Proposed Residential Subdivision
8-12 Princes Highway
Mollymook NSW 2539

Stormwater Management Strategy

5th SEPTEMBER 2022

Project No. 496

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APPROVED

Land and Environment Court of NSW

LEC No: 2021/00329677 DA20/1466

Date: 27/1/2023

Document Verification

Document title: Proposed Residential Subdivision 8-12 Princes Highway Mollymook

Client Contact: Peter Smith

Project number: 496

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Issue and date: Rev G (5th September 2022)

Document history: Rev A (Dec 2019), Rev B (Aug 2020), Rev C (May 2021), Rev D (June 2022), Rev E (August 2022), Rev F (August 2022)

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1.0 INTRODUCTION

1.1. Background

This stormwater management strategy report and associated stormwater concept plan has been prepared to accompany the development application for the proposed medium density development at 8-12 Princes Highway as described in the architectural plans by Edmiston Jones.

1.2. Scope and objective

This report addresses the requirements for stormwater management as described by:

- Chapter G2: Sustainable Stormwater Management and Erosion/Sediment Control of the Shoalhaven Council Development Control Plan 2014, and associated supporting documents; and
- Shoalhaven City Council's Engineering Design Specification D5 – Stormwater Drainage Design.

The objective is to outline, and where possible, quantify the potential water quantity and quality impacts and issues associated with the proposed development. Information is presented in the form of modelled as well as designs of management strategies to meet current best practice relevant for the site.

1.3. Proposal

Demolition of existing motel and constructing of medium density development as described in the architectural plans by Edmiston Jones.

2.0 SITE DESCRIPTION

The Site, 8-12 Princes Highway, comprises Lots 1 & 2 DP518702 and Lot 3 DP523625. The existing Site contains a number of buildings, carpark/driveways and landscaped areas that make up the Ocean View Motel, refer Figure 2.1.

The Site generally grades to the north east with slopes across the site vary between 2-20%.

There is minimal formal stormwater infrastructure across the Site with only one existing building and the front driveway/carpark draining to the Princes Highway. The remaining majority of Site runoff currently sheets off onto landscaped areas and disperses along the northern boundary.

Refer to drawings in Appendix A outlining pre-development sub-catchments and illustration of current runoff behaviour.

Figure 2.1 Site locality

3.0 COUNCIL PLANNING REQUIREMENTS

3.1. Minor and major system design

Design for the major and minor stormwater systems shall address the requirements set out in section 5.1.1 of Chapter G2 of the Shoalhaven DCP and Council's Engineering Design Specification to a level acceptable for development application.

3.2. Climate change controls

Climate change impacts, such as changes to rainfall intensity, will be incorporated into system design as per relevant policies and/or Australian Rainfall and Runoff (AR&R) guidelines.

3.3. Onsite Stormwater Detention (OSD)

Detention of stormwater is necessary to maintain the capacity of existing stormwater infrastructure, provide protection of downstream infrastructure and limit flooding impacts.

In this case OSD will applied to reduce peak flow rates to existing levels.

3.4. Stormwater reuse

The Building Sustainability Index (BASIX) may not apply to the proposed development however rainwater harvesting and reuse will be implemented with capturing majority of roof runoff in nominal 10kL tank with reuse for external demands.

3.5. Stormwater quality and waterway protection

Chapter G2 of the Shoalhaven DCP contains a range of specific stormwater quality and quantity requirements which are summarised below.

Erosion and Sediment control

A conceptual soil and water management plan will be prepared for the development in accordance with the Managing Urban Stormwater: Soils and Construction series.

Retention

For medium density 9mm depth of retention is to be provided for the difference in impervious area over the development. This will be achieved through capturing majority of roof runoff in nominal 10kL rainwater tank for reuse including external irrigation and wash-down demands.

Stormwater quality

Pollutant load reduction must be a minimum percentage reduction of the post development average annual load of pollutants in accordance with the following:

Pollutant	Post development average annual load reduction
Gross pollutants	90%
Total suspended solids (TSS)	80%
Total phosphorus (TP)	45%
Total nitrogen (TN)	45%

4.0 STORMWATER MANAGEMENT

4.1. Stormwater Management Strategy Overview

Table 1 and Table 2 provide a breakdown of pre and post-development imperviousness and ultimate discharge points.

Table 1: Pre-development catchment breakdown

Pre development catchment breakdown			
	Draining to Princes Hwy	**Draining to rear of property**	**Total**
Pervious area (m^2)	75	1649	**1724**
Impervious areas (m^2)	688	603	**1291**
Total area (m^2)	**763**	**2252**	**3015**
% of Site area	**25%**	**75%**	
% pervious	9.8%	73.2%	**57.2%**
% impervious	90.2%	26.8%	**42.8%**

Table 2: Post-development catchment breakdown

Post development catchment breakdown					
	Draining direct to Princes Hwy	**Draining to Princes Hwy via OSD**	**Collected and pumped to Princes Hwy**	**Draining to rear of property**	**Total**
Pervious area (m^2)	5	64	0	643.7	712.6
Impervious areas (m^2)	60	1886	200	151.4	2297.4
Total area (m^2)	**65**	**1950**	**200**	**795**	**3010**
% of Site area	**2%**	**65%**	**7%**	**26%**	
% pervious	7.7%	3.3%	0.0%	81.0%	23.7%
% impervious	92.3%	96.7%	100.0%	19.0%	79.3%

Key observation from these table as follows:

- Increase in impervious area of 1006.4m^2 under post-development scenario – pre-development site imperviousness of 43% vs post-development imperviousness of 79.3%
- Decrease in total area draining to the rear of the property under post-development scenario - 75% of the Site vs 26% of the Site
- Decrease in impervious area draining to the rear of the property under post-development scenario – 603m^2 vs 151.4m^2

The proposed stormwater management strategy aims to reduce runoff to neighbouring properties directly to the north and limit peak flow discharge to the Princes Highway to existing levels as well as meet Council's stormwater quantity and quality requirements.

Stormwater management measures will include:

- New internal stormwater network to manage runoff from new roof areas to new rainwater tank (RWT) / On-site detention (OSD) tank;
- RWT to provide opportunity harvesting and reuse for external demands (irrigation and wash down);
- "Stormfilter" Chamber with Stormfilter cartridges for stormwater treatment;
- OSD tank to temporarily detain runoff and reduce peak flow discharge to the Princes Highway via Site discharge pit and kerb outlet on Princes Highway;
- Basement collection tank and pump out arrangement for new carpark ramp runoff with submersible pumps directing flows to the Highway via new Site discharge pit and kerb outlets – Note this system must have a backup pump and power arrangement such as solar battery;
- Within the carpark runoff collection tank will be a "Stormfilter" Chamber with Stormfilter cartridges for stormwater treatment; and
- Areas that cannot drain to new RWT / OSD tank to be directed to landscaped depressions to promote detention and infiltration.

Appendix A contains development design drawings which outline all the stormwater management features to be implemented at the site.

4.1. Stormwater Quantity

4.1.1. Treatment Approach

Post-development peak flow is to be reduced to pre-development levels through the incorporation of stormwater detention.

Both pre and post-development hydrologic and hydraulic models were developed to establish peak flow targets (pre-development) and determine performance of proposed stormwater system (post-development) for a range of storm events (2, 20 and 100 year ARI).

4.1.1. Hydrologic and Hydraulic Modelling

The pre and post-development stormwater systems were assessed using DRAINS Hydrologic and Hydraulic Urban Catchment modelling. Relevant Australian Rainfall and Runoff (ARR) procedures were used to set up the hydrological model. Site IFD data was downloaded from the Bureau of Meteorology (BOM) website and storm patterns, pre-burst and losses downloaded from ARR Data Hub website.

Impervious percentages were based on sub-catchment land use (roofs, hardstand, open space etc.). Refer to pre and post-development catchment plans in Appendix A.

Model assumptions included: soil type = Normal (3.0), paved (impervious) area depression storage = 1mm, grassed (pervious) area depression storage =2.5mm and antecedent moisture condition = 3.0.

The carpark ramp sump and pump arrangement was modelled with the basin and pump tool within DRAINS to size an appropriate collection volume and determine pumping capacity.

4.1.2. Design Process

The design process undertaken for this project within DRAINS is outlined below:

- Using Site survey data Pre-development Site split up into sub-catchments based on land use and ultimate drainage points (i.e. Princes Highway or northern boundary) to establish pre-development peak flows;
- Post-development Site split up into sub-catchments based on land use and ultimate drainage points (i.e. Princes Highway or northern boundary);
- OSD sized to match pre and post development peak flows for range of events up to the 100 year ARI through refinement of orifice sizes and tank volumes.

The proposed OSD was modelled in DRAINS as detailed below:

- Determining the maximum height of the OSD system within the constraints of draining the tank under gravity to the low point in the kerb fronting the Site;
- Preliminary orifice equations were undertaken for the depth in the storage to determine the 100 year orifice sizing;
- The OSD surface area was then modified to accommodate the required storage volume.

4.1.3. Results

The proposed OSD tank has a volume of approximately 83m^3 with the following configuration:

- OSD area = 99m^2
- OSD base level = 38.2 (with 0.5% grade)
- OSD top level 39.50 m (incl. 100mm roof slab)
- OSD depth = 1000-1200mm
- Low level outlet = 150mm, IL 38.2
- High level outlet = 2x 150mm, IL 38.75

The proposed carpark runoff collection tank and pump arrangement includes an 18m^3 collection sump and nominal 2L/s pump capacity (dual pumps). The collection tank has been sized to capture the runoff volume for a 1% AEP, 1.5hr storm. Although Council's policy doesn't provide basement drainage design criteria the adopted storm event is above what many other Councils would specify. Examples of other Council policies can be provided upon request.

Refer to design of the proposed stormwater system in Appendix A.

The results from the proposed OSD design are summarised in Table 3 highlighting compliance with the matching of pre and post-development peak flows up to the 100 year ARI.

The maximum discharge also complies with the maximum allowable kerb discharge rate of 55L/s as outlined in Councils Stormwater Design Specification.

Table 3: Pre and Post-Development Peak Flows to Princes Highway + OSD Levels

ARI event	Pre-dev peak flow to Princes Highway (m3/s)	Post-dev peak flow to Princes Highway (m3/s) with OSD	Levels in OSD Basin
5 year	0.026	0.023	38.56
20 year	0.041	0.029	38.79
100 year	0.060	0.054	38.98

Table 4: Pre and Post-Development Peak Flows to rear of property

ARI event	Pre-dev peak flow to rear of property (m3/s)	Post-dev peak flow to rear of property (m3/s) with OSD
5 year	0.073	0.019
20 year	0.111	0.032
100 year	0.169	0.053

4.2. Stormwater Quality

4.2.1. Introduction

The effectiveness of proposed stormwater quality measures is estimated using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). MUSIC uses a continuous period of rainfall, combined with a rainfall-runoff model and pollutant generation rates to estimate pollutant loads generated by landscapes. MUSIC has a range of treatment modalities that estimate pollutant collection as a factor of area, shape, retention time and treatment type.

This assessment follows the stormwater objectives outlined in Council's Urban Stormwater Quality Management Plan, and the Water Sensitive Urban Design (WSUD) Objectives as outlined by the WSUD Program through the NSW Sydney Catchment Management Authority (SMCMA). These objectives are based on a comparison of pollutant loads from an equivalent untreated development with a development employing treatment.

4.2.2. Modelling Parameters

The model procedure follows Council's guidelines along with the Sydney Catchment Authority Guideline on Using MUSIC in Sydney's Drinking Water Catchment.

Climate information is sourced from the Nowra RAN continuous rainfall gauge with data from 1966 to 1975.

4.2.3. Treatment Approach

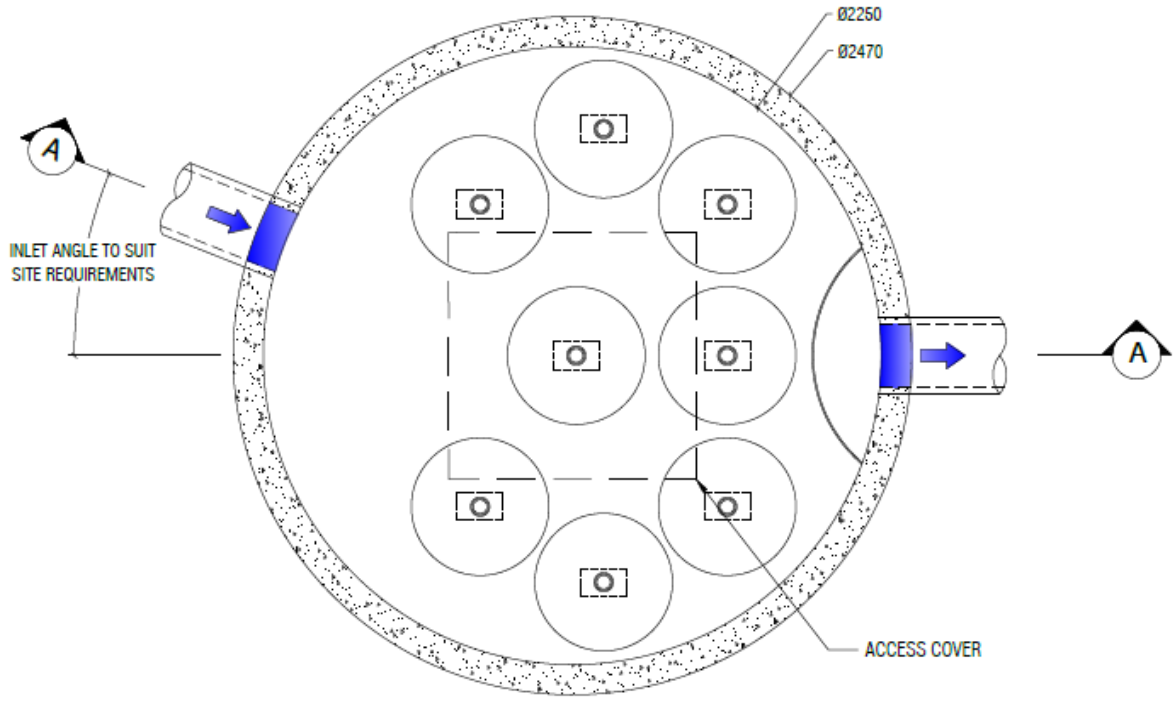
Stormwater treatment measures include:

Rainwater harvesting and reuse - 3kL rainwater tank to harvest roof water from minimum 50sqm of roof and reuse for irrigation of rear landscaped area (nominal 500sqm @ 200mm per annum = 100kL).

StormFilters - Stormfilters will be installed to treat roof and hardstand runoff.
The StormFilter™ cleans stormwater through a passive filtration system, with rechargeable, self-cleaning, media-filled cartridges to absorb and retain pollutants from stormwater runoff including total suspended solids, hydrocarbons, nutrients, soluble heavy metals, and other common pollutants.

The siphon actuated, high surface area cartridges draw stormwater evenly through the filter media. For modelling purposed certified MUSIC nodes have been obtained from the manufacturer with high flow bypass adjustments made based on the number of cartridges nominated.

The proposed arrangement will include 8 stormfilters.



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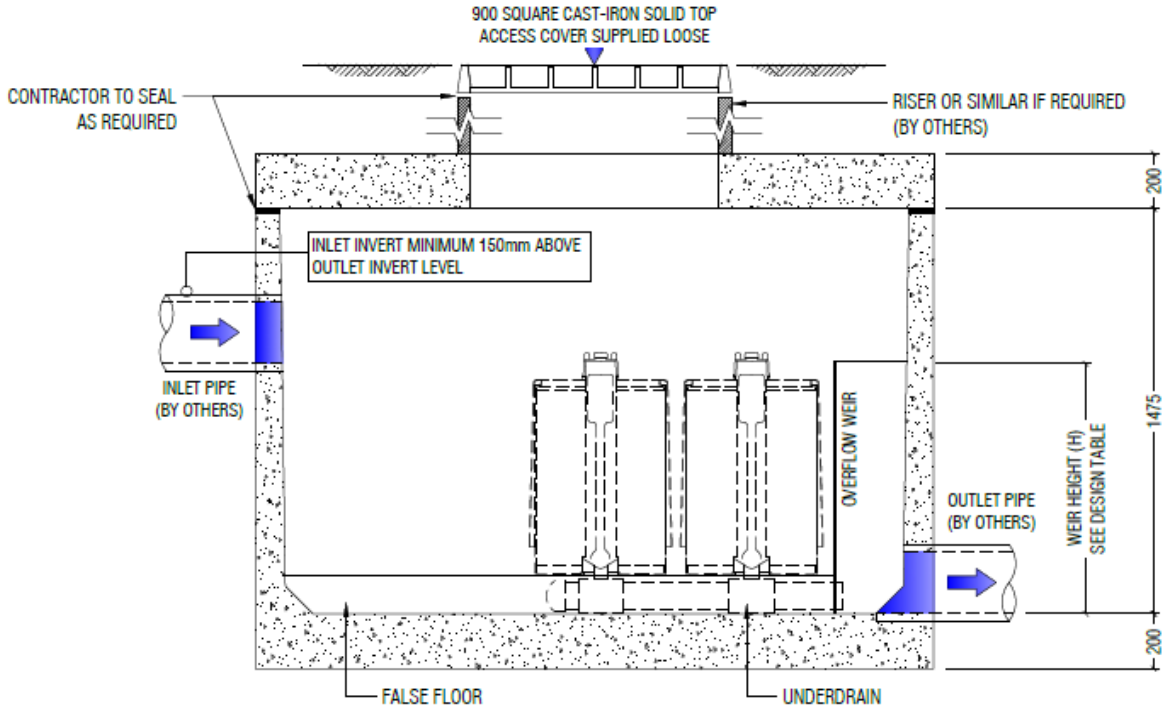

SECTION A-A

Stormfilter typical plan view

Passive irrigation – Private open space area will be largely vegetated with either grass or planter beds. Sub-surface drainage will be provided for planter beds which will essential act as raingardens. For modelling purposes generic buffer treatment nodes were adopted to represent passive irrigation treatment.

4.2.4. Model Configuration

Council's water quality target is the retention of a percentage of the annual pollutant load from a development based on comparison of pollutant loads from an equivalent untreated development with a development employing treatment.

4.2.5. Stormwater Modelling Results

The stormwater treatment targets appropriate for the site will be met by the treatment measures provided. The pollutant removal performance as predicted by MUSIC modelling exceeded Council's targets of 85%/45%/45% for TSS/TP/TN respectively. The results are summarised in Table 5.

Table 5: Pre and Post-Development Mean Annual Pollutant Loads

POST-DEVELOPMENT	Pollutant load (kg/yr)	Residual Load (kg/yr)	% Reduction	Benchmark (minimum reduction)
Suspended Solids	285	56.9	80%	80%
Total Phosphorus	0.599	0.177	70.5%	45%
Total Nitrogen	5.42	2.88	46.8%	45%

Council's water quality targets are met for TSS, TP and TN.

4.3. Operation and Maintenance

Maintenance requirements are shown in Table 6.

Table 6: Maintenance requirements.

Item	Maintenance	
	Description	Inspection Frequency
RWT	Inspect and clean inlet pipes Test pump Clean tank	1/ 12 months 1/ 12 months As required
OSD	Inspect and clean inlet and outlets Clean tank	1/ 12 months As required
StormFilters	Inspect StormFilter interior to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, the cartridges need to be replaced (Typically 1 – 5 year intervals) Removal of accumulated sediments should be performed during periods of dry weather.	1/ 12 months Also check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system.
Basement pump-out system Note this system must have a backup pump and power arrangement such as solar battery;	Inspect and clean inlet pipes Test main pump, back up pump and back up power arrangement Clean tank	1/ 12 months 1/ 12 months As required

In addition, inspection of system elements will also be required after large rain events to check for blockages.

4.4. Construction Period Controls

A Soil and Water Management Plan (SWMP) shall be developed for CC in accordance with the *Managing Urban Stormwater, Soils and Construction* (Blue Book).

Excavation and earthworks will need to include diversions and erosion and sediment controls that can accommodate steeper slopes.

5.0 SUMMARY AND CONCLUSION

5.1. Stormwater Management Strategy Overview

Stormwater management measures will include:

- New internal stormwater network to manage runoff from new roof areas to new rainwater tank (RWT) / On-site detention (OSD) tank;
- RWT to provide opportunity harvesting and reuse for external demands (irrigation and wash down);
- "Stormfilter" Chamber with Stormfilter cartridges for stormwater treatment;
- OSD tank to temporarily detain runoff and reduce peak flow discharge to the Princes Highway via Site discharge pit and kerb outlet on Princes Highway;
- Collection tank and pump out arrangement for new carpark ramp runoff with submersible pumps directing flows to the Highway via new Site discharge pit and kerb outlets;
- Within the carpark runoff collection tank will be a "Stormfilter" Chamber with Stormfilter cartridges for stormwater treatment; and
- Areas that cannot drain to new RWT / OSD tank to be directed to landscaped depressions to promote detention and infiltration.

The proposed strategy has been developed in accordance with Chapter G2: Sustainable Stormwater Management and Erosion/Sediment Control of the Shoalhaven Council Development Control Plan 2014. Councils planning requirements and the proposed development measures are outlined in Table 7.

Table 7: Assessment of proposed Stormwater Management Strategy

Council Planning Requirement	Proposed measures/Comments	Assessment
Provision of major and minor stormwater system	Site stormwater system to be designed for the 100 year ARI	Complies
Stormwater Quantity measures	Post-development peak flow is to be reduced to pre-development levels through the incorporation of stormwater detention.	Complies
Stormwater Quality Measures	The proposed stormwater quality measures include stormfilters, rainwater tanks (and reuse), detention and landscaping to promote detention/infiltration. The inclusion of these stormwater quality controls ensures that the development meets the Councils target benchmark of 80% removal of TSS, 45% removal of TP and very close to the 45% removal of TN (43.1%) for the development.	Complies

6.0 REFERENCES

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APPENDIX A – STORMWATER MANAGEMENT CONCEPT PLAN