



Report

Sands SWMP Update – Townhouse Subdivision

St Quentin

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ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.



Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

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1 INTRODUCTION

The Sands development, located adjacent to the Karaaf wetland, includes a series of online amenity lakes designed for stormwater treatment, detention, and harvesting to support irrigation of the golf course. However, the urbanisation of the Karaaf wetland catchment has resulted in increased freshwater flows via surface runoff, which is negatively affecting the health of the surrounding salt marsh.

In response, the Surf Coast Shire is currently investigating stormwater management strategies to divert excess runoff away from the Karaaf wetland. Within the context of the broader technical review, this investigation and report is aimed at identifying effective stormwater management approaches to support potential 9-lot townhouse development (as shown in Figure 1-1) within the Sands development.

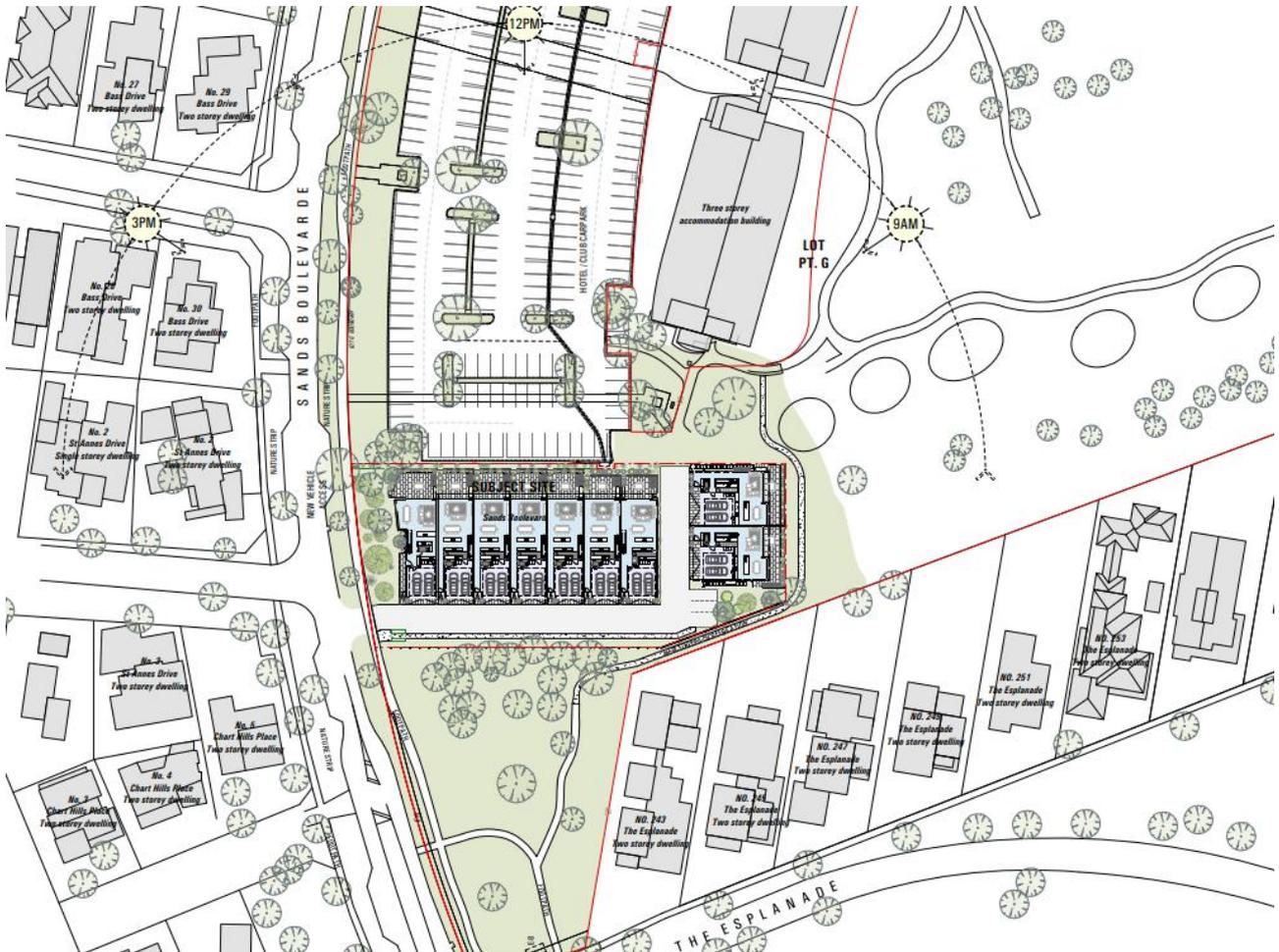


Figure 1-1 Development Plans (IDLE Architecture Studio December 2025)

1.1 Objectives

The objectives of this Stormwater Management Plan (SWMP) are to:

- Assess the on-site detention storage (OSD) and stormwater treatment requirements to support the 9-lot townhouse application.
- Assess the volumetric and water quality impacts on the Karaaf wetland due to proposed development.

1.2 Proposed development

As seen in the development plans in Figure 1-1, 9 townhouses have been proposed for development to the South of the Sands Carpark adjacent to Sands Boulevard. The land is currently being used as tennis courts, pathways, and open space as shown in Figure 1-2.



Figure 1-2 Proposed Townhouse Location

2 HYDROLOGICAL ASSESSMENT

Hydrological modelling using DRAINS has been undertaken to assess whether the existing downstream drainage network has capacity to handle the stormwater runoff from the townhouse development. Modelling was undertaken for the 20% AEP storm event assuming the existing minor drainage has been sized to convey flows up to 20% AEP event. Details on the hydrological model set-up can be found in Appendix A.

Figure 2-1 depicts where the townhouse development drainage is expected to outfall into the existing drainage network within Sands Boulevard. The orange pipes were modelled in DRAINS based on the existing council GIS drainage network data. Both the existing and post-development scenarios were modelled, with the addition of the site to the catchment being the main change in the post-development model.

The final townhouse surface level design, and stormwater piped network, should allow for the conveyance of the existing stormwater flows (both minor and major events) from the existing northern carpark through the proposed development. The existing carpark piped and overland flows are anticipated to be conveyed through the proposed development driveway.

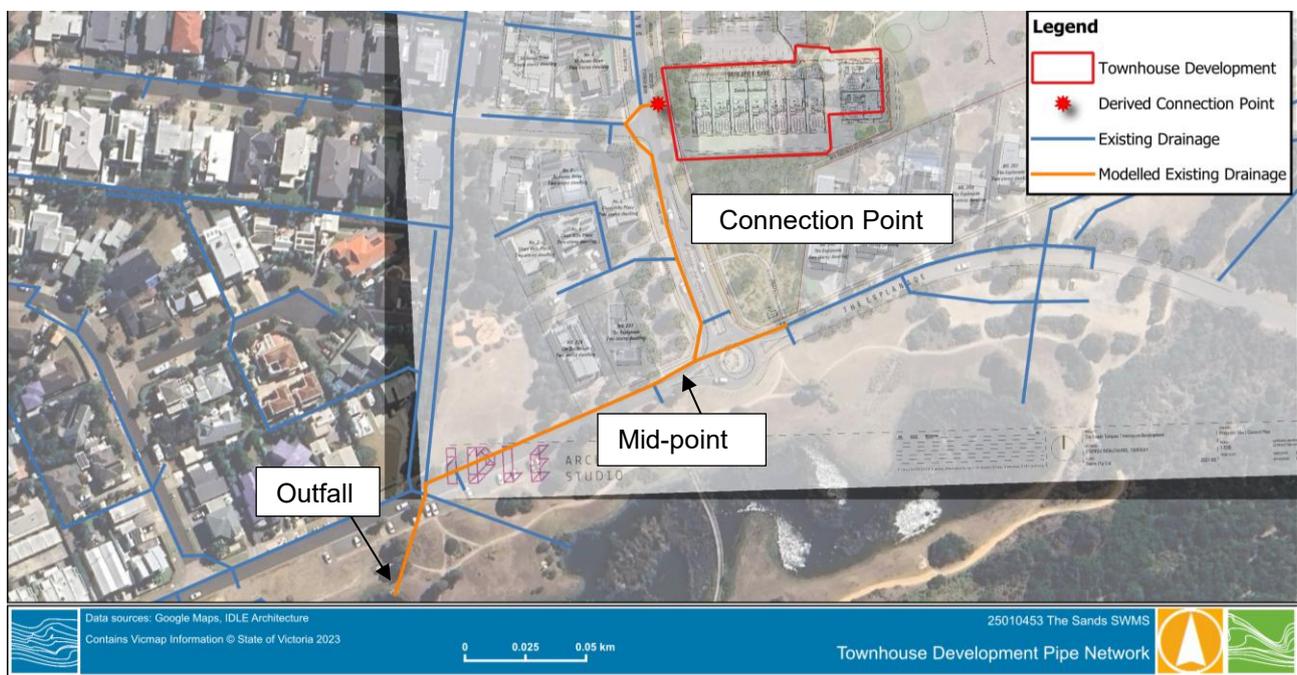


Figure 2-1 Townhouse Development Pipe Network

2.1 Results

Three pipe capacity check locations were chosen for reporting (Figure 2-1). As illustrated in Table 2-1, the pipe flow rate has increased in the post-development scenario but was below the respective pipe capacity. This indicates that the downstream pipe network has capacity for the additional flows coming from the townhouse development. Therefore, onsite detention (OSD) storage is not required for the proposed townhouse development. The final existing pipe segment from The Esplanade into the receiving waterbody also receives flows from a large catchment to the west. Due to the different catchment sizes, and associated critical time of concentration, the peak flows from the minor catchment (including the subject site) was not assessed in conjunction with the wider catchment.

Table 2-1 Flow Rate Results (20% AEP Event)

Location	Pipe capacity (m ³ /s)	Pipe Flow Rate (m ³ /s)	
		Pre-development	Post-development
Connection Point	0.07	0.009	0.04
Mid-point	0.29	0.222	0.251
Outfall	2.96	0.236	0.264

3 WATER QUALITY ASSESSMENT

As per Victorian Planning Provisions (VPP) 55.05-1, stormwater runoff from the additional lots should be treated to reach the Best Practise Environmental Management (BPEM) Targets of:

- 70% removal of the Total Gross Pollutant Load (Litter);
- 80% removal of Total Suspended Solids (TSS);
- 45% removal of Total Phosphorus (TP); and
- 45% removal of Total Nitrogen (TN).

Additionally, there is an expectation to minimise impacts of the development on the Karaaf wetland, with the goal of the treatment strategy being to mitigate the impacts of increased flows to the Wetland.

The existing Water Technology Karaaf MUSIC Model¹ was modified to include the townhouse development. The model was used to assess the pollutant and volume reduction that can be achieved through lot-scale rainwater tank reuse and proprietary Water Sensitive Urban Design (WSUD) products. Other WSUD options, such as bioretention basins and swales, were excluded from analysis as the Development Plans show minimal pervious area available per lot for their inclusion.

The units were modelled using a split catchment approach to separate the roof and remaining area nodes so that the flows to the rainwater tanks could be accurately modelled. A maximum reuse stormwater harvesting scenario was selected, with assumptions made regarding the stormwater harvesting in Table 3-1. Irrigation demand was not considered as there is little garden space available to irrigate as shown in the Development Plans. Figure 3-1 illustrates the planned unit sizes, with Table 3-3 displaying how the units were subsequently lumped into MUSIC catchments. More information about the MUSIC model set-up can be found in Appendix B.

Table 3-1 Table of Stormwater Reuse Assumptions

Number	Assumption
1	1 by 5 kl rainwater tank per lot
2	Roof area was modelled based on the latest Development Plans. Roof area was taken as the top roof lever only.
3	100% of the roof area is connected to the rainwater tanks
4	Average household size is 2.7 people ³
5	Toilet flushing takes 20 L/person/day ⁴
6	Laundry takes 80 L/household/day ⁴

¹ Water Technology, *TorquaySands_v05a(GeelongNorth)_20yr_6min* (2025)

³ <https://abs.gov.au/census/find-census-data/quickstats/2021/SAL22551>

⁴ Melbourne Water (2024). *MUSIC Guidelines*. <https://www.melbournewater.com.au/building-and-works/developer-guides-and-resources/guidelines-drawings-and-checklists/guidelines>

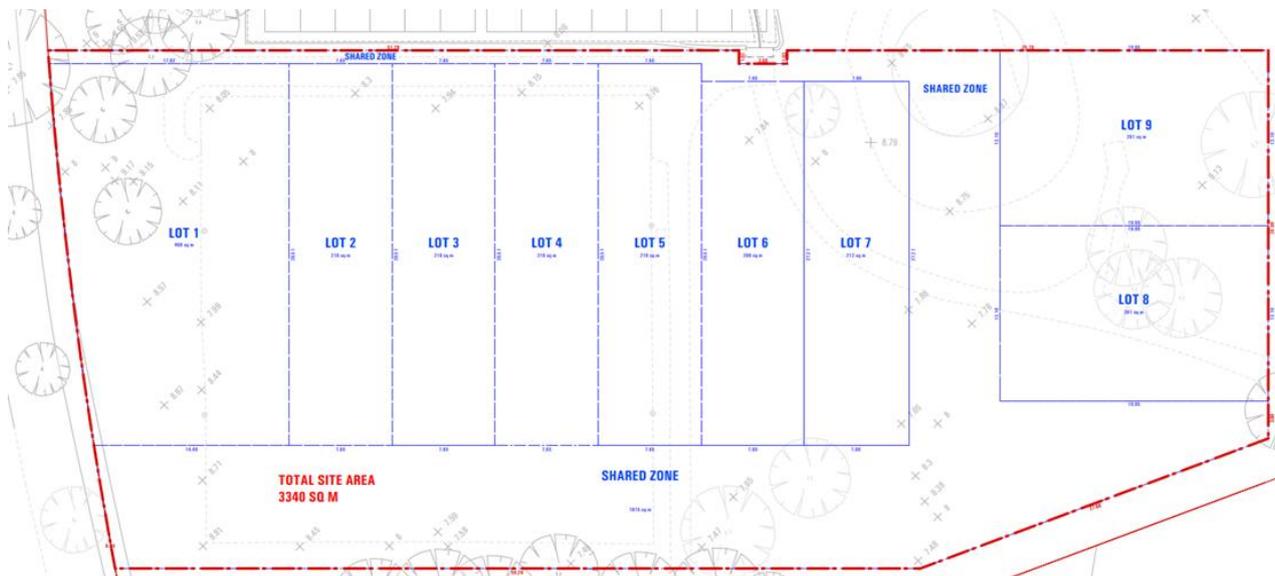


Figure 3-1 Unit Sizes (IDLE Architecture December 2025)

Table 3-2 Lumped Catchments

MUSIC Townhouse Catchment	Units Included	Average Area (m ²)	Total Area (ha)
T1	Unit 1	466	0.046
T2	Unit 2, Unit 2, Unit 3, Unit 4, Unit 5, Unit 6, Unit 7	215	0.129
T3	Unit 8, Unit 9	261	0.052
T4	Driveway	740	0.102

3.1 Results

3.1.1 Townhouse Development Performance

Table 3-3 summarises the pollutant removal and volumetric reduction performance of the lot-scale rainwater harvesting system. The results indicate that the BPEM stormwater quality targets are not achieved through rainwater harvesting alone. However, with the addition of one proprietary product asset to each lot and the driveway, BPEM is achieved for all pollutants (Table 3-4).

Table 3-3 Stormwater treatment and volumetric reduction performance - lot-scale rainwater harvesting only

Parameter	Lot-scale Inflow	Lot-scale residual Load	Load Reduction	% Load Reduction
Flow Volume (ML/yr)	1.09	0.792	0.298	27
TSS Load (Kg/yr)	73.7	64.1	9.6	13.1

Parameter	Lot-scale Inflow	Lot-scale residual Load	Load Reduction	% Load Reduction
TP Load (Kg/yr)	0.224	0.177	0.047	21.1
TN Load (Kg/yr)	2.24	1.5	0.74	32.8

Table 3-4 Stormwater treatment and volumetric reduction performance- lot-scale rainwater harvesting and proprietary GPT asset

Parameter	Lot-scale Inflow	Lot-scale residual Load	Load Reduction	% Load Reduction
Flow Volume (ML/yr)	1.09	0.792	0.298	27
TSS Load (Kg/yr)	74.2	13.6	60.6	81.7
TP Load (Kg/yr)	0.225	5.49E-02	0.1701	75.6
TN Load (Kg/yr)	2.23	0.664	1.566	70.2

The proprietary asset chosen for use in the Townhouse Development is the AtlanFilter, a cartridge filter product built for tertiary stormwater treatment. The AtlanFilter (Half-height) option requiring the least head, Half Height-Short Legs, was selected. Modelling specifications for the AtlanFilter can be seen in Table 3-5. More information about the selected proprietary asset can be seen in the online brochure⁵ and drawings set⁶. A single AtlanFilter would be located underground at the legal point of discharge (LPOD) for each lot. This asset would sit at the legal point of discharge of the property (LPOD) and receive all plumbed stormwater flows from the property, including overflow from the rainwater tank and surface flows from impervious surfaces. The ultimate driveway area finished surface grading, and any associated collection pit(s), should direct flows to a stormwater pit/vault which houses an AtlanFilter (Half-height) prior to discharging to the LPOD.

Alternative proprietary stormwater proprietary products which achieve the same pollutant removal results may be considered.

Table 3-5 Proprietary AtlanFilter (Half Height-Short Legs) Modelling Summary

Parameter	Value
Height (mm)	615
Diameter (mm)	726
Minimum Head Required (mm)	450
High flow bypass rate (L/sec)	0.0015
TSS load reduction rate (%)	85
TP load reduction rate (%)	74
TN load reduction rate (%)	59

⁵

atlanstormwater.sharepoint.com/:b/g/EQvh8kdvbqpfFohYL90iqc8YBI9GB87mxfX1kH91bl2zOFA?e=dc2hnx

⁶ [Product Library - Product Library - 1.5 & 3.5 Filter Drawings - All Documents](#)

3.1.2 Overall Volume Reduction

Runoff from the new lots will discharge to the Karaaf wetland via the existing Esplanade Wetland system. Accordingly, the overall pollutant load reductions at the Karaaf wetland inlet were compared between existing and future development scenarios (Table 3-6). As seen by Table 3-6, with the mitigation assets the existing treatment quality for the downstream Karaaf wetland is matched, and there is negligible change on the overall urbanised Karaaf catchment pollutant removal efficiency.

Table 3-6 Overall pollutant removal by stormwater treatment assets at the Karaaf Wetland inlet

Parameter	Existing	Future with proposed development + rainwater harvesting + Proprietary product
Flow Volume	10.9%	10.9%
TSS	74.5%	74.7%
TP	61.2%	61.3%
TN	39.2%	39.3%

As presented in Table 3-7 and Table 3-8, the MUSIC Modelling indicates that with the use of a water quality treatment strategy, the existing flow volume downstream is close to being matched, with a negligible flow volume increase (0.03%) expected at the Karaaf wetland inlet. Additional mitigation options are not considered necessary due to the negligible change in volume. Furthermore it is understood that Council is currently investigating the potential to alter the Esplanade low flow outlet to discharge to the ocean (via deep creek), further mitigating the subject sites post-development impacts on the Karaaf system. The combined rainwater tanks and proprietary asset strategy is the preferred option, with results mitigating the increase in TSS load to a marginal 0.53% (Table 3-8). The overall TP and TN load are modelled to decrease (Table 3-8).

Table 3-7 Percentage load increase from baseline at the Karaaf Wetland Inlet – Rainwater tanks only

Parameter	Load Increase	% Load Increase
Flow Volume (ML/yr)	0.41	0.03
TSS Load (Kg/yr)	538.29	0.73
TP Load (Kg/yr)	-0.30	-0.13
TN Load (Kg/yr)	-5.34	-0.20

Table 3-8 Percentage load increase from baseline at the Karaaf Wetland Inlet – Rainwater tanks and Proprietary GPT

Parameter	Load Increase	% Load Increase
Flow Volume (ML/yr)	0.41	0.03
TSS Load (Kg/yr)	387.6	0.53
TP Load (Kg/yr)	-0.09	-0.04
TN Load (Kg/yr)	-5.76	-0.21

4 SUMMARY

This report sets out the SWMP for the proposed 9-lot townhouse residential development in the Sands development, Torquay. This SWMP demonstrates the following key outcomes;

- The existing downstream drainage infrastructure can handle the increase in flows generated by the townhouse development up to the 20% AEP event
 - An OSD system is not required for the townhouse development to maintain 20% AEP flows
- BPEM for the townhouse development can be achieved through a combination of rainwater tank harvesting and the use of proprietary WSUD asset(s) (1 WSUD asset per lot).
- The increase in stormwater volume and pollutant load from the proposed development at the Karaaf wetland inlet under the rainwater tank and proprietary WSUD asset treatment strategy is considered to be negligible compared with existing conditions.
 - Assessment of pre- and post-development pollutant loads indicates comparable outcomes, with any change considered insignificant in the context of the broader catchment.

APPENDIX A
DRAINS MODEL DEVELOPMENT



A-1 Model Set-up

The DRAINS model was set up using ARR2019 procedures. The Initial Loss/Continuous Loss (IL/CL) method was used as the hydrological modelling method. The IL/CL parameters are shown in Table A-1 below (the pervious area losses were obtained from the ARR Datahub online portal).

Table A-1 IL/CL Values

Parameter	Selected value
Impervious Area Initial Loss	1 mm
Impervious Area Continuing Loss	0 mm/hr
Pervious Area Initial Loss	24 mm
Pervious Area Continuing Loss	4.4 mm/hr

BoM IFD rainfall depths and temporal patterns for subject site location (-38.3125, 144.3375) was used for the modelling. As per ARR2019 guidelines, 75th percentile pre-burst rainfall was applied in combination with unmodified Data Hub values of pervious area initial and continuing loss.

Minor design storm was set to 20% AEP and Major design storm was set to 1% AEP.

A suite of the standard 10 temporal patterns was modelled with storm durations ranging from 5 minutes to 12 hours.

A-2 Existing Model

The existing connecting drainage infrastructure at the Sands Boulevard was modelled based on council pit and pipe data. The existing drainage catchments C1-C3 were derived based on site topography and the drainage layout (Figure A-1). The fraction impervious (FI) value of the existing catchments was derived based on the typical land use zone values. The DRAINS model inputs of these catchments can be seen in Table A-2 below. A schematic of the DRAINS model can be seen in Figure A-2 below.

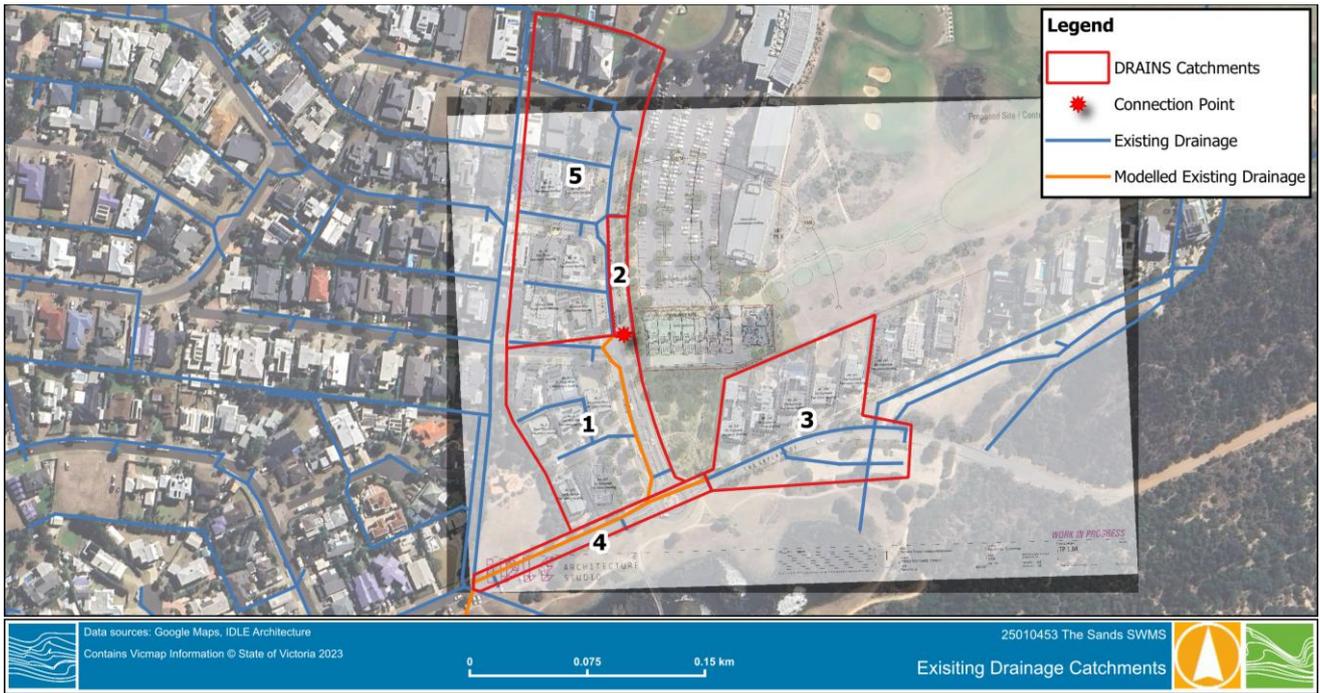


Figure A-1 Existing DRAINS Model Catchments

Table A-2 Existing Drainage Catchment Parameters

Parameter	C1	C2	C3	C4	C5
FI (%)	75	60	75	90	75
Effective Impervious Area (EIA) (%)	45	36	45	54	45
Remaining Impervious Area (RIA) (%)	30	24	30	36	30
Pervious Area (PA) (%)	25	40	25	10	25
Flow Path Length (m)	100	74.6	100	161	241
Flow Path Slope (%)	1.14	1.6	1.14	0.1	1.14
Retardance coefficient	0.013	0.013	0.013	0.013	0.013

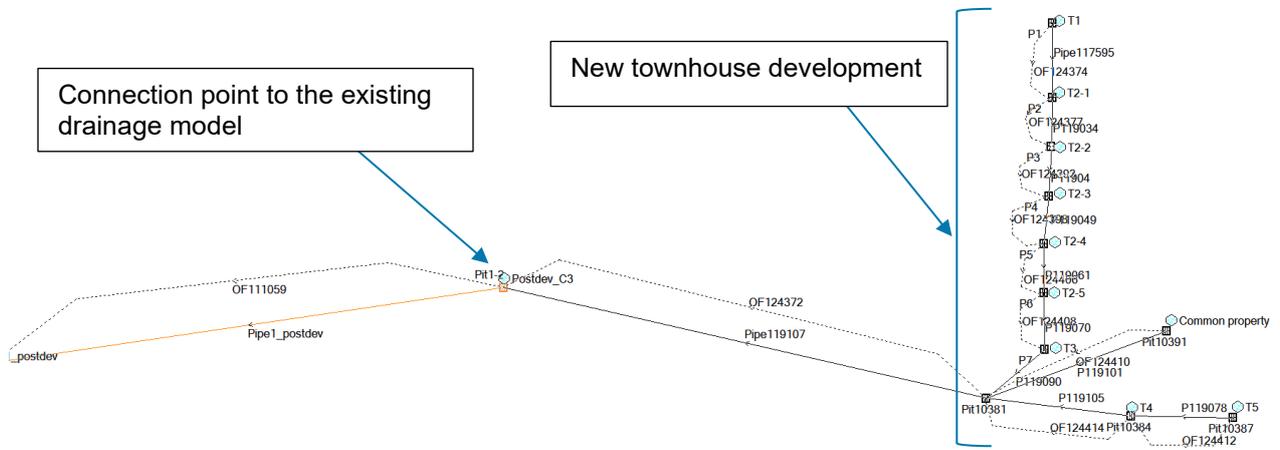


Figure A-3 Post-development Townhouse DRAINS Schematic

APPENDIX B
MUSIC MODEL SETUP



B-1 Model Set-up

The existing Torquay MUSIC Model² was used and modified for this assessment. No changes were made to the original climate template. The pollutant generation parameters varied between the roof nodes and the remaining catchment nodes, as per the Melbourne Water MUSIC guidelines for split catchments⁴. Typical values for the rainfall-runoff and pollutant generation parameters were used, apart from field capacity which was reduced from 80mm to 50mm.

A summary of the properties assigned to each MUSIC catchment can be seen in Table B-1. As seen from Table B-1 the FI values were assigned to each catchment to align with the DRAINS model and typical FI values for the given lot sizes. Table B-2 summarises the number of tanks and reuse demand for each catchment.

Table B-3 summarises the number of proprietary GPT flow filters modelled for each catchment to simulate lot-scale implementation of this additional mitigation measure.

Table B-1 MUSIC Catchment Values

MUSIC Catchment	Total Lot Area	Total FI (%)	Total Roof area	Roof area to RWT	Roof FI (%)	Remaining Area	Remaining FI (%)
T1	0.047	75	0.010	0.010	100	0.037	0.535
T2	0.129	85	0.070	0.070	100	0.059	0.308
T3	0.052	85	0.023	0.023	100	0.029	0.409
T4-Driveway	0.102	90	NA	NA	NA	NA	NA

Table B-2 MUSIC Reuse Values

MUSIC Catchment	Total Number of Lots	Total Number of Tanks	Total Reuse Demand (kL/day)
T1	1	1	0.134
T2	6	5	0.534
T3	2	3	0.214
T4-Driveway	NA	NA	NA

Table B-3 MUSIC Reuse Values

MUSIC Catchment	Total Number of Lots	Total Number of GPTs modelled
T1	1	1
T2	6	6
T3	2	2
T4-Driveway	NA	1