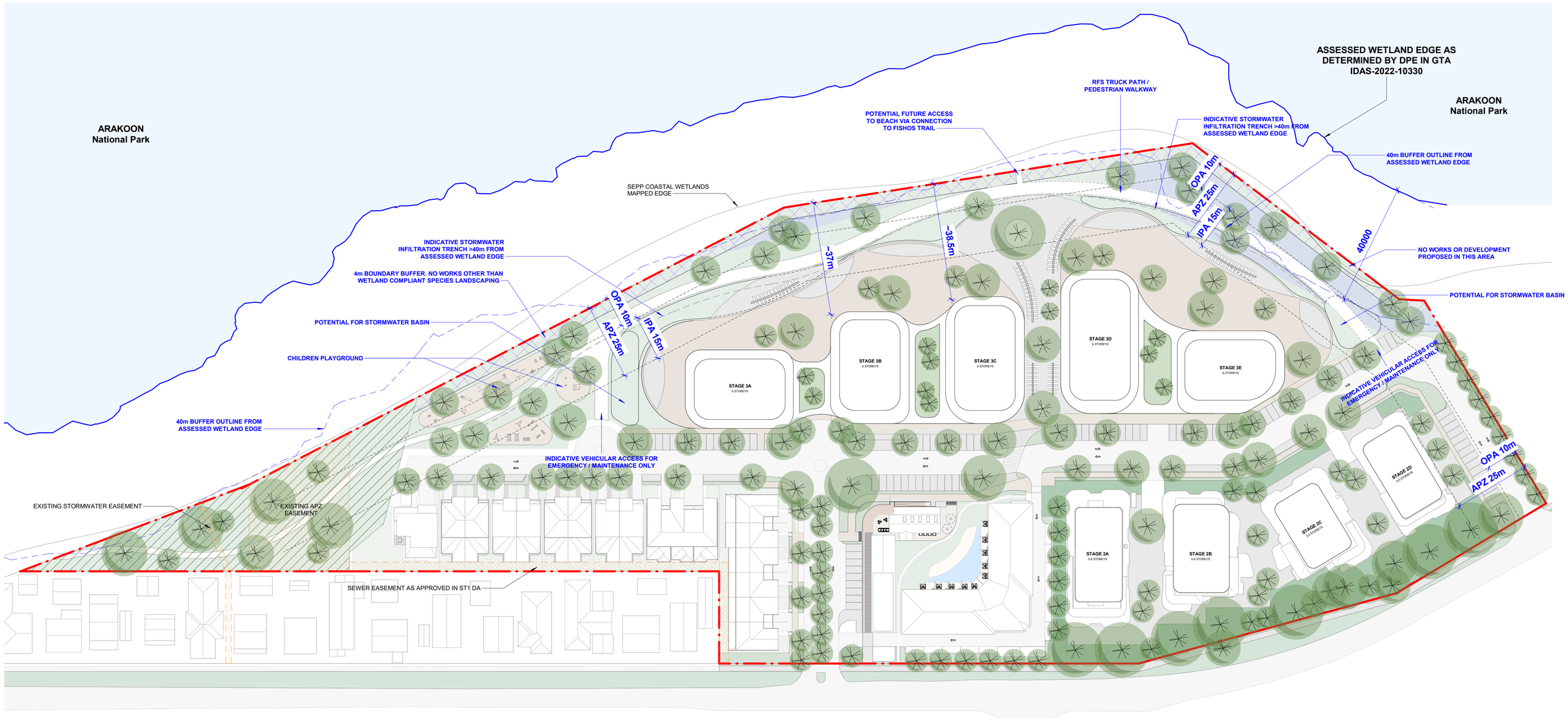
	Sources	Residual Load	% Reduction
Flow (ML/yr)	66	65.2	1.21
Total Suspended Solids (kg/yr)	13700	500	96.4
Total Phosphorus (kg/yr)	26.7	2.64	90.1
Total Nitrogen (kg/yr)	136	45	66.9
Gross Pollutants (kg/yr)	1330	0	100

For and on behalf of the Xavier Knight team.

Kind regards,

Ali Akel
Senior Civil Engineer
BSc (Civil) MIEAust

Appendix A – Site and Staging Plans



Date	REV	Description
24.10.23	B	FINAL FOR CONCEPT DA LODGEMENT
18.10.23	A	DRAFT FINAL FOR COORDINATION

RISE PROJECTS

ADDRESS:
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DRAWN BY: Author | CHECKED: Checker

ADDRESS:

**LOT 2 PHILLIP DRIVE,
SOUTH WEST ROCKS**

VIEW:

SITE PLAN

JOB No : **RP 260**

SCALE : A1/1 : 700

DATE: 24.10.23

NORTH:

DW No. DA-CST2&3-04.01

REV: B

PROPOSED ESTIMATED OVERALL GFA:

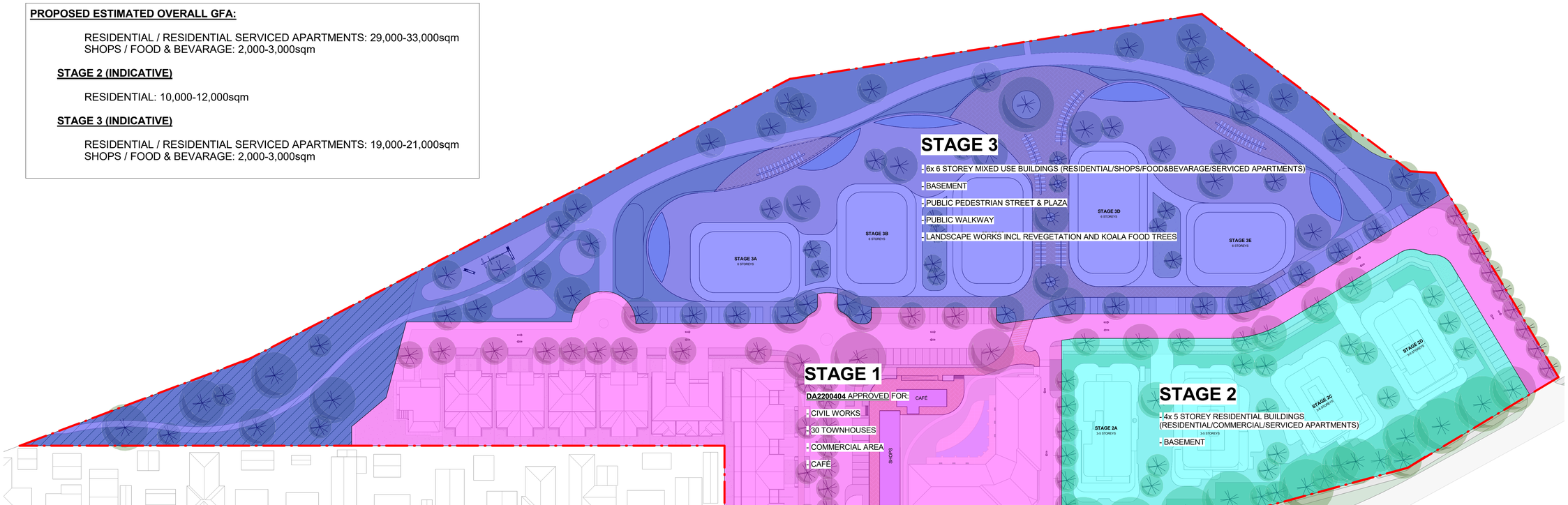
RESIDENTIAL / RESIDENTIAL SERVICED APARTMENTS: 29,000-33,000sqm
SHOPS / FOOD & BEVARAGE: 2,000-3,000sqm

STAGE 2 (INDICATIVE)

RESIDENTIAL: 10,000-12,000sqm

STAGE 3 (INDICATIVE)

RESIDENTIAL / RESIDENTIAL SERVICED APARTMENTS: 19,000-21,000sqm
SHOPS / FOOD & BEVARAGE: 2,000-3,000sqm



SHEET TO BE STAMPED IN APPROVAL

Date	REV	Description
24.10.23	B	FINAL FOR CONCEPT DA LODGEMENT
18.10.23	A	DRAFT FINAL FOR COORDINATION

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ADDRESS:

LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

VIEW:

STAGING PLAN

JOB No : **RP 260**

NORTH:

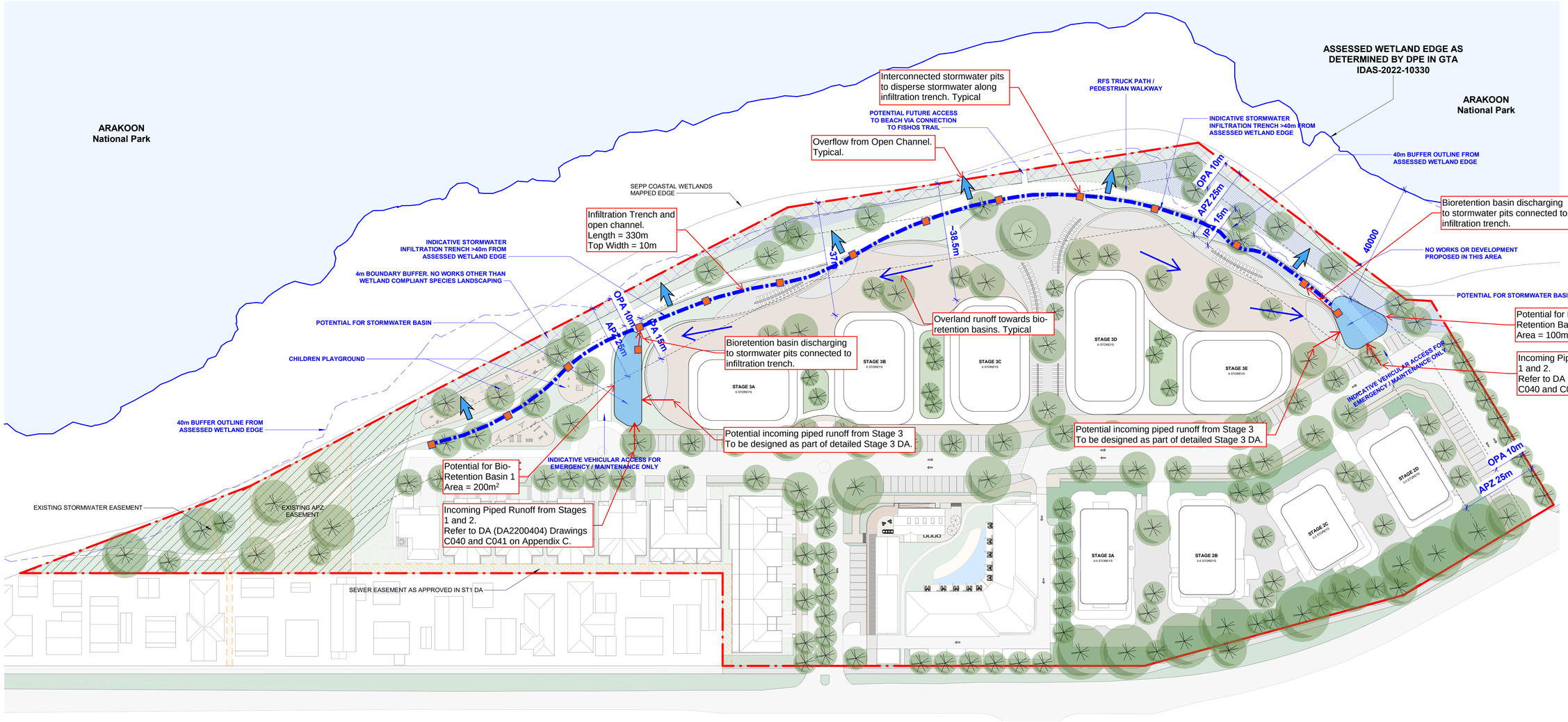
SCALE : A1/1 : 700

DATE: 24.10.23

DW No. DA-CST2&3-04.02

REV: B

Appendix B – Concept Stormwater and Water Quality Design



Date	REV	Description
24.10.23	B	FINAL FOR CONCEPT DA LODGEMENT
18.10.23	A	DRAFT FINAL FOR COORDINATION

RISE PROJECTS

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DRAWN BY: Author | CHECKED: Checker

ADDRESS:

LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

VIEW:

SITE PLAN

JOB No : **RP 260**

SCALE : A1/1 : 700

DATE: 24.10.23

NORTH:

DW No. DA-CST2&3-04.01

REV: B

Appendix C - Stage 1 Approved Engineering Report and Drawings

XAVIER
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DA ENGINEERING DESIGN REPORT

For

Lot 2 Phillip Drive, South West Rocks

Project Number 211107
Date 04/04/2022

Prepared for: Rise Projects

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TABLE OF CONTENTS

QUALITY CONTROL REGISTER

This report has been prepared and checked as per below.

	Name	Signature	Date
Report Author:	Ali Akel		04/04/22
Checked by:	Scott Sharma		04/04/22
Authorised by:	Scott Sharma		04/04/22

DOCUMENT SUMMARY

Project Number:	211107
Project Name:	2 Phillip Drive, South West Rocks
Prepared For:	Rise Projects
Date Prepared:	04/04/22
XK Project Director:	Scott Sharma

Status	Issue	Date	Prepared By	Approved By
Development Application	A	04.04.2022	Ali Akel	Scott Sharma

1 INTRODUCTION

1.1 BACKGROUND

This report has been prepared to accompany the Development Application for the development known as Lot 2 Phillip Drive, South West Rocks (The Site) on behalf of Rise Projects.

The development is located along New South Wales (NSW) east coast and is wholly located within the jurisdiction of Kempsey Council. The development is approximately 4.82Ha currently consisting of mild to dense vegetation. Saltwater Creek is located about 30 to 90 metres from the northern lot boundary and is separated from the site by crown land managed as a council reserve. The Site is bounded by Phillip Drive to the south, which is a local unclassified performing the function of a collector route through the local area [1].

The proposed site will be subdivided into 2 super lots which will be developed over time in stages. The subject of this report is the proposed Stage 1 located on the southern half of the site. Stage 1 Has an area of 2.37Ha and involves the construction of roadworks, residential and retail buildings.

This report details the procedures and design criteria used in developing the Development Application documentation. The Analysis takes into consideration the economic, engineering, environmental and social aspects of the works that include a residential subdivision, a commercial and mixed-use development and retaining a large portion of the site.

This document is submitted in accompaniment of the engineering plans shown attached as (APPENDIX A – Civil Engineering Design for DA) and demonstrates compliance with Kempsey Council Development Control Plan(s), Kempsey Council guidelines and design specifications.

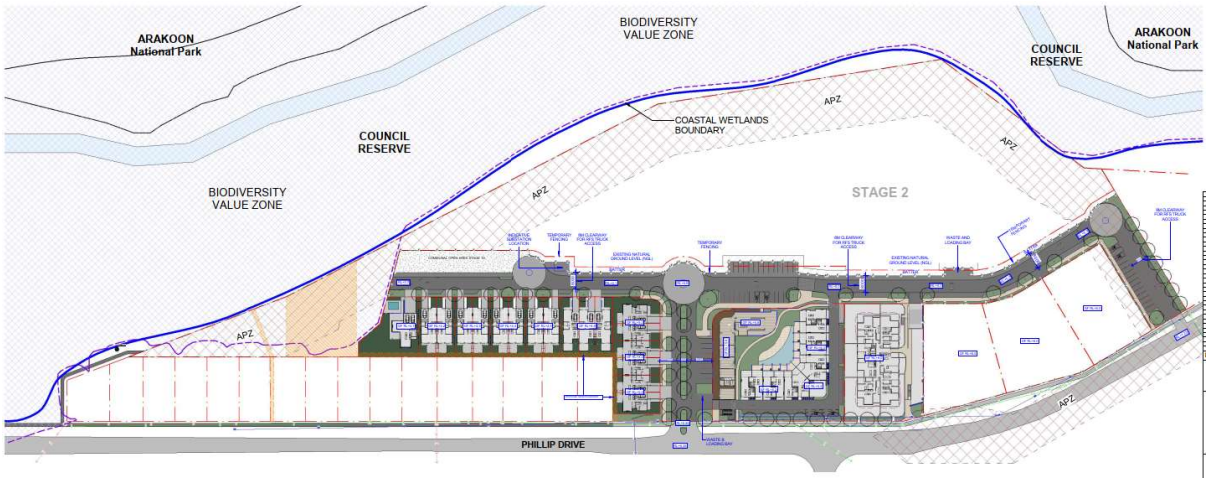

Figure 1 Proposed Stage 1 Site Plan (Rise Projects)

2 EXISTING CONDITIONS

A mapped coastal wetland borders the north and east of the development and has been afforded an average of 40m buffer.

The south west corner of the site contains an area mapped as a Biodiversity Value Area. This area will be excluded from development as it is considered an important area for the swift parrot [2].

The site features approximately 5m of level difference (RL 7.0m to RL 2.0m) over a 215m path from south to north. The Site generally falls between 7.5% - 2% at any given location on the site. Beyond the development, the land continues to fall towards the North until it reaches Saltwater Creek

2.1 DETAIL SURVEY

A Detail survey of The Site was undertaken by ADW Johnson in May 2021. The extent of the survey in depicted in Figure 2. A survey model was provided in DWG (AutoCAD) format. Survey control including coordinates and levels relative to the Map Grid of Australia (MGA) and Australian Height Datum (AHD) respectively.

The detail survey included all existing natural and built form features within the subject site and was later extended to cover the extents of the proposed development limit of works. Existing utilities depicted on the survey should be verified at Construction Certificate (CC) stage to confirm location and depth.

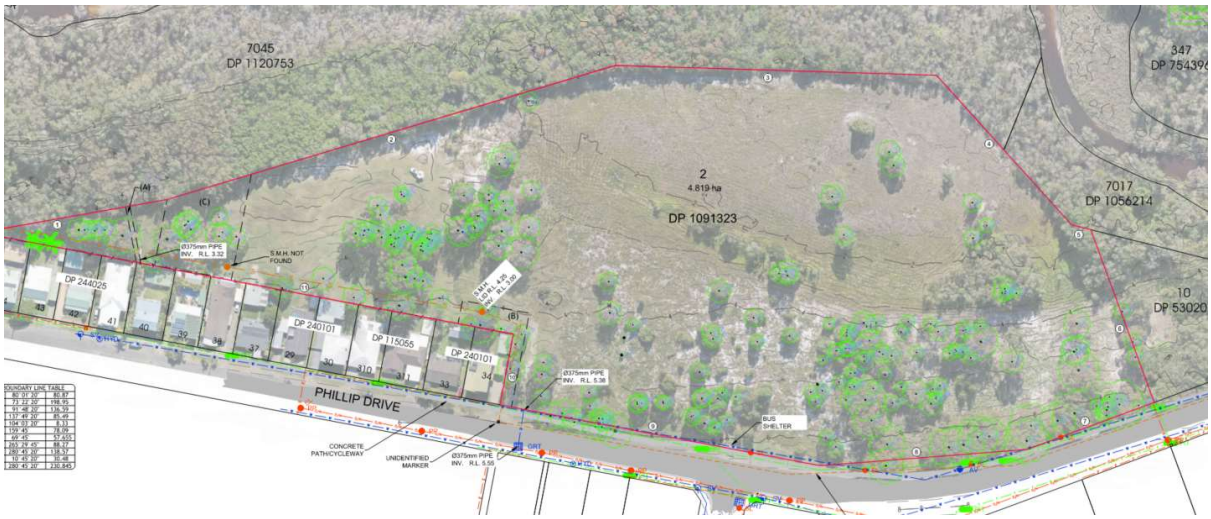

Figure 2 Detail survey plan (ADW Johnson)

2.2 EXISTING SOIL

The ground on the southern half of the site consists of an elevated terrace of sand dune deposits. In northern half of the site, at approximately 80m from Phillip drive, the ground surface drops by approx. 1-2m onto low lying alluvial deposits [3].

The existing drainage regime is mainly by a combination of surface runoff towards saltwater creek as well as surface infiltration into the site. A seepage area occurs along the boundary of the alluvial deposits.

2.3 EXISTING GROUNDWATER

The groundwater is typically found at a depth of 0.5m to 2.0m below the surface for the aeolian sand dune (southern) area while it is encountered at depths of 0.5m to 1.0m on the low lying (northern) areas. [3]
The water table appears to sit at an elevation of 1.2 mAHD and 2.8 mAHD and the hydraulic gradient suggests groundwater flows north towards Saltwater Creek [4].

3 Road Design

3.1 DESIGN VEHICLE

The site is located on designated Bushfire Prone Land [5] so it is important that the roads can accommodate NSW Rural Fire Service 7.8m long fire trucks. Road geometries have been designed to accommodate the requirements of these vehicles as required in Section 6.8.2 of "Planning for Bush Fire Protection" [6].

Swept path analysis for an 8.8m long Medium Rigid Vehicle (MRV) was prepared and shown in the traffic planning report [1] confirming the road geometry can serve these vehicles.

3.2 ROAD GEOMETRY

Proposed roads have been designed generally in accordance with Kempsey Council's Development Design Specification Chapter D1, Austroads Guide to Road Design and to the requirements NSW Rural Fire Service.

The are 4 road alignments in the proposed Stage 1 Development:

1. MC00 is a divided road with a central depressed median serving as the main access to the development. The cross slope of the road falls towards the central median where drainage pits are provided to pick up stormwater runoff. The kerbing on the median is 150mm high castellated kerb to facilitate stormwater flow into the depressed median. The road ties into existing Phillip drive in a simple T-Intersection.
2. MC01 is an undivided two-way road running east-west across the site. The road is uncrowned and has a single crossfall towards the north. This road will be used by NSW

Rural Fire Service trucks so a total trafficable width of 8.0m has been provided as required in Section 6.8.2 of "Planning for Bush Fire Protection".

3. MC02 is an undivided two-way road serving as a secondary access to the development. The road is uncrowned and has a single crossfall falling towards the east. The road ties into existing Phillip drive in a simple T-Intersection
4. MC03 is a small access road servicing the mixed retail and residential building.

Road alignments and typical cross-sections can be found in (APPENDIX A – Civil Engineering Design for DA).

An assessment of lane widths with movement of MRV and light vehicles is presented below.

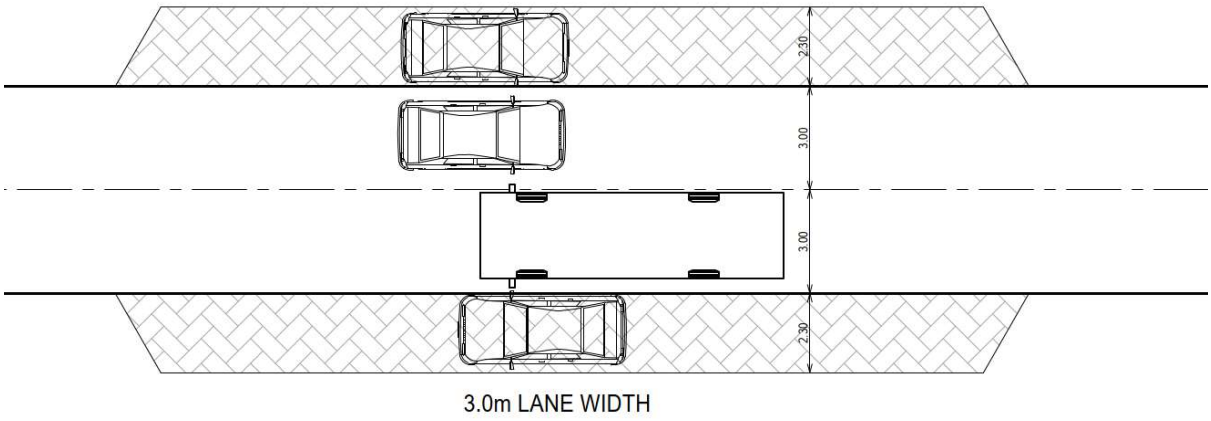

Figure 3 MRV passing light vehicle with parked vehicles both sides of road

4 STORMWATER DESIGN

All stormwater drainage and water treatment has been designed in accordance with Kempsey Council's DCP Chapter B5 and Development Design Specification Chapter D5.

The DCP encourages "Sustainable Stormwater Management" which could be generally achieved using three strategies:

a. Techniques that encourage the infiltration of stormwater into soils.

b. Techniques that encourage the temporary storage of stormwater on-site, instead of transporting it off-site for centralized detention within a development project.

c. Techniques, such as the construction of artificial wetlands, which also allow some degree of longer-term retention and treatment of the stormwater by natural processes before it is discharged.

In addition to Council requirements, the biodiversity assessment report (BDAR) [2] records the presence of the Wallum Froglet (Crinia tinnula) and Southern Myotis (Myotis macropus) within the site boundary.

Section 5.5 of the BDAR recommends mitigation measures to minimise Impacts of the development on biodiversity. These include soil erosion and sediment controls, replacement nest boxes and weed control. Sediment and Erosion Control plans and accompanying details and notes can be found in (APPENDIX A – Civil Engineering Design for DA).
The wallum froglet additionally requires tannin-stained water flowing through the frog habitat via groundwater expression [7].

To meet the requirements of the DCP and to ensure the requirements of the Wallum Froglet are met, the stormwater system has been designed as:

- A conventional Pit and Pipe System to drain the lots and roads. The pit and pipe system is an effective measure to ensure safety and convenience for pedestrians and traffic in frequent stormwater events.

- Two Bio-retention Basins to treat stormwater quality to Kempsey council requirements. The bio-retention basins are to have permeable sides to avoid standing water remaining in the basin for longer periods as this can provide a habitat for mosquitoes as indicated by the Mosquito Risk Assessment report [8] for the adjacent saltwater development that was made available to Xavier Knight.

- The construction of an infiltration trench connecting the two bio-retention basins. The trench will encourage water infiltration into the soil to recharge groundwater and provide suitable conditions for the Wallum froglets and maintain the existing stormwater regimes as far as practicable. Infiltrating the water into the ground provides a suitable stormwater discharge point away from the mapped coastal wetland and mapped crown land to the north. Stormwater events in excess of the capacity of the trench will sheet flow from the

top of the trench towards Saltwater Creek in a manner similar to the pre-developed condition.

4.1 DRAINAGE CATCHMENT

4.1.1 EXTERNAL CATCHMENT

The total development is approximately 4.82Ha in size. A locality plan is provided below.

Figure 4 Locality plan – Lot 2 Phillip Drive, South West Rocks (Sixmaps)

A portion of Phillip Drive and the existing residential development at the south west of the site currently drain through the vacant site area.
The external catchment was determined using QGIS software and LIDAR survey information.

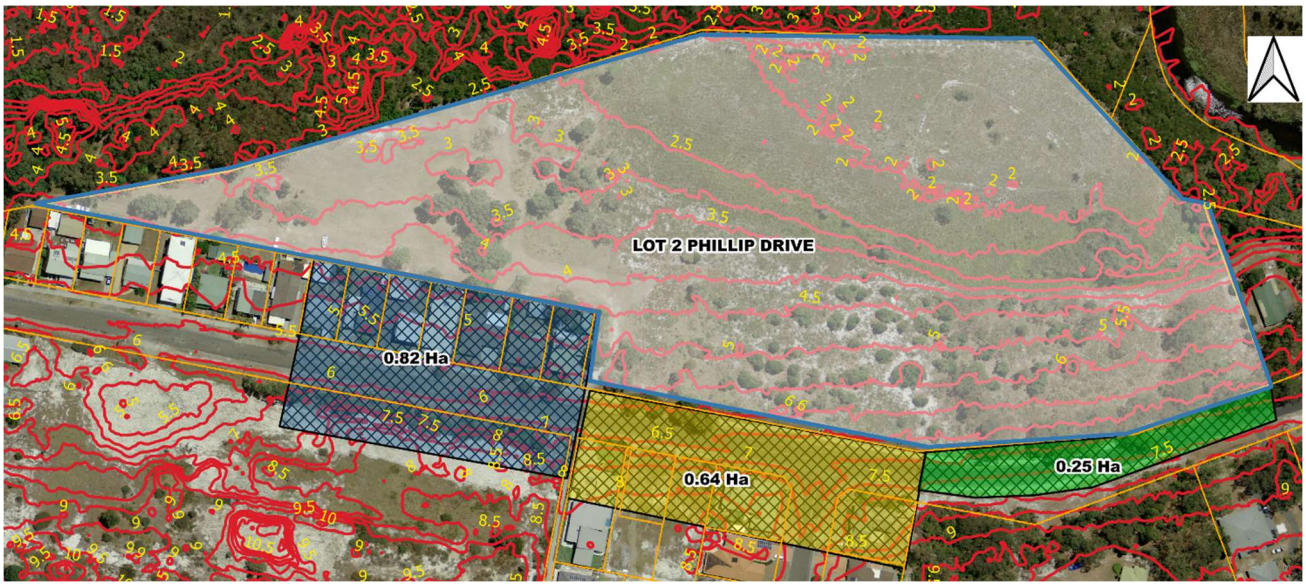

Figure 5 External Catchment Plan

The external catchment area draining towards the site has been determined to be a total of 1.71 Ha.
The portion of the external catchment shaded in yellow and green will be captured by the proposed pit and pipe stormwater system for the Stage 1 development.
Th area highlighted in blue currently drains towards the north west through a 1.83m wide easement (DP 244025).

The rear of the lots highlighted in blue is assumed to discharge towards the north using overland runoff. As the new stage 1 villas will block this flow path, a new diversion swale is proposed at the rear of the lots to intercept the upstream catchment runoff and divert it westward towards 1.83m wide easement.

4.1.2 STAGE 1 CATCHMENT

Two Bio-retention Basins have been proposed for the development and catchment area has been divided accordingly. A summary of Stage 1 catchment is shown below, the upstream catchments have been added to the relevant sub catchments:

Table 1 - Drainage Catchments

	Pre-developed (m^2)	Bioretention 1 Catchment (m^2)	Bioretention 2 Catchment (m^2)
Roof Area	*0*	*3845*	*0*
Paved Area (100% Imp.)	*0*	*5109*	*4434*
Landscape (0% Imp.)	*31110*	*631*	*432*
Mixed Use (80% Imp.)	*890*	*13104*	*5145*

From assessment of The Site and the external catchment post development layout, Xavier Knight has utilised DRAINS to design the minor and major drainage systems being the 20% AEP and 1% AEP respectively. Times of concentration were calculated to mimic the existing conditions accordingly.

A DRAINS model is available, reference file name: *2 Phillip Drive – DRAINS Model*

It should be noted that the development is impacted by the 1% AEP flood event along the northern boundary as a result of Saltwater Creek conveyance, the identified flood level is RL 2.84 mAHD [9] for the 1% AEP event. On the other hand, the top water level of the proposed bioretention basins sits at an elevation of 2.90 mAHD. Therefore, a tailwater of elevation of 2.90 mAHD will be modelled for the 20% and 1% AEP Storms.

4.2 STORMWATER QUANTITY

The proposed residential development has been designed in accordance with Kempsey Council's design specification (refer to Figure 6 below). The proposed concept stormwater drainage network (pit and pipe) has been designed to convey the 20% AEP (5 years ARI) for the proposed residential development with overland flow paths incorporated into the road design to allow the 1% AEP event (100 year) to be safely conveyed to the downstream discharge points.

5. Recurrence intervals for major/minor events depend on the zoning of the land being serviced by the drainage system. The system design ARIs are detailed below:-

- 100 years for the "major" system in all developments.
- 20 years for trunk drainage "minor" systems
- 10 years for commercial/industrial area "minor" systems
- 5 years for residential area "minor" systems
- 5 years for rural residential area "minor" systems
- 1 year for parks and recreation area "minor" systems.

Figure 6 Extract form Kempsey Council's Development Design Specification

The external catchment as identified in Figure 5 above has been modelled in DRAINS as part of it is collected by the internal stormwater drainage system.
The catchment areas have been analysed using the impervious fractions as per Kempsey Council's design specifications.

Open space	10%
Low density residential	50%
Medium & high density residential	75%
Industrial	95%
Commercial	100%
Other	as calculated.

Figure 7 Extract from Kempsey Council's design specifications.

It should be noted that the existing pit and pipe drainage system that conveys stormwater runoff from the existing development to the south of the development (termed external catchment in this report) has been modelled with assumptions including:

- Appropriate pipe sizes
- Surface level and invert levels of existing pits

It is important to note that as this existing system has been previously approved and constructed, any results from the DRAINS model in relation to the existing drainage network within Phillip Drive is only indicative and subject to further analysis and survey information if required.

The internal drainage system has been modelled with appropriate blockage factors to the pit and pipe system as detailed in Council's design specifications as a conservative approach to the concept design. The acceptable velocity x depth range for the design storm within the roadway gutter is not to exceed 0.4 m^2/s and the maximum flow gutter width shall not exceed 2.5m for the 1% AEP.

DRAINS results from are reflected in (APPENDIX C – DRAINS Results).

4.3 STORMWATER QUALITY

Chapter B6 (Water Sensitive Urban Design) of the Kempsey council DCP is still being developed so chapter B5 of the DCP recommends the following documents as guidelines for water quality designs:

- The current version of Australian Runoff Quality (Institute Engineers)
- Guidelines for Managing Risks in Recreational Water
- ANZECC Guidelines

In addition to the above, the following documents were used to inform the stormwater quality design:

- MUSIC Modelling Guidelines
- Neutral or Beneficial Effect on Water Quality Assessment Guideline
- D3 - South Kempsey Industrial Precinct
- Stage 1 Scoping Study for the Saltwater Creek and Lagoon Coastal Management Program [10]
- Saltwater Creek and Lagoon Estuary CMP Stage 2, Water Quality Assessment [11]. In the absence of reduction targets in chapter B5, the reduction targets from Kempsey council DCP chapter D3 will be used as guidance.

The reduction targets presented in chapter D3 are as follows

- 80% Total suspended solids (TSS)
- 45% Total Phosphorus (TP)
- 45% Total Nitrogen (TN)
- 90% Gross Pollutants (GP)

4.3.1 COASTAL MANAGEMENT PROGRAM (CMP)

Kempsey Shire Council is preparing a coastal management program (CMP) to set the long-term strategy for managing Saltwater creek and lagoon. This CMP will supersede the previous "Estuary Management Study & Plan" (WBM 2006).

Stage 1 [10] of the study represents the first of five stages of the CMP and reviews the history of managing the estuaries and develops a program for the remaining stages.

The CMP highlights that the estuary has historically experienced poor water quality and highlights that Phosphorus and Nitrogen concentrations far exceed the ANZECC guidelines. The observed phosphorus concentrations in Saltwater creek and Lagoon are generally between 10 and 300 µg/L while Oxidised nitrogen concentrations are generally between 60 and 1000 µg/L.

Following the Stage 1 study, a detailed water quality assessment report [11] was developed as part of Stage 2 of the CMP. This report re-iterates the Stage 1 statement that the estuary has historically experienced poor water quality.
The report adopts new water quality criteria / trigger values for different indicators based several water quality guidelines relating to the estuary. The study notes that the ANZECC guidelines have already been superseded and uses more contemporary guidelines to set the trigger values.

The report adopts the following water quality trigger values:

Table 2 New Estuary Water Quality Trigger Values (Reproduced from Table 4-2 of Saltwater Creek and Lagoon Estuary CMP Stage 2 Water Quality Assessment. Alluvium, 2021)

Indicator	Trigger values (numerical criteria) for NSW Estuary Lagoons
Total phosphorus	25 µg/L
Total nitrogen	625 µg/L
pH	7.5 – 8.9
Dissolved Oxygen	76% – 107% (or 5.7 mg/L – 7.9 mg/L)

It should be noted that the values listed in the table above are dry weather values for the receiving environment and not discharge from sites.

To measure the ambient concentrations on site, the study conducted field sampling for key water parameters from different locations in the area as shown in below:

Figure 8 Monitoring program sampling locations (Extracted from water quality assessment study)

The monitoring results for Total Nitrogen (TN) and Total Phosphorus (TP) are listed below:

Table 3 TN site statistics comparison (Reproduced from Table 5-1 of Saltwater Creek and Lagoon Estuary CMP Stage 2 Water Quality Assessment. Alluvium, 2021)

	Brighton Park	Oil Terminal	Lagoon View	Treatment Road
Mean	0.6	0.7	0.7	0.9
Median	0.6	0.6	0.6	0.9
10th Percentile	0.4	0.4	0.4	0.6
90th Percentile	1.0	1.0	0.9	1.3

Table 4 TP site statistics comparison (Reproduced from Table 5-2 of Saltwater Creek and Lagoon Estuary CMP Stage 2 Water Quality Assessment. Alluvium, 2021)

	Brighton Park	Oil Terminal	Lagoon View	Treatment Road
Mean	0.04	0.03	0.02	0.07
Median	0.04	0.02	0.02	0.06
10th Percentile	0.02	0.01	0.01	0.04
90th Percentile	0.07	0.05	0.03	0.11

The Lagoon View and Oil Terminal sites are the most representative as they are located upstream and downstream of the site and have been selected as a guide to target water quality. MUSIC modelling will be conservative as it will be compared against these dry weather values since ambient water quality will inevitably worsen during storm events when discharge from the development is occurring.
Ongoing water quality monitoring will assist in confirming ambient water quality during dry and wet weather conditions.

There is limited data for groundwater quality in the vicinity with the closest data at the wastewater treatment plant located approximately 1.3 km south west of the site. Notwithstanding, the results from the groundwater monitoring well are presented in Figure 9 and Figure 10 below and generally show elevated concentrations of nitrogen and phosphorus exceeding surface water concentrations in similar locations. Ongoing groundwater monitoring will assist in understanding groundwater characteristics at the site.

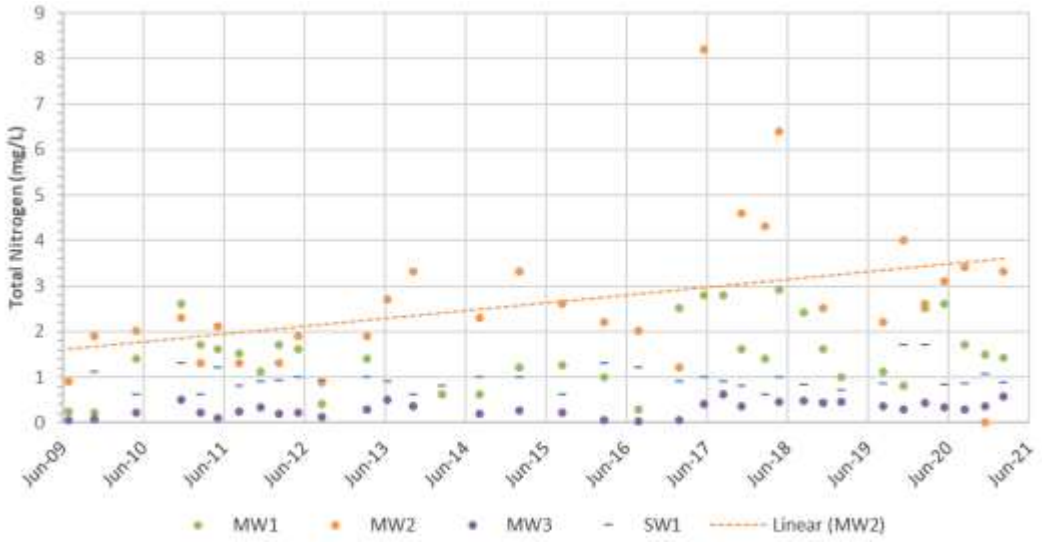

Figure 9 WWTP groundwater monitoring well water quality results - Total Nitrogen (Reproduced from Figure 5-9 of Saltwater Creek and Lagoon Estuary CMP Stage 2 Water Quality Assessment. Alluvium, 2021)

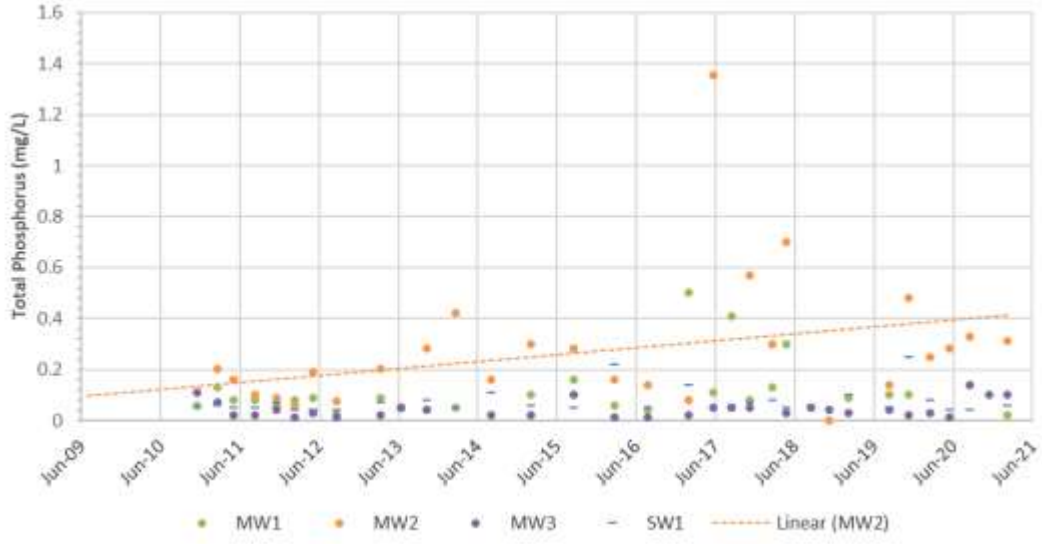

Figure 10 WWTP groundwater monitoring well water quality results - Total Phosphorus (Reproduced from Figure 5-9 of Saltwater Creek and Lagoon Estuary CMP Stage 2 Water Quality Assessment. Alluvium, 2021)

A neutral or beneficial effect (NoRBE) approach will be used in water quality design; that is, the water quality model will compare the post-developed pollutants against the pre-developed pollutants and demonstrate that the post developed scenario has a neutral or beneficial effect compared to the pre-developed scenario.

4.3.2 RAINFALL-RUNOFF PARAMETERS AND POLLUTANT LOADING

The pre-developed area of stage 1 was modelled in MUSIC as a Forested land use with the following Rainfall-Runoff parameters:

Table 5 - Adopted Forested Soil Parameters for MUSIC

Soil Parameter	Value
Impervious Area Properties	
Impervious Rainfall Threshold (mm/day)	1.00
Pervious Area Properties	
Soil Storage Capacity (mm)	120
Initial Storage (% of Capacity)	10
Field Capacity (mm)	80
Infiltration Capacity Coefficient – a	200
Infiltration Capacity Coefficient – b	1.00
Groundwater Properties	
Initial Depth (mm)	50
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	3.00
Daily Deep Seepage Rate (%)	0.00

The pollutant loading used for the pre-developed and post-developed land uses are summarised below:

Table 6 - Pollutant Loading

Land Use	Flow Type	TSS LOG^{10} Values		TP LOG^{10} Values		TN LOG^{10} Values	
		Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Forest	Base Flow	0.510	0.280	-1.790	0.280	-0.590	0.220
	Storm Flow	1.900	0.200	-1.100	0.220	-0.075	0.240
Urban - Roof	Base Flow	-	-	-	-	-	-
	Storm Flow	1.300	0.340	-0.890	0.310	0.260	0.230
Urban - Sealed	Base Flow	1.000	0.340	-0.970	0.310	0.200	0.200
	Storm Flow	2.430	0.390	-0.300	0.310	0.260	0.230
Urban - Mixed	Base Flow	1.000	0.340	-0.970	0.310	0.200	0.200
	Storm Flow	2.180	0.390	-0.470	0.320	0.260	0.230
Urban - Landscape	Base Flow	1.000	0.340	-0.970	0.310	0.200	0.200
	Storm Flow	2.180	0.390	-0.470	0.310	0.260	0.230

4.3.3 STAGE 1 WATER QUALITY TREATMENT MEASURES

- **Rainwater Tanks**

  Rise projects has been informed by Kempsey Council about the availability of a recycled water network in the vicinity of the site and advised on extending the network into the site.
  Chapter B5, Section 4.2 of the Kempsey DCP specifically states: "*In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*"
  In addition, Section 4.3 states: *"In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*"
  No rainwater tanks are therefore proposed in the site due to the availability if the recycled water system.

- **Bioretention Basins**

  Two bioretention basins are proposed on site. An Oceanprotect Filterra® bioretention system has been adopted to achieve high pollutants removal rates required:

Table 7 Bioretention Basin Parameters

	Catchment Area (Ha)	Extended Detention Depth (m)	Filter Area (m^2)	Filter Depth (m)	Saturated Hydraulic Conductivity (mm/hr)	Exfiltration Rate (mm/hr)
Bio-retention Basin 1	2.27	0.40	135	0.53	3550	0
Bio-retention Basin 2	1.00	0.40	60	0.53	3550	0

- **Infiltration Swale**

The infiltration swale will treat the catchment areas captured by the Bio-Retention basins. To achieve better performance with the infiltration system, two "Evertrench Small" arched liners will be installed in the infiltration trench. The product spec. sheet can be found in APPENDIX B – WSUD Details.

A groundwater study prepared by AGE [4] for the development recommended the infiltration system to have sufficient storage volume to accommodate 30% of rainfall.
A previous groundwater study prepared by Douglas Partners [12] for the adjacent Saltwater Development was also made available to Xavier Knight. The report recommended the infiltration system to have sufficient storage volume to accommodate 40% of the average daily rainfall excluding non-rainy days. The report analysed rainfall records and determined the average daily rainfall event to be 11mm.
Based on the above, the infiltration system for Stage 1 will be sized to accommodate the storage of 30% of the average daily rainfall event for the Stage 1 site and the upstream catchment draining into the site. This is equal to a volume of (0.3*11mm/1000) * (3.27Ha * 10,000) = 107.91m^3

The length of the proposed infiltration trench is 175m. Two "Evertrench Small" cells will be utilised and will each be laid in a 0.6m wide trench and a 0.2m gravel bed will be laid under the arches with a void of 20%. The storage volume for a linear metre of an "Evertrench Small" is 0.08m^3 while that for the gravel layer is (0.6*0.2*20%) = 0.024, therefore; the total storage for a linear metre of the two-cell trench is 2*(0.08+0.024) = 0.208 m^3. For a 175m long trench, the storage volume = 36.4m^3.

The infiltration area of the trench is equal to the perimeter times the length; therefore 2*(0.23+0.2+0.6) *175 = 360.5 m^2.

71.51 m^3 of storage volume is still required to accommodate 30% of the average daily rainfall event. This will be provided in the two bio-retention basins. Each will be sized in proportion to the catchment area they receive.

The bed area for Bio-Retention Basin 1 has been sized as 135 m^2. With a 0.4m extended detention depth, the capacity of Bio-retention Basin 1 is 54 m^3.

Similarly, the bed area for Bio-Retention Basin 2 has been sized as 60 m^2. With a 0.4m extended detention depth, the capacity of Bio-retention Basin 2 is 24 m^3.

The total storage capacity of the Bioretention Basin and the Infiltration trench is now 36.4+54+24 = 114.4 m^3 which is enough to store 30% of the average daily rainfall.

A grassed swale is proposed over infiltration trench to handle larger flows. The proposed bed width is 5.0m and the depth is 0.5m while the side slopes shall be 1:4. The length of the swale will be equal to that of the infiltration trench which is 175m long. This will provide an additional storage volume of 612.5 m^3. Combined with the Bio-Retention Basin and the infiltration trench, The total storage volume is 114.4+612.5 = 726.9m^3
The infiltration area provided by the swale is 1596 m^2

The bed of the Swale will be placed at RL 2.40m. The geotechnical report [3] shows the groundwater level at depth of 0.5 to 1 m in the low-lying areas downstream of the infiltration trench. As the existing ground level downstream is generally at RL 2.0m, the water table will be assumed at RL 1.5m for the purpose of drainage design.

The top of the overflow swale will be at RL 2.90m for a ponding depth of 0.5m. As the soil layers are generally sandy, the typical porosity is 20%. The groundwater mound under the swale will provide an additional 312.5 m^3 above the ground water table.

Any events larger than the total system capacity will overflow over the top of channel. The channel will act as a broad crested weir that is 175m long.

4.3.4 STAGE 1 MUSIC MODEL AND RESULTS

Water quality has only been modelled and designed for the Stage 1 development proposal. To meet the water quality targets outlined above, a combination of, pit baskets filters, bio-retention basins and an infiltration trench have been adopted to achieve the water quality requirements.

Conceptual modelling of the water quality treatment was undertaken using the MUSIC software to determine the appropriate treatment systems required to meet Kempsey Council's water quality targets. The total MUSIC model treatment train is shown in Figure 11 below.

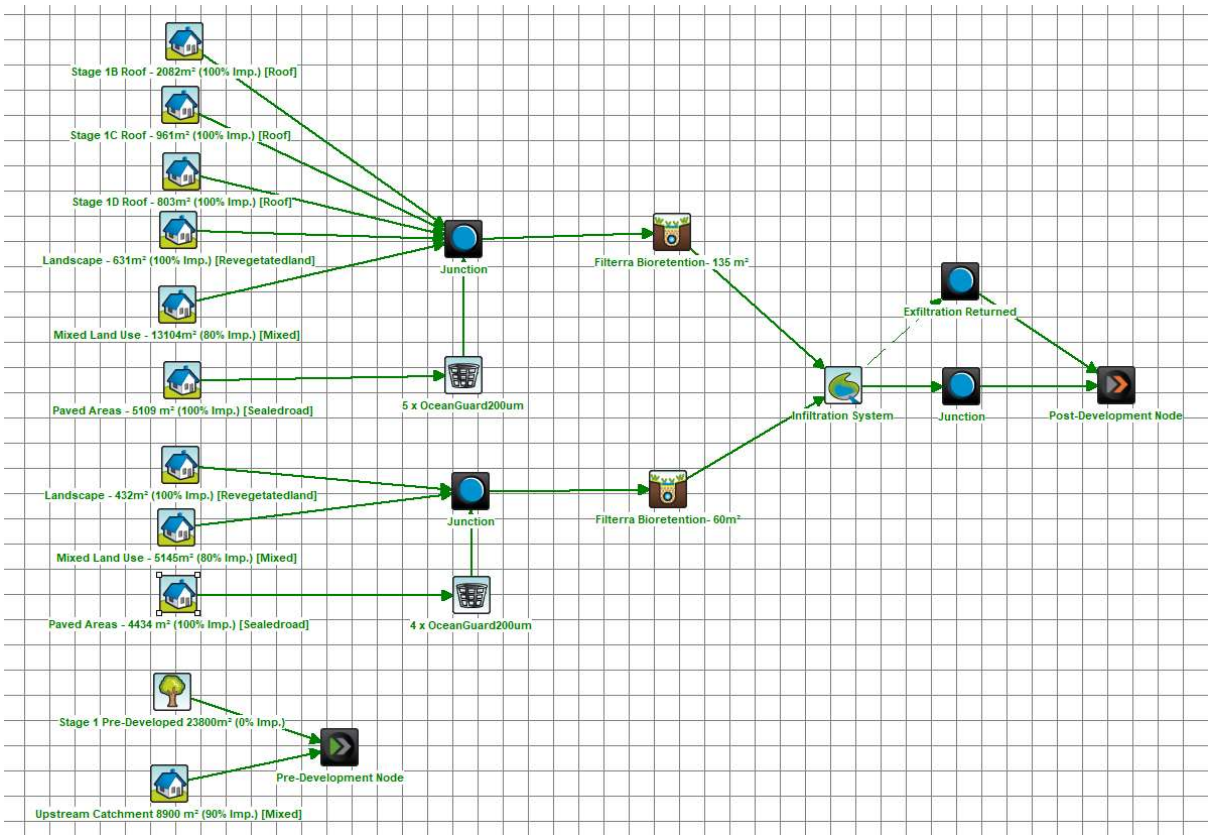

Figure 11 Concept treatment train MUSIC model

A comparison of pollutant loads and concentrations has been made against the values shown in tables and figures above with the pollutant removal anticipated by the stormwater management strategy developed for the site.

Table 8 below compares the annual pollutant loads from the pre and post developed conditions. The pre-developed pollutant loads are read from the "Pre-Development Node" shown in Figure 11 above while the post-developed pollutant loads is read from the "Post-Development Node", that is, after the flow has passed though the treatment train. On a load basis, percentage reductions show a no worsening but rather a beneficial effect compared to the existing condition.

Similarly, the pollutant concentrations in Table 9 are read from the "Pre-Development Node" and "Post-Development Node". Modelling confirm that discharge concentrations are in line with values shown in Table 3 and Table 4 above can be achieved. As mentioned earlier, MUSIC modelling has been conservative as it is comparing wet weather values against the dry weather values shown in Table 3 and Table 4.

Table 10 compares the effectiveness of the treatment train for the post-developed scenario at the "Post-Development Node". The "Sources" column shows the pollutants loads generated by the post developed source nodes while the "Residual Load" column shows the pollutant loads remaining after it has passed through the treatment train.
The values in Table 10 are in line with the pollutant reduction targets shown above in Section 4.3

Table 8 Pre and Post development pollutant load comparison

	Inflow	
	Pre	Post
Flow (ML/yr)	28.3	45.0
Total Suspended Solids (kg/yr)	3.79E3	353
Total Phosphorus (kg/yr)	6.91	1.70
Total Nitrogen (kg/yr)	37.6	30.8
Gross Pollutants (kg/yr)	307	0.00

Table 9 Pollutant Concentrations

Inflow	Mean
TSS Concentration (mg/L)	8.46
TN Concentration (mg/L)	0.691
TP Concentration (mg/L)	6.30E-02

Table 10 Treatment train results

	Sources	Residual Load	% Reduction
Flow (ML/yr)	45.5	45	1.1
Total Suspended Solids (kg/yr)	11400	353	96.9
Total Phosphorus (kg/yr)	21	1.7	91.9
Total Nitrogen (kg/yr)	94.6	30.8	67.4
Gross Pollutants (kg/yr)	1030	0	100

4.4 RESPONSE TO PLANNING CONTROLS

4.4.1 COMPLIANCE WITH KEMPSEY DCP SECTION B5

Development Requirement	Response
4.1 General	
Desired Outcomes	
DO1 - All stormwater generated within the development is controlled and managed to an appropriate degree.	All stormwater within the site has been collected by the pit and pipe system and discharged to a bio-retention basin
DO2 - All stormwater passing through the development from the surrounding catchment is controlled and managed to an appropriate degree.	Upstream catchment has been delineated and runoff is either collected or diverted as detailed in this report.
DO3 - An effective legal point of discharge for all collected stormwater is provided, from the development to a natural watercourse, Council drainage system or approved outfall.	The proposed stormwater system discharges to a bio-retention basin within the site away from the mapped coastal wetland and mapped crown land to the north. An average of 40m buffer zone has been provided between the development impact zone and the site boundary.
DO4 - Safety and convenience for pedestrians and traffic in frequent stormwater flows is provided by controlling these flows within prescribed limits.	The stormwater drainage system has been designed to the requirements of Kempsey Council Development Design Specification chapter D5. Velocity depth criteria has been designed to not exceed 0.4 m^2/s.
DO5 - Stormwater systems minimise erosion.	Stormwater outfall is not concentrated at a single point but rather discharges into a bio-retention basin and infiltration trench where it slowly percolates into the ground.
DO6 - Each component of the stormwater management system is designed and constructed in accordance with the relevant requirements of Council's Engineering Guidelines for Subdivision and Development.	The stormwater system has been designed in accordance with Kempsey Council DCP chapters B5 and D5 and relevant standard outlined in this document.
Development Requirements	
4.1.1 General	
a) An application for subdivision or development involving significant impervious area must be accompanied by a Stormwater Management Plan, incorporating WSUD, prepared by a certified practicing Engineer.	This document prepared by Xavier Knight outlines the stormwater management plans and includes WSUD measures applied.

b) The Designer shall adopt the 'major/minor' approach to urban drainage systems as outlined in the current version of Australian Rainfall and Runoff.	A major/minor approach has been adopted as outlined in AR&R and Kempsey DCP Chapter D5
c) The storm water drainage system is to be designed in accordance with: *(i) Council's Engineering Guidelines for Subdivision and Development;* *(ii) The current version of Australian Rainfall and Runoff;* *(iii) Any relevant Australian Guidelines; and* *(iv) Any relevant industry guidelines.*	Development will comply with these guidelines. Compliance will be shown as part of the Construction Certificate (CC) process
d) Flows through the major system shall follow a designated overland flow path, which shall: *(i) Follow a road if the catchment area is small; and/or* *(ii) Follow a natural water course or, as a last resort, a drainage reserve, if it is impractical or unsafe for a road to carry the excess flows; and* *(iii) Not increase risk to public safety; and* *(iv) Not exceed the capacity to safely transport design flows including minor system blockages and storm flows from events greater than the design event without property damage*	Roads have been designed to accommodate major flows while complying with Kempsey council chapter D5 requirements. Velocity depth criteria has been designed to not exceed 0.4 m^2/s while the maximum gutter flow width shall not exceed 2.5m.
e) Detention and retention basins are to be integrated into public open space such that there is no loss of function, where appropriate.	No retention or detention basins are proposed for Stage 1 works.
4.1.2 Site Drainage	
f) The drainage system has the capacity to control site specific design surface flows and additional flows entering the site from upstream property to stop	A DRAINS model has been provided showing that the proposed system has the capacity to handle design surface flows as well as upstream catchment flows.

stormwater entering dwellings during the design event.	
g) Development of the site is situated and designed to eliminate water inundation.	A flood study "Lot 2 Phillip Drive Flood Impact Assessment" has been prepared by Water Modelling Solutions. The development is following recommendations outlined in that report, such as fill levels and freeboard requirements, so the development can withstand the flood effects of 1% AEP.
h) The drainage system shall be designed to minimise ponding for protracted periods of time.	Stormwater pits have been provided at road low points and overflow paths at low points have been created to minimise ponding
i) Various source control measures to minimise the quantity of stormwater runoff shall be deployed where site conditions allow.	Source control measures have been applied wherever possible throughout the site. Permeable landscape areas have been provided in lots. common areas and road verges. Porous pavements will also be installed in some parking areas to reduce stormwater runoff.
4.2 Water Quality	
Desired Outcomes	
DO1 - Stormwater within subdivisions and development does not detrimentally affect: *• the environment;* *• surface and subsurface water quality;* *• groundwater infiltration characteristics;* *• adjoining and neighbouring properties downstream of the drainage outlet by damage or nuisance flows; and* *• watercourses, either upstream or downstream of the subdivision or development.*	The stormwater system has been designed to discharge into Bio-retention basins and an infiltration trench to mimic the existing stormwater regime. The bio-retention basins will treat the infiltrating water to acceptable water quality targets. Providing the infiltration trench also ensures that the habitat of existing fauna such as the wallum froglet is not compromised.
DO2 - Stormwater runoff meets specified quality objectives during all phases of a development.	Sedimentation and erosion plans have been provided to minimise the impact of construction works on water quality. Bio-retention basins have been proposed to treat water quality to acceptable targets post-construction.
Development Requirements	
a) On development sites where the existing groundwater level is close to the surface, Council may require submission of a Hydrogeological Report including the interaction between surface and groundwater flows.	An initial groundwater assessment has been prepared by AGE [4]. It is understood further groundwater monitoring and assessment will be carried out in future if appropriate to the site and Council requirements.

b) The current version of Australian Runoff Quality (Institute Engineers) design guideline is to be used to estimate urban stormwater contaminants, quality management practices and procedures for estimating performance	The current version of Australian Runoff Quality (Institute Engineers) has been used as a guiding document for water quality modelling.
c) Proposed Water Sensitive Urban Design stormwater quality treatment train options are to be assessed using the MUSIC model. In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.	MUSIC has been used to assess water quality. A MUSIC model is provided with this submission.
d) Urban Stormwater drainage systems are to be designed and constructed to effectively capture and remove gross pollutants using a combination of at source and inline systems only.	Pit basket inserts have been proposed to capture gross pollutants. Any gross pollutants bypassing the pit baskets will be captured by the bio-retention basins. MUSIC modelling results (Table 8 and Table 10) show very high gross pollutant reduction results. Gross pollutants will be periodically cleared from the system as part of a maintenance regime.
e) The quality of the water retained and or leaving the urban development is to meet the current Guidelines for Managing Risks in Recreational Water and ANZECC Guidelines.	The quality of water has been designed in accordance with the latest water quality objectives adopted for Saltwater Lagoon and Creek. See section 4.3.1 for the criteria adopted. MUSIC modelling pollutant load comparison (Table 8 Pre and Post development pollutant load comparison that site discharge will be of superior quality than the pre-developed condition.
f) Both temporary and permanent stormwater drainage systems are to be designed to retain sediment generated by development in accordance with Councils Engineering Guidelines for Subdivision and Development and the current Landcom publication Managing Urban Stormwater- Soils and Construction.	Temporary Sediment Basins and a permanent Bio-retentions Basin have been designed to retain sediments generated by the development. Sediment basins have been designed to comply with Landcom and Kempsey Council DCP Chapter D7 requirements.
g) Where groundwater recharge is deemed appropriate, the quality of the water collected from the site for this purpose is to meet current Guidelines for	The quality of water has been designed in accordance with the latest water quality objectives adopted for Saltwater Lagoon and Creek. See section 4.3.1 for the criteria adopted.

Managing Risks in Recreational Water and ANZECC Guidelines.	MUSIC modelling pollutant load comparison (Table 8 Pre and Post development pollutant load comparison that site discharge will be of superior quality than the pre-developed condition.
4.3 Water Cycle Balance	
Desired Outcomes	
DO1 - Hydrological processes are managed so that: *• Peak flows do not exceed the natural conditions of the site;* *• Environmental flows in relation to surface and groundwater are maintained;* *• Flow duration and velocity is managed to maintain downstream waterway morphology; and* *• Continuing filtration maintains downstream ground water systems at pre-development levels.*	The stormwater system has been provided with a bioretention basin and infiltration trench. These will allow runoff to slowly percolate into the ground instead of being discharged to a single outflow point. The bioretention basin and infiltration trench will also treat the storm water quality to acceptable levels and recharge the groundwater system in a wat that mimics the pre-developed condition.
Development Requirements	
a) A Water Balance Assessment is to be provided for developments where the water balance will be disturbed. *(i) Where the development drains into a designated wetland, a Wetlands Water Balance Report is to be prepared by an appropriately qualified and experienced person having regard to, but not limited to, precipitation, surface water, groundwater etc.*	A designated wetland is located adjacent to the site. Care has been taken in the design to mitigate any changes to downstream hydrology. Surface drainage collected over the site will not be directly discharged into the designated wetland. Instead, Bioretention basins and an infiltration trench have been deigned to capture and slowly infiltrate stormwater runoff into the ground, thereby, protecting the designated wetland by maintaining the existing hydrological water quality. The volume of rainwater capture by the basins and the trench have been designed in accordance with the groundwater report [4] to ensure sufficient groundwater recharge and to avoid disturbing the water balance.
b) No direct drainage to designated Wetlands or associated buffers and or habitat protection zones will be permitted.	A designated wetland is located adjacent to the site. Care has been taken in the design to mitigate any changes to the downstream water balance. An average of 40m buffer zone has been provided between the development impact zone and the

	site boundary in conformance with the BDAR [2] and the specialist wetland consultant AWC [7]. Surface drainage collected over the site will not be directly discharged into the designated wetland. Instead, Bioretention basins and an infiltration trench have been deigned to capture and slowly infiltrate stormwater runoff into the ground, thereby, protecting the designated wetland. The volume of rainwater capture by the basins and the trench have been designed in accordance with the groundwater report [4] to ensure sufficient groundwater recharge and to avoid disturbing the water balance.
c) The development is not to alter the natural water balance of downstream wetlands.	Infiltration trenches have been included to mimic the existing stormwater regime to avoid altering the natural water balance.
d) All stormwater passing through the development from the surrounding catchment is to be controlled and managed.	Upstream catchment has been delineated and runoff is either collected or diverted as detailed in this report.
e) Identify stormwater quantity management practices and procedures for estimating the performance of these practices in accordance with Council's Engineering Guidelines for Subdivision and Development.	Stormwater quantity has been designed in accordance with Kempsey council chapter D5 requirements.
f) Stormwater systems are to minimise erosion.	Stormwater outfall is not concentrated at a single point but rather discharges into bio-retention swales and infiltration trench where they slowly percolate into the ground.
g) A stormwater system does not adversely detract from the principal function of open space areas where they are utilised for infiltration of runoff and stormwater retention.	The bioretention basins and the infiltration trench have been allocated to an area north of the east-west road (MC01) and do not adversely affect open spaces available around the site.
4.4 Stormwater Reuse (Harvesting)	
Desired Outcomes	
DO1 - Proposed urban stormwater harvesting and reuse option planning and design has regard for the current version of the NSW Government publication	Rise projects has been informed by Kempsey Council about the availability of a recycled water network in the vicinity of the site and advised on extending the network into the site. Chapter B5, Section 4.2 of the Kempsey DCP specifically states: "*In areas where there is an*

Managing Urban Stormwater Harvesting and Reuse.	*existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*" In addition, Section 4.3 states: *"In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*"
DO2 - In developments where it is suitable to install rainwater tanks, the tanks are *sized having regard for the area of the roof, soils, rainfall, anticipated usage, the Rainwater Tank Design and Installation Guide (Australian Water Commission) and the NSW Department Health requirements.*	Rise projects has been informed by Kempsey Council about the availability of a recycled water network in the vicinity of the site and advised on extending the network into the site. Chapter B5, Section 4.2 of the Kempsey DCP specifically states: "*In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*" In addition, Section 4.3 states: *"In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*"
Development Requirements	
a) Stormwater harvesting options will generally not be permitted where the development has or will have access to a Council recycled water supply *system.*	Rise projects has been informed by Kempsey Council about the availability of a recycled water network in the vicinity of the site and advised on extending the network into the site. Chapter B5, Section 4.2 of the Kempsey DCP specifically states: "*In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*" In addition, Section 4.3 states: *"In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*"
b) Urban stormwater harvesting and reuse is not to be used as a source of raw *water for use in large scale potable water schemes.*	Rise projects has been informed by Kempsey Council about the availability of a recycled water network in the vicinity of the site and advised on extending the network into the site. Chapter B5, Section 4.2 of the Kempsey DCP specifically states: "*In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*"

	In addition, Section 4.3 states: *"In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse."*
c) In developments where it is suitable to install Porous Pavement the area is isolated from sources of sediment during construction and post construction and is not a high or heavily trafficked area.	Porous pavements will be installed in some parking areas not subject to heavy vehicular loads.
d) In developments where suitable site conditions allow the installation of infiltration devices are permitted. Design and construction is to be consistent with Councils Engineering Guidelines for Subdivision and Development, the inlet is fitted with a silt trap and overflow pipe connected to the stormwater drainage system.	Infiltration system detailing to be done at CC stage.
e) Council will require any proposal to store rainwater in an underground aquifer for later non-potable reuse will require a detailed Design and Management Plan prepared by an experienced and qualified person which addresses elements such as hydrology, hydrogeology, soils, pollutants, public health and any other related matters.	Infiltrating rainwater will not be reused.
f) In developments where it is suitable to install rainwater tanks the source of the rainwater is to be limited to rooves, the collection system is to have a first flush device for removing pollutants, the water from the tank is to be used in the main for toilet flushing irrigation and laundry, the overflow is connected to an infiltration device (where soils allow) or the stormwater drainage system, noise from pressure pumps do not exceed 5dB(A) above ambient background noise measured at the lot boundary.	Rise projects has been informed by Kempsey Council about the availability of a recycled water network in the vicinity of the site and advised on extending the network into the site. Chapter B5, Section 4.2 of the Kempsey DCP specifically states: "*In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*" In addition, Section 4.3 states: *"In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse."*
g) In developments where it is suitable to install rainwater tanks and the source	Rise projects has been informed by Kempsey Council about the availability of a recycled water

of the rainwater is other than roof water (driveways, paved areas or grassed surfaces) then there will be no interconnection with the potable water supply network at the site, the collection system has integrated into it first flush pit or oil/grit separator and the fixtures are to be marked "Not Suitable for Drinking".	network in the vicinity of the site and advised on extending the network into the site. Chapter B5, Section 4.2 of the Kempsey DCP specifically states: "*In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*" In addition, Section 4.3 states: *"In areas where there is an existing and or proposed recycled water system water tanks cannot be used to treat or store water for reuse.*"
4.5 Natural Drainage Systems	
Desired Outcomes	
DO1 - The impact of stormwater on natural watercourses, aquatic habitat and riparian vegetation mimics the pre-development natural drainage system.	Bio-retention basins and infiltration trenches have been proposed to recharge groundwater to mimic the natural drainage system and provide habitat for Wallum froglets as recommended in the biodiversity report.
Development Requirements	
a) Incorporate natural water courses within the development as part of the drainage network and integrate into public open space to minimise use of artificial drainage systems.	No natural water courses run through the development
b) Retain and restore riparian vegetation (Controlled Activity refer NSW Office Water) to improve water quality through bio-filtration.	Not applicable to this site as it this not run through a riparian corridor.
c) Identify and address future management strategies affecting development having regard for any relevant plans, including but not limited to, Estuary Management Plans, Flood Management Plans and Stormwater Management Plans.	A scoping study for Saltwater Creek and Lagoon [10] has been prepared by Water Technology to set the long-term management of the estuary. The development has complied with relevant sections of the study, including but not limited to identifying and maintaining a buffer from designated coastal wetlands, complying with water quality criteria set by Stage 2 [11] of the study, protecting the biodiversity and fauna of the development site, identifying and mitigating flood risks associated with the development. A detailed groundwater assessment [4] is also currently underway to assess the impacts of the proposed development on the groundwater regime. The design of the site will be refined to address any new requirements that may arise as the ongoing studies develop.

d) Minimise the use of artificial drainage systems and convert drains into natural streams.	The stormwater system has been designed with bioretention basins and infiltration trenches to mimic the natural predeveloped conditions.
4.6 Public Health	
Desired Outcomes	
DO1 - The stormwater management system is designed and constructed to minimise adverse impacts on public health.	Public health was considered when designing the stormwater system. Bio-Retention basins have been designed with porous sides to prevent long periods of ponding water which may serve as a habitat for disease carrying mosquitos as per the Mosquito Risk Assessment report.
Development Requirements	
a) Identify the health effects of the urban development proposal and measures to mitigate those effects having regard to the NSW Government publication Healthy Urban Development Checklist guidelines.	The Healthy Urban Development Checklist covers a broader scope than specifically covered in this report. This report has been assessed against the HUDC, effects have been identified and the measures in this report are considered appropriate to mitigate impacts. The design elements in this report appropriately address the applicable requirements of the HUDC, including walkability, active transport, streetscape, open space, water quality and environmental sustainability.
b) Safety and convenience for pedestrians and traffic in frequent stormwater flows is provided by controlling these flows within prescribed limits.	Roads have been designed to accommodate major flows while complying with Kempsey council chapter D5 requirements. Velocity depth criteria has been designed to not exceed 0.4 m^2/s while the maximum gutter flow width shall not exceed 2.5m.
4.7 Protection of the Built Environment	
Desired Outcomes	
DO1 - The built environment is suitably protected from the impacts of flooding and water-logging.	A flood study "Lot 2 Phillip Drive Flood Impact Assessment" has been prepared by Water Modelling Solutions. The development is following recommendations in that report, such as fill levels and freeboard requirements, so the development can withstand the flood effects of 1% AEP.
DO2 - The design of the stormwater management system will result in the prevention of stormwater damage to property and the natural environment.	A flood study "Lot 2 Phillip Drive Flood Impact Assessment" has been prepared by Water Modelling Solutions. The development is following recommendations in that report, such as fill levels , freeboard and D x V product requirements, so the development can withstand the flood effects of 1% AEP.
Development Requirements	

a) Store and detain excess runoff from large rainfall events in parks and multiple use corridors.	Bioretention basins and an infiltration trench are proposed to store and infiltrate runoff. The design keeps excess runoff diverted and stored away from the built environment.
b) Convey excess groundwater to the nearest watercourse.	An infiltration trench has been proposed on site to mimic the pre-developed groundwater flow regime.
4.8 Best Practice and ESD	
Desired Outcomes	
DO1 - Best practice stormwater management incorporating the principles of Ecological Sustainable Development are adopted in the design of stormwater management systems.	The stormwater system has been designed in line with the recommendation in the Biodiversity Development Assessment Report to ensure a sustainable ecosystem
Development Requirements	
a) Best practice should ensure decisions in relation to development have regard for stormwater impacts on receiving waters and corrective measures are deployed in a cost effective, integrated and organized way. The current Australian Guidelines for Urban Stormwater Management represent current best practice in stormwater planning and management in Australia.	The stormwater system has been designed in line with considerations outlined in the with the *Australian Guidelines for Urban Stormwater Management (AGUSM).* Water quality targets mentioned in AGUSM has been met have been met as detailed in Section 4.3of this document. The system has been designed to minimise impacts to the current hydrology by using bioretention basins and an infiltration trench to maintain the existing groundwater regime and protect the habitats of fauna living downstream of the site in accordance with recommendations from the BDAR [2] and Wetlands consultant [7]. Source control methods, including landscaping, open areas and porous pavements have been employed around the site to reduce runoff quantity.
b) Ecologically Sustainable Development meets the community needs whilst conserving and improving ecosystems for the benefit of future generations.	The stormwater system has been designed in line with the recommendation in the Biodiversity Development Assessment Report to ensure a sustainable ecosystem

4.9 Economic Maintenance	
Desired Outcomes	
DO1 – The stormwater system will be economical to maintain.	The stormwater system, including the pit and pipe system, bioretention basins and infiltration trench have been assessed and found to be feasible and suitable for economical management by the community title management scheme.
DO2 - Stormwater management is efficient and reduces potable water demand.	Not applicable to this site as a recycled water system is available to the site to reduce potable water demand.
Development Requirements	
a) Determine the economic viability of the proposed stormwater management practices to be deployed having regard for not only the capital cost but the ongoing operation and maintenance costs over the life cycle of these practices.	The stormwater system, including the pit and pipe system, bioretention basins and infiltration trench have been assessed and found to be feasible and suitable for economical management by the community title management scheme.
b) Stormwater management devices which are not affordable on an ongoing basis and compromise the effectiveness of the device will not be accepted.	The stormwater system, including the pit and pipe system, bioretention basins and infiltration trench have been assessed and found to be feasible and suitable for economical management by the community title management scheme.
4.10 Social, Cultural and Aesthetic Values	
Desired Outcomes	
DO1 - Sites of cultural or heritage significance are identified and maintained.	An "Aboriginal Cultural Heritage Assessment Report" has been prepared by Everick Heritage. The report indicated that no heritage sites were identified in project area.
DO2 - The stormwater management system does not have a significant adverse impact on social, cultural and aesthetic values.	The report by Everick indicated that no heritage sites were identified in project area. The infiltration trench and swale are lined by grass and will have a low visual impact while the bioretention basin will be landscaped with suitable planting and made aesthetically pleasing.
Development Requirements	
a) The stormwater management system complies with the relevant Desired Outcomes and Development Requirements of: *(i) Chapter B12 - Aboriginal Heritage; and* *(ii) Chapter B13 – Heritage Areas/Developments.*	An "Aboriginal Cultural Heritage Assessment Report" has been prepared by Everick Heritage. The report indicated that no heritage sites were identified in project area.

4.5 SALTWATER CREEK FLOOD IMPACT

The flood impact assessment report [9] has identified Saltwater Creek as flooding during the 1% AEP event. Referring to Figure 12 below, the 1% AEP flood level that impacts the site (stage 1) following introduction of fill along the boundary extents is RL 2.84m AHD. Therefore, it is recommended that all areas within the development site are to be raised above RL 2.84m AHD and all habitable floor levels to be sited at a minimum RL 3.34m AHD (1% AEP + 0.5m freeboard).

Figure 13 below show the peak depth for the PMF event. The flood assessment report has proposed an evacuation route (Figure 14) for safe egress to South West Rocks via Phillip Drive in case of a PMF event. Further guidance on flooding event can be found in the report.

Figure 12 - 1% AEP Peak Depth for Stage 1 Development

Figure 13 - PMF Peak Depth for Stage 1 Development

Figure 14 Evacuation route

5 CONCLUSIONS

This design engineering report demonstrates that the development has met various development requirements including, but not limited to, roads, biodiversity, stormwater hydrology, water quality and flooding.

Care has been taken to protect the mapped coastal wetland by including an average of 40m buffer and ensuring no development takes places outside the impact footprint.

Roads have been designed to accommodate daily site users and service vehicles while roads widths were designed to comply with the requirements of Rural Fire Services in case of emergencies.

The stormwater design has employed the use of a pit and pipe system as well as bioretention and infiltration trench to minimise impacts to the existing site hydrology and to protect the habitats of fauna downstream of the site. Water quality modelling was undertaken and a NoRBE analysis was performed to show that the development will have no negative impact on the receiving downstream waters.

A flood impact assessment was also undertaken and floor levels and evacuation routes have been identified to ensure the safety of the development and its residents.

Should you require any further advice or clarification of any of the above, please do not hesitate to contact the undersigned.

6 REFERENCES

[1] Varga Traffic Planning, Proposed Subdivision and Mixed-Use Development, Lot 2 Phillip Drive, South West Rocks, Traffic and Parking Assessment Report, March 2022.

[2] Australia, Biodiversity, Biodiversity Development Assessment Report Philip Drive, South West Rocks, March 2022.

[3] Regional Geotechnical Solutions, Preliminary Geotechnical Assessment, Report No., September 2021 .

[4] Australasian Groundwater & Environmental Consultants, Proposed development at Lot 2 Phillip Drive, South West Rocks – Groundwater Assessment Methodology, March 2021.

[5] Blackash Bushfire Consulting, Bushfire Hazard Assessment, February 2022 .

[6] NSW Rural Fire Service, Planning for Bush Fire Protection – A guide for councils, planners, fire authorities and developers, November 2019 .

[7] Australian Wetlands Consulting, Technical Memorandum, March 2022.

[8] D. C. E. Webb, Mosquito Risk Assessment: Saltwater Development, South West, April 2018.

[9] Water Modelling Solutions, Lot 2 Phillip Drive Flood Impact Assessment, March 2022.

[10] Water Technology, Stage 1 Scoping Study for the Saltwater Creek and Lagoon Coastal Management Program, September 2020.

[11] Alluvium, Saltwater Creek and Lagoon Estuary CMP Stage 2, Water Quality Assessment, November 2021.

[12] Douglas Partners, Report on Groundwater Impact Assessment, Proposed Stage 1 – Saltwater Development, South West Rocks, Novermber 2013.

For and on behalf of the Xavier Knight team.

Kind regards,

Scott Sharma
PROJECT DIRECTOR

7 APPENDIX A – Civil Engineering Design for DA

SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS, NSW

LOCALITY PLAN

IMAGE FROM SIXMAPS
23.03.2022

DRAWING SCHEDULE	
Sheet Number	Sheet Title
C000	COVER PAGE
C002	GENERAL ARRANGEMENT PLAN
C020	SEDIMENT AND EROSION CONTROL PLAN
C021	SEDIMENT AND EROSION CONTROL DETAILS
C022	SEDIMENT AND EROSION CONTROL NOTES
C030	ROAD TYPICAL SECTIONS SHEET 1
C031	ROAD TYPICAL SECTIONS SHEET 2
C040	CIVIL WORKS PLAN SHEET 1
C041	CIVIL WORKS PLAN SHEET 2
C045	DRAINAGE DETAILS
C050	ROAD LONGITUDINAL SECTION
C060	TURNING PATH PLAN
C070	MUSIC CATCHMENT PLAN
C071	STROMWATER CATCHMENT PLAN

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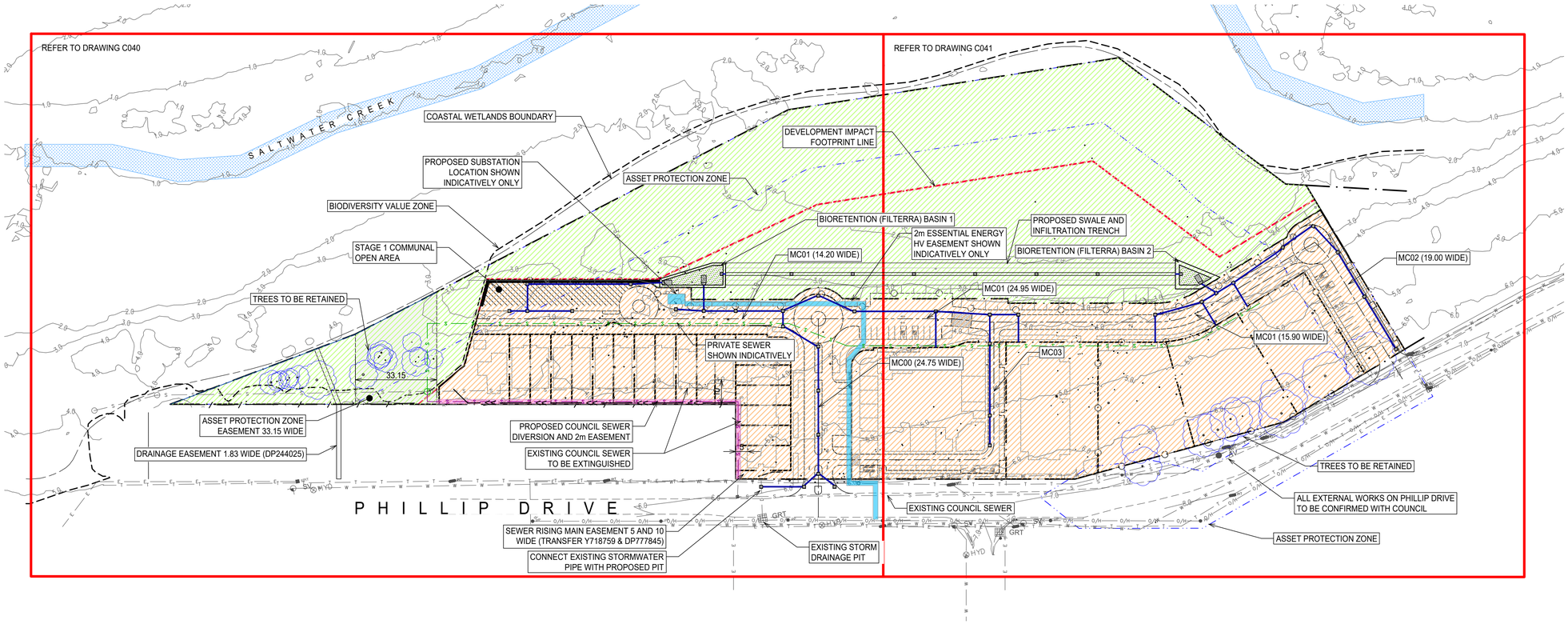
SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
COVER PAGE

Scale at A1	Drawn	Approved
NTS	AA	SS
Job No	**Drawing No**	**Revision**
211107	C000	B



LEGEND

- STAGE 1 WORKS
- STAGE 2 WORKS
- PROPOSED SEWER EASMENT
- PROPOSED ELECTRICAL EASMENT (INDICATIVE)
- EXISTING TREES TO REMAIN
- STAGE 1 FENCE
- BIODIVERSITY VALUE ZONE
- ASSET PROTECTION ZONE
- DEVELOPMENT IMPACT FOOTPRINT LINE
- COASTAL WETLANDS BOUNDARY
- PROPOSED STORM WATER DRAINAGE
- LOT BOUNDARY
- PROPOSED SEWER
- PROPOSED PRIVATE SEWER (INDICATIVE)
- EXISTING WATER
- EXISTING COMMS
- EXISTING OVERHEAD POWER
- EXISTING STORM WATER DRAINAGE
- EXISTING SEWER
- EXISTING ELECTRICAL
- EXISTING CONTOUR

GENERAL ARRANGEMENT PLAN

SCALE 1:1000

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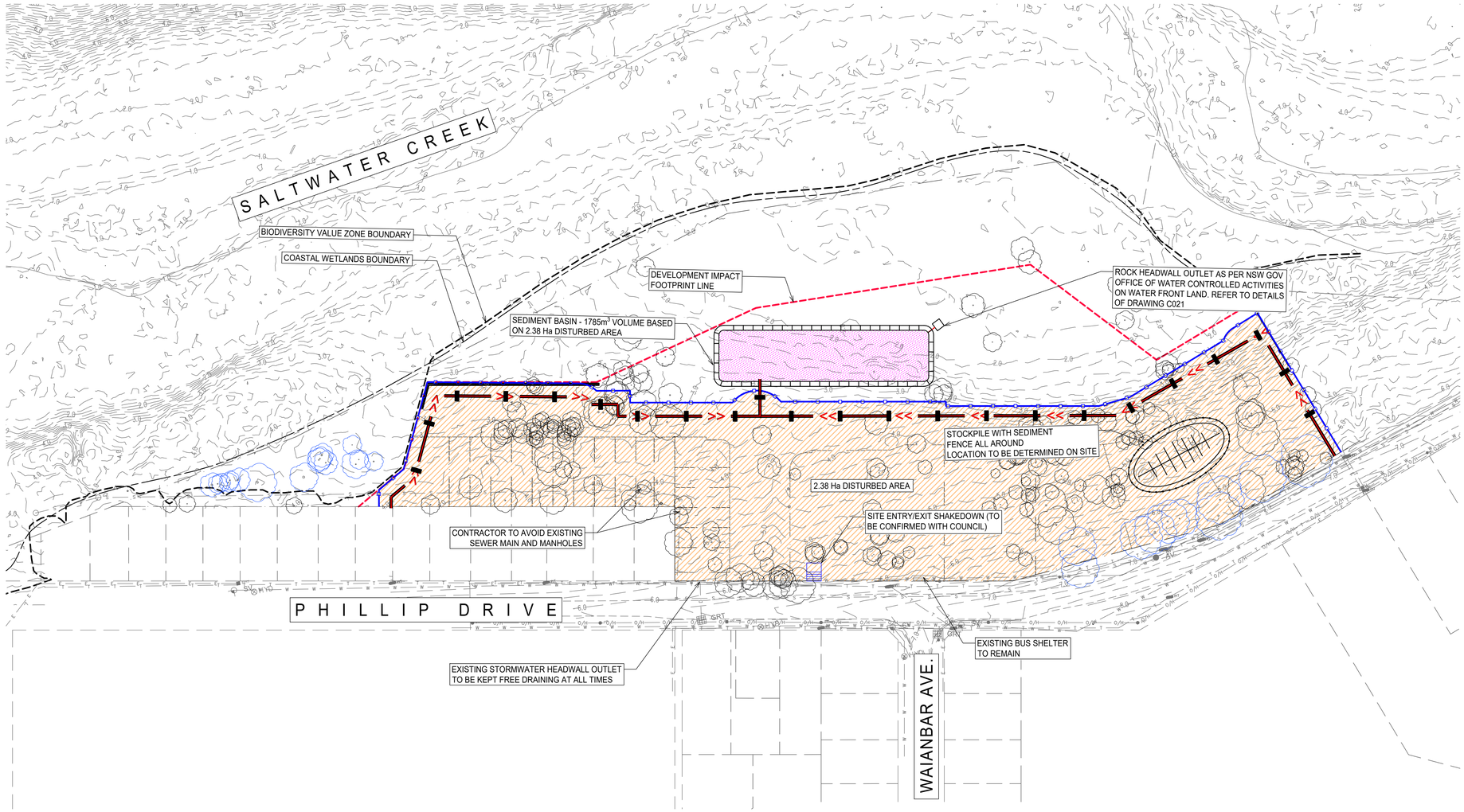
211107	C002	C



LEGEND

- PROPOSED CLEARING AREA
- EXISTING TREES TO REMAIN
- EXISTING TREES TO BE REMOVED
- BIODIVERSITY VALUE ZONE
- DEVELOPMENT IMPACT FOOTPRINT LINE
- COASTAL WETLANDS BOUNDARY
- PROPOSED SEDIMENT FENCE
- PROPOSED PERIMETER BANK (WITH SPARSELY GRASSED SWALE)
- PROPOSED SEDIMENT BASIN
- STOCKPILE
- PROPOSED SITE ENTRY/EXIT
- ROCK CHECK DAM
- PROPERTY BOUNDARY
- EXISTING WATER
- EXISTING COMMS
- EXISTING OVERHEAD POWER
- EXISTING STORM DRAINAGE
- EXISTING SEWER
- EXISTING ELECTRICAL
- EXISTING CONTOUR

RUSLE CALCULATION NOTE:

REVISED UNIVERSAL SOIL LOSS EQUATION:

$A = R * K * LS * P * C$ (t/Ha/yr)

$R = 164.74\ (1.1177)^{S} * S^{0.6444}$

WHERE S = 2-YEAR 6-HOUR RAINFALL INTENSITY = 13.91 mm/h

R = 4224

K = 0.072 (APPROXIMATED)

LS = 0.53 (BASED ON 2.5% SLOPE FOR 80m)

P = 1.2

C = 0.15

A = 29 t/Ha/yr

SITE AREA = 2.38 Ha

SOIL LOSS = 69.02 t/yr < 150 t/yr

HENCE, PER TABLE 4.2 OF LANDCOM BLUE BOOK, EROSION HAZARD = VERY LOW

SEDIMENT AND EROSION CONTROL PLAN

SCALE 1:1000

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SEDIMENT AND EROSION CONTROL PLAN

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Job No	Drawing No	Revision
211107	C020	B

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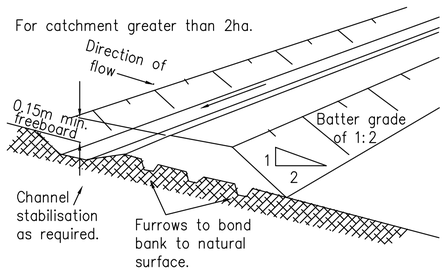
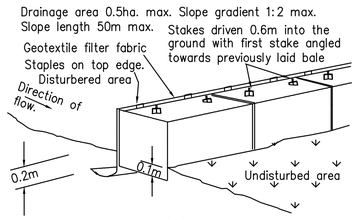
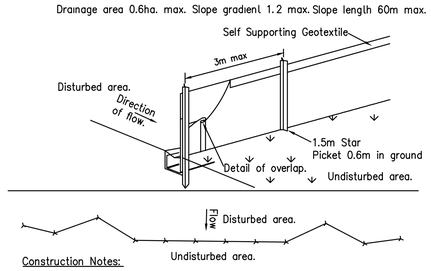


Perimeter Bank (with channel)

CHANNEL DIMENSIONS
TOP WIDTH = 3.5 m
BASE WIDTH = 1.5 m
DEPTH (INCLUDING 150mm FREEBOARD) = 0.65 m



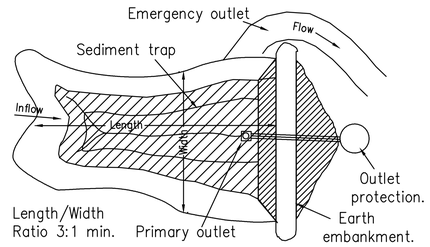
Hay Bale Sediment Fence.



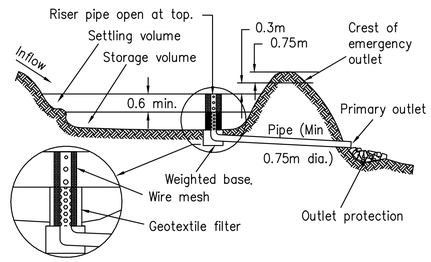
Construction Notes:

1. Construct sediment fence as close as possible to parallel to site contours.
2. Drive 1.5m star pickets into ground 3m apart.
3. Dig 150mm deep trench along upslope line of fence for the bottom of the fabric to be entrenched.
4. Backfill trench over base of fabric.
5. Fix self supporting Geotextile to upslope side of posts with wire ties or as recommended by Geotextile manufacturer.
6. Join sections of fabric at a support post with a 150mm overlap.

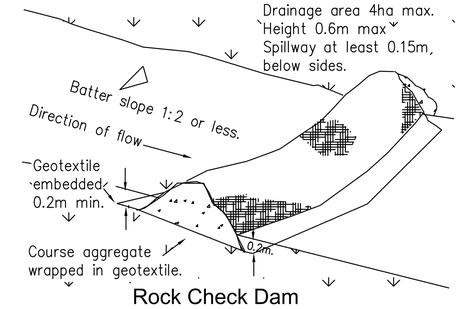
Sediment Fence.



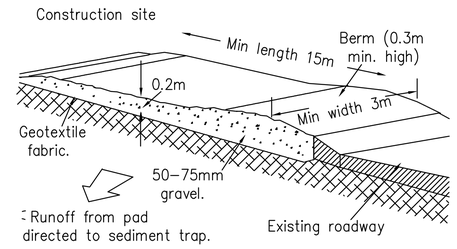
Plan View of Typical Sediment Basin



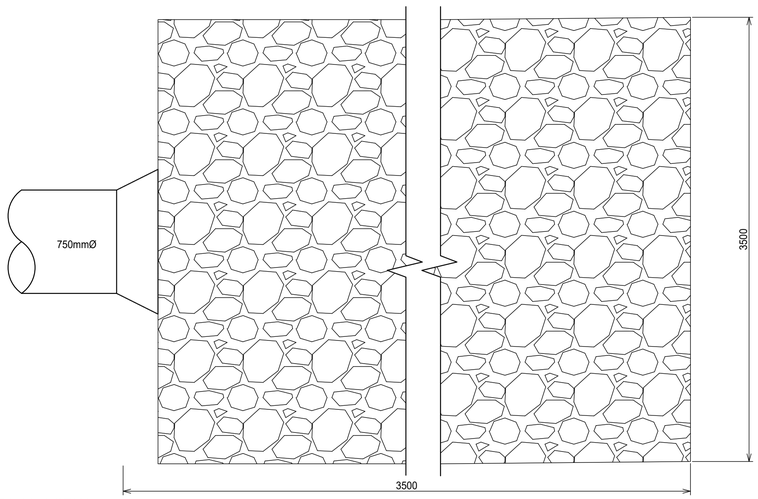
Cross Section of Typical Sediment Basin.



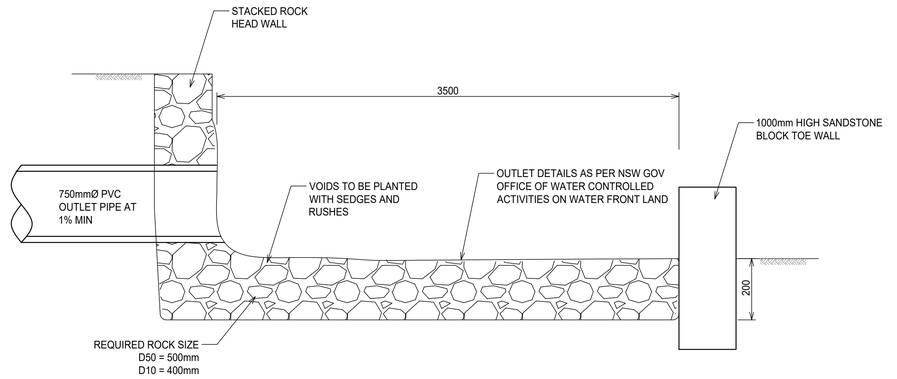
Rock Check Dam



Temporary Construction Exit



PLAN VIEW



ROCK HEADWALL OUTLET STRUCTURE

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PROPOSED CLEARING AND DISTURBANCE WORKS

THE PROPOSED CLEARING AND DISTURBANCE WORKS INCLUDE:

- DEMOLITION AND SITE CLEARING TO SUIT THE FULL EXTENT OF EARTHWORKS PROPOSED FOR THE DEVELOPMENT
- CLEARING AND GRUBBING TO SUIT THE EXTENT OF THE PROPOSED WORKS.

GENERAL CLEARING MEASURES

- SITE INDUCTION IS TO SPECIFY THAT NO CLEARING IS TO OCCUR BEYOND THE MARKED AREA. ALL VEHICLES ARE ONLY TO BE PARKED IN DESIGNATED AREAS.
- CLEARING AND EARTHWORKS IS TO AVOID DAMAGE TO ROOT ZONES OF THE RETAINED TREES.
- NO MATERIALS OR FILL ARE TO BE PLACED UNDER RETAINED TREES OR WITHIN ADJACENT VEGETATION.
- WEEDS ARE NOT TO BE MULCHED WITH NATIVE VEGETATION AND SHOULD BE TAKEN TO A LICENCED LANDFILL FACILITY.

PRE-CLEARING SURVEY AND CLEARING SUPERVISION

- THE CLEARING EXTENT IS TO BE INSPECTED FOR FAUNA BY A QUALIFIED ECOLOGIST IMMEDIATELY PRIOR TO COMMENCEMENT OF ANY VEGETATION REMOVAL INVOLVING MACHINERY AND/OR TREE-FELLING. THIS IS TO OCCUR EACH MORNING IF CLEARING SPANS OVER MULTIPLE DAYS/WEEKS. PRE-CLEARING CHECKS WOULD INCLUDE SEARCHES OF HABITAT (E.G. LIFTING AND DESTRUCTIVE SEARCHES OF LOGS) AND SEARCHES FOR BIRD NESTS. IF POSSIBLE, ANY DETECTED FAUNA IS TO BE RELOCATED OFF-SITE TO NEARBY SUITABLE AREAS (PREFERABLY WITHIN THEIR NATURAL HOME RANGE) PRIOR TO CLEARING.
- DURING THE PRE-INSPECTION, ANY HABITAT FEATURES DETECTED (E.G. HOLLOWS, LOGS, NESTS) ARE TO BE CLEARLY MARKED WITH FLAGGING TAPE TO ALLOW EASY IDENTIFICATION DURING CLEARING.
- THE ECOLOGIST IS TO BE PRESENT ON SITE TO SUPERVISE ALL CLEARING WORKS TO RETRIEVE ANY FAUNA DETECTED DURING WORKS AND UNDERTAKE APPROPRIATE ACTION (E.G. HUMANELY EUTHANISE SEVERELY INJURED ANIMALS AND/OR RELOCATE UNINJURED ANIMALS WHERE POSSIBLE). THE FAUNA SPOTTER MUST ALSO BE PRESENT DURING DE-WATERING OF ANY WATER BODIES ON THE SITE TO RESCUE AND RELOCATE AND STRANDED AQUATIC FAUNA SPECIES.
- A REPORT DETAILING THE RESULTS OF THE CLEARING MONITORING IS TO BE PROVIDED TO THE CONSENT AUTHORITY WITHIN 14 DAYS OF WORKS COMPLETION.

WEED CONTROL

DISTURBANCE OF THE DEVELOPMENT SITE'S SOILS HAS POTENTIAL TO ENCOURAGE WEED INVASION. HENCE, IT IS RECOMMENDED THAT:

- DISTURBANCE OF VEGETATION AND SOILS ON THE SITE SHOULD BE LIMITED TO THE AREAS OF THE PROPOSED WORK AND SHOULD NOT EXTEND INTO ADJACENT VEGETATION;
- ALL PLANT USED FOR CLEARING AND CONSTRUCTION WORKS IS CERTIFIED AS WEED FREE;
- APPROPRIATE COLLECTION AND DISPOSAL OF ALL WEED MATERIAL REMOVED VIA CLEARING;
- ANY RECENT WEED INVASIONS WITHIN THE DEVELOPMENT AREA SHOULD BE REMOVED, AND
- ONGOING WEED CONTROL IN THE DEVELOPMENT AREA.

EXISTING AND PROPOSED DRAINAGE WORKS

EXISTING

- THE SITE, LOT 2 PHIILIP DRIVE, SOUTH WEST ROCKS, NSW SLOPES FROM SOUTH TO NORTH WITH AN AVERAGE PRE-DEVELOPED SLOPE OF AROUND 2.6%. THE CURRENT DEVELOPED SITE CONSISTS OF VACANT LAND WITH MILDLY DENSE VEGETATION. NO EVIDENCE OF FORMAL DRAINAGE STRUCTURES WERE OBSERVED.

PROPOSED DRAINAGE

- AS PART OF THIS DEVELOPMENT, THE FOLLOWING TEMPORARY DRAINAGE WORKS ARE PROPOSED:

TEMPORARY WORKS:

- PLACEMENT OF PERIMETER SEDIMENT FENCING AND INCREMENTAL SEDIMENT TRAPS
- UNLINED DRAINAGE DIVERSION SWALES INCLUDING COIR LOGS PLACED AT NOMINAL 25 M CTRS
- ESTABLISHMENT OF STOCKPILE LOCATIONS
- ESTABLISHMENT OF SEDIMENT BASIN TO SUIT CALCULATED VOLUME (AS REQUIRED)

PRINCIPAL CONTRACTORS RESPONSIBILITIES

- THE PRINCIPAL CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL REQUIRED SEDIMENT AND EROSION CONTROL MEASURES THROUGHOUT THE CONSTRUCTION PHASE OF THIS PROJECT. THE CONSTRUCTION PHASE IS CONSIDERED TO EXTEND THROUGH UNTIL THE FINAL LANDSCAPING HAS ESTABLISHED TO PROVIDE A MINIMUM 70% GROUND COVER OVER AREAS LANDSCAPED AND COMPLETION OF ALL HARDSTAND/GRAVEL SURFACES TO THE DESIGN INTENT. THIS INCLUDES ANY AREAS DISTURBED THROUGH THE CONSTRUCTION WORKS, SUCH AS STOCKPILE LOCATIONS AND LOCALISED ACCESS TRACKS.
- UPON COMPLETION TO THE ABOVE ACCEPTED VEGETATION COVER, THE CONTRACTOR SHALL THEN BE RESPONSIBLE FOR REMOVING ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES, AS WELL AS DESILTING ANY SEDIMENT TRAPS OR BASINS AND DISPOSING OF THE ACCUMULATED SEDIMENTS. THE PROPOSED METHOD OF TRANSPORTATION AND DISPOSAL OF ANY MATERIAL NOT ABLE TO BE REUSED WITHIN THE SITE SHALL BE APPROVED AS PART OF THE PROJECT WASTE MANAGEMENT PLAN.
- THE CONTRACTOR IS REQUIRED TO NOTIFY THE SUPERINTENDENT OF ANY DISCHARGE OFFSITE OF SEDIMENT LADEN WATERS AND ALSO TO NOTIFY THE SUPERINTENDENT OF ANY PLANNED DISCHARGE OF TREATED STORMWATER FROM ANY CONSTRUCTED SEDIMENT BASINS OR OTHER WATER HOLDING DEVICES.

THE FOLLOWING SECTION OUTLINES THE INTENDED EROSION CONTROL FACTORS THAT SHOULD BE CONSIDERED SUFFICIENT FOR THIS SITE, GIVEN THE CLASSIFICATION OF LOW EROSION HAZARD AS PER SECTION 4.4.1 OF THE "BLUE BOOK".

EROSION CONTROL MEASURES

- THE CONTRACTOR IS REQUIRED TO IMPLEMENT THE NECESSARY EROSION CONTROL MEASURES REQUIRED TO MAXIMISE THE RETENTION OF SOILS AT SOURCE. AS A GUIDE, THE FOLLOWING MEASURES SHOULD BE CONSIDERED:

TEMPORARY GROUND COVER OR STABILISATION

- WHERE AREAS OF WORKS ARE TO BE ON-HOLD FOR PERIODS EXCEEDING 14 DAYS, THE CONTRACTOR MAY APPLY A TEMPORARY GROUND COVER TO REDUCE THE SEDIMENT MOVEMENT AND REDUCE DUST GENERATION.
- TEMPORARY GROUND COVERS MAY INCLUDE MULCH, GRAVEL, SEEDING, POLYMER, SURFACE WETTING OR OTHER MEANS TO BIND THE SURFACE.
- ALTERNATIVE MANAGEMENT MAY INCLUDE SURFACE ROUGHENING OR LIGHT SCARIFYING.

NO GO ZONES OR VEGETATIVE FILTER STRIPS

- WHERE AREAS OF THE SITE ARE CURRENTLY VEGETATED/STABILISED AND NOT INTENDED TO BE DISTURBED, THE CONTRACTOR SHALL NOMINATE VIA INSTALLATION OF FLAGGING, A NO-GO ZONE FOR THIS AREA. THIS IS INTENDED TO KEEP ALL VEHICLES, STOCKPILES OR MATERIALS OFF THESE AREAS TO PROTECT THE SOIL STRUCTURE AND EXISTING VEGETATION.
- EXISTING VEGETATION SHOULD ALSO BE RETAINED WHERE POSSIBLE DOWNSTREAM OF DISTURBED AREAS TO ENHANCE THE SEDIMENT REMOVAL AT SOURCE.

DUST CONTROL

- TEMPORARY PROTECTION FROM WIND AND WATER EROSION WILL BE UNDERTAKEN ON LANDS WHERE WORKS ARE UNLIKELY TO PROCEED FOR PERIODS OF AT LEAST TWO MONTHS AND FINAL SHAPING HAS NOT BEEN COMPLETED (EG. TOPSOIL STOCKPILES). THIS MAY BE ACHIEVED WITH A VEGETATIVE COVER. A RECOMMENDED LISTING OF PLANT SPECIES FOR TEMPORARY COVER IS AS FOLLOWS:-

SEPTEMBER - MARCH SOWING	-	JAPANESE MILLET @ 50 KG/HA
APRIL - AUGUST SOWING	-	OATS/RYECORN @ 50 KG/HA
	-	TETILA RYE @ 5 KG/HA

FOOT AND VEHICULAR TRAFFIC SHOULD BE KEPT AWAY FROM ANY REHABILITATED AREAS WHERE PRACTICAL.

- DURING WINDY WEATHER, LARGE, UNPROTECTED AREAS ARE TO BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER FOR DUST CONTROL.

SEDIMENT CONTROL MEASURES

STABILISED SITE ACCESS

- A STABILISED SITE ACCESS SHALL BE PLACED AS PART OF THE INITIAL EROSION AND SEDIMENT CONTROL ESTABLISHMENT. THE LOCATION SHALL ALLOW ACCESS FOR ALL VEHICLES EXITING THE SITE.
- WHERE EVIDENCE OF SEDIMENT TRANSPORTATION ONTO PUBLIC ROADS IS EVIDENT, THE STABILISED SITE ACCESS POINT MAY REQUIRE INCLUSION OF A SHAKER GRATE OR WASH BATH TO AID IN THE REMOVAL OF SEDIMENTS BEFORE EXITING THE SITE.

ROCK CHECK DAMS/COIR LOGS

- ROCK CHECK DAMS/COIR LOGS SHOULD BE ADOPTED BY THE CONTRACTOR TO MANAGE THE VELOCITY OF WATERS AND SETTLEMENT OF SEDIMENTS AS FOLLOWS:
  - ALONG EXCAVATED CHANNELS TO STRIP OUT SEDIMENTS AT REGULAR INTERVALS
  - AT END OF COLLECTION POINTS PRIOR TO DISCHARGE OFFSITE, TO ALLOW FOR A TEMPORARY COLLECTION AND SLOW RELEASE THROUGH INFILTRATION.
- WHERE ROCK CHECK DAMS ARE LOCATED, THE ACCUMULATION OF SEDIMENT SHOULD BE MONITORED AND CLEANED OUT AFTER EACH RAINFALL EVENT.
- WHERE SCOURING IS IDENTIFIED WITHIN EXCAVATED CHANNELS, ROCK CHECK DAMS SHOULD BE CONSIDERED FOR INCLUSION TO MANAGE THE SCOURING.
- TO ASSIST IN REMOVAL OF SEDIMENTS AND ALLOW FOR EASE OF CLEANING, FILTER WRAPPING WITH AN APPROPRIATE GEOTEXTILE SHOULD BE CONSIDERED.

SEDIMENT FENCING

- SEDIMENT FENCING IS INTENDED TO TRAP LARGER SEDIMENTS AT THEIR SOURCE, PREVENTING SEDIMENT TRANSPORTATION INTO PITS, CHANNELS OR OFFSITE. SEDIMENT FENCING SHOULD BE EMPLOYED IN THE LOCATIONS SHOWN ON THE PLAN, PLACED PARALLEL TO THE CONTOURS. WHERE PLACED ALONG SLOPES, RETURNS SHALL BE INCLUDED AT REGULAR INTERVALS TO PREVENT CONCENTRATING FLOW ALONG THE FENCE LINE.
- SEDIMENT FENCES SHALL BE MONITORED REGULARLY TO REMOVE BUILD-UP OF SEDIMENTS THAT MAY CAUSE THE FENCE TO FAIL.
- SEDIMENT FENCES, OR STRAW BALES SHOULD ALSO BE PLACED TO FORM A PERIMETER AROUND STORM WATER PITS TO PREVENT SEDIMENT BLOCKAGE WITHIN PIPES. NOTE, WHERE STRAW BALES ARE USED, THESE SHOULD BE INTENDED FOR SHORT DURATION (LESS THAN 2 MONTHS) AND CLOSELY MONITORED FOR DETERIORATION/LOSS OF STRAW WHICH MAY CAUSE THE BALES TO LOSE THEIR STRUCTURE AND WASH AWAY.

STAGING PLAN

THE SITE CLEARING, ESTABLISHMENT AND GENERAL CONSTRUCTION IS ASSUMED TO BE COMPLETED IN ONE STAGE, THE WORKS WILL INCLUDE:

- CONSTRUCTION OF INITIAL EROSION AND SEDIMENT CONTROL MEASURES INCLUDING STABILISED SITE ACCESS, ESTABLISHMENT OF NO-GO ZONES (WHERE FEASIBLE), PERIMETER SEDIMENT FENCE AROUND PROPOSED SOIL STOCKPILE LOCATIONS.
- CONSTRUCTION OF DIVERSION DRAINAGE INCLUDING PLACEMENT OF COIR LOGS OR OTHER SIMILAR SEDIMENT RETENTION METHODS ALONG THE LENGTH OF DRAINAGE.
- CONSTRUCTION OF SEDIMENT BASIN TO VOLUME REQUIRED, WITH DEPTH MARKERS INSTALLED.
- CLEARING AND GRUBBING WORKS, WITH ANY TOPSOIL INTENDED TO BE REUSED TO BE STOCKPILED IN MAXIMUM 2 METRE HIGH WINDROWS SEPARATE TO GENERAL SOIL STOCKPILES.

SEDIMENT BASINS- INSTALLATION AND MAINTENANCE

- SEDIMENT BASINS SHALL BE CONSTRUCTED AND FULLY OPERATIONAL PRIOR TO ANY OTHER SOIL DISTURBANCE IN THEIR CATCHMENT. CONSTRUCTION SHALL INCLUDE PLACEMENT OF A RAIN GAUGE TO ACCURATELY MEASURE AND RECORD DAILY RAINFALL AS WELL AS PLACEMENT OF A VISIBLE MARKER TO DELINEATE THE REQUIRED SEDIMENT STORAGE ZONE AND SETTLING ZONE.
- PRIOR TO THE CONTROLLED DISCHARGE (E.G. DE-WATERING ACTIVITIES FROM EXCAVATIONS AND SEDIMENT BASINS) OF ANY WATER (GROUNDWATER OR SEDIMENT LADEN WATER) FROM THE SITE DURING CONSTRUCTION, THE FOLLOWING WATER QUALITY OBJECTIVES SHALL BE ACHIEVED:
  - TOTAL SUSPENDED SOLIDS (TSS) TO A MAXIMUM 50MG/L
  - TURBIDITY (MEASURED IN NTUS MAXIMUM OF 60 NTU)
- PRIOR TO ANY FORECAST WEATHER EVENT LIKELY TO RESULT IN SEDIMENT LADEN RUNOFF ON THE SITE, THE SEDIMENT BASIN SHALL BE DEWATERED TO ACHIEVE THE REQUIRED SETTLING ZONE CAPACITY
- NO ALUMINIUM BASED PRODUCTS MAY BE USED, UNLESS APPROVED IN WRITING BY COUNCILS ENVIRONMENTAL OFFICER.
- THE PREFERRED CHEMICAL/AGENT TO BE EMPLOYED IS A GYPSUM BASED PRODUCT. AS A GUIDE, THE INITIAL DOSAGE RATES WILL BE APPROXIMATELY 30 KILOGRAMS PER 100 CUBIC METRES OF TREATED WATER. THIS DOSAGE RATE SHALL BE CONFIRMED AND REFINED FOLLOWING THE OBSERVATIONS OF THE INITIAL TREATMENTS ATTEMPTS.
- THE APPLICATION METHOD SHALL ENSURE THAT THE CHEMICAL/AGENT IS SPREAD THROUGHOUT THE ENTIRE SURFACE OF THE SEDIMENT BASIN AND MIXED THROUGH TO AID IN RAPID SETTLEMENT.
- THE APPLICATION, SETTLEMENT AND SUBSEQUENT TESTING (OR OTHER METHOD OF CONFIRMING WATER QUALITY) IS REQUIRED TO BE ACHIEVED WITHIN FOUR DAYS OF THE CONCLUSION OF THE STORM EVENT, ALLOWING ONE DAY TO PUMP IT OUT TO RESTORE SETTLING VOLUMES. THE NOMINATED PUMP SHOULD ENSURE SUFFICIENT CAPACITY TO ACHIEVE THIS PUMP OUT RATE AND A SUITABLE DESIGN TO COMPLY WITH COUNCIL NOISE RESTRICTIONS.
- ALL MANUFACTURER'S INSTRUCTIONS SHALL BE FOLLOWED FOR THE USE OF ANY CHEMICALS/AGENTS USED ONSITE, EXCEPT WHERE APPROVED BY THE RESPONSIBLE PERSON OR AN APPROPRIATE COUNCIL OFFICER.
- SUFFICIENT QUANTITIES OF CHEMICALS/AGENTS TO TREAT TURBID WATER SHALL BE SECURELY STORED ON-SITE TO PROVIDE FOR AT LEAST THREE COMPLETE TREATMENTS OF ALL BASINS REQUIRING CHEMICAL TREATMENT ONSITE.
- ALL SEDIMENT BASINS SHALL REMAIN FULLY OPERATIONAL AT ALL TIMES UNTIL THE BASIN'S DESIGN CATCHMENT ACHIEVES 70% GROUND COVERAGE, OR SURFACE STABILISATION ACCEPTABLE TO COUNCIL.
- SETTLED SEDIMENT SHALL BE REMOVED AS SOON AS REASONABLE AND PRACTICABLE FROM ANY SEDIMENT BASIN IF:
  - IT IS ANTICIPATED THAT THE NEXT STORM EVENT IS LIKELY TO CAUSE SEDIMENT TO SETTLE ABOVE THE BASIN'S SEDIMENT STORAGE ZONE; OR
  - THE ELEVATION OF SETTLED SEDIMENT IS ABOVE THE TOP OF THE BASIN'S SEDIMENT STORAGE ZONE; OR
  - THE ELEVATION OF SETTLED SEDIMENT IS ABOVE THE BASINS SEDIMENT MARKER LINE.
- SCOUR PROTECTION MEASURES PLACED ON SEDIMENT BASIN EMERGENCY SPILLWAYS SHALL APPROPRIATELY PROTECT THE SPILLWAY CHUTE AND ITS SIDE BATTERS FROM SCOUR, AND SHALL EXTEND A MINIMUM OF 3M BEYOND THE DOWNSTREAM TOE OF THE BASIN'S EMBANKMENT WHERE IN ERODIBLE SOILS.
- ALL MATERIALS REMOVED FROM ESC DEVICES DURING MAINTENANCE, OR DECOMMISSIONING, WHETHER SOLID OR LIQUID, SHALL BE DISPOSED OF IN A MANNER THAT DOES NOT CAUSE ANY ONGOING EROSION OR POLLUTION HAZARD.
- SEDIMENT BASIN WATER QUALITY SAMPLES SHALL BE TAKEN AT A DEPTH NO LESS THAN 200MM BELOW THE WATER SURFACE WITHIN THE BASIN.
- THE VOLUMES AND STORAGE CAPACITIES IDENTIFIED WITHIN THIS SWMP ARE BASED ON A RAINFALL DEPTH ASSOCIATED WITH THE 5 DAY, 75th %ILE RAINFALL EVENT. ANY CHANGE TO THE REQUIRED RAINFALL EVENT WILL REQUIRE AMENDMENT TO THE ASSOCIATED VALUES.

MAINTENANCE AND RECORD KEEPING

- THE SITE MANAGER (PRINCIPAL CONTRACTOR) WILL ENSURE THAT ALL SEDIMENT AND EROSION CONTROL WORKS ARE LOCATED AS INSTRUCTED IN THIS SPECIFICATION OR IN ANY SUBSEQUENT SITE INSTRUCTION AND APPROVED CONSTRUCTION DRAWINGS.
- ALL BUILDERS AND SUB-CONTRACTORS SHALL BE INFORMED OF THEIR RESPONSIBILITIES BY THE SITE MANAGER (PRINCIPAL CONTRACTOR) IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWNSLOPE LANDS AND WATERWAYS.
- RECEPTORS FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER ARE TO BE EMPTIED AS NECESSARY. DISPOSAL OF WASTE SHALL BE IN A MANNER APPROVED BY THE SITE SUPERINTENDENT AND GENERALLY OFF SITE.
- ALL CHEMICALS SHALL BE STORED IN APPROVED, FIT FOR PURPOSE BUNDING, STORAGE BUNDING SHALL HAVE A CAPACITY OF 120% OF THE STORED CHEMICAL.
- AT LEAST WEEKLY, THE CONTRACTOR SHALL INSPECT THE SITE AND ENSURE THAT:-
  - DRAINS OPERATE EFFECTIVELY AND INITIATE REPAIR OR MAINTENANCE AS REQUIRED.
  - SPILLED SOIL (OR OTHER MATERIAL) IS REMOVED FROM HAZARD AREAS, INCLUDING LIKELY AREAS OF CONCENTRATED OR HIGH VELOCITY FLOWS WHERE THERE IS POTENTIAL TO BE TRANSPORTED OFFSITE.
  - REHABILITATED LANDS HAVE EFFECTIVELY REDUCED THE EROSION HAZARD AND INITIATE UPGRADING OR REPAIRS AS APPROPRIATE.
- THE CONTRACTOR SHALL PROVIDE A DETAILED 'LOG BOOK' RECORDING INFORMATION & DATA WITH RESPECT TO THE SEDIMENT & EROSION CONTROL PLAN AND TO ENSURE SEDIMENT CONTROL DEVICES ARE FUNCTIONING PROPERLY. THIS IS TO BE KEPT ON SITE AT ALL TIMES AND UPDATED DAILY. INFORMATION RECORDED MUST INCLUDE:-
  - RAINFALL EVENTS
  - RAINFALL IN MILLIMETERS
  - RESULTS OF ANY INSPECTIONS

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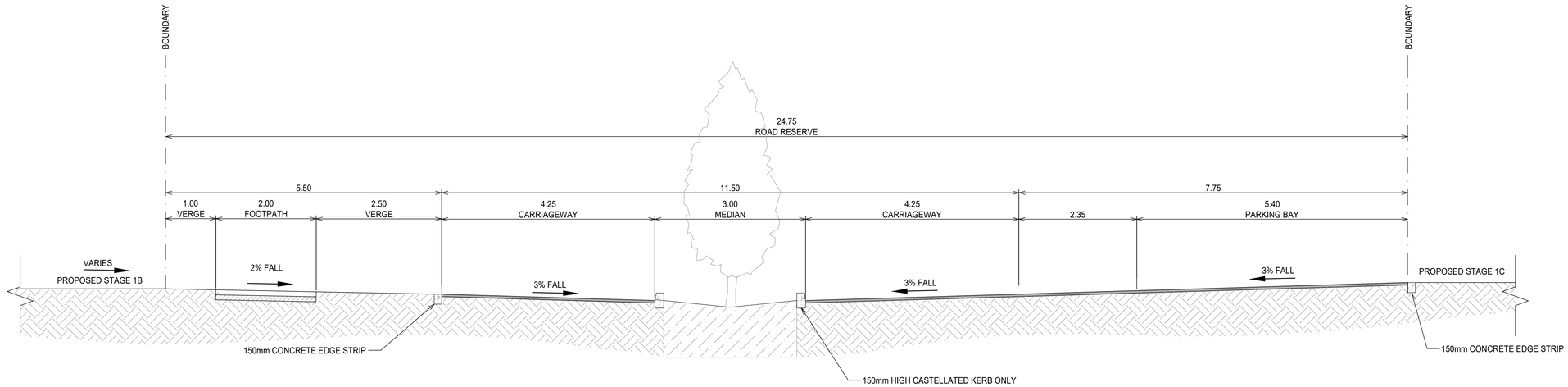
Project
SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
SEDIMENT AND EROSION CONTROL NOTES

Scale at A1	Drawn	Approved
NTS	AA	SS
Job No	**Drawing No**	**Revision**
211107	C022	B



TYPICAL CROSS SECTION (MC00)

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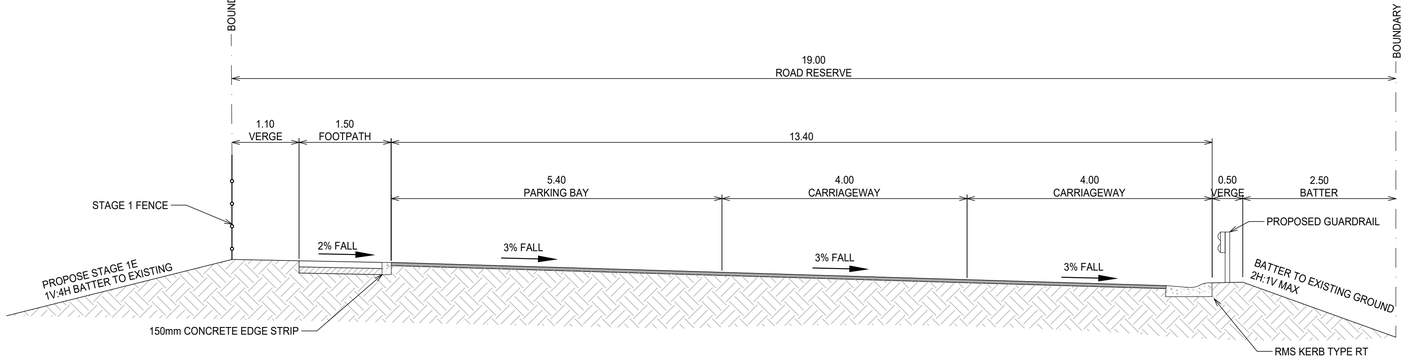
C040



TYPICAL CROSS SECTION (MC02)

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SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
ROAD TYPICAL SECTIONS SHEET 1

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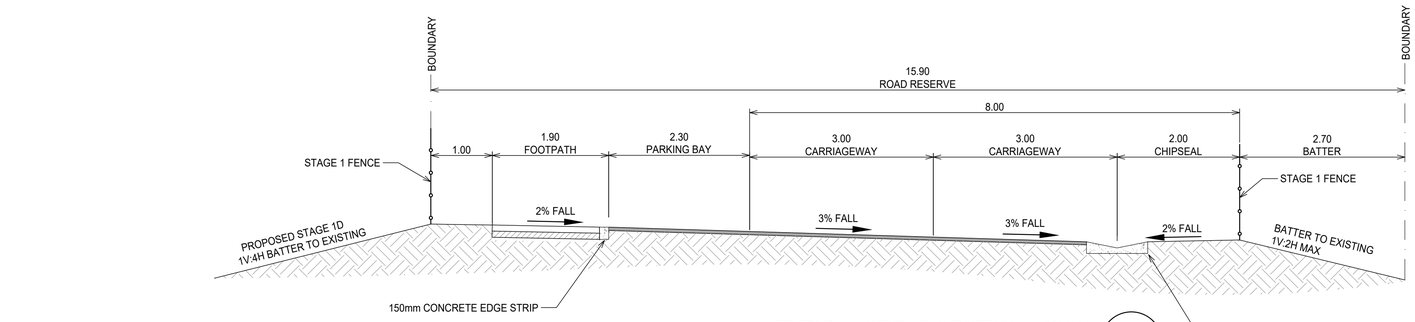
211107	C030	C



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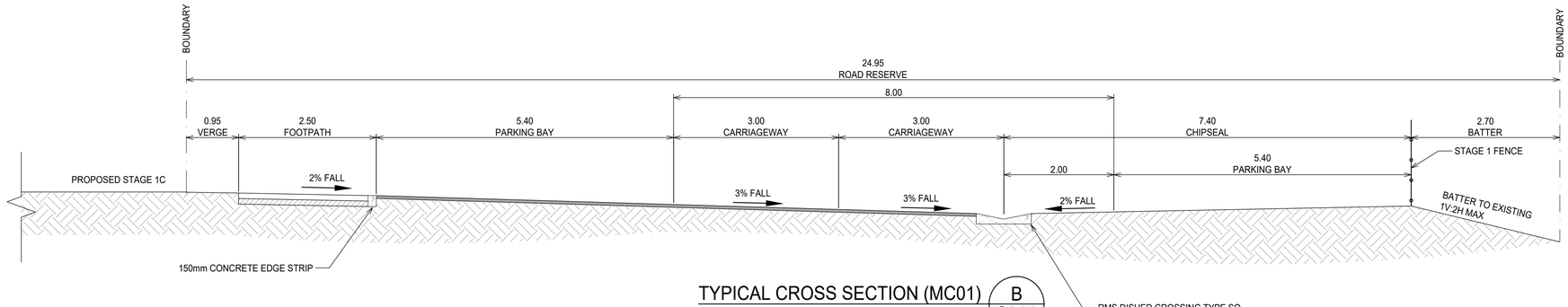

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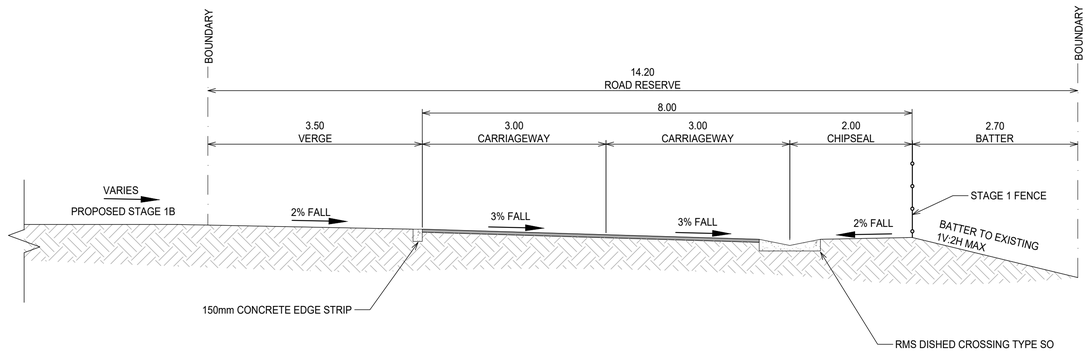

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C040

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SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
ROAD TYPICAL SECTIONS SHEET 2

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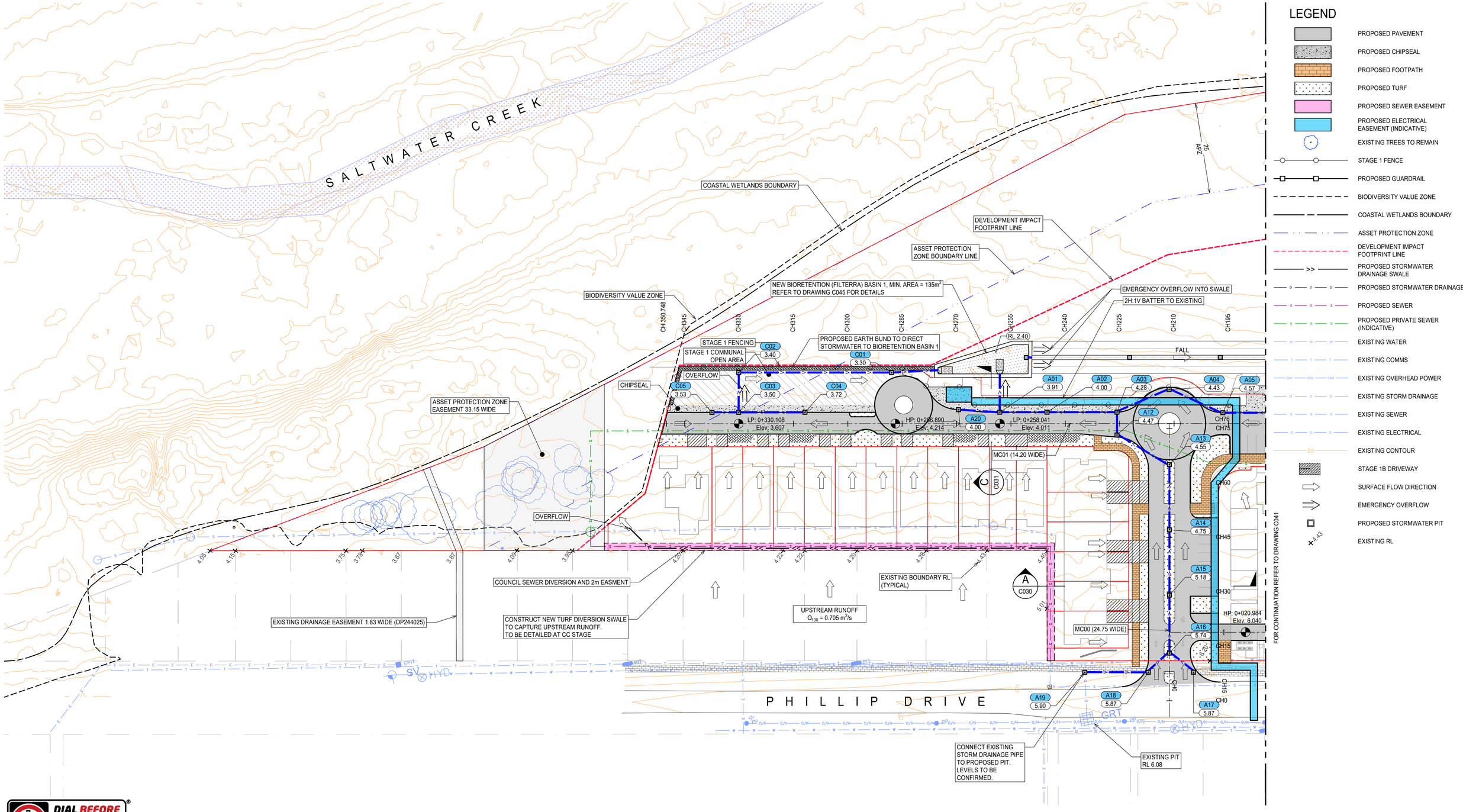
Job No	**Drawing No**	**Revision**
211107	C031	C



LEGEND

- PROPOSED PAVEMENT
- PROPOSED CHIPSEAL
- PROPOSED FOOTPATH
- PROPOSED TURF
- PROPOSED SEWER EASEMENT
- PROPOSED ELECTRICAL EASEMENT (INDICATIVE)
- EXISTING TREES TO REMAIN
- STAGE 1 FENCE
- PROPOSED GUARDRAIL
- BIODIVERSITY VALUE ZONE
- COASTAL WETLANDS BOUNDARY
- ASSET PROTECTION ZONE
- DEVELOPMENT IMPACT FOOTPRINT LINE
- PROPOSED STORMWATER DRAINAGE SWALE
- PROPOSED STORMWATER DRAINAGE
- PROPOSED SEWER
- PROPOSED PRIVATE SEWER (INDICATIVE)
- EXISTING WATER
- EXISTING COMMS
- EXISTING OVERHEAD POWER
- EXISTING STORM DRAINAGE
- EXISTING SEWER
- EXISTING ELECTRICAL
- EXISTING CONTOUR
- STAGE 1B DRIVEWAY
- SURFACE FLOW DIRECTION
- EMERGENCY OVERFLOW
- PROPOSED STORMWATER PIT
- EXISTING RL

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CIVIL WORKS PLAN SHEET 1

SCALE 1:500

NOTES

1. ALL EXTERNAL WORKS SUBJECT TO COUNCIL CONFIRMATION AND APPROVAL.

PRINTING NOTE:

THIS DRAWING TO BE PRINTED IN COLOUR.

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Rev	Description	Eng	Draft	Date
D	ISSUE FOR APPROVAL	AA	AA	01.04.22
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B	UPDATED SITE PLAN	AA	AA	01.03.22
A	ISSUE FOR APPROVAL	AA	AA	03.12.21

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LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
CIVIL WORKS PLAN SHEET 1

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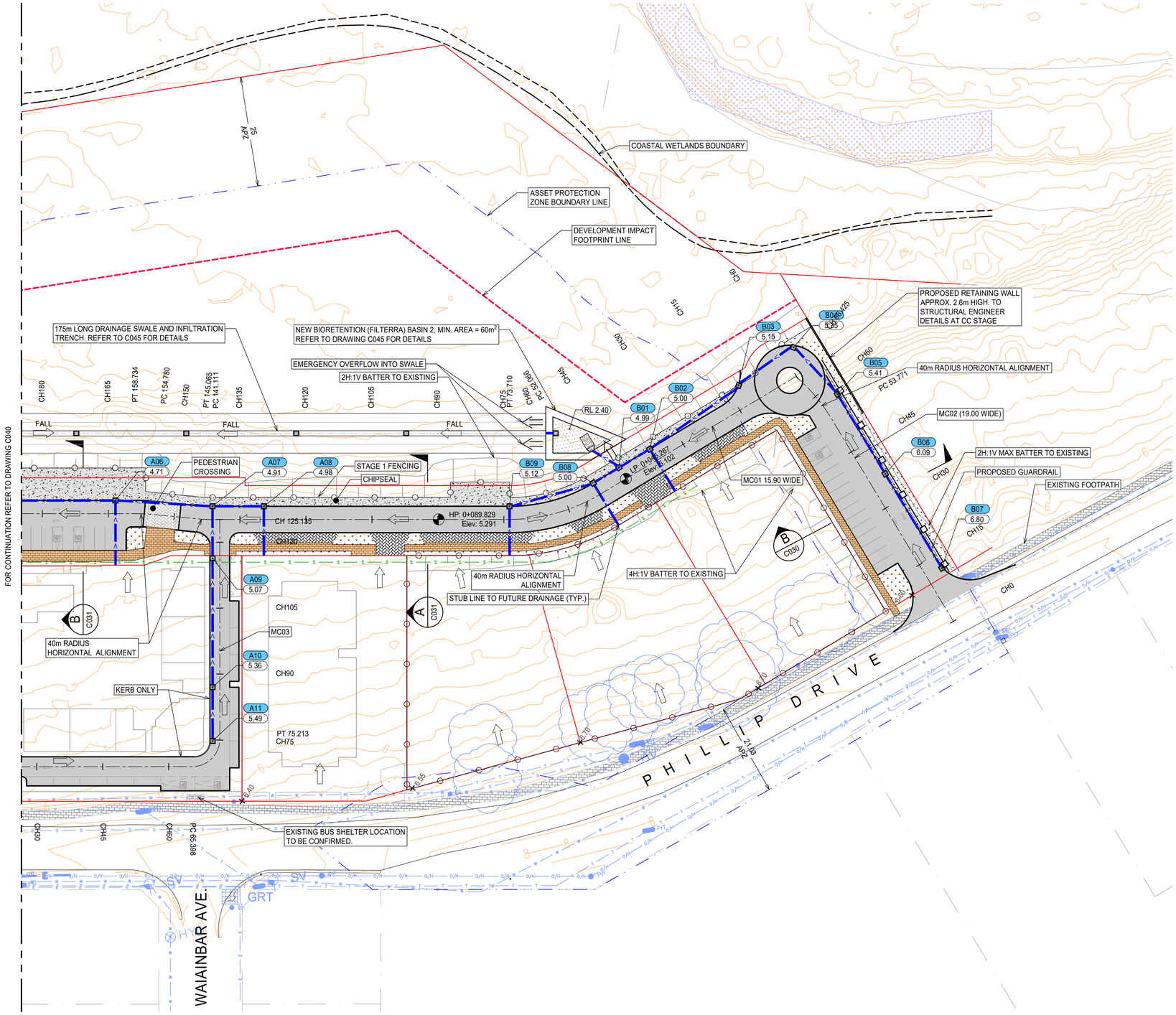
Job No	**Drawing No**	**Revision**
211107	C040	D



LEGEND

- PROPOSED PAVEMENT
- PROPOSED CHIPSEAL
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- EXISTING ELECTRICAL
- EXISTING CONTOUR
- STAGE 1B DRIVEWAY
- SURFACE FLOW DIRECTION
- EMERGENCY OVERFLOW
- PROPOSED STORMWATER PIT
- EXISTING RL

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CIVIL WORKS PLAN SHEET 2

SCALE 1:500

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NOTES

1. ALL EXTERNAL WORKS SUBJECT TO COUNCIL CONFIRMATION AND APPROVAL.

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D	ISSUE FOR APPROVAL	AA	AA	01.04.22
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SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
CIVIL WORKS PLAN SHEET 2

Scale at A1	Drawn	Approved
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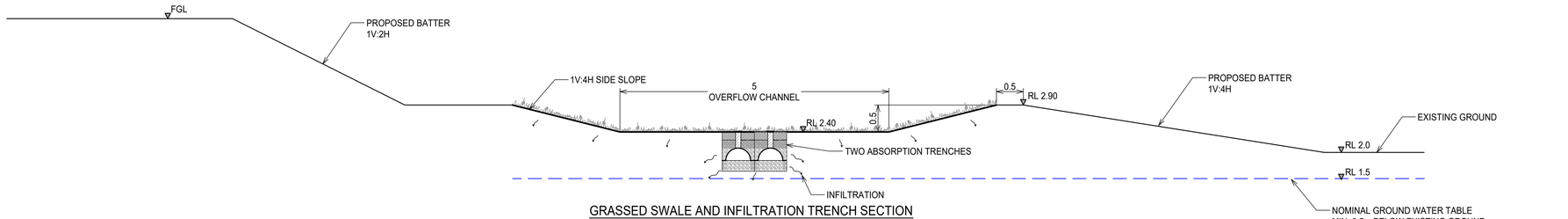
Job No	Drawing No	Revision
211107	C041	D



GRASSED SWALE AND INFILTRATION TRENCH SECTION
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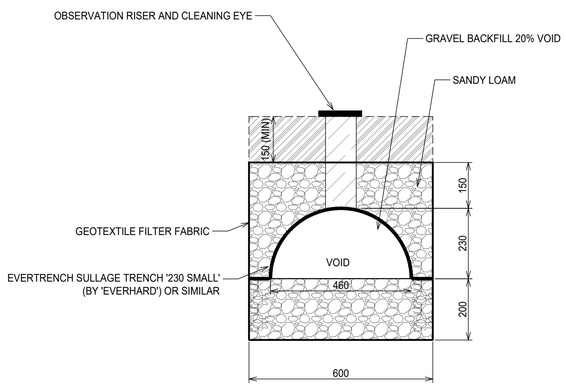

INFILTRATION TRENCH DETAIL
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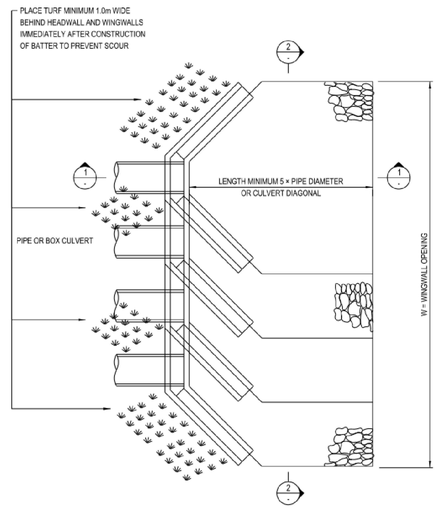
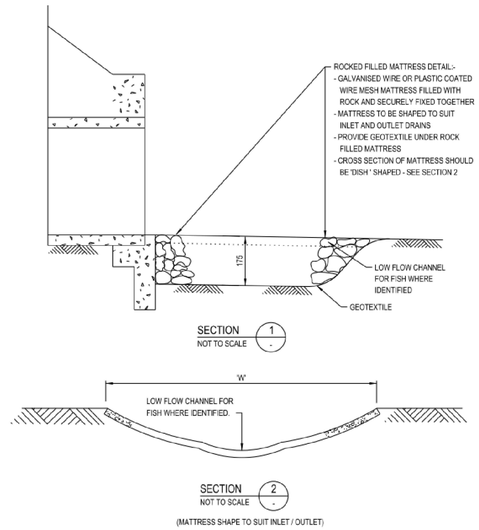
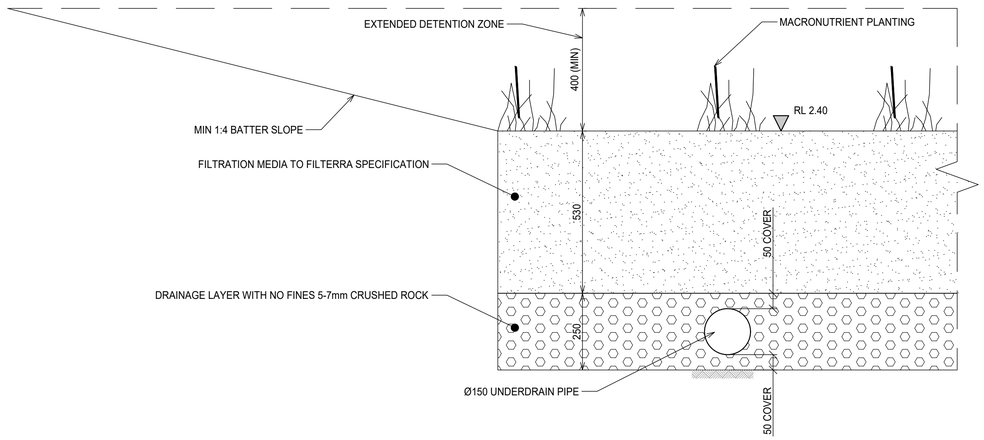


PLAN
CULVERT INLET OR OUTLET



SCOUR PROTECTION DETAILS
SCALE NTS
SOURCE: RMS STANDARD DRAWINGS



BIORETENTION (FILTERRA) BASIN DETAIL
SCALE 1:10

FOR COORDINATION

Rev	Description	Eng	Draft	Date
C	ISSUE FOR APPROVAL	AA	AA	01.04.22
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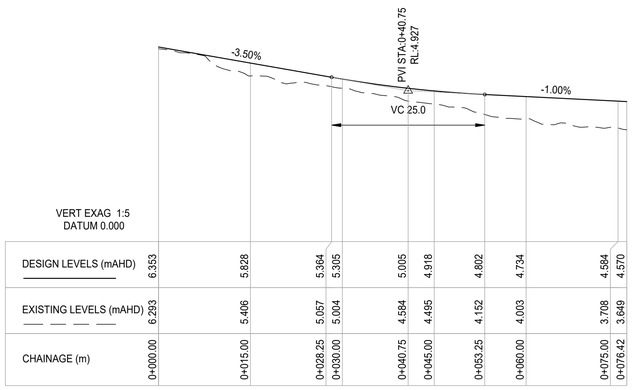
Project
SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
DRAINAGE DETAILS

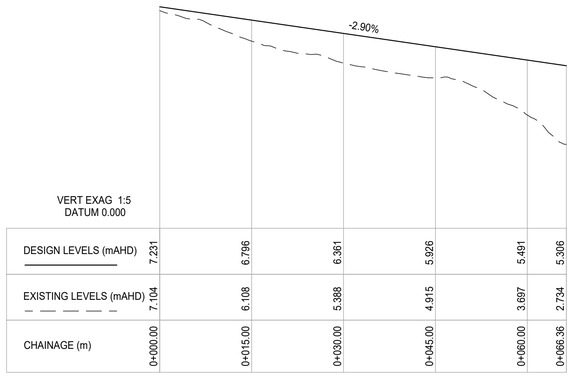
Scale at A1	Drawn	Approved
-	AA	SS

Job No	Drawing No	Revision
211107	C045	C



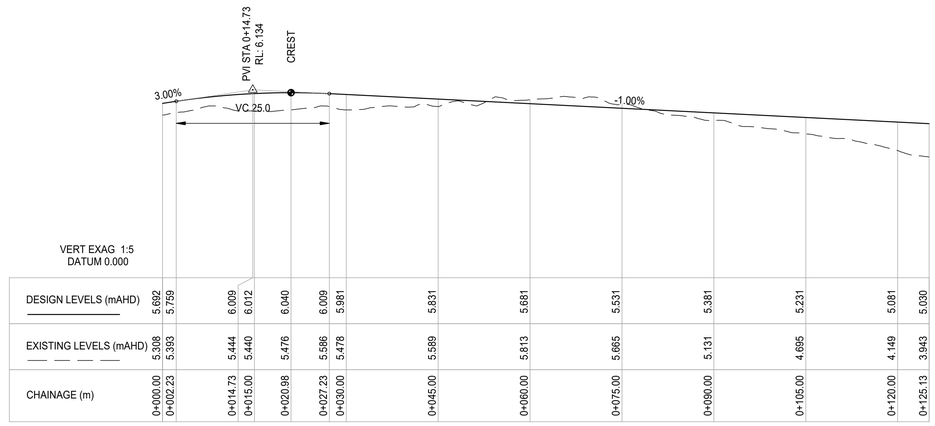
MC00 LONGITUDINAL SECTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



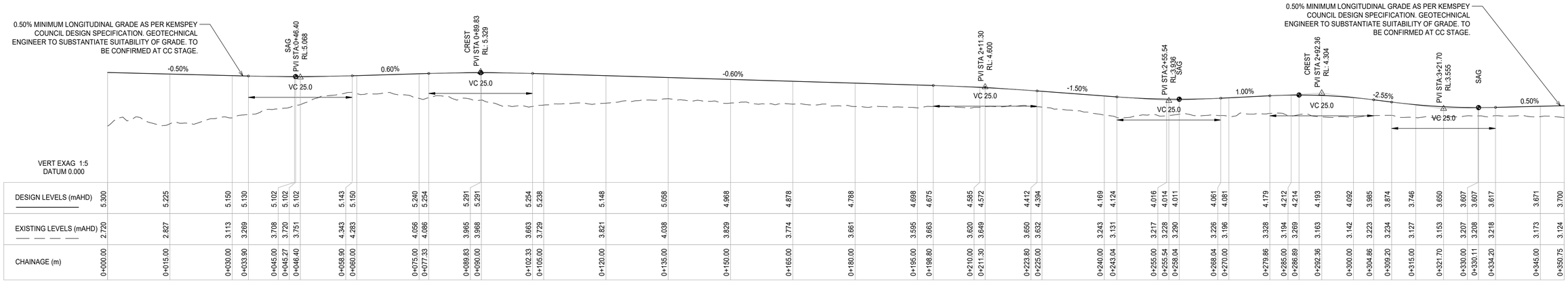
MC02 LONGITUDINAL SECTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



MC03 LONGITUDINAL SECTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100



MC01 LONGITUDINAL SECTION

HORIZONTAL SCALE 1:500
VERTICAL SCALE 1:100

FOR APPROVAL

Rev	Description	Eng	Draft	Date
B	ISSUE FOR APPROVAL	AA	AA	01.04.22
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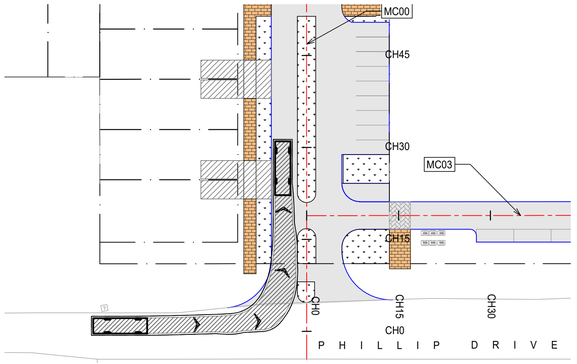
Project
SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
ROAD LONGITUDINAL SECTION

Scale at A1	Drawn	Approved
AS SHOWN	AA	SS

Job No	Drawing No	Revision
211107	C050	B



TURNING PATH 01
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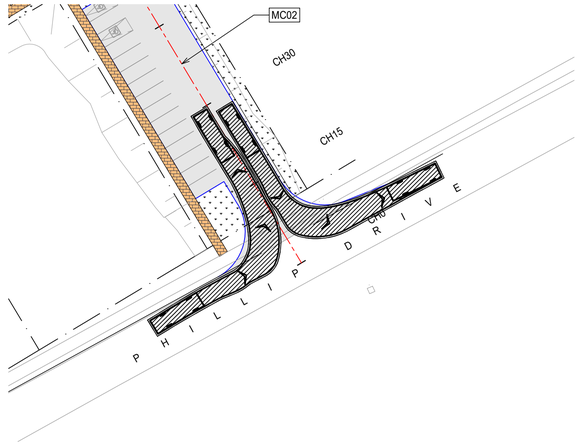

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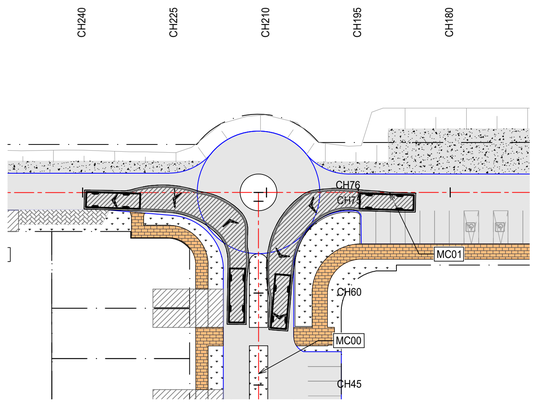
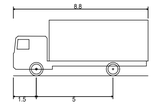


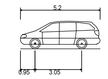
TURNING PATH 03
SCALE 1:500

VEHICLE DIAGRAMS



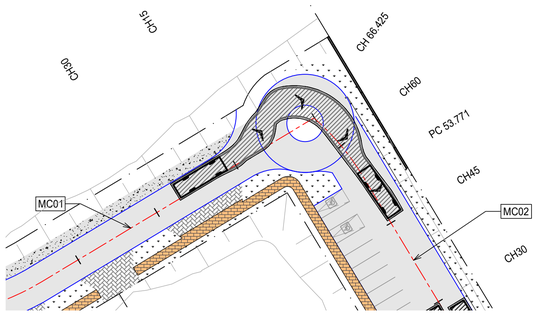
MRV - Medium Rigid Vehicle

Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	10.000m



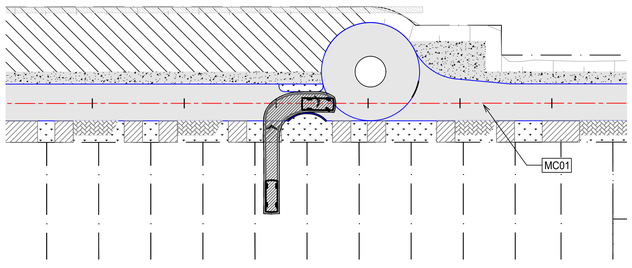
Passenger vehicle (5.2 m)

Overall Length	5.200m
Overall Width	1.940m
Overall Body Height	1.804m
Min Body Ground Clearance	0.295m
Track Width	1.840m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	6.300m



TURNING PATH 04
SCALE 1:500

TURNING PATH 05
SCALE 1:500



TURNING PATH 06
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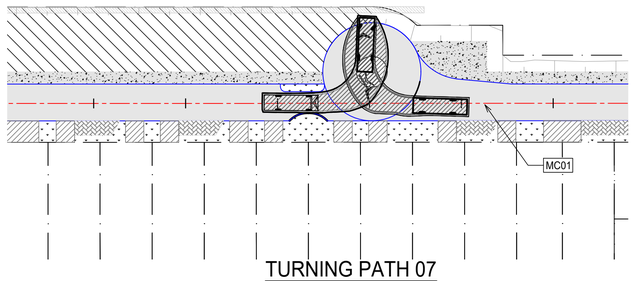

TURNING PATH 07
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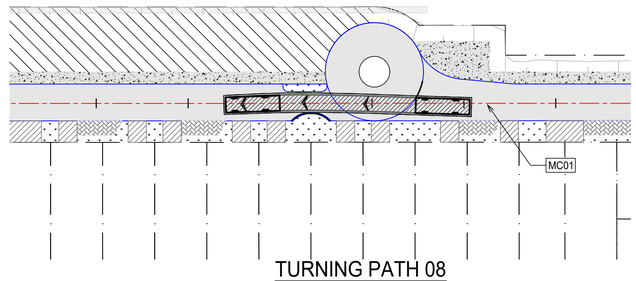

TURNING PATH 08
SCALE 1:500

PRINTING NOTE:

THIS DRAWING TO BE PRINTED IN COLOUR.

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FOR APPROVAL

Rev	Description	Eng	Draft	Date
D	ISSUE FOR APPROVAL	AA	AA	01.04.22
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A	ISSUE FOR APPROVAL	AA	AA	03.12.21

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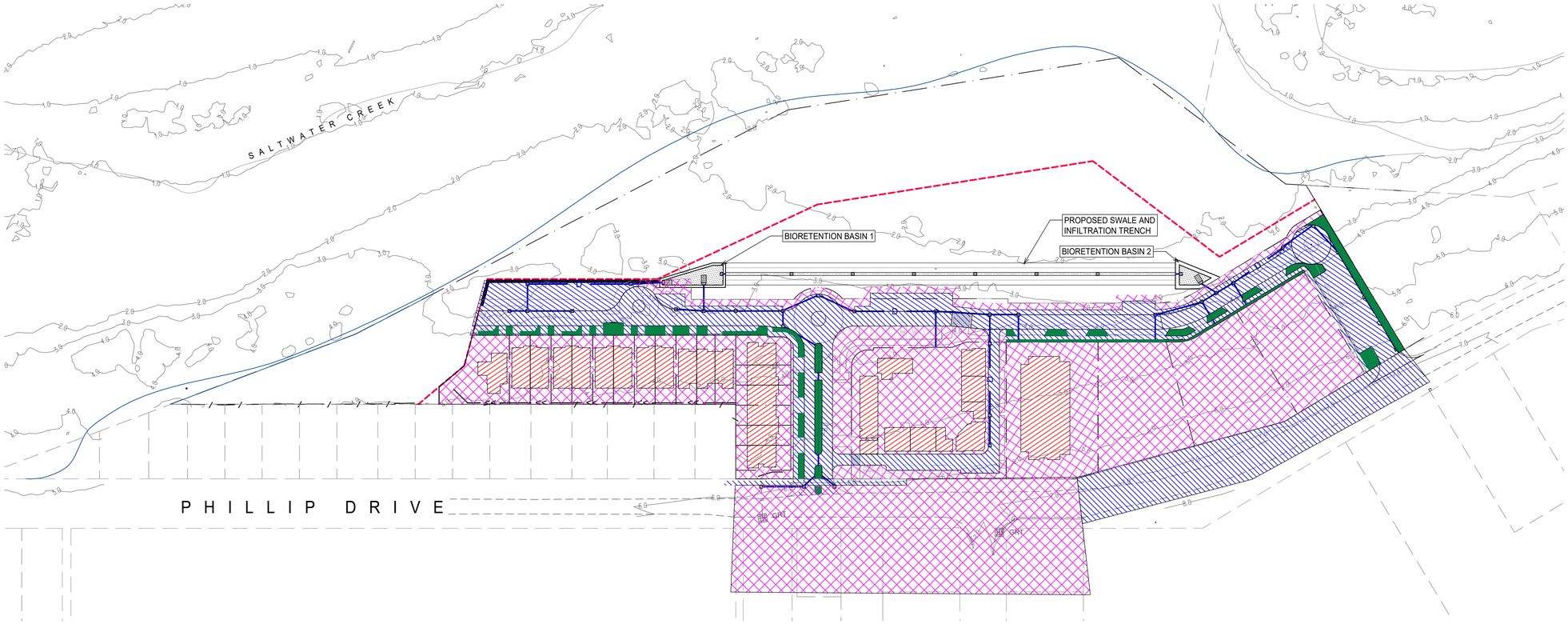
Project
SUBDIVISION DEVELOPMENT - STAGE 1
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
TURNING PATH PLAN

Scale at A1	Drawn	Approved
1:500	AA	SS
Job No	**Drawing No**	**Revision**
211107	C060	D



LEGEND

- ROOF LAND USE
- PAVED LAND USE
- TURF LAND USE
- MIXED LAND USE
- BIODIVERSITY VALUE ZONE
- ASSET PROTECTION ZONE
- COASTAL WETLANDS BOUNDARY
- PROPOSED STORM WATER DRAINAGE
- 2.0 EXISTING CONTOUR

MUSIC CATCHMENT PLAN

SCALE 1:1000

CATCHMENT BREAKDOWN:

BIORETENTION 1

ROOF : 3845 m^2
PAVED : 5109 m^2
LANDSCAPE 631 m^2
MIXED 13104 m^2

BIORETENTION 2

ROOF : 0 m^2
PAVED : 4434 m^2
LANDSCAPE 432 m^2
MIXED 5145 m^2

PRINTING NOTE:

THIS DRAWING TO BE PRINTED IN COLOUR.

A1 0 10 20 30 40 50 60 70 80 90 100 1:1000

FOR APPROVAL

Rev	Description	Eng	Draft	Date
B	ISSUE FOR APPROVAL	AA	AA	01.04.22
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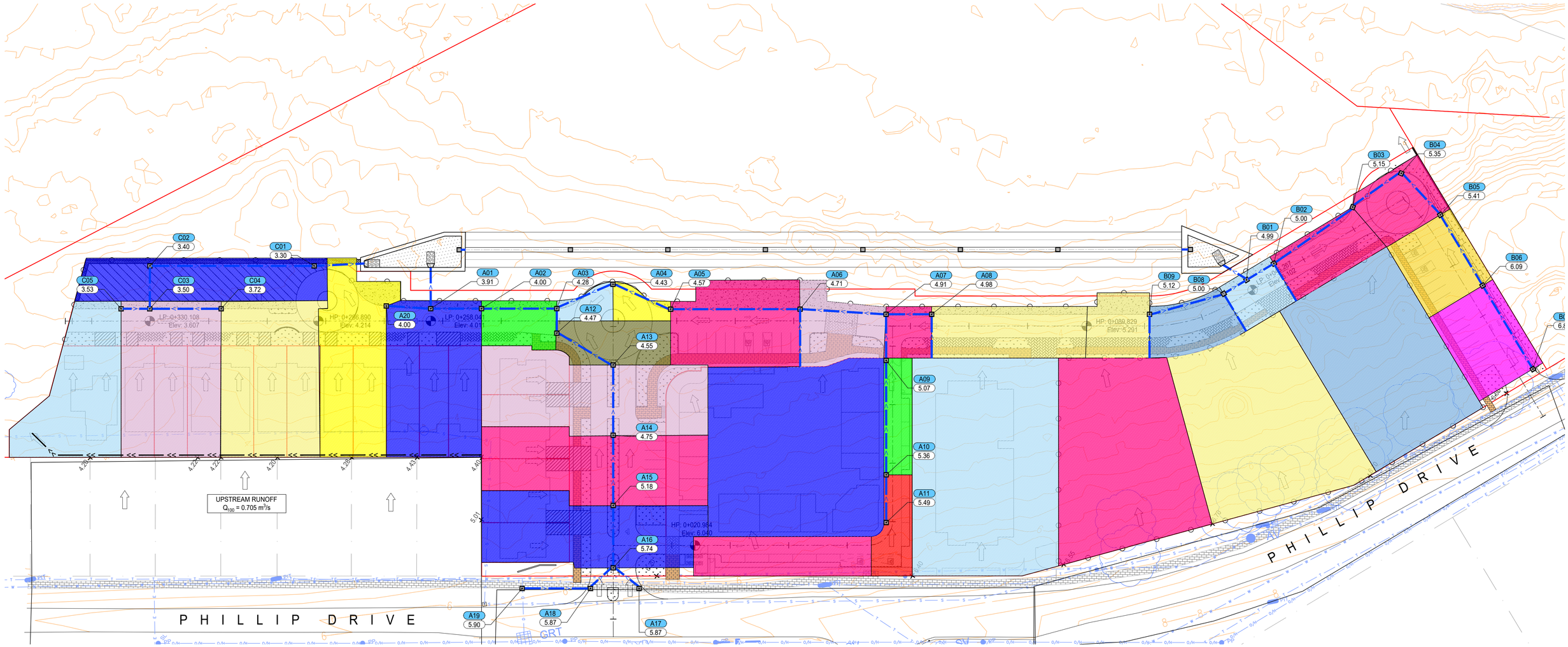
LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
MUSIC CATCHMENT PLAN

Scale at A1	Drawn	Approved
1:1000	AA	SS
Job No	**Drawing No**	**Revision**
211107	C070	B



STORMWATER CATCHMENT PLAN

SCALE 1:1000

PRINTING NOTE:

THIS DRAWING TO BE PRINTED IN COLOUR.

FOR APPROVAL

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Rev	Description	Eng	Draft	Date
B	ISSUE FOR APPROVAL	AA	AA	01.04.22
A	ISSUE FOR APPROVAL	AA	AA	22.03.2022

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LOT 2 PHILLIP DRIVE, SOUTH WEST ROCKS

Sheet Subject
STROMWATER CATCHMENT PLAN

Scale at A1	Drawn	Approved
1:1000	AA	SS
Job No	**Drawing No**	**Revision**
211107	C071	B

8 APPENDIX B – WSUD Details

EVERHARD
ENVIRONMENTAL

A family owned Australian business | ESTABLISHED 1926

SPEC SHEET

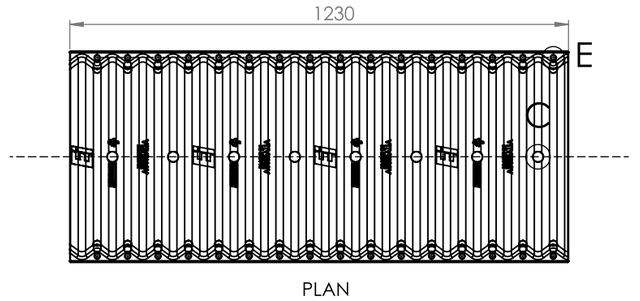
Product Name:
Evertrench - Small

EI Code:
82014

Dimensions:
230 H x 1200 L x 520mm D

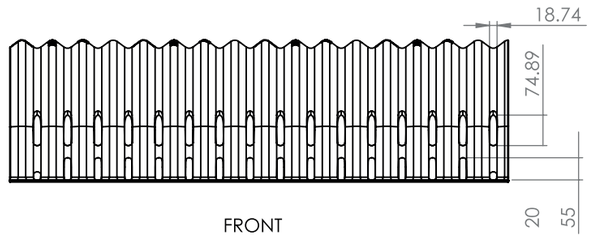
Weight:
1kg

Material:
Recycled PP



PLAN

·ALL GATES TO
TRIM BELOW TOP SURFACE·



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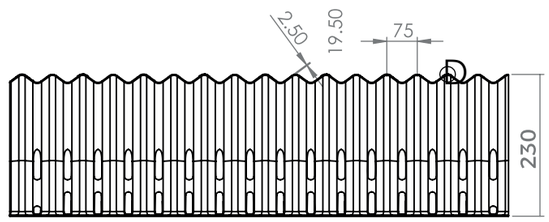
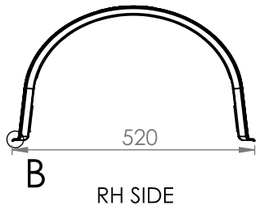


SECTION A-A



RH SIDE

Additional Information:

In addition to this product, you will need to get the following for installation (refer to installation instructions for assistance):

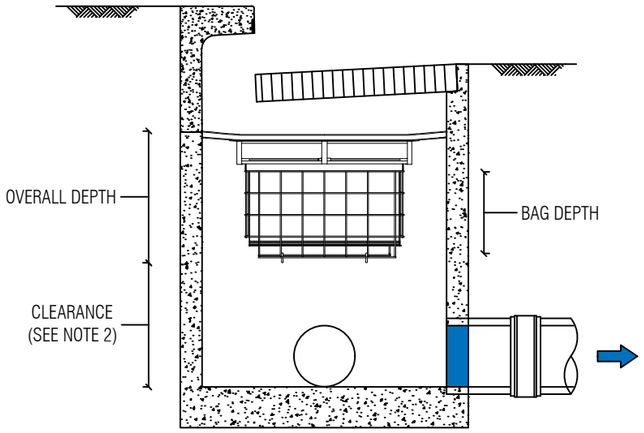
- Evertrench 230mm Trench End Cap **(A)**
- Evertrench Spreader Bars **(B)**
- Geotextile Fabric **(C)**

A

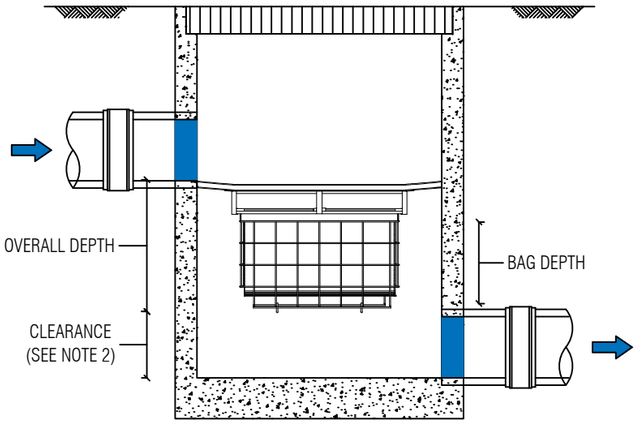
B

C

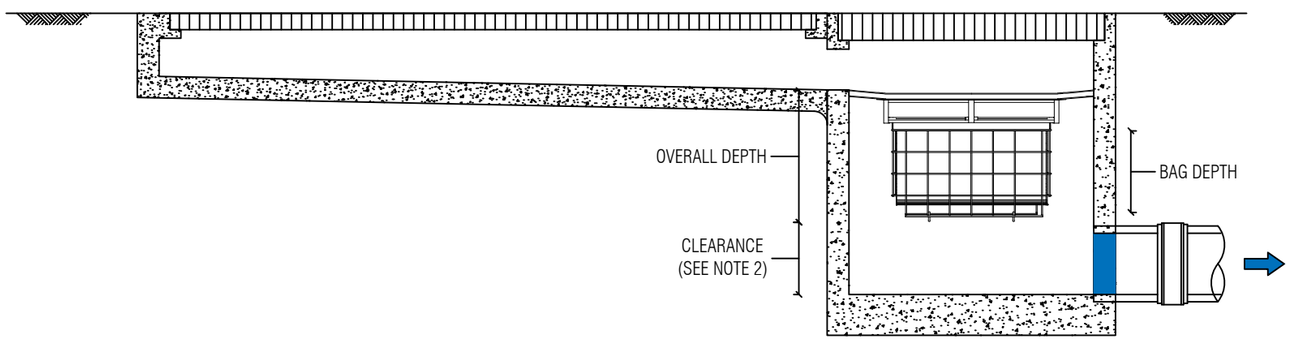
Disclaimer: All measurements are in millimetres and are subject to change without any prior notice. It is advised for this product to be installed by a professional contractor to ensure installation is correct. Further information is available at www.everhard.com.au



SURFACE FLOW CONFIGURATION



PIPE FLOW CONFIGURATION

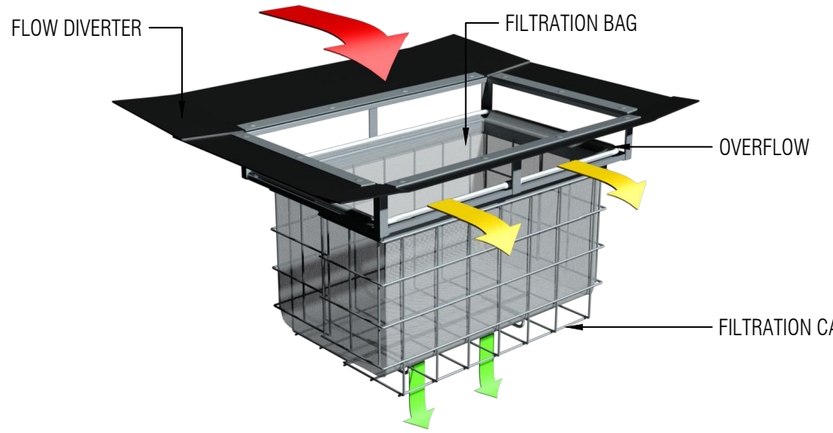


GRATED STRIP DRAIN CONFIGURATION

PLAN ID	MAXIMUM PIT PLAN DIMENSIONS
S	450mm x 450mm
M	600mm x 600mm
L	900mm x 900mm
XL	1200mm x 1200mm

DEPTH ID	BAG DEPTH	OVERALL DEPTH
1	170	270
2	300	450
3	600	700

		DEPTH ID		
		1	2	3
PLAN ID	S	■		
	M	■	■	
	L	■	■	■
	XL	■	■	■



GENERAL NOTES

1. THE MINIMUM CLEARANCE DEPENDS ON THE CONFIGURATION (SEE NOTE 2) AND THE LOCAL COUNCIL REQUIREMENTS.
2. CLEARANCE FOR ANY PIT WITHOUT AN INLET PIPE (ONLY USED FOR SURFACE FLOW) CAN BE AS LOW AS 50mm. FOR OTHER PITS, THE RECOMMENDED CLEARANCE SHOULD BE GREATER OR EQUAL TO THE PIPE OBVERT SO AS NOT TO INHIBIT HYDRAULIC CAPACITY.
3. OCEAN PROTECT PROVIDES TWO FILTRATION BAG TYPES:- 200 MICRON BAGS FOR HIGHER WATER QUALITY FILTERING AND A COARSE BAG FOR TARGETING GROSS POLLUTANTS.
4. DRAWINGS NOT TO SCALE.

OCEAN PROTECT
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www.oceanprotect.com.au

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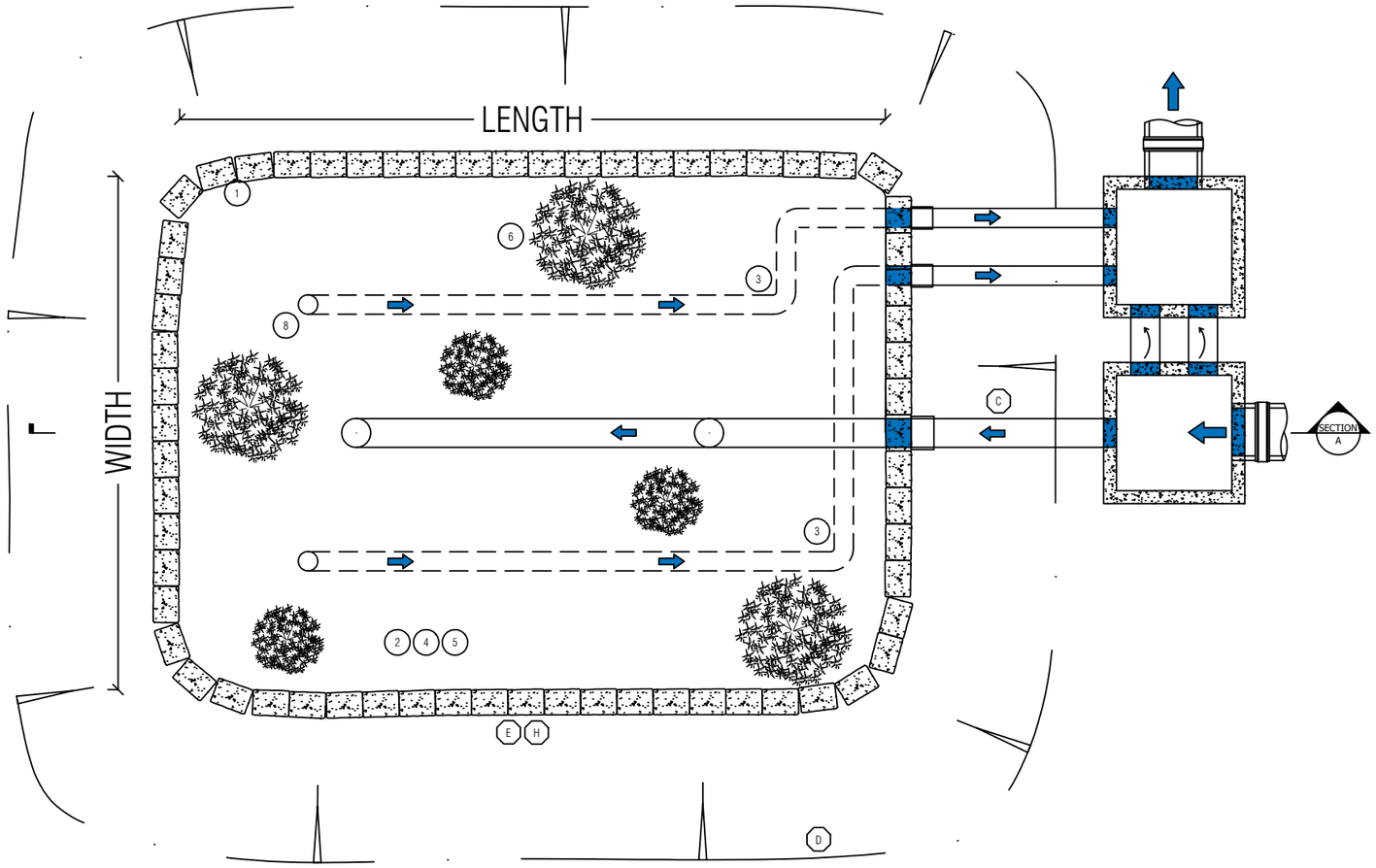
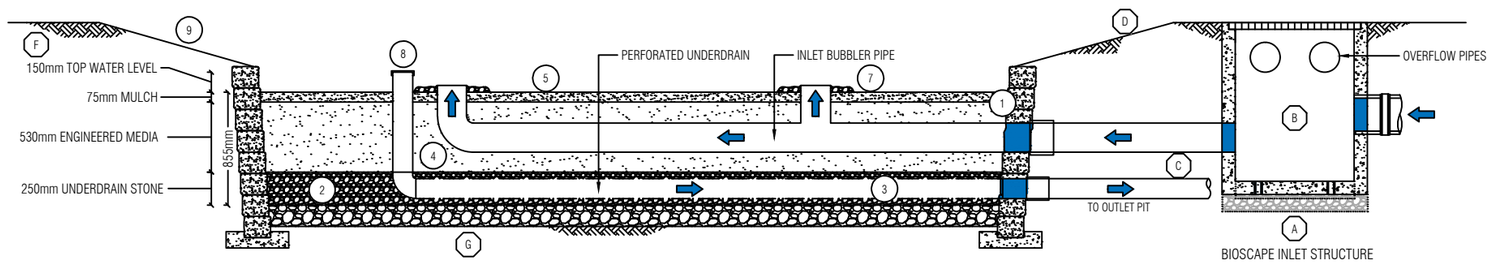
SPECIFICATION DRAWING

LAST MODIFIED: 18-03-19

NOT FOR CONSTRUCTION



PLAN



SECTION A-A

(PLANTING NOT SHOWN FOR CLARITY)

SITE SPECIFIC REQUIREMENTS		
COUNT	DESCRIPTION	INSTALLED BY
	FILTERRA SURFACE AREA (m^2)	OCEAN PROTECT
	MULCH VOLUME (m^3)	OCEAN PROTECT
	FILTERRA MEDIA DEPTH (mm)	OCEAN PROTECT
	VOLUME OF UNDERDRAIN STONE (m^3)	OCEAN PROTECT
	FILTERRA LINER (m)	OCEAN PROTECT

PLANTING SCHEDULE	
COUNT	FILTERRA BIOSCAPE SYSTEM PLANT PALETTE

GENERAL NOTES

- CONTRACTOR SHALL CONTACT OCEAN PROTECT TO COORDINATE DELIVERY AND INSTALLATION OF FILTERRA BIOSCAPE SYSTEM. OCEAN PROTECT ACTIVIATION CAN ONLY OCCUR ONCE CONTRACTOR RESPONSIBILTIES ARE COMPLETE.
- PERFORM FILTERRA BIOSCAPE SYSTEM EXCAVATION ONLY AFTER ALL THE CONTRIBUTING DRAINAGE AREAS ARE PERMANENTLY STABILISED. DO NOT CONSTRUCT FILTERRA BIOSCAPE SYSTEM IN AN AREA PREVIOUSLY USED AS EROSION AND SEDIMENT CONTROL FACILITIES. DO NOT STOCKPILE MATERIALS OR STORE EQUIPMENT IN THIS AREA. CONTRACTOR SHALL TAKE APPROPRIATE MEASURES TO PREVENT CONSTRUCTION-RELATED EROSION RUNOFF FROM ENTERING THE FILTERRA MEDIA BAY.
- FILTERRA SHALL BE INSTALLED OFFLINE AS EARLY AS POSSIBLE AFTER SITE STABILISATION TO ALLOW FOR SOIL MATURITY AND SYSTEM ESTABLISHMENT.
- CONTRACTOR SHALL COORDINATE WITH OCEAN PROTECT BEFORE THE FILTERRA BIOSCAPE SYSTEM IS EXCAVATED TO MINIMISE THE TIME BETWEEN EXCAVATION AND COMPLETION OF THE FILTERRA BIOSCAPE SYSTEM. ONCE EXCAVATED, ANY STANDING WATER THAT ACCUMULATES IN THE EXCAVATED AREA MUST BE REMOVED BY THE CONTRACTOR BEFORE OCEAN PROTECT CAN COMMENCE THE FILTERRA BIOSCAPE SYSTEM. ANY ADDITIONAL EXCAVATION WILL BE THE RESPONSIBILITY OF THE CONTRACTOR.
- CONTRACTOR SHALL PROVIDE ACCESS TO THE EXCAVATED AREA(S) FOR OCEAN PROTECT TO USE DURING THE CONSTRUCTION OF THE FILTERRA BIOSCAPE SYSTEM(S). ACCESS SHALL NOT PROHIBIT LIGHT DUTY EQUIPMENT THAT MAY BE USED TO INSTALL THE COMPONENTS (STONE, MEDIA, ETC). THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY RE-STABILIZATION THAT MAY BE REQUIRED AFTER THE FILTERRA BIOSCAPE SYSTEM INSTALLATION/ACTIVATION.
- OCEAN PROTECT AND/OR ITS REPRESENTATIVES SHALL BE RESPONSIBLE FOR THE LIST ENTITLED 'OCEAN PROTECT INSTALLATION RESPONSIBILITIES'.
- NO FLOW SHALL ENTER THE FILTERRA SYSTEM UNLESS OCEAN PROTECT HAS ACTIVATED THE SYSTEM AND CONFIRMED ESTABLISHMENT

CONTRACTOR WORKS AND INSTALLATION RESPONSIBILITIES

A. CONTRACTOR TO PLACE FILTERRA INLET STRUCTURE ON BEDDING AS SPECIFIED BY THE ENGINEER. OCEAN PROTECT SUGGESTS AS A MINIMUM TO USE 150MM BEDDING STONE ON COMPACTED SUB-GRADE TO 90% DENSITY. UNSUTIABLE MATERIAL SHALL BE REPLACED AS ADVISED BY THE ENGINEER.
B. CONTRACTOR SHALL PROVIDE AND INSTALL DRAINAGE ITEMS TO, FROM AND INCLUDING THE INLET AND OUTLET STUCTURES AS PER THE APPROVED SITE PLANS.
C. OCEAN PROTECT CAN PROVIDE COUPLERS AT THE FILTERRA INTERFACE FOR CONNECTION TO THE INLET DIVERSION PIPES. ALL DRAINAGE TO AND FROM THE FILTERRA MUST ALLOW FOR POSITIVE FLOW.
D. CONTRACTOR TO PROVIDE BATTER ACCORDING TO DIMENSION AND SLOPE SHOWN ON PLANS. SLOPE FROM SHOULDER TO FILTERRA BIOSCAPE SYSTEM SURFACE PERIMETER SHALL NOT EXCEED 3:1. TURF IS REQUIRED TO STABILISE SIDE SLOPES SHOWN ON DETAIL AND ON PLAN SHEETS.
E. CONTRACTOR TO EXCAVATE MEDIA AREA CORRESPONDING TO THE SIZE OF THE FILTERRA BIOSCAPE SYSTEM SURFACE AREA AS SHOWN ON DETAIL AND ON PLAN SHEETS.
F. CONTRACTOR SHALL EXCAVATE VERTICALLY FROM BOTTOM OF UNDERDRAIN STONE OR DRAINAGE STONE IF REQUIRED, TO ELEVATION OF MULCH AS SHOWN ON THIS DETAIL.
G. CONTRACTOR TO CONFIRM DEPTH OF EXCAVATION. IF THE EXCAVATION HAS BEEN MADE TOO DEEP AND ADDTITIONAL UNDERDRAIN STONE NEEDS TO BE USED TO RAISE THE BASE OF THE FILTERRA, THIS COST SHALL BE TAKEN ON BY THE CONTRACTOR.
H. RETAINING WALLS AND ADDITIONAL EROSION CONTROL AROUND THE FILTERRA BIOSCAPE SYSTEM. RETAINED OFFLINE FROM FILTERRA

OCEAN PROTECT SUPPLY AND INSTALLATION RESPONSIBILITIES

1. GEOTEXTILE FABRIC ALONG THE PERIMETER OF THE FILTERRA BIOSCAPE SYSTEM EXCAVATION.
2. UNDERDRAIN STONE. TYPICALLY 250mm THICK (50mm UNDER THE PIPING 150mm AROUND THE PIPING AND 50mm ABOVE THE PIPING)
3. 150mm UNDERDRAIN PIPING UNLESS OTHERWISE APPROVED BY OCEAN PROTECT, ASSOCIATED PIPING AND FITTINGS/ELBOWS TO CONNECT TO THE PIPING/FITTING(S) THAT IS PROVIDED BY CONTRACTOR (SEE CONTRACTOR INSTALLATION RESPONSIBILITIES THIS DETAIL).
4. 530mm FILTERRA MEDIA.
5. 75mm DOUBLE SHREDDED HARDWOOD MULCH OVER ENTIRE FILTERRA BIOSCAPE SYSTEM SURFACE AREA.
6. PLANTINGS OF PLANTS SELECTED BY ENGINEER THAT MATCH OCEAN PROTECTS APPROVED PLANTING LIST.
7. RIPRAP APRON AROUND ALL FLOW ENTRY POINTS AS DESIGNED AND INDICATED ON THIS DETAIL
8. CLEAN-OUT ADAPTER,PLUG AND PIPING.
9. COMMISIONING THE SYSTEM

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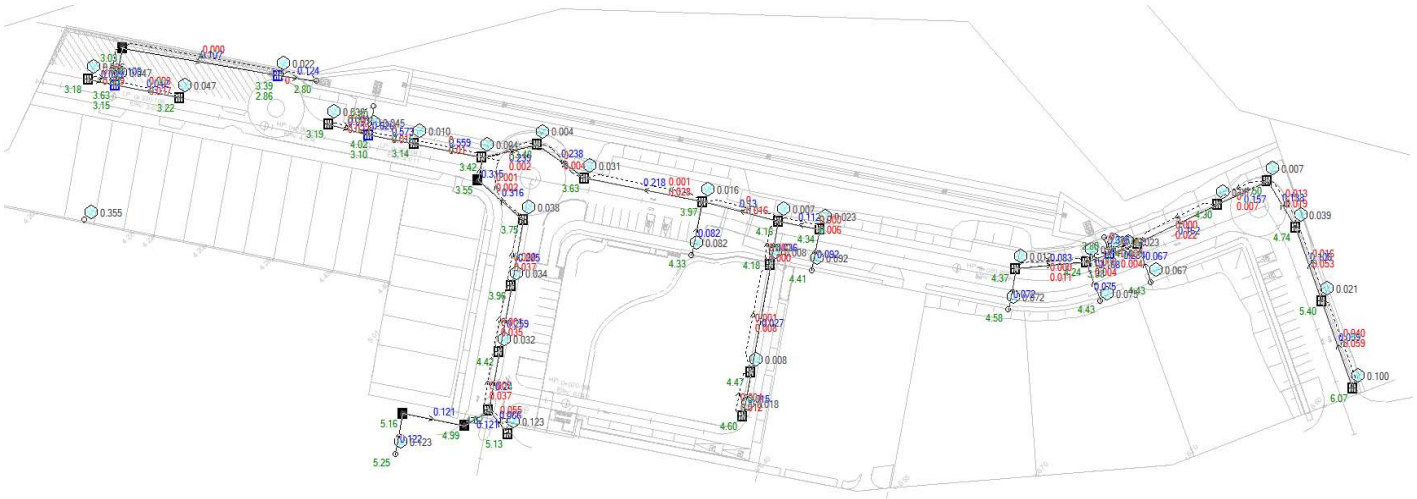
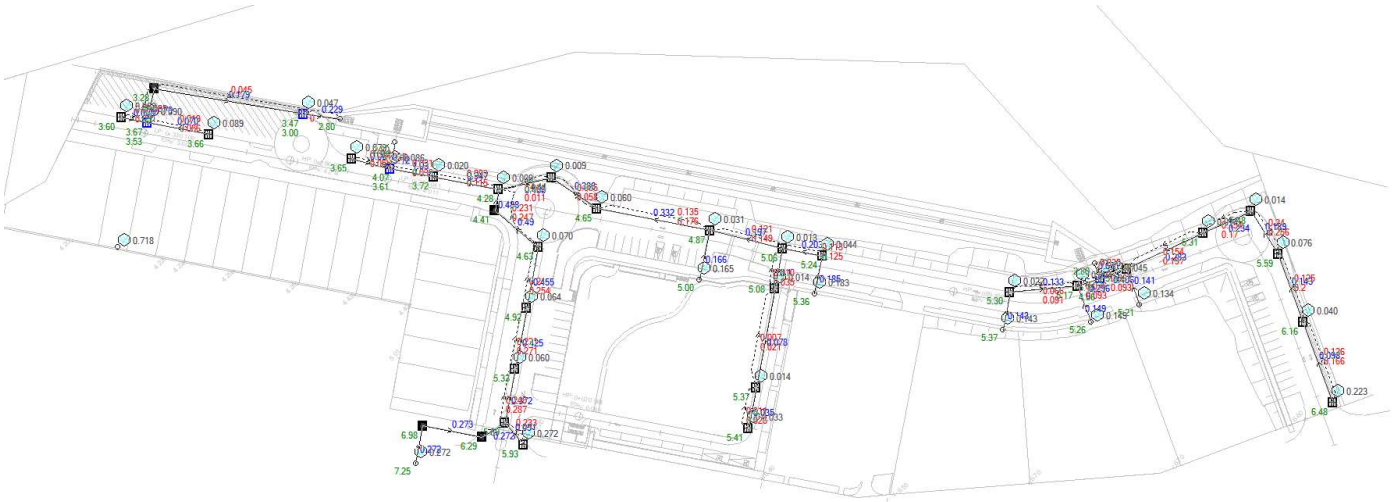
OCEAN PROTECT
FILTERRA BIOSCAPE SYSTEM
WITH BIOSCAPE INLET STRUCTURE
SPECIFICATION DRAWING

LAST MODIFIED: 24-05-19

9 APPENDIX C – DRAINS Results



20% AEP DRAINS output



1% AEP DRAINS output

XAVIER
KNIGHT

23 June 2022

Attn: Liam Porrit
Senior Development Manager

BCD Referral Response

Proposed Subdivision, Lot 2 Phillip Drive, South West Rocks (DA2200404)

Dear Liam,

We have prepared the following response in relation to the NSW Department of Planning and Environment (Biodiversity and Conservation Division (BCD)) relating to the staged community title subdivision at Lot 2 DP 1091323 Phillip Drive, South West Rocks. Items 29 and 30 in Attachment 1 from BCD relate to the civil engineering design documentation and report prepared by Xavier Knight Consulting Engineers (submitted as Appendix J to the planning portal) and have been addressed below.

Item 29. Stormwater Management and ICOLL protection
BCD Recommendation ***The proposal should more comprehensively consider possible nutrient and sediment impacts to Saltwater Creek. The proposal should identify and commit to best practice and rigorous approaches to reduce, with high certainty, nutrient and sediment inputs via storm water and as associated with the use and occupation of the site.***
We agree that Saltwater Creek is an ICOLL with very little capacity to assimilate additional nutrients originating from urban development. The sensitivity of the receiving waters has directly informed the stormwater management strategy developed for the site (within the Engineering Design Report, 1st April 2022). The guiding principle adopted is to negate this risk by adopting an objective of neutral or beneficial effect (NorBE) as the required outcome for stormwater discharge. Steps taken to achieve this were to: • To characterise water quality within Saltwater Creek and to ensure the stormwater strategy maintains or improves this water quality. • An in depth assessment of water quality into Saltwater Creek has been addressed in Section 4.3 of the Engineering Design report with water quality objectives (WQO's) developed in response to existing data sources for Saltwater Creek. Specifically, the "Stage 1 Scoping Study for the Saltwater Creek and Lagoon Coastal Management Program" by Water Technology and the "Saltwater Creek and Lagoon Estuary CMP Stage 2, Water Quality Assessment" by Alluvium were used to guide the design of water quality criteria for the development (refer to Table 2, Section 4.3.1). • The water quality criteria/trigger values from these studies have been adopted for the development and the efficacy of the stormwater strategy was tested

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iteratively in MUSIC until it was confirmed that post-development pollutant loads and concentrations can achieve the WQO's adopted.

- Results have been presented in Section 4.3.4 of the report showing that adopted WQO's can be achieved via an integrated approach to water cycle management which is consistent with current best practice approaches to stormwater management for urban development adjoining coastal wetlands.

- Ongoing monitoring and adaptive management will ensure these WQO's continue to be achieved post construction. Contingency measures can include additional on-site detention, additional infiltration areas and stormwater harvest and re-use, however current modelling suggests WQO's will be comfortably achieved.

Item 30. Stormwater Management and ICOLL protection

BCD Recommendation

The proposal should assess the likely increase in fresh water (Stormwater) input to the Saltwater Creek ICOLL associated with the hard-surfaces of the proposed development foot-print. The proposal should consider and describe the impacts of this increase on the natural hydrological regime of the ICOLL and any associated impacts to ASS.

Section 4.2 of the Engineering Design Report specifically addresses the impact of increased hard surfaces on stormwater generation and associated run-off into Saltwater Creek by quantifying stormwater discharge volumes and patterns pre and post development and develop management responses to ensure an appropriate hydrological regime is maintained post development.

Integration of WSUD measures means that effective imperviousness post development will match existing site conditions via infiltration and attenuation and reduction of pervious surfaces (eg use of pervious paving).

Total discharge from the site (<4 hectares) compared to the broader catchment flow (870ha's – or less than 0.5% of the catchment) cannot possibly change the hydraulic regime of Saltwater Creek, which is controlled by larger catchment processes. It is acknowledged however that each development will incrementally influence catchment hydrology with potential consequences for Saltwater Creek.

In response an assessment of pre and post development hydrological regimes has been completed to ensure appropriate quantities, pathways and duration of stormwater discharge are achieved. This strategy will ensure the development does not contribute to more frequent opening of the ICOLL and associated impacts such saltwater ingress, dewatering of water tables and oxidation of Acid Sulfate Soils.

Runoff quantities into Saltwater Creek have been addressed in section 4.3.3 of the report and include bioretention basins and an infiltration swale which is sized to intercept and infiltration 30% of average daily rainfall. Monitoring post construction can

ensure volumes of water being intercepted are appropriate and there is scope to increase the level of infiltration and attenuation if results suggest this is necessary.

Groundwater studies prepared by AGE (2021) and Douglas Partners (2013) were used to determine the amount of average daily rainfall that needs to be captured to achieve groundwater recharge rates similar to the pre-developed conditions and the bio-retention basins and infiltration trench have been sized accordingly. Rainfall in excess of the trench capacity will overtop and sheet flow towards the creek in a manner similar to the pre-developed conditions. This will ensure no physical impacts related to increased or concentrated stormwater discharge, which can create scour, damage vegetation or transport weeds and sediment into the adjoining coastal wetland.

Kind regards,

SCOTT SHARMA Principal - Civil Engineer
BE (Civil) / BE (Environmental) Hons MIEAust