State code 1: Development in a state-controlled road environment

State Development Assessment Provisions guideline - State Code 1: Development in a state-controlled road environment. This guideline provides direction on how to address State Code 1.

Table 1.1 Development in general

Performance outcomes	Acceptable outcomes	Response
Buildings, structures, infrastructure, services	and utilities	
PO1 The location of the development does not	AO1.1 Development is not located in a state-	Complies with PO# / AO#
create a safety hazard for users of the state-	controlled road.	Use this column to indicate whether compliance is
controlled road.		achieved with the relevant PO or AO (or if they do not
	AND	apply), and explain why
	AO1.2 Development can be maintained without	
	requiring access to a state-controlled road.	
PO2 The design and construction of the	No acceptable outcome is prescribed.	
development does not adversely impact the		
structural integrity or physical condition of the		
state-controlled road or road transport		
infrastructure.		
PO3 The location of the development does not	No acceptable outcome is prescribed.	
obstruct road transport infrastructure or		
adversely impact the operating performance of		
the state-controlled road.		
PO4 The location, placement, design and	No acceptable outcome is prescribed.	
operation of advertising devices, visible from		
the state-controlled road, do not create a		
safety hazard for users of the state-controlled		
road.		

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Performance outcomes	Acceptable outcomes	Response
PO5 The design and construction of buildings and structures does not create a safety hazard by distracting users of the state-controlled	A05.1 Facades of buildings and structures fronting the state-controlled road are made of non-reflective materials.	
	AND	
	AO5.2 Facades of buildings and structures do not direct or reflect point light sources into the face of oncoming traffic on the state-controlled road .	
	AND	
	AO5.3 External lighting of buildings and structures is not directed into the face of oncoming traffic on the state-controlled road .	
	AND	
	AO5.4 External lighting of buildings and structures does not involve flashing or laser lights.	
PO6 Road, pedestrian and bikeway bridges over a state-controlled road are designed and constructed to prevent projectiles from being	AO6.1 Road, pedestrian and bikeway bridges over the state-controlled road include throw protection screens in accordance with section	
thrown onto the state-controlled road.	4.11 of the Design Criteria for Bridges and Other Structures Manual, Department of Transport and Main Roads, 2020.	
Landscaping		· · · · · · · · · · · · · · · · · · ·
PO7 The location of landscaping does not create a safety hazard for users of the state-controlled road .	AO7.1 Landscaping is not located in a state- controlled road.	
	AND	
	AO7.2 Landscaping can be maintained without requiring access to a state-controlled road .	

Performance outcomes	Acceptable outcomes	Response
	AND	
	A07.3 Landscaping does not block or obscure the sight lines for vehicular access to a state-controlled road .	
Stormwater and overland flow		
PO8 Stormwater run-off or overland flow from the development site does not create or exacerbate a safety hazard for users of the state-controlled road.	No acceptable outcome is prescribed.	Complies with PO8. Peak stormwater run-off and overland flow from the development site will be limited to expected residential levels. Refer to SMP prepared by Empire Engineering.
PO9 Stormwater run-off or overland flow from the development site does not result in a material worsening of the operating performance of the state-controlled road or road transport infrastructure .	No acceptable outcome is prescribed.	Complies with PO8. Peak stormwater run-off and overland flow from the development site will be limited to expected residential levels. Refer to SMP prepared by Empire Engineering.
PO10 Stormwater run-off or overland flow from the development site does not adversely impact the structural integrity or physical condition of the state-controlled road or road transport infrastructure .	No acceptable outcome is prescribed.	Complies with PO8. Peak stormwater run-off and overland flow from the development site will be limited to expected residential levels. Refer to SMP prepared by Empire Engineering.
PO11 Development ensures that stormwater is lawfully discharged.	AO11.1 Development does not create any new points of discharge to a state-controlled road .	Complies with AO11.1, the site already discharges to the state-controlled road.
	AND AO11.2 Development does not concentrate	Complies with AO11.2, the development will discharge to the existing kerb on the state-controlled road to no-more than peak residential levels.
	flows to a state-controlled road.	Complies with AO11.3, the state-controlled road is the lawful point of discharge.
	AO11.3 Stormwater run-off is discharged to a lawful point of discharge.	Complies with AO11.4, the development will discharge to the existing kerb on the state-controlled road to no-more than peak residential levels.
	AND	Refer to SMP prepared by Empire Engineering.

Performance outcomes	Acceptable outcomes	Response
	AO11.4 Development does not worsen the condition of an existing lawful point of discharge to the state-controlled road .	
Flooding		
PO12 Development does not result in a material worsening of flooding impacts within a state-controlled road .	AO12.1 For all flood events up to 1% annual exceedance probability, development results in negligible impacts (within +/- 10mm) to existing flood levels within a state-controlled road.	Complies with AO12.1, AO12.2 and AO12.3, peak stormwater flow from the development site will be limited to expected residential levels, and therefore there will be negligible impacts to flood levels, peak velocities and time of submergence. Refer to SMP prepared by Empire Engineering.
	 AO12.2 For all flood events up to 1% annual exceedance probability, development results in negligible impacts (up to a 10% increase) to existing peak velocities within a state-controlled road. AND AO12.3 For all flood events up to 1% annual exceedance probability, development results in negligible impacts (up to a 10% increase) to existing time of submergence of a state-controlled road. 	
Drainage Infrastructure		
PO13 Drainage infrastructure does not create a safety hazard for users in the state-controlled road .	AO13.1 Drainage infrastructure is wholly contained within the development site, except at the lawful point of discharge . AND	Complies with AO13.1 and AO13.2, refer to SMP prepared by Empire Engineering.

Performance outcomes	Acceptable outcomes	Response
	AO13.2 Drainage infrastructure can be maintained without requiring access to a state-controlled road .	
PO14 Drainage infrastructure associated with, or within, a state-controlled road is constructed, and designed to ensure the structural integrity and physical condition of existing drainage infrastructure and the surrounding drainage network.	No acceptable outcome is prescribed.	Complies with PO14. Drainage infrastructure for the site will be connected to kerb only, existing drainage infrastructure within the vicinity will not be physically altered.

Table 1.2 Vehicular access, road layout and local roads

Performance outcomes	Acceptable outcomes	Response
Vehicular access to a state-controlled road or w	ithin 100 metres of a state-controlled road interse	ction
PO15 The location, design and operation of a	No acceptable outcome is prescribed.	Complies with PO# / AO#
new or changed access to a state-controlled		Use this column to indicate whether compliance is
road does not compromise the safety of users of		achieved with the relevant PO or AO (or if they do
the state-controlled road.		not apply), and explain why
PO16 The location, design and operation of a	No acceptable outcome is prescribed.	
new or changed access does not adversely		
impact the functional requirements of the state-		
controlled road.		
PO17 The location, design and operation of a	No acceptable outcome is prescribed.	
new or changed access is consistent with the		
future intent of the state-controlled road.		
PO18 New or changed access is consistent with	No acceptable outcome is prescribed.	
the access for the relevant limited access road		
policy:		
1. LAR 1 where direct access is prohibited; or		
2. LAR 2 where access may be permitted,		
subject to assessment.		
PO19 New or changed access to a local road	No acceptable outcome is prescribed.	
within 100 metres of an intersection with a state-		
controlled road does not compromise the safety		
of users of the state-controlled road.		

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Performance outcomes	Acceptable outcomes	Response
PO20 New or changed access to a local road within 100 metres of an intersection with a state-controlled road does not adversely impact on the operating performance of the intersection.	No acceptable outcome is prescribed.	
Public passenger transport and active transport		
PO21 Development does not compromise the safety of users of public passenger transport infrastructure , public passenger services and active transport infrastructure .	No acceptable outcome is prescribed.	
PO22 Development maintains the ability for people to access public passenger transport infrastructure, public passenger services and active transport infrastructure .	No acceptable outcome is prescribed.	
PO23 Development does not adversely impact the operating performance of public passenger transport infrastructure, public passenger services and active transport infrastructure .	No acceptable outcome is prescribed.	
PO24 Development does not adversely impact the structural integrity or physical condition of public passenger transport infrastructure and active transport infrastructure .	No acceptable outcome is prescribed.	

Table 1.3 Network impacts

Performance outcomes	Acceptable outcomes	Response
PO25 Development does not compromise the	No acceptable outcome is prescribed.	Complies with PO# / AO#
safety of users of the state-controlled road		Use this column to indicate whether compliance is
network.		achieved with the relevant PO or AO (or if they do
		not apply), and explain why
PO26 Development ensures no net worsening of	No acceptable outcome is prescribed.	
the operating performance of the state-controlled		
road network.		
PO27 Traffic movements are not directed onto a	No acceptable outcome is prescribed.	
state-controlled road where they can be		
accommodated on the local road network.		

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Performance outcomes	Acceptable outcomes	Response
PO28 Development involving haulage exceeding	No acceptable outcome is prescribed.	
10,000 tonnes per year does not adversely impact		
the pavement of a state-controlled road.		
PO29 Development does not impede delivery of	No acceptable outcome is prescribed.	
planned upgrades of state-controlled roads.		
PO30 Development does not impede delivery of	No acceptable outcome is prescribed.	
corridor improvements located entirely within		
the state-controlled road corridor.		

Table 1.4 Filling, excavation, building foundations and retaining structures

Performance outcomes	Acceptable outcomes	Response
PO31 Development does not create a safety hazard for users of the state-controlled road or road transport infrastructure .	No acceptable outcome is prescribed.	Complies with PO# / AO# Use this column to indicate whether compliance is achieved with the relevant PO or AO (or if they do not apply), and explain why
PO32 Development does not adversely impact the operating performance of the state-controlled road .	No acceptable outcome is prescribed.	
PO33 Development does not undermine, damage or cause subsidence of a state-controlled road .	No acceptable outcome is prescribed.	
PO34 Development does not cause ground water disturbance in a state-controlled road .	No acceptable outcome is prescribed.	
PO35 Excavation, boring, piling, blasting and fill compaction do not adversely impact the physical condition or structural integrity of a state- controlled road or road transport infrastructure .	No acceptable outcome is prescribed.	
PO36 Filling and excavation associated with the construction of new or changed access do not compromise the operation or capacity of existing drainage infrastructure for a state-controlled road .	No acceptable outcome is prescribed.	

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Table 1.5 Environmental emissions

Statutory note: Where a **state-controlled road** is co-located in the same transport corridor as a railway, the development should instead comply with Environmental emissions in State code 2: Development in a railway environment.

Performance outcomes	Acceptable outcomes	Response
Reconfiguring a lot		
Involving the creation of 5 or fewer new residen	tial lots adjacent to a state-controlled road or type	e 1 multi-modal corridor
PO37 Development minimises free field noise	AO37.1 Development provides a noise barrier or	Complies with PO# / AO#
intrusion from a state-controlled road.	earth mound which is designed, sited and	Use this column to indicate whether compliance
	 to achieve the maximum free field acoustic levels in reference table 2 (item 2.1); in accordance with: a. Chapter 7 integrated noise barrier design of the Transport Noise Management Code of Practice: Volume 1 (Road Traffic Noise), Department of Transport and Main Roads, 2013; b. Technical Specification-MRTS15 Noise Fences, Transport and Main Roads, 2019; c. Technical Specification-MRTS04 General Earthworks, Transport and Main Roads, 2020. 	do not apply), and explain why
	OR	
	AO37.2 Development achieves the maximum free field acoustic levels in reference table 2 (item 2.1) by alternative noise attenuation measures where it is not practical to provide a noise barrier or earth mound. OR	
	AO37.3 Development provides a solid gap-free fence or other solid gap-free structure along the	

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Performance outcomes	Acceptable outcomes	Response
	full extent of the boundary closest to the state-	
	controlled road.	
Involving the creation of 6 or more new resident	tial lots adjacent to a state-controlled road or type	e 1 multi-modal corridor
noise intrusion from a state-controlled road.	 A038.1 Development provides noise barrier or earth mound which is designed, sited and constructed: 1. to achieve the maximum free field acoustic levels in reference table 2 (item 2.1); 2. in accordance with: a. Chapter 7 integrated noise barrier design of the Transport Noise Management Code of Practice: Volume 1 (Road Traffic 	
	 Noise), Department of Transport and Main Roads, 2013; b. Technical Specification-MRTS15 Noise Fences, Transport and Main Roads, 2019; c. Technical Specification-MRTS04 General Earthworks, Transport and Main Roads, 2020. 	
	OR	
	AO38.2 Development achieves the maximum free field acoustic levels in reference table 2 (item 2.1) by alternative noise attenuation measures where it is not practical to provide a noise barrier or earth mound.	
Material change of use (accommodation activity)		
Ground floor level requirements adjacent to a state-controlled road or type 1 multi-modal corridor		
PO39 Development minimises noise intrusion from	AO39.1 Development provides a noise barrier or	
a state-controlled road in private open space.	earth mound which is designed, sited and	
	constructed:	
	1. to achieve the maximum free field acoustic	
	ieveis in reference table 2 (item	

Performance outcomes	Acceptable outcomes	Response
	 2.2) for private open space at the ground floor level; 2. in accordance with: a. Chapter 7 integrated noise barrier design of the Transport Noise Management Code of Practice: Volume 1 (Road Traffic Noise), Department of Transport and Main Roads, 2013; b. Technical Specification-MRTS15 Noise Fences, Transport and Main Roads, 2019; c. Technical Specification-MRTS04 General Earthworks, Transport and Main Roads, 2020. 	
	OR	
	AO39.2 Development achieves the maximum free field acoustic level in reference table 2 (item 2.2) for private open space by alternative noise attenuation measures where it is not practical to provide a noise barrier or earth mound.	
PO40 Development (excluding a relevant	AO40.1 Development (excluding a relevant	
residential building or relocated building) minimises noise intrusion from a state- controlled road in habitable rooms at the facade.	 residential building or relocated building) provides a noise barrier or earth mound which is designed, sited and constructed: 1. to achieve the maximum building façade acoustic level in reference table 1 (item 1.1) for habitable rooms; 2. in accordance with: a. Chapter 7 integrated noise barrier design of the Transport Noise Management Code of Practice: Volume 1 (Road Traffic Noise), Department of Transport and Main Roads 2013: 	

Performance outcomes	Acceptable outcomes	Response
	 b. Technical Specification-MRTS15 Noise Fences, Transport and Main Roads, 2019; c. Technical Specification-MRTS04 General Earthworks, Transport and Main Roads, 2020. 	
	OR	
	AO40.2 Development (excluding a relevant residential building or relocated building) achieves the maximum building façade acoustic level in reference table 1 (item 1.1) for habitable rooms by alternative noise attenuation measures where it is not practical to provide a noise barrier or earth mound.	
PO41 Habitable rooms (excluding a relevant residential building or relocated building) are designed and constructed using materials to achieve the maximum internal acoustic level in reference table 3 (item 3.1).	No acceptable outcome is provided.	
Above ground floor level requirements (accomn	nodation activity) adjacent to a state-controlled ro	ad or type 1 multi-modal corridor
 PO42 Balconies, podiums, and roof decks include: a continuous solid gap-free structure or balustrade (excluding gaps required for drainage purposes to comply with the Building Code of Australia); highly acoustically absorbent material treatment for the total area of the soffit above balconies, podiums, and roof decks. 	No acceptable outcome is provided.	
PO43 Habitable rooms (excluding a relevant residential building or relocated building) are designed and constructed using materials to achieve the maximum internal acoustic level in reference table 3 (item 3.1).	No acceptable outcome is provided.	
material onunge of add (other adds)		

Performance outcomes	Acceptable outcomes	Response
Ground floor level requirements (childcare cent	re, educational establishment, hospital) adjacent	to a state-controlled road or type 1 multi-modal
corridor PO44 Development	No cocontable sutaema is previded	
PO44 Development:	No acceptable outcome is provided.	
i. provides a noise partier of earth mound that		
is designed, sited and constructed.		
a. to achieve the maximum free field		
2.3) for all outdoor education areas and		
2.3) for all outdoor education areas and		
h in accordance with:		
i Chanter 7 integrated noise barrier		
design of the Transport Noise		
Management Code of Practice		
Volume 1 (Road Traffic Noise)		
Department of Transport and Main		
Roads, 2013:		
ii. Technical Specification-MRTS15		
Noise Fences, Transport and Main		
Roads, 2019;		
iii. Technical Specification-MRTS04		
General Earthworks, Transport		
and Main Roads, 2020; or		
2. achieves the maximum free field acoustic		
level in reference table 2 (item 2.3) for all		
outdoor education areas and outdoor		
play areas by alternative noise		
attenuation measures where it is not		
practical to provide a noise barrier or earth		
mound.		
PO45 Development involving a childcare centre	No acceptable outcome is provided.	
or educational establishment:		
1. provides a noise barrier or earth mound that		
is designed, sited and constructed:		
2. to achieve the maximum building facade		
acoustic level in reference table 1 (item		
1.2);		

Performance outcomes Acceptable outcomes Response	
3. in accordance with:	
a. Chapter 7 integrated noise barrier design	
of the Transport Noise Management	
Code of Practice: Volume 1 (Road Traffic	
Noise), Department of Transport and	
Main Roads, 2013;	
b. Technical Specification-MRTS15 Noise	
Fences, Transport and Main Roads,	
2019;	
c. Technical Specification-MRTS04 General	
Earthworks, Transport and Main Roads,	
2020; or	
4. achieves the maximum building lacade	
1.2) by alternative noise attenuation	
measures where it is not practical to provide	
a noise barrier or earth mound	
PO46 Development involving: No acceptable outcome is provided.	
1. indoor education areas and indoor play	
areas; or	
2. sleeping rooms in a childcare centre ; or	
3. patient care areas in a hospital achieves the	
maximum internal acoustic level in reference	
table 3 (items 3.2-3.4).	
Above ground floor level requirements (childcare centre, educational establishment, hospital) adjacent to a state-cor	trolled road or type 1 multi-
modal corridor	
PO47 Development involving a childcare centre No acceptable outcome is provided.	
or educational establishment which have	
balconies, podiums or elevated outdoor play	
areas predicted to exceed the maximum free	
field acoustic level in reference table 2 (item 2.3)	
due to noise from a state-controlled road are	
provided with.	
halustrade (evoluding gans required for	

Performance outcomes	Acceptable outcomes	Response
 drainage purposes to comply with the Building Code of Australia); highly acoustically absorbent material treatment for the total area of the soffit above balconies or elevated outdoor play areas. 		
 PO48 Development including: indoor education areas and indoor play areas in a childcare centre or educational establishment; or sleeping rooms in a childcare centre; or patient care areas in a hospital located above ground level, is designed and constructed to achieve the maximum internal acoustic level in reference table 3 (items 3.2- 3.4). 	No acceptable outcome is provided.	
Air, light and vibration		
PO49 Private open space, outdoor education areas and outdoor play areas are protected from air quality impacts from a state-controlled road.	AO49.1 Each dwelling or unit has access to a private open space which is shielded from a state-controlled road by a building, solid gap-free fence, or other solid gap-free structure.	
	AO49.2 Each outdoor education area and outdoor play area is shielded from a state- controlled road by a building, solid gap-free fence, or other solid gap-free structure.	

Performance outcomes	Acceptable outcomes	Response
PO50 Patient care areas within hospitals are protected from vibration impacts from a state- controlled road or type 1 multi-modal corridor.	AO50.1 Hospitals are designed and constructed to ensure vibration in the patient treatment area does not exceed a vibration dose value of 0.1m/s ^{1.75} .	
	AND	
	AO50.2 Hospitals are designed and constructed to ensure vibration in the ward of a patient care area does not exceed a vibration dose value of 0.4m/s ^{1.75} .	
PO51 Development is designed and sited to ensure light from infrastructure within, and from users of a state-controlled road or type 1 multi-	No acceptable outcomes are prescribed.	
modal corridor, does not:		
 intrude into buildings during night hours (10pm to 6am); create unreasonable disturbance during evening hours (6pm to 10pm). 		

Table 1.6: Development in a future state-controlled road environment

Performance outcomes	Acceptable outcomes	Response
PO52 Development does not impede delivery of a	AO52.1 Development is not located in a future	Complies with PO# / AO#
future state-controlled road.	state-controlled road.	Use this column to indicate whether compliance is
		achieved with the relevant PO or AO (or if they do
	OR ALL OF THE FOLLOWING APPLY:	not apply), and explain why
	AO52.2 Development does not involve filling and excavation of, or material changes to, a future state-controlled road .	
	AND	

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Performance outcomes	Acceptable outcomes	Response
	AO52.3 The intensification of lots does not occur within a future state-controlled road .	
	AND	
	AO52.4 Development does not result in the landlocking of parcels once a future state-controlled road is delivered.	
PO53 The location and design of new or	AO53.1 Development does not include new or	
changed access does not create a safety hazard	changed access to a future state-controlled	
BO54 Filling exceptation building foundations and	No acceptable outcome is prescribed	
retaining structures do not undermine damage	No acceptable outcome is prescribed.	
or cause subsidence of a future state-controlled		
road.		
PO55 Development does not result in a material	No acceptable outcome is prescribed.	
worsening of stormwater, flooding, overland flow		
or drainage impacts in a future state-controlled		
road or road transport infrastructure.		
PO56 Development ensures that stormwater is lawfully discharged.	AO56.1 Development does not create any new points of discharge to a future state-controlled road .	
	AND	
	AO56.2 Development does not concentrate flows to a future state-controlled road .	
	AND	
	AO56.3 Stormwater run-off is discharged to a lawful point of discharge.	
	AND	

Performance outcomes	Acceptable outcomes	Response
	AO56.4 Development does not worsen the condition of an existing lawful point of discharge to the future state-controlled road .	



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Stormwater Management Plan

5 Unit Development

22 Dalgangal Road, Gayndah

Prepared for T & J Builders

Project Ref CC-7330

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Executive Summary

This report outlines stormwater quantity measures recommended to be incorporated into the proposed 5-unit development design as detailed in subsequent sections. Bulk stormwater quantity is proposed to be managed by directing runoff from the site to a small detention basin within the landscaping adjacent to the front of the site, with a throttled outlet discharging flows to the Dalgangal Road Lawful Point of Discharge kerb to no more than peak levels expected from a standard residential allotment.



1. Introduction

1.1. Project Background

Empire Engineering Pty Ltd (Empire Engineering) has been commissioned by T & J Builders to prepare a Site Based Stormwater Management Plan (SMP) for a proposed 5-unit development at 22 Dalgangal Road, Gayndah. This SMP presents the results of a drainage investigation and proposes measures to be adopted in relation to stormwater quantity for the site in question. Industry recognised computer software has been utilised in the preparation of this report. XP Storm has been utilised to size drainage structures and mitigation measures for the relevant Annual Exceedance Probability (AEP) storm events.

1.2. Aim

This SMP aims to provide a conceptual framework of drainage management strategies for the development proposal to be incorporated into the detailed design of the project works. It also aims to specifically act as a response to the SARA Information Request dated 22 August 2023 pertaining to the development proposal.

1.3. Locality and Description

The subject site is a 1395m² residential allotment located on Dalgangal Road which forms part of the state-controlled A3 Burnett Highway. The development site as displayed in Figure 2.1 is a vacant grassed area with some existing trees. Contours from 2011 Lidar display that the land generally falls towards Dalgangal Road.

1.4. Proposed Development

The development proposal involves the construction of a 5-unit complex with associated driveway, visitor carparks and landscaping areas. The proposed site plan prepared by Gatley Building Design is attached as Appendix A.

1.5. Lawful Point of Discharge

It is proposed for the development that stormwater will discharge to the existing kerb on Dalgangal Road, and therefore forms the lawful point of discharge for the development proposal as described by the Queensland Urban Drainage Manual (QUDM). Dalgangal Road is under the control of a statutory authority, being the Queensland Government.





Figure 1.1 – Aerial of Subject Site with 1m Contours (Google Maps)



2. Stormwater Quantity Management

2.1. Background

The purpose of this section of the report is to determine the general requirements for bulk stormwater management for runoff from the proposed development site. Modelling in this section was undertaken using the software package XP-STORM.

The specific objectives of this section of the report are as follows:

- Identify pre and post-development catchment conditions to determine the changes to characteristics of the stormwater runoff generated by the development; and
- If required, demonstrate that the proposed on-site mitigation methods will result in non-worsening of peak flows from the subject site to Dalgangal Road.

2.2. Existing Drainage System

As the site is in a residential area with no existing inter-allotment drainage systems, it is assumed that fencing and boundary treatments result in stormwater runoff discharging from the site to the Dalgangal Road frontage as intended. This is also assumed to be the case for the neighbouring property to the east. Runoff discharging to the existing Dalgangal Road kerb flows west approximately 40m to an inlet pit on the eastern corner of Dalgangal Road and Station Street. This underground system discharges to the Boorunbeh Street drain culvert under Dalgangal Road approximately 140m further to the west, which drains via a waterway to the Burnett River. Figure 3.1 gives an overview of the drainage features downstream of the site.



Figure 2.1 – Existing drainage from site (1m contours)



2.3. Proposed Drainage System

The proposed multi-unit development incorporates an increase in the amount of impervious surface when compared with that of a typical residential allotment. There will therefore be an increase in peak stormwater flow rates from the subject site compared to that expected by the current zoning. It is therefore proposed for the development to incorporate stormwater detention to mitigate peak post-development flow rates from the site. Runoff from the site is proposed to be collected into a small detention basin located within the landscaping adjacent to the front of the site. A throttled outlet from the detention basin will be provided to the kerb on Dalgangal Street.

A concept plan of the stormwater management proposal has been prepared and is attached to this report as Appendix B.

2.4. Modelling Overview

For this development site three 1D XP-Storm hydrology and hydraulic models will be created, the three models being:

- Subject site pre-development;
- Subject site post-development; and
- Subject site post-development with mitigation.

Hydrology assessments for pre and post development were undertaken and iterative 1D hydraulic simulations were combined with the post development case to determine appropriate mitigation measures to reduce peak flows from the site to acceptable levels.

2.5. Catchments

2.5.1. Sub-catchment Delineation and Slope

The main catchment area was delineated with reference to allotment boundaries. The main catchment area of 1395m² is displayed in Figure 3.2. Multiple sections through lidar were analysed and a catchment slope of 4% was adopted for both the pre-development and post-development scenarios.

2.5.2. Fraction Impervious

Fraction impervious was set to 45% to represent a typical residential allotment in the pre-development scenario. The post-development scenario was comprised of 1230m² impervious and 160m² pervious area, as calculated from the proposed site layout (refer to Figure 3.3).

2.5.3. Roughness

Manning's values of 0.015 for impervious and 0.04 for pervious were adopted.

2.5.4. Losses

The Uniform Loss method was used in the models with the initial and continuing losses set as 1 mm and 0 mm/hr for impervious and 10 mm and 1 mm/hr for pervious.

2.5.5. Routing Method

The Laurenson routing method was used with default values retained.





Figure 2.2 – Pre-development Catchment



Figure 2.3 – Post-development Catchments



2.6. Storm Events

The 2019 Australian Rainfall and Runoff (ARR) temporal pattern ensembles have been utilised in this analysis. Storm patterns were setup using 2019 Australian Rainfall and Runoff ensembles and 50th percentile pre-burst volumes for the local area. Storm durations of 10 minutes to 1 hour were investigated for the Annual Exceedance Probability (AEP) 39%, 18%, 10%, 5%, 2%, 1%, and 1% plus climate change (19.7% rainfall increase) storm events. The associated ARR methodology specifies that the design temporal pattern is the storm that produces a median peak flow rate of the ensemble for the duration that has the overall highest mean flow rate. For this analysis, all durations have been included in the pre- versus post-development comparisons.

2.7. Pre-development Model

The pre-development model was created to represent the subject site as a typical residential allotment and was set up with the parameters previously specified. The median peak flow rate results for all storm durations analysed are displayed in Table 3.1 columns 2 and 3, with peak values highlighted in yellow.

2.8. Post-development Model

The post-development model was created to represent the development proposal and was set up with the parameters previously specified. The median peak flow rate results for all storm durations analysed are displayed in Table 3.1 columns 4 and 5, with peak values highlighted in yellow.

2.9. Post-Development with Mitigation Model

The specific objective of the post-development with mitigation model is to demonstrate how the increase in peak flow rates that result from the proposed development of the site can be mitigated prior to discharging from the site. The strategy to achieve this is to receive all stormwater runoff into a small detention basin located within the landscaping adjacent to the front of the site. A throttled outlet will be provided to the kerb on Dalgangal Road.

The post-development model was revised to include a detention basin node as well as links representing the proposed throttled detention basin outlet consisting of underground pipe/s and an overland weir for major storm events. Multiple model iterations were run to determine suitable detention area and outlet sizes, as per the following:

- detention basin with 45m² crest level area, and 27m² bed level area at 0.7m depth;
- 2/150x100 reinforced hollow section (RHS) outlet to kerb at 1%; and
- 400mm wide overflow weir at 0.5m above the detention basin bed level.

The indicative post-development with mitigation model layout is shown as Figure 3.4. The median peak flow rate results for all storm durations analysed are displayed in Table 3.1 columns 6 and 7, with peak values highlighted in yellow.



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Figure 2.4 – Post-development with mitigation XP-Storm model layout

2.10. Results

The results displayed in Table 3.1 columns 8 and 10 demonstrate that the proposed development results in an increase in peak design flows from the subject site for all durations compared to that of a typical residential site. The inclusion of the specified detention basin with throttled outlet in the post development with mitigation model reduces the peak design flows to no more than the typical residential site's peak level as shown by columns 9 and 11.



Pro: dev AEP Pre: dev (main pask) Dev (main pask) Dev (main pask)	1	2	3	4	5	6	7	8	9	10	11
APD Ress (ms) Norm defit defit defi	Storm	Pre dev median peak	Pre dev median peak	Post dev median peak	Post dev median peak	Mitigated post dev median peak	Mitigated post dev median peak flow	Pre vs post dev	Pre vs mit post dev	Peak pre vs	Peak pre vs
0.03112 ECK_0.05Fr_10min_1 0.08270 ECN_0.05Fr_10min_1 0.00384 ECN_0.05Fr_10min_0 0.00134 0.03347 ECK_0.05Fr_10min_0 0.04477 ECN_0.05Fr_10min_0 0.00138 ECN_0.05Fr_10min_0 0.00134 0.00038 0.03346 ECN_0.05Fr_10min_0 0.04473 ECN_0.05Fr_10min_1 0.00328 ECN_0.05Fr_10min_0 0.00134 0.03347 ECN_0.05Fr_10min_0 0.03146 ECN_0.05Fr_10min_1 0.00366 ECN_0.05Fr_10min_1 0.00036 0.0387 ECN_0.05Fr_10min_1 0.0366 ECN_0.02Fr_10min_1 0.00367 ECN_0.02Fr_10min_1 0.00388 ECN_0.02Fr_10min_1 0.00388 ECN_0.02Fr_10min_1 0.00387 ECN_0.02Fr_10min_1 0.00388 ECN_0.02Fr_10min_1 0.00388 ECN_0.02Fr_10min_1 0.00388 ECN_0.02Fr_10min_1 0.00388 ECN_0.02Fr_10min_1 0.00488 ECN_0.02Fr_10min_1	AEP	flow (m3/s)	flow storm	flow (m3/s)	flow storm	flow (m3/s)	storm	diff	diff	diff (m3/s)	diff (m3/s)
0000000 ECN_0.25F_15mm_0 0000000 ECN_0.25F_15mm_0 0000000 0000000 0000000 398 000000 CKL_0.25F_15mm_0 000000 00000000 00000000 000000		0.03112	ECN 0.5EV 10min 1	0.05270	ECN 0.5EV 10min 7	0.03342	ECN 0.5EV 10min 10	(m3/s)	(m3/s)		
0.00210 ECN_0.55F_200m_3 0.00139 ECN_0.55F_200m_3 0.00324 ECN_0.55F_200m_3 0.00130 0.00130 0.00364 CRU_0.57F_200m_3 0.00140 ECN_0.57F_200m_3 0.00130 0.00130 0.00130 0.00130 0.00367 CRU_0.57F_200m_3 0.00140 ECN_0.57F_200m_3 0.00140 CCU_0.57F_200m_3 0.00140 0.00014 0.00367 CRU_0.57F_200m_3 0.00140 ECN_0.57F_200m_3 0.00140 CCU_0.57F_200m_3 0.00140 0.00038 0.00014 0.00420 CRU_0.27F_100m_1 0.00557 ECN_0.27F_200m_4 0.00371 CCU_0.27F_200m_5 0.00140 0.00038 0.00138		0.03112	ECN_0.5EY_15min_6	0.03270	ECN_0.5EY_15min_4	0.03289	ECN_0.5EY_15min_6	0.02138	-0.00058		
998 0.03364 ECH_0.5EY_15mn_6 0.04104 ECH_0.5EY_25mn_3 0.03306 ECH_0.5EY_25mn_7 0.0771 0.00051 0.00051 0.0280 ECH_0.5EY_10mn_6 0.0282 ECH_0.5EY_10mn_3 0.03140 ECH_0.5EY_10mn_3 0.00051 0.00051 0.00051 0.00114 0.00051 0.00114 ECH_0.22F_10mn_1 0.00114 ECH_0.22F_10mn_1 0.00114 ECH_0.22F_10mn_1 0.00114 ECH_0.22F_10mn_1 0.00114 ECH_0.02F_10mn_1 0.00114		0.03210	ECN 0 5EY 20min 5	0.04733	ECN 0 5EY 20min 3	0.03344	ECN_0.5EY_20min_9	0.01523	0.00134		
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0.05182 ECN_10pct_30min_8 0.05673 ECN_10pct_45min_9 0.04297 ECN_10pct_43min_9 0.00491 0.00491 0.00491 0.04918 ECN_10pct_45min_2 0.05573 ECN_10pct_45min_1 0.04027 ECN_10pct_1107 0.00491 0.00081 0.06639 ECN_5pct_10min_9 0.08203 ECN_5pct_10min_1 0.05586 ECN_5pct_10min_6 0.01514 -0.00810 0.06637 ECN_5pct_20min_1 0.07138 ECN_5pct_21min_1 0.05586 ECN_5pct_20min_1 0.00738 -0.00630 0.05597 ECN_5pct_20min_3 0.06221 ECN_5pct_20min_1 0.00751 ECN_5pct_20min_1 0.00754 -0.00810 0.05773 ECN_5pct_45min_8 0.06251 ECN_5pct_45min_1 0.00528 ECN_5pct_45min_10 0.00241 -0.00810 0.07788 ECN_2pct_10min_7 0.05806 ECN 2pct_10min_7 0.01848 0.00012 0.00102 0.001037 0.07764 ECN_2pct_20min_1 0.07555 ECN_2pct_20min_1 0.01243 0.00301 0.00241 0.08663 ECN_2pct_20min_1 0.076	10%	0.04844	ECN_10pct_25min_8	0.06845	ECN_10pct_25min_6	0.04188	ECN_10pct_25min_7	0.02001	-0.00656	0656 0.01681	
0.04918 ECN_10pct_45min_2 0.0514 ECN_10pct_45min_9 0.04027 ECN_10pct_45min_10 0.00089 0.00030 0.06688 ECN_Spet_10min_9 0.08203 ECN_Spet_10min_10 0.08379 ECN_10pct_11r_3 0.00030 0.00030 0.06337 ECN_Spet_15min_8 0.08233 ECN_Spet_20min_1 0.005866 ECN_Spet_15min_7 0.0136 0.00038 0.06410 ECN_Spet_20min_1 0.07581 ECN_Spet_20min_1 0.005866 ECN_Spet_20min_7 0.00138 0.00137 0.00586 0.05573 ECN_Spet_30min_8 0.06221 ECN_Spet_45min_9 0.04837 ECN_Spet_45min_7 0.00584 0.00514 0.00549 0.00137 0.04748 ECN_Spet_10min_7 0.04587 ECN_Spet_45min_10 0.00585 ECN_2pet_10min_7 0.0188 0.00134 0.00354 0.07048 ECN_2pet_10min_7 0.04587 ECN_2pet_20min_1 0.01488 ECN_2pet_20min_1 0.01488 0.00144 0.07044 ECN_2pet_20min_6 0.08347 ECN_2pet_20min_5 0.06734 ECN_2pet_20min_1 0.01689		0.05182	ECN_10pct_30min_8	0.05673	ECN_10pct_30min_1	0.04297	ECN_10pct_30min_9	0.00491	-0.00885		
0.04098 ECN 10pct 1hr 6 0.04911 ECN 10pct 1hr 2 0.03590 ECN 10pct 1hr 3 0.00813 0.00508 0.06689 ECN 5pct 10min 9 0.08203 ECN 5pct 10min 1 0.05879 ECN 5pct 10min 6 0.01514 0.000510 0.06410 ECN 5pct 20min 1 0.0793 ECN 5pct 20min 1 0.05846 ECN 5pct 20min 1 0.00783 0.000520 0.00137 0.00564 5% 0.0563 ECN 5pct 20min 8 0.07531 ECN 5pct 20min 1 0.05848 ECN 5pct 20min 1 0.00520 0.01344 0.05737 ECN 5pct 45min 2 0.06551 ECN 5pct 1hr 9 0.04877 ECN 5pct 45min 10 0.00688 0.07788 ECN 2pct 10min 7 0.09934 ECN 2pct 10min 8 0.007815 ECN 2pct 10min 7 0.01434 0.07788 ECN 2pct 20min 1 0.07651 ECN 2pct 20min 5 0.06714 ECN 2pct 20min 1 0.01243 0.00390 0.07664 ECN 2pct 25min 8 0.07651 ECN 2pct 25min 3 0.06633 ECN 2pct 25min 3 0.06634 ECN 2pct 25min 3 0.06634 0.00339		0.04918	ECN_10pct_45min_2	0.05414	ECN_10pct_45min_9	0.04027	ECN_10pct_45min_10	0.00496	-0.00891		
0.06689 ECN_Spct_10min_9 0.08203 ECN_Spct_1smin_10 0.05879 ECN_Spct_1omin_6 0.01514 0.00810 0.06337 ECN_Spct_1Smin_8 0.08238 ECN_Spct_1smin_10 0.05586 ECN_Spct_1smin_7 0.01914 0.00791 0.00791 5% 0.05863 ECN_Spct_2Smin_1 0.07931 ECN_Spct_2Smin_6 0.04826 ECN_Spct_2Smin_7 0.01988 0.01037 0.01564 -0.00810 0.05731 ECN_Spct_4Smin_2 0.06211 ECN_Spct_4Smin_9 0.04826 ECN_Spct_3Omin_10 0.00560 -0.00810 0.05731 ECN_Spct_1fsmin_2 0.06211 ECN_Spct_4Smin_9 0.04827 ECN_Spct_1fsmin 0 0.00520 -0.00114 0.07788 ECN_2pct_1fsmin_9 0.09234 ECN_2pct_1fsmin_2 0.04651 ECN_2pct_1fsmin 0 0.00230 0.00124 -0.00866 0.06664 ECN_2pct_2Smin_1 0.07565 ECN_2pct_2Smin_9 0.06231 ECN_2pct_1fsmin 0 0.00322 0.001631 0.00230 0.01639 -0.02411 0.06664 ECN_2pct_1fsmin 5 0.01974 ECN_2p		0.04098	ECN_10pct_1hr_6	0.04911	ECN_10pct_1hr_2	0.03590	ECN_10pct_1hr_3	0.00813	-0.00508		
0.06337 ECN Spct 15min 8 0.08253 ECN Spct 15min 10 0.05586 ECN Spct 15min 7 0.01916 0.00751 5% 0.05863 ECN Spct 25min 8 0.07831 ECN Spct 25min 8 0.07831 ECN Spct 25min 9 0.01584 ECN Spct 10min 1 0.07838 0.00954 0.00954 0.00954 0.00954 0.00137 0.01564 0.00520 0.01144 0.05731 ECN Spct 10min 7 0.06501 ECN Spct 10min 7 0.06560 ECN Spct 10min 7 0.00585 ECN Spct 10min 7 0.00144 0.07788 ECN 2pct 10min 7 0.09594 ECN 2pct 10min 8 0.07855 ECN 2pct 10min 7 0.01484 0.00241 0.07788 ECN 2pct 10min 7 0.09594 ECN 2pct 10min 8 0.07694 ECN 2pct 10min 7 0.01484 0.00241 0.07104 ECN 2pct 10min 1 0.07594 ECN 2pct 10min 3 0.06613 0.00143 0.00143 0.00144 0.06697 ECN 2pct 10min 10 0.07594 ECN 2pct 10min 3 0.00144 ECN 2pct 10min 3 0.00144 0.00153 0.05225		0.06689	ECN_5pct_10min_9	0.08203	ECN_5pct_10min_1	0.05879	ECN_5pct_10min_6	0.01514	-0.00810		
0.06410 ECN_Spct_20min_1 0.07193 ECN_Spct_20min_1 0.00783 0.00964 0.00783 0.00964 5% 0.05833 ECN_Spct_20min_8 0.07851 ECM_Spct_30min_8 0.07851 ECM_Spct_30min_8 0.06522 ECM_Spct_45min_9 0.00583 ECM_Spct_45min_0 0.00583 ECM_Spct_45min_0 0.00583 ECM_Spct_45min_0 0.00584 ECM_Spct_45min_0 0.00144 0.00144 0.00147 0.001639 ECM_2pct_2pcmin_0 0.001639		0.06337	ECN_5pct_15min_8	0.08253	ECN_5pct_15min_10	0.05586	ECN_5pct_15min_7	0.01916	-0.00751		
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0.05973 ECN_Spct_30min_8 0.06522 ECN_Spct_40min_9 0.00588 ECN_Spct_30min_9 0.00589 0.00114 0.00589 0.00114 0.00589 0.00114 0.00114 0.00114 0.00114 0.00114 0.00124 0.00144 0.00124 0.00144 0.00124 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144 0.00144	5%	0.05863	ECN_5pct_25min_8	0.07851	ECN_5pct_25min_6	0.04826	ECN_5pct_25min_7	0.01988	-0.01037	0.01564	
0.05731 ECN 5pct 45min 2 0.06251 ECN 5pct 45min 9 0.04587 ECN 5pct 45min 10 0.00520 0.00114 0.04748 ECN 5pct 1hr_2 0.04052 ECN 5pct 1hr_3 0.00912 0.00696 0.08096 ECN 2pct 10min 7 0.09594 ECN 2pct 10min 8 0.007855 ECN 2pct 10min 7 0.0094 0.00914 0.07788 ECN 2pct 10min 7 0.09735 ECN 2pct 15min 2 0.076954 ECN 2pct 10min 7 0.0094 0.00944 0.07104 ECN 2pct 20min 6 0.08347 ECN 2pct 20min 5 0.06714 ECN 2pct 20min 1 0.0123 0.00944 0.06664 ECN 2pct 45min 10 0.06586 ECN 2pct 1hr 8 0.04518 ECN 2pct 1hr 9 0.00530 0.00939 0.05325 ECN 1pct 10min 7 0.05588 ECN 1pct 10min 8 0.04939 ECN 1pct 10min 7 0.0093 0.00939 0.05629 ECN 1pct 20min 6 0.09249 ECN 1pct 10min 9 0.07636 ECN 1pct 1min 5 0.0176 ECN 1pct 20min 6 0.0127 0.00174 0.07952 ECN 1pct 20min 6 0.09249		0.05973	ECN_5pct_30min_8	0.06522	ECN_5pct_30min_1	0.05088	ECN_5pct_30min_9	0.00549	-0.00885		
0.04748 ECN_Sptlhr_6 0.05600 ECN_Sptlhr_2 0.04052 ECN_Sptlhr_3 0.00912 0.00969 0.08096 ECN_2ptl10min_7 0.09594 ECN_2ptl10min_8 0.07855 ECN_2ptl10min_7 0.01498 0.00214 0.07788 ECN_2ptl15min_9 0.09735 ECN_2ptl20min_5 0.01744 ECN_2ptl20min_9 0.06764 ECN_2ptl30min_1 0.00309 0.06664 ECN_2ptl45min_10 0.06586 ECN_2ptl30min_9 0.06213 ECN_2ptl30min_10 0.00451 0.05325 ECN_2ptl1m_8 0.05888 ECN_2ptl45min_5 0.05548 ECN_2ptl19 0.00533 0.000499 0.00339 0.05325 ECN_1ptl10min_7 0.10599 ECN_1ptl10min_8 0.04393 ECN_1ptl10min_7 0.00049 0.00174 0.000499 0.00311 0.0529 ECN_1ptl1min_5 0.0176 ECN_1ptl20min_9 0.08585 ECN_1ptl10min_7 0.0027 0.00174 0.00027 0.00174 0.07746 ECN_1ptl_25min_8 0.0872 ECN_1ptl20min_9 0.07635 ECN_1ptl5min_5 0.01774 0.00277<		0.05731	ECN_5pct_45min_2 0.06251 ECN_5pct_45min_9		0.04587	ECN_5pct_45min_10	0.00520	-0.01144			
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0.07788ECN_2pct_15min_90.09735ECN_2pct_15min_20.07694ECN_2pct_15min_50.019470.000940.07104ECN_2pct_20min_60.08347ECN_2pct_20min_50.06714ECN_2pct_20min_10.01243-0.03902%0.06664ECN_2pct_25min_80.07651ECN_2pct_25min_100.06838ECN_2pct_25min_30.00688-0.002410.06664ECN_2pct_30min_10.07265ECN_2pct_30min_90.06213ECN_2pct_45min_100.00683-0.002410.0687ECN_2pct_45min_100.05886ECN_2pct_45min_90.005548ECN_2pct_45min_100.00693-0.002390.05325ECN_2pct_1hr_80.05886ECN_2pct_1hr_80.04933ECN_2pct_1fn_90.00563-0.009340.08629ECN_1pct_1omin_70.10599ECN_1pct_1omin_80.08994ECN_1pct_1omin_70.10574-0.00310.07992ECN_1pct_2omin_60.09249ECN_1pct_2omin_90.07826ECN_1pct_2omin_60.01751-0.003610.07745ECN_1pct_2omin_60.09249ECN_1pct_2omin_90.07826ECN_1pct_4omin_70.0054-0.002740.07745ECN_1pct_2omin_10.08723ECN_1pct_4omin_90.07634ECN_1pct_4omin_60.00274-0.003610.07745ECN_1pctC_1omin_70.0592ECN_1pctC_1fr0.07634ECN_1pct_4omin_60.00274-0.003610.06118ECN_1pctC_1omin_70.12682ECN_1pctC_1fr0.06538ECN_1pctC_1omin_70.0554-0.002741%CCN_1pctC_1omin_70.12682<		0.08096	ECN_2pct_10min_7	0.09594	ECN_2pct_10min_8	0.07855	ECN_2pct_10min_7	0.01498	-0.00241		
0.07104ECN_2pct_20min_60.08347ECN_2pct_20min_50.06714ECN_2pct_20min_10.012430.00300MARAMARA2%0.06603ECN_2pct_25min_80.07651ECN_2pct_25min_100.06838ECN_2pct_25min_30.006880.001250.016390.002110.06604ECN_2pct_45min_100.07655ECN_2pct_45min_50.05548ECN_2pct_45min_100.004990.003390.00110.004990.00110.05325ECN_2pct_1hr_80.05848ECN_2pct_1hr_90.00560.009320.000110.001410.001410.001410.08699ECN_1pct_1omin_70.10599ECN_1pct_1omin_80.08994ECN_1pct_1omin_70.015740.000110.001410.08792ECN_1pct_1omin_60.0999ECN_1pct_1omin_90.08585ECN_1pct_2omin_60.012770.001640.07736ECN_1pct_2omin_60.0999ECN_1pct_2omin_90.07763ECN_1pct_2omin_60.012770.001640.07745ECN_1pct_2omin_10.0872ECN_1pct_2omin_80.00745ECN_1pct_2omin_80.002740.001640.0618ECN_1pct_1hr_80.06592ECN_1pct_1hr_80.05134ECN_1pctC_1omin_70.01580.00131%0.0357ECN_1pctC_1omin_70.1114ECN_1pctC_2omin_90.06514ECN_1pctC_1omin_70.016840.001071%0.0598ECN_1pctC_1omin_70.01144ECN_1pctC_2omin_90.06744ECN_1pctC_1omin_70.016840.001031%0.05137ECN_1pctC_1omin_70.126		0.07788	ECN_2pct_15min_9	0.09735	ECN_2pct_15min_2	0.07694	ECN_2pct_15min_5	0.01947	-0.00094		-0.00241
2% 0.06963 ECN_2pct_25min_8 0.07651 ECN_2pct_25min_10 0.06838 ECN_2pct_25min_3 0.00688 -0.00125 0.01639 -0.00241 0.06664 ECN_2pct_30min_1 0.07265 ECN_2pct_30min_9 0.06213 ECN_2pct_30min_8 0.00609 -0.00451 -0.00451 0.06087 ECN_2pct_45min_10 0.06586 ECN_2pct_45min_5 0.05548 ECN_2pct_45min_10 0.00499 -0.00539 0.05325 ECN_2pct_1hr_8 0.05888 ECN_2pct_1hr_8 0.04393 ECN_2pct_1hr_9 0.0053 -0.00932 0.08629 ECN_1pct_10min_7 0.10599 ECN_1pct_10min_8 0.08994 ECN_1pct_10min_7 0.00744 -0.00031 0.07922 ECN_1pct_20min_6 0.09249 ECN_1pct_25min_10 0.07763 ECN_1pct_20min_8 0.04949 0.00027 -0.00360 0.07736 ECN_1pct_20min_6 0.08485 ECN_1pct_25min_8 0.06592 ECN_1pct_25min_10 0.07763 ECN_1pct_30min_8 0.0027 -0.00360 0.07445 ECN_1pct_45min_10 0.07323 ECN_1pct_20min_8 <		0.07104	ECN_2pct_20min_6	0.08347	ECN_2pct_20min_5	0.06714	ECN_2pct_20min_1	0.01243	-0.00390	0.01639	
0.06664 ECN_2pct_30min_1 0.07265 ECN_2pct_30min_9 0.06213 ECN_2pct_30min_8 0.00601 -0.00451 0.06087 ECN_2pct_45min_10 0.06586 ECN_2pct_45min_5 0.05548 ECN_2pct_45min_10 0.00499 -0.00539 0.05325 ECN_2pct_1hr_8 0.05888 ECN_2pct_1hr_8 0.04939 ECN_2pct_1hr_9 0.00563 -0.00313 0.08629 ECN_1pct_10min_7 0.10599 ECN_1pct_15min_2 0.08585 ECN_1pct_15min_5 0.0176 ECN_1pct_20min_9 0.07826 ECN_1pct_20min_6 0.09249 ECN_1pct_20min_9 0.07826 ECN_1pct_20min_6 0.01257 -0.00166 0.07736 ECN_1pct_20min_6 0.09249 ECN_1pct_20min_9 0.07826 ECN_1pct_30min_8 0.00277 0.01751 -0.00311 0.07736 ECN_1pct_30min_1 0.08072 ECN_1pct_45min_5 0.06508 ECN_1pct_45min_10 0.00274 -0.00361 0.06018 ECN_1pctC_10min 7 0.12682 ECN_1pctC_10min 8 0.11071 ECN_1pctC_15min 5 0.0268 -0.00074 -0.00084 1%	2%	0.06963	ECN_2pct_25min_8	0.07651	ECN_2pct_25min_10	0.06838	ECN_2pct_25min_3	0.00688	-0.00125		
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0.07445 ECN_1pct_30min_1 0.08072 ECN_1pct_30min_9 0.07085 ECN_1pct_30min_8 0.00627 -0.00360 0.06782 ECN_1pct_45min_10 0.07323 ECN_1pct_45min_5 0.06508 ECN_1pct_45min_10 0.00274 -0.00274 0.06018 ECN_1pct_1hr_8 0.06592 ECN_1pct_1hr_8 0.05134 ECN_1pct_1hr_9 0.00574 -0.00884 0.11174 ECN_1pctC_10min_7 0.12682 ECN_1pctC_10min_8 0.11071 ECN_1pctC_10min_7 0.01038 -0.00103 0.10357 ECN_1pctC_20min_10 0.1114 ECN_1pctC_20min_9 0.09674 ECN_1pctC_20min_6 0.00129 -0.00103 1% CCN_1pctCC_20min_10 0.1114 ECN_1pctC_20min_9 0.09674 ECN_1pctC_20min_6 0.0146 -0.00204 0.09694 ECN_1pctCC_20min_10 0.1114 ECN_1pctC_20min_9 0.09674 ECN_1pctC_20min_6 0.0146 -0.00103 1% CC 0.09694 ECN_1pctCC_25min_8 0.10147 ECN_1pctC_25min_10 0.09411 ECN_1pctC_25min_8 0.00129 0.01791 -0.00103 <	1%	0.07736	ECN_1pct_25min_8	0.08485	ECN_1pct_25min_10	0.07763	ECN_1pct_25min_8	0.00749	0.00027	0.01751	-0.00031
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0.09017 ECN_1pctCC_30min_9 0.09739 ECN_1pctCC_30min_9 0.08989 ECN_1pctCC_30min_1 0.00722 -0.00028 0.08157 ECN_1pctCC_45min_10 0.08839 ECN_1pctCC_45min_10 0.08839 ECN_1pctCC_45min_10 0.00072 0.07365 ECN_1pctCC_1hr_7 0.07952 ECN_1pctCC_1hr_6 0.06751 ECN_1pctCC_1hr_9 0.00587 -0.00614	+00	0.09282	ECN_1pctCC_25min_8	0.10147	ECN_1pctCC_25min_10	0.09411	ECN_1pctCC_25min_8	0.00865	0.00129	0.01791	
0.08157 ECN_1pctCC_45min_10 0.08839 ECN_1pctCC_45min_5 0.08229 ECN_1pctCC_45min_10 0.00682 0.00072 0.07365 ECN_1pctCC_1hr_7 0.07952 ECN_1pctCC_1hr_6 0.06751 ECN_1pctCC_1hr_9 0.00587 -0.00614	+00	0.09017	ECN_1pctCC_30min_9	0.09739	ECN_1pctCC_30min_9	0.08989	ECN_1pctCC_30min_1	CC_30min_1 0.00722 -0.00028			
0.07365 ECN_1pctCC_1hr_7 0.07952 ECN_1pctCC_1hr_6 0.06751 ECN_1pctCC_1hr_9 0.00587 -0.00614		0.08157	ECN_1pctCC_45min_10	0.08839	ECN_1pctCC_45min_5	0.08229	ECN_1pctCC_45min_10	0.00682	0.00072		
		0.07365	ECN_1pctCC_1hr_7	0.07952	ECN_1pctCC_1hr_6	0.06751	ECN_1pctCC_1hr_9	0.00587	-0.00614		

Table 2.1 – XP-Storm Modelling Results



2.11. Model Validation

Rational Method calculations have been undertaken as a validity check of the XP-Storm Laurenson Method hydrology modelling. The calculations were conducted as per the applicable procedure outlined in QUDM for both the pre-development and post-development scenarios. A comparison of the modelled median peak flow rates from XP-Storm and Rational Method flow rates (Q_y) and the Rational Method parameters used are displayed in Table 3.2. The time of concentration adopted from Figure 4.4 in QUDM was 10 minutes for pre-development and 8 minutes was used for post-development.

Scenario	Design Storm Event	Area (Ha)	fi	^י l _{io} (mm/h)	Fy	C 10	Cy	^t l _y (mm/h)	Q _y (m³/s)	XP Peak Flow (m³/s)	Flow Difference (%)
Pre-dev	ECN_0.5EY_30min_6	0.139	0.45	64.1	0.85	0.74	0.63	116.00	0.02817	0.03468	23
Pre-dev	ECN_0.2EY_30min_10	0.139	0.45	64.1	0.95	0.74	0.70	145.00	0.03936	0.04592	17
Pre-dev	ECN_10pct_10min_6	0.139	0.45	64.1	1.00	0.74	0.74	167.00	0.04772	0.05501	15
Pre-dev	ECN_5pct_10min_9	0.139	0.45	64.1	1.05	0.74	0.78	191.00	0.05730	0.06689	17
Pre-dev	ECN_2pct_10min_7	0.139	0.45	64.1	1.15	0.74	0.85	222.00	0.07294	0.08096	11
Pre-dev	ECN_1pct_10min_7	0.139	0.45	64.1	1.20	0.74	0.89	246.00	0.08435	0.09025	7
Post-dev	ECN_0.5EY_10min_7	0.139	0.88	64.1	0.85	0.86	0.73	125.00	0.03528	0.05270	49
Post-dev	ECN_0.2EY_10min_7	0.139	0.88	64.1	0.95	0.86	0.82	156.00	0.04921	0.06567	33
Post-dev	ECN_10pct_15min_10	0.139	0.88	64.1	1.00	0.86	0.86	180.00	0.05977	0.07182	20
Post-dev	ECN_5pct_15min_10	0.139	0.88	64.1	1.05	0.86	0.90	206.00	0.07182	0.08253	15
Post-dev	ECN_2pct_15min_2	0.139	0.88	64.1	1.15	0.86	0.99	240.00	0.09165	0.09735	6
Post-dev	ECN_1pct_15min_2	0.139	0.88	64.1	1.20	0.86	1.03	266.00	0.10599	0.10776	2

Table 2.2 – XP Storm Model and Rational Method Flow Comparison

As can be seen in Table 3.2 the modelled XP-Storm Laurenson Method median peak flow rates tend to be similar to or higher than the estimated peak flow rates calculated via the Rational Method. The variances observed are not unusual as the different methods use different calculation techniques to predict peak flows. Overall, the similar peak flows returned by the Rational Method calculations aid to confirm the XP-Storm model validity. The XP-Storm model is considered to be a more advanced technique than the Rational Method. The XP-Storm model's higher values, and the higher differences in the 10% AEP and lower events post-development versus pre-development suggest that the XP-modelling has returned results that are more conservative than the Rational Method.



3. Conclusion

This report has outlined the detailed modelling and analysis that has been undertaken to determine a strategy for stormwater quantity management for the proposed 5-unit development at 22 Dalgangal Road, Gayndah. On-site stormwater mitigation measures have been sized to ensure a situation of non-worsening of critical duration peak design flow rates from the subject site.

MacLean Street and George Street road reserves have been nominated as the lawful point of discharge for the development proposal.



4. References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2016, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia).

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Appendix A – Development Site Plan prepared by Gatley Building Design











Appendix B – Concept Stormwater Layout Plan





