Tumbi Umbi Retirement Living

Stormwater Management Plan

Prepared for: Mingara Leisure Group Pty Ltd

Date: 29th May 2025

Prepared by: Lauren Todd / Nathan Oakley

Ref: 301351398

Stantec Australia Pty Ltd
Level 9, The Forum, 203 Pacific Highway, St Leonards NSW 2065
Tel: +61 2 8484 7000 Web: www.stantec.com

U:\301351398\PROJECT DOCUMENTATION\CIVIL\DOCUMENTS & REPORTS\INTEGRATED STORMWATER MANAGEMENT PLAN\301351398-CV-RP-001 - TUMBI UMBI RETIREMENT VILLAGE IWMP [03].DOCX

Stantec

Revision

Site Address:	14 Mingara Drive, Tumbi Umbi, NSW 2261
Real Property Description:	Lot 13/ DP1204397
Proposed Development:	Construction of retirement village and assisted living units
Client:	Mingara Leisure Group Pty Ltd
Local Authority	Central Coast Council
Authority Reference #:	N/A
Stantec Reference:	301351398-CV-RP-001

Vivie Eccles

Civil Project Technical Lead, Team Lead

Stantec Australia Pty Ltd

Revision	Date	Comment	Prepared By	Approved By
01	28.03.24	SSDA Issue	LPT	JMB
02	15.04.24	Issue for Approval	LPT	JMB
03	28.05.24	Issue for Approval	LPT	VSE
04	16.07.24	Issue for Approval	NO	VSE
05	26.07.24	Issue for Approval	NO	VSE
06	29.05.25	SSDA Re-issue	VSE	VSE

Contents

Contents

Abbreviations Definitions

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
BoM	Bureau of Meteorology
DA	Development Application
DCP	Development Control Plan
DN	Diameter Nominal (mm)
EY	Exceedances per Year
FFL	Finished Floor Level
FPL	Flood Planning Level
GPT	Gross Pollutant Trap
IFD	Intensity-Frequency-Duration
IL	Invert Level
ILU	Independent Living Units
L/s	Litres per second
m/s	Metres per second
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OSD	On-Site Stormwater Detention
PSD	Permissible Site Discharge
RCP	Reinforced Concrete Pipe
RL	Relative Level
RWT	Rainwater Tank
SID	Safety In Design
SSR	Site Storage Requirement
WSUD	Water Sensitive Urban Design

1. Introduction

1.1 Background

Stantec has been commissioned by Mingara Leisure Group Pty Ltd to prepare this Integrated Water Management Plan (IWMP) in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs), and in support of the State Significant Development Application (SSD-63475709) for the proposed.

This IWMP illustrates that the proposed development complies with the conditions set out by Central Coast Council, Australian Rainfall and Runoff (ARR) 2019, Australian Standards and best engineering practices.

1.2 Site Details

1.2.1 Description of the Site and Locality

The site is located at 14 Mingara Drive, Tumbi Umbi, within the Central Coast Local Government Area (LGA). The development site is legally described as Lot 13 DP1204397.

The broader Mingara Club Precinct also encompasses Lot 1 and Lot 2 in DP 1010532 and Lot 71 DP1011971 and currently contains a registered club, health and wellness centre (including aquatics, gym facilities, physio, hairdresser, beautician and martial arts studio), car parking, creche, bowling greens and green space with a regional athletics centre. A hotel is currently under construction.

Immediately surrounding the Mingara Club Precinct are fast food outlets and other restaurants, service station, car wash, retail, medical centre and a retirement village to the south and west. Industrial development is to the north of Wyong Road and residential development to the west. The specific area of the site, the subject of the proposed development, is land located to the west of the Mingara Recreation Club and south of the Athletics field. This development site is currently a vacant grassed area.

The site is bound by Mingara Athletics Centre along the north, Mingara Club and Mingara Parking Lots to the east, and residential developments along the south and west of the site. The site is located immediately north-west of Tumbi Umbi Creek. Refer to locality plan in Figure 1 for further clarification and location of the proposed development within the site.

Figure 1: Site Location Plan (Source: Nearmaps Feb 2024)

Key features of the site are as follows:

- The topography of the site is generally flat, with some fill historically used to level the study area, particularly in the northern portion of the site.
- The development site is vacant grassland with some mature trees located on the eastern boundary.
- The western and southern boundary of the development site has a registered easement following the drainage corridor defining the site boundaries to the west and south.
- Vehicle access will continue to be provided via the existing Wyong Road access to the north and the existing access from Mingara Drive into the broader Mingara Club precinct to the east.
- The development site does not have a direct street frontage and is bounded by the Athletics field to the north, Club access road and Mingara carpark to the east and Glengara Retirement Village to the south and west and low density residential uses to the north-west. The Mingara Club precinct has frontage to Wyong Road and Mingara Drive.
- Vehicular access to the site from the local road network is available from Wyong Road, via left in and left out and from the signalised intersection at Mingara Drive/Wyong Road and then a roundabout on Mingara Drive.
- Internal pedestrian connectivity within the broader Mingara Precinct site includes pedestrian pathways from the north and west and pedestrian crossings from the car parking area into the main club building.
- A hotel is under construction on the broader Mingara precinct to the east of the development site.
- To the north west of the site is a constructed wetland / gross pollutant trap

The surrounding locality is described as follows:

- North: Immediately north of the development site is the athletics track/field, forming part of the broader Mingara Club precinct. Further north on the northern side of Wyong Road is industrial zoned land and the vast majority of the surrounding context comprises low density residential, environmental conservation, living and management.
- East: Directly east of the site is a hotel (under construction), the main Club building and car park, accessible from Mingara Drive and Wyong Road. Further east of the site are fast food and commercial land uses on Wyong Road, then low density residential uses. Further east is more residential development with the Bateau Bay Square shopping centre forming the major commercial node for the area.
- South: The Glengara Retirement Village is immediately south (and south west) of the site and is one to two storeys in height. Beyond that, the area of Tumbi Umbi is primarily larger environmental living residential lots.
- West: A drainage corridor and some taller vegetation is located directly west of the site. Further west is the northern portion of the Glengara Retirement Village.

The proposed development forms part of the site with the following property details:

Site Address:	14 Mingara Drive, Tumbi Umbi, NSW 2261
Real Property Description:	Lot 13/ DP1204397
Development Site Area	Approximately 29,957.5m² (2.996Ha)

The proposed development can be seen on the Civil Design Documentation shown in Appendix A of this report.

The proposed site development consists of the following:-

- Construction of new retirement homes, care suites and amenities;
- Car parking;
- Landscaping and terraced areas.

1.2.2 Topography

The local topography within the proposed development site demonstrate that the site predominately falls from south west to north east. The low point of the site is located along the north eastern boundary at ~ RL 6.9 mAHD. The high point of the site is located along the south western boundary at ~ RL 9.55 mHAD. Refer to Figure 2.

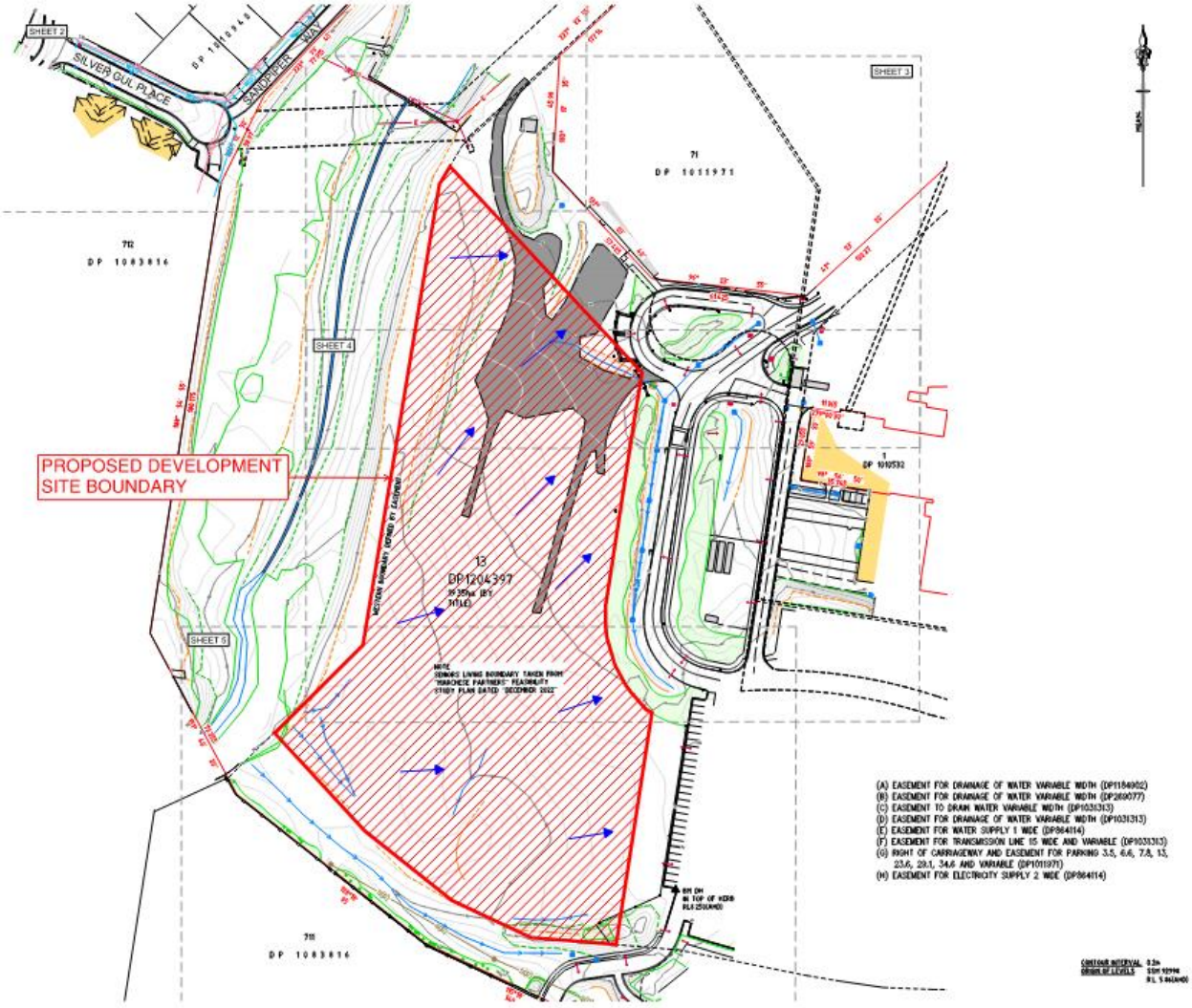

Figure 2: Site Topography (Source: Site Survey by Beveridge Williams, Land Development Consultants Registered Surveyors)

1.3 Summary of Consultation

Refer to Table 1 for a summary of consultation undertaken with relevant authorities and agencies.

Table 1: Summary of Consultation

Stakeholder	How this group was consulted and when	Issues discussed	Project responses
Central Coast Council	Virtual meeting on 12/02/2024 between Stantec and the following Council departments: • Planning • Flood • Stormwater	• Flood planning levels applicable to the development • On-site detention (OSD) volume requirements	• Council have confirmed that the PMF flood level is to be adopted as the flood planning level for this development • OSD is to be provided to limit post development discharge rates to pre-development levels for storm events up to the 5% AEP event
Refer to Flood Impact Assessment and Flood Emergency Management Plan by Stantec for consultation related to flooding			

1.4 Response to SEARs

The Integrated Water Management Plan is required by the Secretary's Environmental Assessment Requirements (SEARs) for the State Significant Development Application. This table identifies the relevant SEARs requirement/s and corresponding reference/s within this report.

Table 2: SEARs and Relevant Reference

SEARs Item	Report Reference
14. Water Management	
Provide an Integrated Water Management Plan for the development that:-	
Is prepared in consultation with the local council and any other relevant drainage or water authority.	Section 1.3, Section 6, Section 7, Section 8, Section 9 & Section 10
Outlines the water-related servicing infrastructure required by the development (informed by the anticipated annual and ultimate increase in servicing demand) and evaluates opportunities to reduce water demand (such as recycled water provision).	Refer to Services Infrastructure Report by Neuron
Details the proposed drainage design (stormwater and wastewater) for the site including any on-site treatment, reuse and detention facilities, water quality management measures, and nominated discharge points.	Section 1.3, Section 6, Section 7, Section 8, Section 9 & Section 10
Demonstrates compliance with the local council or other drainage or water authority requirements and avoids adverse downstream impacts.	Section 1.3, Section 6, Section 7, Section 8, Section 9 & Section 10 Refer to the Flood Emergency Management Plan (FEMP) and Flood Impact Assessment (FIA), prepared by Stantec Australia, for further details
Where water and drainage infrastructure works are required that would be handed over to the local council, or other drainage or water authority, provide full hydraulic details and detailed plans and specification of proposed works that have been prepared in consultation with, and comply with the relevant standards, the local council or other drainage or water authority.	N/A
15. Flooding Risk	
Identify any flood risk on-site having regard to adopted flood studies, the potential effects of climate change, and any relevant provisions of the NSW Floodplain Development Manual.	Refer to the Flood Emergency Management Plan (FEMP), prepared by Stantec Australia, for commentary on effects of climate change.
Assess the impacts of the development, including any changes to flood risk on-site and off-site, and detail design solutions and operational procedures to mitigate flood risk where required.	Refer to the Flood Impact Assessment (FIA), prepared by Stantec Australia, for details

1.5 Response to Submissions

This report has been updated to address and respond to requirements and recommendations received following

the exhibition of the SSDA. Comments related to Stormwater is summarised in section below. Refer to Flood Risk Assessment and Flood Emergency Management Report by Stantec for comments regarding flooding.

1.5.1 Conservation Programs, Heritage and Regulation (CPHR)

Table 3: Response to CPHR RFI / Recommendation

Request for Information / Recommendation	Response
Insufficient information on additional flood storage works An insufficient level of detail has been provided regarding the proposed alterations to the swale located along the southern boundary. The Flood Impact Assessment (FIA), prepared by Stantec 2024, proposes mitigating off-site impacts by lowering the swale and creating additional flood storage. Specifically, more information is required on the: • Extent of Changes: The FIA lacks information on the extent of the proposed swale modifications. Detailed cross-sections and long-sections of the proposed channel works are required to fully understand the scope of the alterations. • Impact on Water Quality Treatment: The FIA has not considered the potential impacts of lowering the swale on existing water quality treatment measures. Given that the swale appears to be an integral part of a broader stormwater treatment system (including constructed wetlands and a series of ponds), an assessment is necessary to ensure the continued functionality of these WSUD components. Recommended actions: • Provide detailed cross sections and long sections of the proposed channel works. • Verify that the function of the existing water quality treatment measures is not impacted by the proposed modifications. Extent and Timing: • Prior to Construction Certificate	The design has been revised to remove the lowering of the southern swale to create additional flood storage. Refer to Flood Risk Assessment and Flood Emergency Management Report by Stantec for changes made to the flood model. The existing southern swale is proposed to be retained.

2. Project Description

The proposed development comprises subdivision of land and the construction and operation of a seniors housing development. The proposal includes thirteen villa buildings, three multi-storey independent living unit (ILU) buildings and one mixed high care and ILU building housing communal facilities together with car parking, open space and associated works including site preparation works and landscaping.

The proposed SSDA seeks approval to redevelop the site to accommodate a seniors living development inclusive of the following:

- Site establishment works, including minor excavation and tree removal and earthworks.
- Construction and operation of:
    - Thirteen (13) townhomes/villa buildings, housing four (4) independent living units in each
    - Three (3) multi storey independent living unit (ILU) buildings of:
        i. Building 1 – undercroft car parking, 5 levels of 2-bed and 3-bed ILUs
        ii. Building 3 - undercroft car parking, 6 levels of 2-bed and 3-bed ILUs
        iii. Building 4 - undercroft car parking, 5 levels of 2-bed and 3-bed ILUs
    - One (1) mixed high care and ILU building (Building 2) of:
        iv. Part undercroft car parking, part communal/amenities level at ground with 3 levels of high care suites and 3 levels of ILUs
        v. The building will include communal facilities including a café, residential lounge, multi-function spaces, consultation/therapy rooms, library, and staff/admin areas.
- Provision of 219 x 2-bed and 3-bed independent living units and 39 high care suites
- Total site GFA of 31,739.7 sqm comprising:
    - Townhouses: 7,223.4 sqm GFA
    - Building 1: 4,595.6 sqm GFA
    - Building 2: 5,315.7 sqm GFA
    - Building 3: 5,520.0 sqm GFA
    - Building 4: 9,085.1 sqm GFA
- Vehicle access will be provided via the existing road access from Wyong Road and via Mingara Drive. The site also accommodates a north-south internal shared access road and dedicated porte cochere in front of Building 2.
- Private, passive and communal open space, landscaping and perimeter and internal pedestrian pathways
- Subdivision of the land and two stage construction.

Refer to Figure 3 for an illustration of the landscape site plan.

Figure 3: Proposed Landscape Site Plan (Source: Landscape Site Masterplan LA 100 by TaylorBrammer, last revised 20 May 2025)

3. Existing Site Characteristics

3.1 External Stormwater Catchments

The surrounding area has been investigated to determine the likely impact of existing external stormwater catchments on the proposed site.

The development site has an athletics track to the north, Mingara Drive (internal precinct roadway) to the east and drainage easements to the south and west. The surface topography data indicates that minimal upstream catchment is directed towards the site. The existing stormwater system in the 1% AEP event has been modelled by Stantec with a combination of 0% and 50% blockage through the catchment to derive peak flood levels. It has been determined that the site experiences minor encroachment of floodwaters into the development in the 1% AEP flood event along the south-western boundary to the eastern boundary. Refer to Flood Impact Assessment (FIA) report by Stantec. Under existing conditions, this stormwater catchment is conveyed as overland flow toward Mingara Drive through the development site. Stantec has incorporated a stormwater management strategy for the site to ensure there will be little to no impact on the proposed development site.

3.2 Existing Stormwater Infrastructure

Through the analysis of survey information and a site inspection, it was found that there are a number of existing pits around the site. There is a swale running along the eastern boundary of the site with five (5) grated inlet pits within the swale. There are two (2) culverts and three (3) headwalls positioned along the northern boundary of the site, which discharge into the north most pit within the existing eastern swale. The existing stormwater infrastructure discharges further north of the site into a constructed swale adjacent to Wyong Road via a pit and pipe network.

Along the western boundary, adjacent to the site, is a drainage easement that discharges to the constructed wetland positioned further north. This drainage easement acts as a channel for upstream stormwater, collecting and directing upstream offsite flows around the proposed site.

In its current condition, the proposed site does not contain any formalised stormwater drainage. Refer to the mark-up survey figures below for further information. The hatched red area is the proposed development site extent.

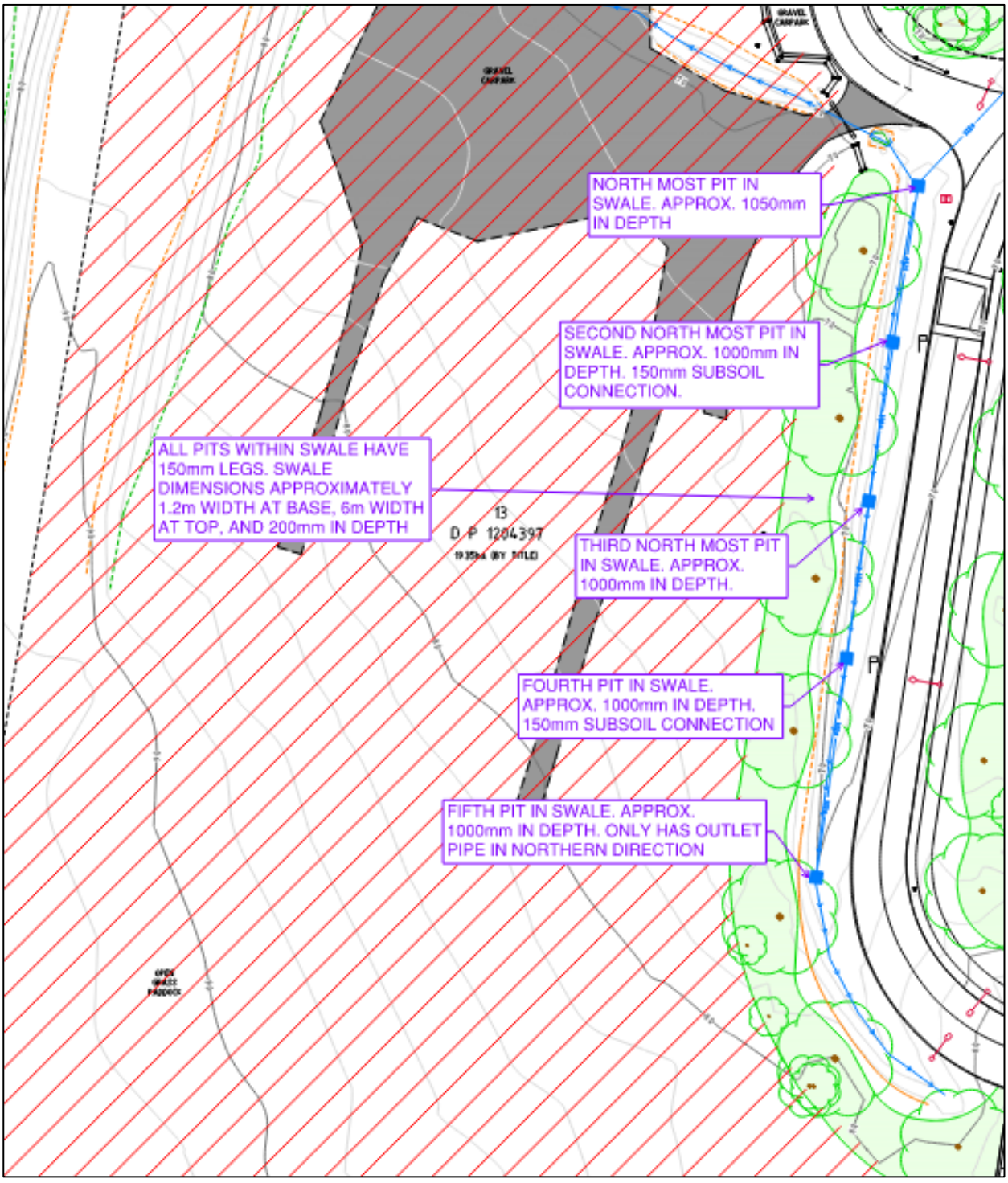

Figure 4: Existing Site Stormwater Network (Source: Beveridge Willliams 2023)

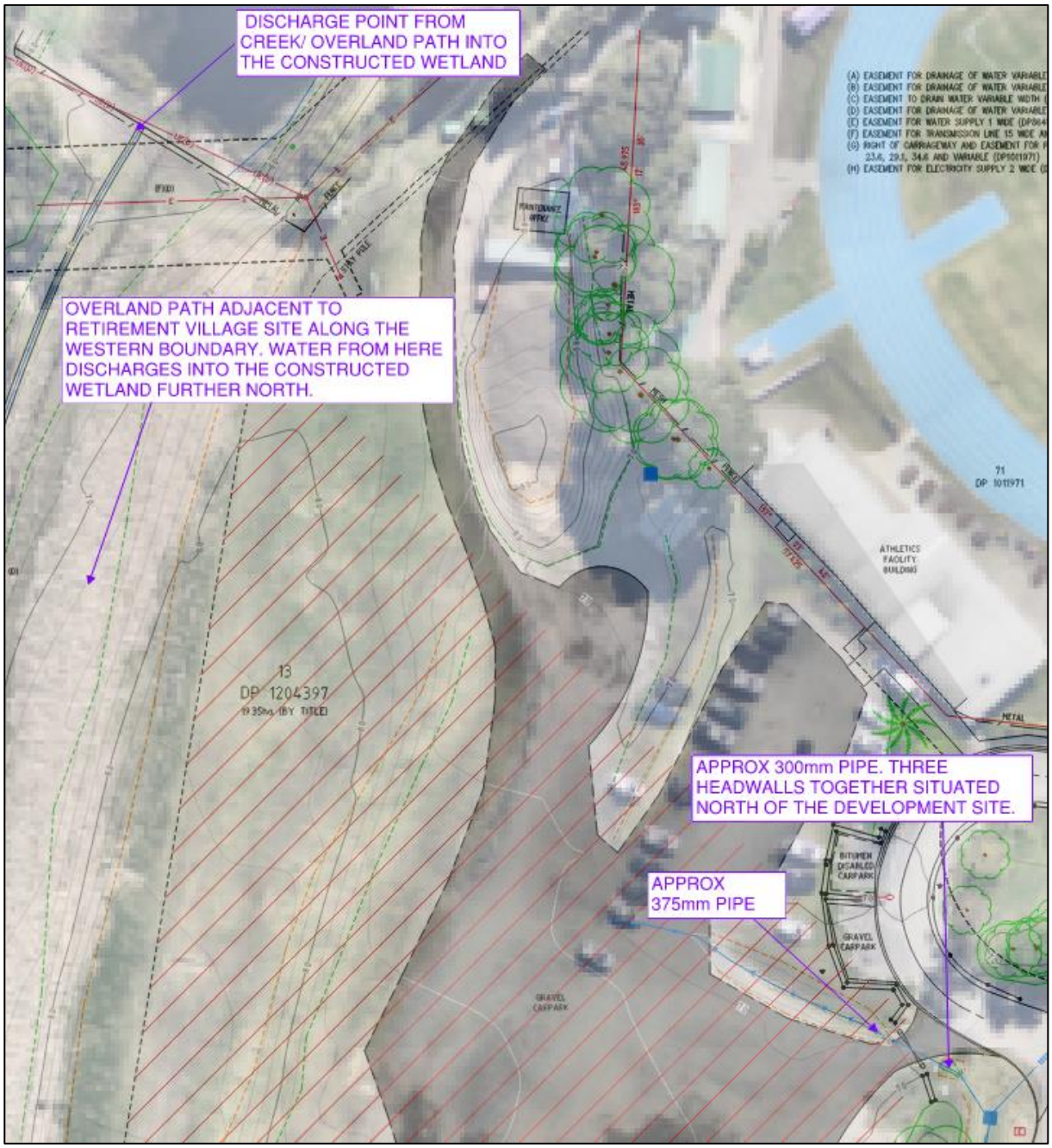

Figure 5: Existing Site Stormwater Network (Source: Beveridge Willliams 2023)

3.3 Existing Stormwater Discharge

Under existing conditions, the site drains overland and is collected by the existing pit and pipe network to the northern and eastern boundaries of the site. The collected stormwater eventually discharges into the constructed swale positioned further north of the subject site, adjacent to Wyong Road. Refer to the figure below for more information.

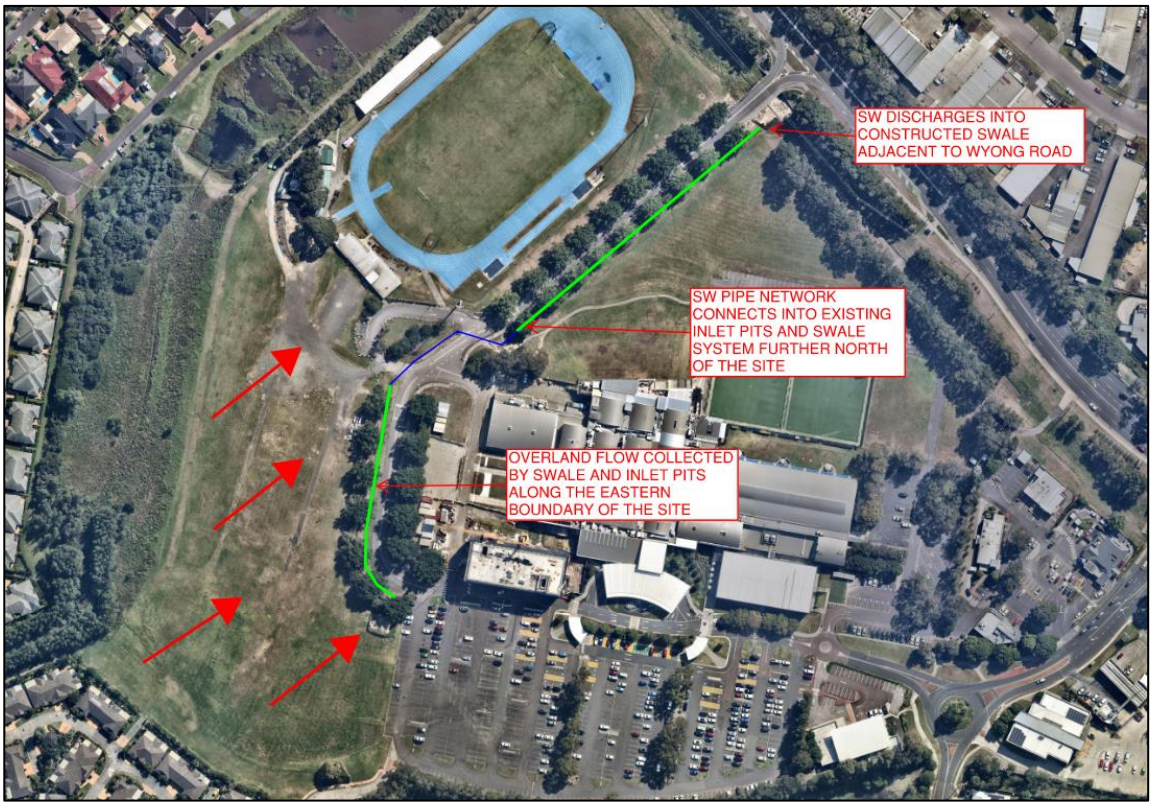

Figure 6: Existing Site Stormwater Discharge (Source: Nearmap 2023)

4. Civil Services

4.1 Purpose of this Document

The purpose of this document is to describe the stormwater services in relation to the development at 14 Mingara Drive, Tumbi Umbi.

4.2 Reference Documents

This report is based on the following reference documents:-

- Survey Plan by Beveridge Williams, dated 16/11/2023 (Project No.: 2103119, Drawing Rev.: DET-003)
- Architectural Site Plan – Prepared by Marchese Partners International Pty Ltd, dated 22/03/2024 (Job No. 16072, Rev 1)
- Dial Before You Dig.

4.3 Civil Scope of Work

The Civil Services scope of work covered in this report consists of the following:-

- Grading Design and Preliminary Bulk Earthworks;
- Stormwater Drainage works;
- Existing and proposed connections to the drainage system;
- WSUD requirements, and;
- Erosion and Sediment Control.

The civil scope for proposed stormwater drainage shall comprise of the in-ground pit and pipe network external to the building and external overland flow paths. For stormwater drainage associated with suspended slabs and roof drainage, refer to the Hydraulic Engineer's design documentation.

4.4 Limitations

This report is based primarily on the information provided by the architect, design team, survey drawings, and information communicated during the design development process. Any assumptions made through the design process have been communicated in this report.

4.5 Design Criteria

Table 4: Civil Design Criteria

Item	Design Criteria
Stormwater Drainage	Australian Rainfall and Runoff (ARR) 2019 AS/NZS 3500.3-2021 – Stormwater Drainage AS 2865 – 2009 Safe Working in a Confined Space Central Coast Development Control Plan 2022 Central Coast Council Civil Works Specification Design Guideline 2020
On-Site Detention (OSD)	Central Coast Development Control Plan 2022 AS 2865 – 2009 Safe Working in a Confined Space Central Coast Council Civil Works Specification Design Guideline 2020
Water Sensitive Urban Design (WSUD)	Central Coast Development Control Plan 2022 Central Coast Council Civil Works Specification Design Guideline 2020
Erosion and Sediment Control	Central Coast Development Control Plan 2022 Landcom 'Blue Book' – Managing Urban Stormwater Soils and Construction Guideline Edition

5. Stormwater Drainage

5.1 Stormwater Drainage Design Requirements

Design requirements for stormwater management on the site have been set out in the Central Coast Development Control Plan 2022. These requirements are summarised in the sections below. Also refer to Section 1.3 for a summary of consultation with Council.

5.1.1 Stormwater Conveyance

The major/ minor drainage system design AEP shall be selected in accordance with the table below.

Table 5: Central Coast Council Major/ Minor System Design AEP

	Major System	AEP (%)
	Overland Flow Paths and Trunk Drainage	1
	Minor System	**AEP (%)**
Land Use	**Urban Residential (single allotments)**	20
	Urban Residential (medium-high density - see text below)	5
	Commercial	5
	Industrial	5
	Rural Developments	10

- The minor (piped) drainage system must be designed to convey stormwater runoff for storm events up to, and including, the 5% Average Exceedance Probability (AEP) storm event;
- The major (overland) drainage system must be designed to convey stormwater runoff for storm events up to, and including, the 1% Average Exceedance Probability (AEP).

5.1.2 On-Site Detention (OSD) Requirements

On-Site Detention shall be in accordance with the Central Coast Development Control Plan 2022 and the Central Coast Council Civil Works Specification 2020. The intent of On-Site Detention is to protect downstream properties and infrastructure from increased stormwater flows from new development.

On-site detention shall be provided where required by council in conjunction with a proposed development. OSD will not be required on alterations, additions, ancillary structures, second storey additions, single dwelling and dual occupancies, except where:

- The volume of total retention storage provided does not correspond to the requirements in Section 3.1.11.2, in such instances the OSD system shall meet the short fall of retention volume and have a Permissible Site Discharge (PSD) of 8L/s, or
- It is required under a specific Council Plan of Management or other Council Plan.

OSD will be required for all other developments, except where:

- The development is located at a point within the catchment considered by Council not to warrant OSD, or
- An OSD system has been previously constructed to accommodate the proposed development, or
- The applicant undertakes a detailed total catchment analysis proving that the proposed development has no effect on properties and infrastructure downstream or upstream of the catchment. The study shall be undertaken by a Certified Practicing Engineer.
- The development is in a rural area and the following measures are implemented:

- All runoff from rural buildings, tracks and paved areas is to be discharged into absorption trenches or onto heavily vegetated areas so as to prevent an increase in the rate of runoff into streams/ drainage systems.
- All runoff is to be controlled so that it causes no nuisance or concentration of flow to watercourses or neighboring properties.
- Inclusion of other WSUD solutions that can be reasonably demonstrated to address stormwater flow and water quality issues to the required level.
- All runoff is to be controlled so as to prevent erosion.

5.1.3 Stormwater Quality

The Central Coast Development Control Plan 2022 states that stormwater quality targets shall be meet to improve the quality of stormwater runoff, which will also improve the health of creeks and waterways and enhance urban amenity.

The objective is to achieve the following minimum reductions in total pollutant load, compared to untreated runoff from the developed impervious areas of the site:

- 80% reduction in Solids: suspended solids and gross pollutants (grit, sediment, leaves, grass clippings, litter);
- 45% reduction in Nutrients: total phosphorus and total nitrogen.

5.2 Stormwater Conveyance

This section of the report discusses the systems proposed to allow for stormwater to be conveyed across the site to the legal point of discharge. Council have set serviceability requirements for the stormwater conveyance network such that minor flows are conveyed through piped drainage, and major flows are discharged via controlled overland flow.

Upstream flows shall also be captured and diverted around the proposed development.

5.2.1 Roof Drainage

The drainage system will be designed in accordance with AS3500.3-2021 to convey the design storm runoff from the roof to the in-ground drainage system. For storm events exceeding the design storm event, flows will surcharge the roof drainage system and discharge onto the surrounding ground where it will then be conveyed to the surrounding ground drainage within the site. Refer to the Hydraulic Engineer's design documentation for details of the roof drainage.

5.2.2 Surface Drainage

The surface areas will be drained through a variety of methods, discussed below, in accordance with AS3500.3-2021 and Council's stormwater drainage guidelines. The in-ground drainage has been designed to meet the following criteria:-

- The minor (piped) drainage system must be designed to convey stormwater runoff for storm events up to, and including, the 5% Average Exceedance Probability (AEP) storm event, and;
- The major (overland) drainage system must be designed to convey stormwater runoff for storm events up to, and including, the 1% Average Exceedance Probability (AEP) storm event.

Surface runoff from concrete pavements and surrounding landscaped areas will be directed to stormwater inlet structures using the design topography of these elements. The inlet structures have been designed to adequately convey the surface runoff into the in-ground drainage network.

The runoff will then be conveyed below-ground across the site to the on-site detention tank, and directed to the discharge point using gravity and the geometric falls of the pipe system.

5.3 Proposed Site Stormwater

The total development site area is 2.9957Ha. A total of 0.7283Ha roof area is captured by OSD 1 in Stage 1, and a total of 0.7695Ha ground area is captured by OSD 1 in Stage 1. A total of 0.3506Ha roof area is captured by OSD 2 in Stage 2, and

a total of 1.0653Ha ground area is captured by OSD 2 in Stage 2. All roof areas shall be captured via a downpipe system and discharged to the proposed below-ground stormwater network.

Two on-site detention (OSD) tanks will be required for the site to cater for the flows generated from the development. Hydraulic modelling in DRAINS has been undertaken to determine the flow rates generated from the pre-development and post development site conditions based on the site perviousness/ imperviousness for all storm events from the 50% AEP to the 5% AEP storm event. According to Central Coast Council and as confirmed during the Pre-DA meeting, the OSD tank is to be sized for the 5% AEP. Stormwater runoff from the development site shall be captured via a pit and pipe network and reticulated to the associated OSD tanks. There is a total of 0.4525Ha bypass from the OSD tanks.

As the post development uncontrolled site flow rates exceed the pre-development flow rates, two (2) OSD tanks have been sized to limit the site discharge using DRAINS to ensure the downstream piped system is not adversely impacted by the development. OSD tank 1 captures stormwater within Stage 1 boundaries and is a volume of 360cu.m, and OSD tank 2 captures stormwater within Stage 2 boundaries and is a volume of 222cu.m. Refer to the table below for the pre-development and post-development discharge rates.

Table 5: Pre-Development vs. Post Development Flows Stage 1

AEP Rainfall Event	Pre-development Discharge (cu.m/s)	OSD 1 Post-development Discharge (cu.m/s)	Bypass Post-development Discharge (cu.m/s)	Total Stage 1 Post-development Discharge (cu.m/s)
50% AEP	0.119	0.103	0.015	0.118
20% AEP	0.228	0.199	0.029	0.228
10% AEP	0.334	0.248	0.043	0.291
5% AEP	0.447	0.290	0.058	0.348

Table 6: Pre-Development vs. Post Development Flows Stage 2

AEP Rainfall Event	Pre-development Discharge (cu.m/s)	OSD 2 Post-development Discharge (cu.m/s)	Bypass Post-development Discharge (cu.m/s)	Total Stage 2 Post-development Discharge (cu.m/s)
50% AEP	0.053	0.047	0.006	0.053
20% AEP	0.139	0.126	0.013	0.139
10% AEP	0.203	0.173	0.02	0.193
5% AEP	0.289	0.202	0.028	0.230

Discharge from the OSD tank 1 shall be directed to the existing stormwater infrastructure to the east of the site.

Discharge from OSD tank 2 shall be directed to existing stormwater infrastructure to the east of the site. As the existing pit and pipe network already caters for the existing catchment, it is believed that this system has sufficient capacity to cater for the flows generated from the development with an OSD tank.

5.3.1 DRAINS Input Parameters

A DRAINS model has been prepared to verify the site stormwater drainage system. DRAINS is a runoff routing software program which assesses stormwater drainage hydraulics based on catchment hydrology input from various sources including the Bureau of Meteorology (BoM) and the Australian Rainfall and Runoff (ARR) Datahub.

The parameters used in the DRAINS model are as follows:-

- Soil Type – Normal 3.0
- Paved (Impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Antecedent Moisture Condition 3.0
- Minimum Pit Blockage (Sag Surface Inlet Pits) 0.5
- Minimum Pit Blockage (Sag Kerb Inlet Pits) 0.2
- Minimum Pit Blockage (On-Grade Surface Inlet Pits) 0.5
- Minimum Pit Blockage (On-Grade Surface Inlet Pit With Legs) 0.2
- Minimum Pit Blockage (On-Grade Kerb Inlet Pits) 0.1
- Minimum Pit Freeboard 150mm
- Minimum Fall Across Pits 30mm

The DRAINS model has been prepared to confirm that the proposed stormwater pit and pipe network is adequately sized to capture and convey the 5% AEP storm.

6. Flooding

When considering a new development, it is important to assess the impact of existing flooding on the proposed development and the impact of the proposed development on existing or potential flooding both upstream and downstream of the development.

6.1 Existing Flooding

6.1.1 Regional Flooding

The site has been identified in the Flood Information Certificate from Central Coast Council from the Tuggerah Lakes Southern Catchments Flood Study, 2018, prepared on the 09/09/2022. The certificate provides flood levels and flood planning advice at 14 Mingara Drive, Tumbi Umbi. As shown in Figure 7 below, the site is not flood affected during the 1% AEP Storm event.

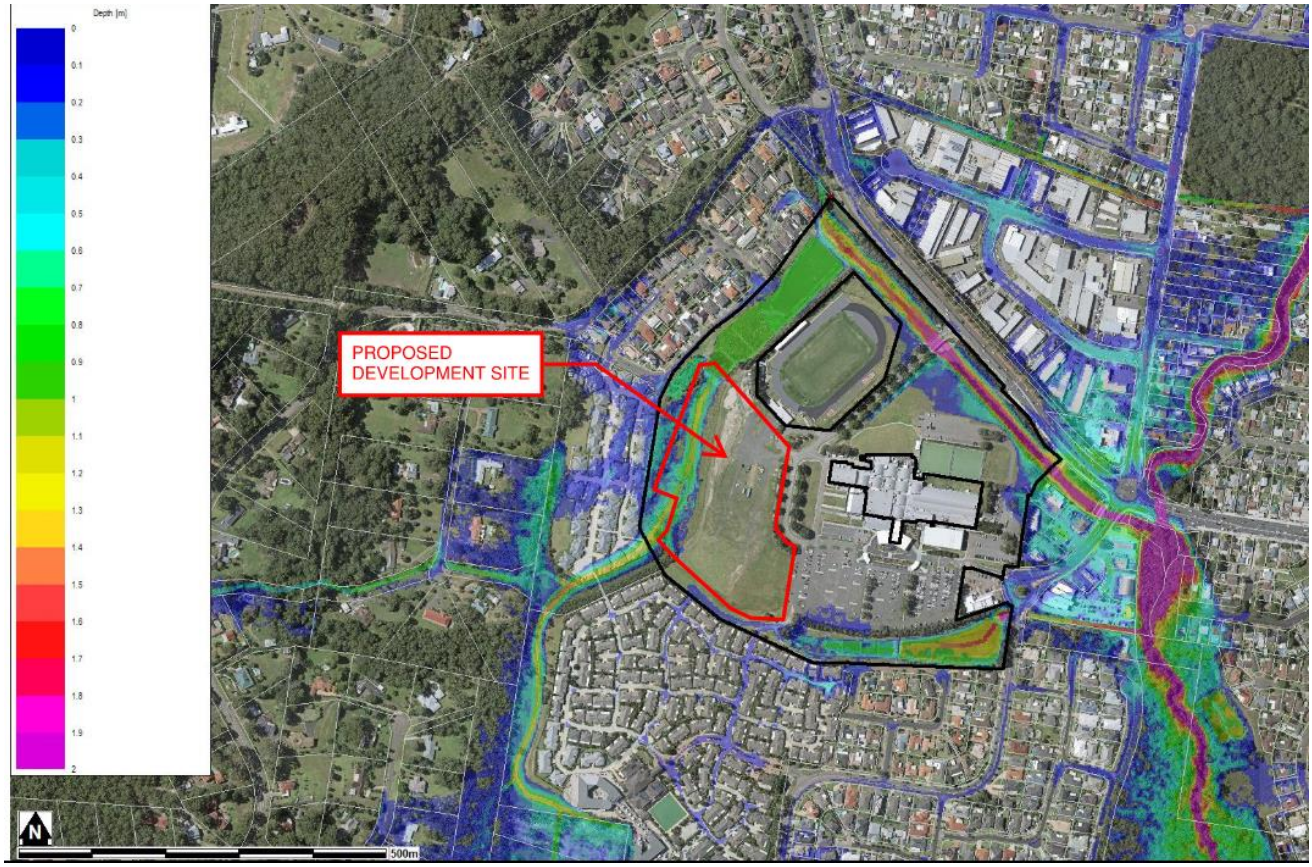

Figure 7: Peak Flood Depth 1% AEP Event (Tuggerah Lakes Southern Catchments Flood Study by WMAwater, 2018)

Stantec Australia has undertaken a review of the Tuggerah Lakes Southern Catchments flood model (WMAwater 2018) provided by Council. The flood model has been updated to include major hydraulic structures upstream and downstream of the project site and incorporated the site-specific survey into the existing scenario flood model to obtain a more accurate representation of flood levels and behaviours in and around the proposed development site in the pre-development condition. Refer to Flood Impact Assessment (FIA) report prepared by Stantec Australia for further information.

The result of the updated existing flood model is shown in Figure 8 below. The revised flood model shows minor encroachment of floodwaters into the development area in the existing scenario during the 1% AEP flood event. Depths range from 10-100mm at the south-western boundary of the development site to 5mm at the eastern boundary of the development site.

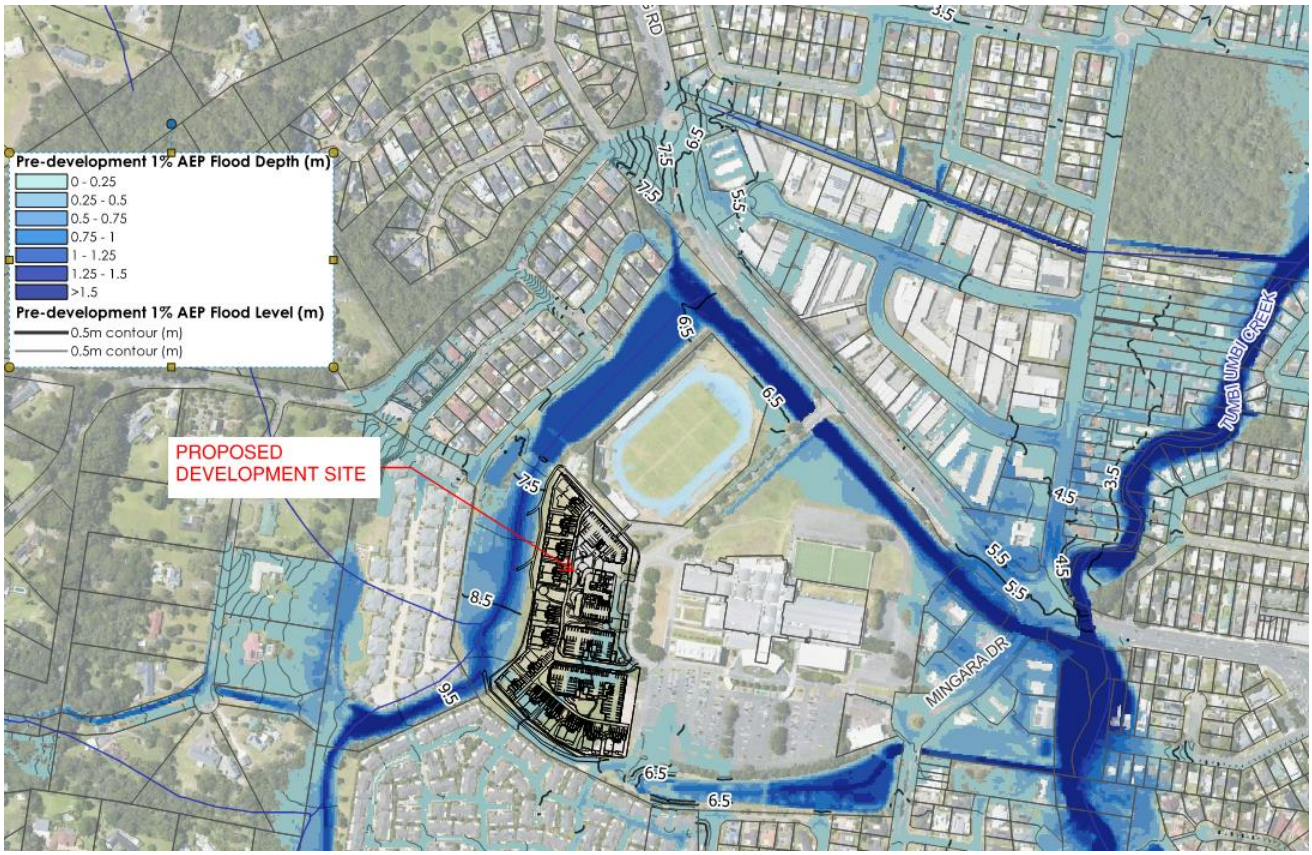

Figure 8: Peak Flood Depth 1% AEP Event – Existing Scenario (Flood Impact Assessment, Stantec 2025)

6.1.2 Local Flooding

Local or nuisance flooding describes flooding occurring due to site specific constraints. Local flooding is often caused by local topographical constraints and/or stormwater drainage capacity limitations.

Stantec have assessed the local constraints surrounding and through the site to ascertain any areas where local flooding may be an issue. The development site has an athletics track to the north, Mingara Drive (internal precinct roadway) to the east and drainage easements to the south and west. The surface topography data indicates that minimal upstream catchment is directed towards the site. Based on flood modelling, the site experiences minor encroachment of floodwaters into the development in the 1% AEP flood event along the south-western boundary to the eastern boundary. Under existing conditions, this stormwater catchment is conveyed as overland flow toward Mingara Drive through the development site. Stantec has incorporated a stormwater management strategy for the site to ensure there will be little to no impact on the proposed development site.

7. Water Quality Management Plan

The proposed treatment train has been modelled in MUSIC. MUSIC conceptually models and estimates the performance of the proposed treatment devices, which demonstrates the reduced percentage of pollutant.

The MUSIC model has been prepared in accordance with the following guidelines & parameters:-

- "Draft NSW MUSIC Modelling Guidelines", Sydney Catchment Management Authority (August 2010)
- No drainage routing between nodes.

7.1 Potential Pollutants

There are a wide range of potential stormwater pollutant sources which occur from urbanised catchments, many which can be managed through appropriate stormwater quality treatment. Typical urban pollutants may include:-

- Atmospheric deposition;
- Erosion (including that from subdivision and building activities);
- Litter and debris;
- Traffic emissions and vehicle wear;
- Animal droppings;
- Pesticides and fertilisers;
- Application, storage and wash-off of car oil, detergents and other household and commercial solvents and chemicals;
- Solid's accumulation and growth in stormwater systems, and;
- Weathering of buildings.

The following specific pollutants in urban stormwater assessed through water quality modelling and management include:-

- Suspended Solids;
- Litter;
- Nutrients such as Nitrogen and Phosphorous;
- Biological oxygen demand (BOD) and chemical oxygen demand (COD) materials;
- Micro-organisms;
- Toxic organics;
- Trace metals, and;
- Oils and surfactants.

While only the key pollutants underlined above will be examined within the modelling, the Stormwater Quality Improvement Devices implemented are expected to assist in reducing a wide range of pollutants. For example, heavy metals are commonly associated with, and bound to fine sediments. This reduces the discharge of fine sediment during the construction and operational phases will also reduce the discharge of heavy metals to existing stormwater systems.

7.2 Pollutant Reduction System

A series of treatment devices have been proposed within the stormwater network which form a treatment train.

The diagram below shows a typical treatment train:-

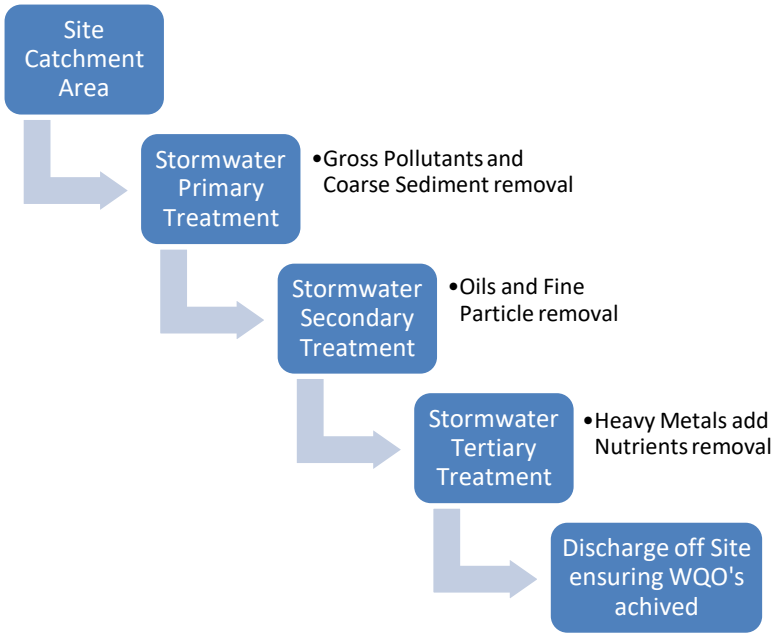

Figure 9: Treatment Train

7.2.1 Proposed Stormwater Treatment Plan

In order to demonstrate that the proposed treatment train has had a benefit on total pollutants discharged into the public stormwater network, a pollutant reduction model using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software has been prepared. The pollutants modelled in MUSIC are Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

Modelling has only been undertaken on the post-development proposal with SQID's installed to demonstrate the percentage reduction for each pollutant type.

The proposed treatment train includes the following:-

- 33x 690mm Psorb Stormfilter Cartridges within a 30sq.m Stormfilter Chamber in OSD 1
- 17x 690mm Psorb Stormfilter Cartridges within a 16sq.m Stormfilter Chamber in OSD 2
- 2 x 30kL Effective Rainwater Tank
- 12x Oceanguard Basket insets within stormwater pits

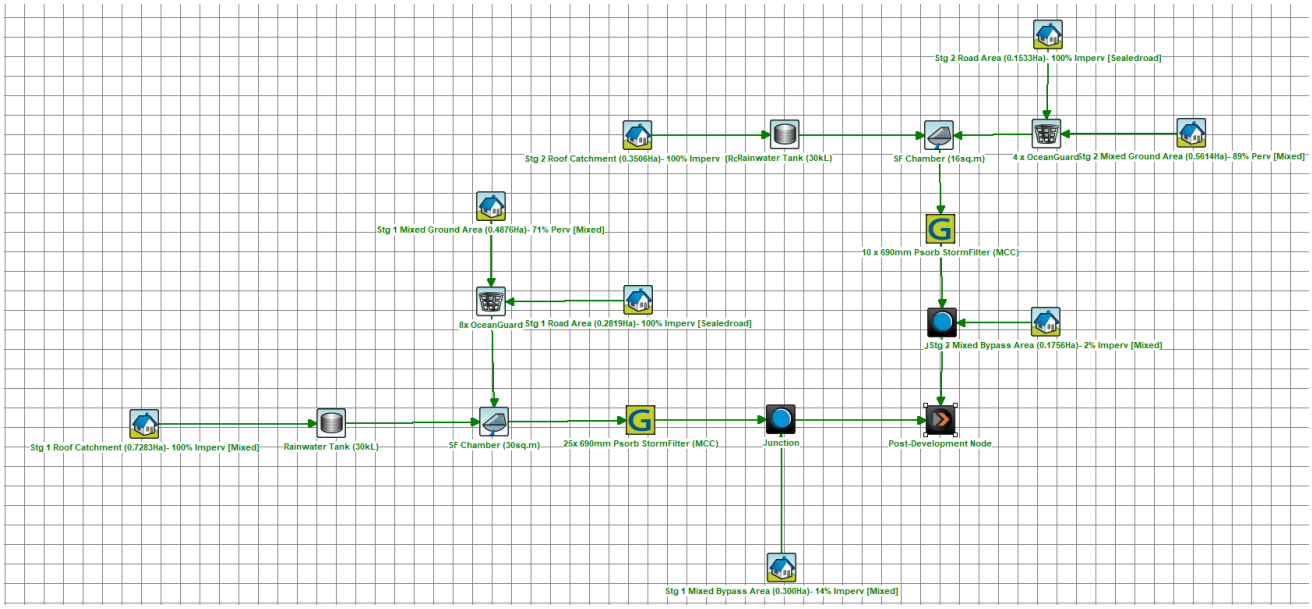

Figure 10: MUSIC Model Treatment Train

	Sources	Residual Load	% Reduction
Flow (ML/yr)	25.4	23.8	6.5
Total Suspended Solids (kg/yr)	4380	723	83.5
Total Phosphorus (kg/yr)	8	2.34	70.7
Total Nitrogen (kg/yr)	54.1	27.2	49.7
Gross Pollutants (kg/yr)	572	24.3	95.7

Figure 11: MUSIC Modelling Results

Table 7: MUSIC Results vs. Site Targets

Pollutant/Issue	Council Target	Reduction
GP	80%	95.7%
TSS	80%	8%
TP	45%	70.7%
TN	45%	46.8%

Ocean Guard Baskets

The OceanGuard Basket is a gully pit basket designed to capture pollution that runs into stormwater drains. It can be installed into existing and new stormwater pits. The system includes filtration bag liners, designed to remove gross pollutants, total suspended solids and attached pollutants.

The filtration bag, filtration cage and flow diverter work together to maximise the flow treated and pollutants captured. This efficient hydraulic design ultimately results in captured pollutants being retained in a dry state.

OceanGuard Baskets are cost-effective, highly efficient, easy to install and simple to maintain.

- Twelve (12) Ocean Guard Baskets have been proposed for the site and will be installed into the proposed grated pits and OSD grated inlet in a surface inlet configuration.

8. Stormwater Network Maintenance Schedule

In order to ensure the ongoing effective operation of the stormwater network and water quality treatment devices, the devices must be maintained in accordance with manufacturer recommendations/requirements and general best practice. It is noted that all pits are to be inspected in a safe manner that assesses localised risk and in accordance with maintenance contractor safe work method statements (SWMS).

The below summarises the various stormwater network components that will need to be maintained, whilst Schedule 1 below details required maintenance of specific items within the network requiring maintenance.

8.1 Pit and Pipe Network

A general inspection of the stormwater pit network is to be undertaken every six (6) months and after major storm events. The general inspection involves visual inspection inside pits, removal and disposal of larger gross pollutants within pits in accordance with waste disposal regulations to prevent blockages, and minimal rectification works as required. Inspection of general pits can coincide with inspection and maintenance of water quality pit inlets (if applicable).

8.2 Water Quality Treatment Devices

The filtration inserts, located within the pits, are to undergo minor service every three (3) months and after major storm events or a hazardous material spill. This involves inspection and evaluation of the filter bad and its condition, removal of captured pollutants, and the appropriate disposal of captured material in accordance with waste disposal regulations. The minor service is designed to return the ocean guard back to optimal operating performance. An inspection of the condition is to be particularly undertaken following major storm events to check for damage and higher than normal sediment accumulation. Refer to manufacturer's maintenance procedures for details of safely undertaking hand maintenance or vacuum maintenance of the ocean guards.

A major service of the ocean guards is undertaken on an as-required basis and involves the inspection of ocean guards to determine the need for filter bag replacement and support frame rectification. Replacement is based on the outcomes from the minor service whereby damage is detected. Contact manufacturer for assessment and replacement components and refer to manufacturer's maintenance procedures for safely replacing components.

8.3 Stormwater Maintenance Schedule

Maintenance Action	Frequency	Responsibility	Procedure
Pit and Pipe Network			
Blockages of inlet and outlet pipes within pits	Six Monthly	Maintenance Contractor	Remove grate. Remove any debris/litter/sludge from within pits.
Condition of inlet grates	Six Monthly	Maintenance Contractor	Clear vegetation and any debris from the pit grate and repair as required.
Condition of pit structures and section of pipes at inlets/ outlets.	Two Years	Maintenance Contractor	Remove grate to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required. Notify structural engineer if detrimental features observed.
Overland flow paths and drainage swales	Six Monthly	Maintenance Contractor	Walk along the flow path and swale. Check batters and condition of path extent. Remove any debris/litter/sludge.
Survey pipe condition with CCTV's and repair defects as necessary	Five Years	Maintenance Contractor	Remove grate. Clear blockages for camera access. Operate camera in accordance with manufacturer specifications and operator standard procedures.
Water Quality Devices			
Blockages and debris within filtration manholes and devices	Six Monthly	Maintenance Contractor	Remove grate. Remove any debris/litter/sludge. Hose out tank and devices from outside manhole.
Blockages and debris within filtration cartridges inside storage manholes.	Six Monthly	Maintenance Contractor	Remove grate. Remove any debris/litter/sludge. Hose out tank and devices from outside manhole.
Blockages and water conveyance within filtration stormwater lines	Annual	Maintenance Contractor	Remove grate. Flow water through filtration stormwater line from inspection openings to remove blockages.
Condition of stormwater pit filtration inserts/ storm sacks	Annual	Manufacturer's Contractor	Remove inserts from pit to inspect. Repair as required.
Condition and performance of treatment tank components	Annual	Manufacturer's Contractor	Remove grate and follow SWMS procedures to enter into the tank. View and repair damaged components.
Condition and performance of filtration cartridges	Annual	Manufacturer's Contractor	Remove cartridges from pit to inspect. Repair as required.

OSD and Discharge Control			
Blockage of orifice plate	Six Monthly	Maintenance Contractor	Remove grate and screen to inspect orifice. See attached Site Stormwater plan for location of Discharge Control Pit.
Orifice structure size and connection to wall	Five Years	Maintenance Contractor	Compare orifice diameter to approved design (see Works as Executed Drawing) and ensure edge of orifice is not pitted or damaged.
Trash rack blockage	Six Monthly	Maintenance Contractor	Remove grate and screen if required to clean it.
Trash rack condition and connection to wall.	Annually	Maintenance Contractor	Remove grate and rack screen. Check corrosion in particular corners. Check screen fixings to wall for stability and corrosion. Repair as required.
Condition and performance of flap valves	Annually	Maintenance Contractor	Remove grate. Test valve hinge by moving flap to full extent and allowing it to drop back into normal position. Flap should freely swing at hinge.
Blockage of overflow weirs	Six Monthly	Maintenance Contractor	Remove grate and open cover to ventilate underground storage if present. Ensure weir clear of blockages.
Tank and pit wall defects and structural adequacy.	Two Years	Maintenance Contractor	Remove grate to inspect internal walls. Repair as required. Clear vegetation from external walls if necessary and repair as required.
Tank slab build-up of sediment and sludge.	Six Monthly	Maintenance Contractor	Remove grate and screen. Remove sediment/ sludge build up, check orifice and flap valves are clear.
Condition and fixing of step irons	Two Years	Maintenance Contractor	Remove grate to inspect step irons and connection into wall. Repair as required. Notify structural engineer if detrimental features observed.
OSD warning signage	Two Years	Maintenance Contractor	Remove grate to inspect signage and connections. Check for fading in sign and any vegetation growth over or near sign impacting visibility. Repair as required.
Rainwater Tank			
First Flush Pit	Six Monthly	Maintenance Contractor	Inspect first flush device to ensure correct operation. Remove accumulated litter & debris. If device is not functioning properly repair or replace.

Internal Inspection	Six Monthly	Maintenance Contractor	Check for evidence of access by animals, birds or insects including the presence of mosquito larvae. If present, identify access point and close. If evidence of algal growth, find and close points of light entry.
Tank and tank roof	Six Monthly	Maintenance Contractor	Check structural integrity of tank including roof and access covers. Any dilapidation including holes or gaps are to be noted and repaired.

9. Erosion & Sedimentation Control

Landcom have published a design guide entitled “Managing Urban Stormwater - Soils and Construction” which is regarded as the standard to which erosion and sedimentation control should be designed to within NSW.

The control of erosion and sedimentation describes the measures incorporated during and following construction of a new development to prevent the pollution and degradation of the downstream watercourse.

According to the Central Coast Council DCP 2022, all developments where the site is disturbed, shall provide Erosion and Sedimentation Control in accordance with the requirements of the Department of Water and Energy, the Environment Protection Authority and Council.

Soil and Water Management plans shall be prepared in accordance with the Department of Environment and Conservation Guidelines, Landcom’s “Managing Urban Stormwater- Soil and Conservation- Volume 1” 4th Edition (2004) and form part of the engineering drawings.

9.1 Stormwater Drainage Infrastructure Inlets

Risk:-

- Sediment from the construction site washing into the existing stormwater drainage inlet infrastructure.

Consequence:-

- The sediment will then be conveyed into the downstream waterbody by stormwater runoff, contaminating the waterbody.
- The sediment will build up blocking the stormwater infrastructure and preventing stormwater conveyance to the downstream waterbody and impacting drainage upstream.

Mitigation:-

- Sediment traps protection will be installed surrounding all existing stormwater drainage infrastructure inlets to prevent sediment entering the system.
- Temporary Stormwater Systems are to be installed where required to capture all site runoff within the zone of excavation. Runoff will be allowed to settle out suspended particles and debris, and an acceptable water of 50mg per litre of Non Filterable Residues (NFR) is required to be achieved prior to discharge.
- Installation of a fence around the perimeter of the basin is required as well as a rip rap to allow for bobcat access for periodic removal of sediment. Also, a perforated riser outlet pipe needs to be placed for the connection and discharge to an existing pit.

Maintenance: -

- Frequent inspection of the sandbags to ensure they are arranged in a manner that prevents sediment from accessing the drainage system. If sediment is building up on the sandbags they should be cleared of sediment and re-established.
- All soil erosion and sediment control structures including temporary sediment basins and sediment traps shall be inspected following each storm event and any necessary maintenance work shall be undertaken to ensure their continued proper operation.

9.2 Construction Exit Protection

Risk:-

- Spoil such as soil being conveyed from the site on the wheels of vehicles.

Consequence:-

- Spoil being tracked onto the public road corridors where it is then washed into the existing stormwater drainage infrastructure and is then washed downstream polluting the downstream waterbody.
- Spoil being tracked onto the public road creating dangerous driving conditions for other road users.

Mitigation:-

- A shaker grid will be installed at all exits from the construction site. All vehicles leaving the site will pass over the shaker grid to remove any spoil collected on their wheels and retaining the spoil on site.

Maintenance:-

- Frequent inspection of the shaker grid to ensure it is clean and still functioning.

9.3 Downstream Site Boundaries

Risk:-

- Rainfall runoff falling on the site collecting sediment from the construction site and conveying it overland onto downstream properties and waterbodies.

Consequence:-

- Sediment discharge polluting downstream properties and waterbodies.

Mitigation:-

- Installation of sediment fences on all downstream boundaries of the site to collect sediment and prevent it discharging onto downstream properties or waterbodies.

Maintenance:-

- Regular inspection of the sediment fences to ensure they are functioning correctly and are intact.
- If sediment build up is present it should be removed to ensure correct functionality of the fences.

9.4 Sediment Runoff

Risk:-

- Sediment from the construction site washing into the existing stormwater drainage inlet infrastructure.

Consequence:-

- The sediment will build up blocking the stormwater infrastructure and preventing stormwater conveyance to the downstream waterbody and impacting drainage upstream.

Mitigation:-

- As a minimum requirement in accordance with Central Coast Council and the Blue Book, an adequate erosion and sediment control plan shall be implemented, and as such, two (2) sediment basins are required as well as inlet sediment traps. All overland flow shall be directed towards the basins, and they shall attenuate stormwater flows allowing for the settlement of sediment preventing discharge into the downstream infrastructure. The sediment basins shall be located in excavated locations of OSD tanks with outlets that discharge “clean water”.

Maintenance:-

- Frequent inspection of the basins to ensure there is sufficient volume for the storage of settlement. If there is insufficient storage the basins should be cleared of sediment and re-established.

Appendix A Civil Design Documentation

Appendix B MUSIC-Link Report

MUSIC-*link* Report

Project Details		Company Details	
Project:	Tumbi Umbi Retirement Living	**Company:**	Stantec.com
Report Export Date:	27-Mar-24	**Contact:**	Lauren Todd
Catchment Name:	MUSIC Model Tumbi Umbi REVC	**Address:**	Level 9, The Forum, 203 Pacific Highway Sydney NSW 2065 AUSTRALIA
Catchment Area:	3.016ha	**Phone:**	
Impervious Area*:	58.97%	**Email:**	Lauren.Todd@stantec.com
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	01-Jan-74 - 31-Dec-93 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Lowland		
Scenario:	Central Coast Development		

* takes into account area from all source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness

Node: Post-Development Node	Reduction
Flow	6.5%
TSS	83.5%
TP	70.8%
TN	49.7%
GP	95.5%

Treatment Nodes

Node Type	Number
Sedimentation Basin Node	2
Rain Water Tank Node	2
GPT Node	2
Generic Node	2

Source Nodes

Node Type	Number
Urban Source Node	8

Comments

The MUSIC model flagged issues can be clarified based on the following details.

The parameters that appear with errors in the Ocean Protect SF Chamber, such as Notional Detention Time. Nitrogen k value, Phosphorus k value and Suspended Solids k value, have been adopted from Ocean Protect's calculation spreadsheet which has been designed specifically for stormfilters.

It is worth noting that 'k' values should be adjusted to 1 or 0 as default values exaggerate performance as the detention tank effectiveness has already been measured and accounted for in the filter node reductions.

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	4 x OceanGuard	Hi-flow bypass rate (cum/sec)	None	99	0.08
GPT	8x OceanGuard	Hi-flow bypass rate (cum/sec)	None	99	0.16
Post	Post-Development Node	% Load Reduction	None	None	6.5
Post	Post-Development Node	GP % Load Reduction	90	None	95.5
Post	Post-Development Node	TN % Load Reduction	45	None	49.7
Post	Post-Development Node	TP % Load Reduction	45	None	70.8
Post	Post-Development Node	TSS % Load Reduction	80	None	83.5
Sedimentation	SF Chamber (16sq.m)	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber (16sq.m)	Extended detention depth (m)	0.25	1	0.77
Sedimentation	SF Chamber (16sq.m)	High Flow Bypass Out (ML/yr)	None	None	0
Sedimentation	SF Chamber (30sq.m)	Exfiltration Rate (mm/hr)	0	0	0
Sedimentation	SF Chamber (30sq.m)	Extended detention depth (m)	0.25	1	0.77
Sedimentation	SF Chamber (30sq.m)	High Flow Bypass Out (ML/yr)	None	None	0
Urban	Stg 1 Mixed Bypass Area (0.300Ha)- 14% Imperv	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Stg 1 Mixed Bypass Area (0.300Ha)- 14% Imperv	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Stg 1 Mixed Bypass Area (0.300Ha)- 14% Imperv	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Stg 1 Mixed Bypass Area (0.300Ha)- 14% Imperv	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Stg 1 Mixed Bypass Area (0.300Ha)- 14% Imperv	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Stg 1 Mixed Bypass Area (0.300Ha)- 14% Imperv	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Stg 1 Mixed Ground Area (0.4876Ha)- 71% Perv	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Stg 1 Mixed Ground Area (0.4876Ha)- 71% Perv	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Stg 1 Mixed Ground Area (0.4876Ha)- 71% Perv	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Stg 1 Mixed Ground Area (0.4876Ha)- 71% Perv	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Stg 1 Mixed Ground Area (0.4876Ha)- 71% Perv	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Stg 1 Mixed Ground Area (0.4876Ha)- 71% Perv	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Stg 1 Road Area (0.2819Ha)- 100% Imperv	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Stg 1 Road Area (0.2819Ha)- 100% Imperv	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Stg 1 Road Area (0.2819Ha)- 100% Imperv	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Stg 1 Road Area (0.2819Ha)- 100% Imperv	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Stg 1 Road Area (0.2819Ha)- 100% Imperv	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Stg 1 Road Area (0.2819Ha)- 100% Imperv	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Stg 1 Roof Catchment (0.7283Ha)- 100% Imperv	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Stg 1 Roof Catchment (0.7283Ha)- 100% Imperv	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85

Urban	Imperv	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Stg 1 Roof Catchment (0.7283Ha)- 100% Imperv	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Stg 2 Mixed Bypass Area (0.1525Ha)- 4% Imperv	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Stg 2 Mixed Bypass Area (0.1525Ha)- 4% Imperv	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Stg 2 Mixed Bypass Area (0.1525Ha)- 4% Imperv	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	Stg 2 Mixed Bypass Area (0.1525Ha)- 4% Imperv	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Stg 2 Mixed Bypass Area (0.1525Ha)- 4% Imperv	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Stg 2 Mixed Bypass Area (0.1525Ha)- 4% Imperv	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Stg 2 Mixed Ground Area (0.5614Ha)- 85% Perv	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Stg 2 Mixed Ground Area (0.5614Ha)- 85% Perv	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Stg 2 Mixed Ground Area (0.5614Ha)- 85% Perv	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Stg 2 Mixed Ground Area (0.5614Ha)- 85% Perv	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Stg 2 Mixed Ground Area (0.5614Ha)- 85% Perv	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	Stg 2 Mixed Ground Area (0.5614Ha)- 85% Perv	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	Stg 2 Road Area (0.1533Ha)- 100% Imperv	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	Stg 2 Road Area (0.1533Ha)- 100% Imperv	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	Stg 2 Road Area (0.1533Ha)- 100% Imperv	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	Stg 2 Road Area (0.1533Ha)- 100% Imperv	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	Stg 2 Road Area (0.1533Ha)- 100% Imperv	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	Stg 2 Road Area (0.1533Ha)- 100% Imperv	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	Stg 2 Roof Catchment (0.3506Ha)- 100% Imperv	Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.32	0.32
Urban	Stg 2 Roof Catchment (0.3506Ha)- 100% Imperv	Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.82	-0.82
Urban	Stg 2 Roof Catchment (0.3506Ha)- 100% Imperv	Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.1	1.1
Urban	Stg 2 Roof Catchment (0.3506Ha)- 100% Imperv	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	Stg 2 Roof Catchment (0.3506Ha)- 100% Imperv	Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.89	-0.89
Urban	Stg 2 Roof Catchment (0.3506Ha)- 100% Imperv	Stormflow Total Suspended Solids Mean (log mg/L)	1.3	1.3	1.3

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Rain	Rainwater Tank (30kL)	Total Nitrogen - C** (mg/L)	1.4	1.4	0
Rain	Rainwater Tank (30kL)	Total Nitrogen - C** (mg/L)	1.4	1.4	0
Rain	Rainwater Tank (30kL)	Total Phosphorus - C** (mg/L)	0.13	0.13	0
Rain	Rainwater Tank (30kL)	Total Phosphorus - C** (mg/L)	0.13	0.13	0
Rain	Rainwater Tank (30kL)	Total Suspended Solids - C** (mg/L)	12	12	0
Rain	Rainwater Tank (30kL)	Total Suspended Solids - C** (mg/L)	12	12	0
Sedimentation	SF Chamber (16sq.m)	Notional Detention Time (hrs)	8	12	0.264
Sedimentation	SF Chamber (16sq.m)	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber (16sq.m)	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber (16sq.m)	Total Suspended Solids - k (m/yr)	8000	8000	1
Sedimentation	SF Chamber (30sq.m)	Notional Detention Time (hrs)	8	12	0.192
Sedimentation	SF Chamber (30sq.m)	Total Nitrogen - k (m/yr)	500	500	1
Sedimentation	SF Chamber (30sq.m)	Total Phosphorus - k (m/yr)	6000	6000	1
Sedimentation	SF Chamber (30sq.m)	Total Suspended Solids - k (m/yr)	8000	8000	1

Only certain parameters are reported when they pass validation

Design with
community in mind

Level 9, The Forum
203 Pacific Highway
St Leonards NSW 2065
Tel +61 2 8484 7000

For more information, please visit www.stantec.com

Stantec