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 create a safety hazard for users of the **state-controlled road.**	**AO1.1** Development is not located in a **state-controlled road**. AND **AO1.2** Development can be maintained without requiring access to a **state-controlled road**.	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
PO2 The design and construction of the development does not adversely impact the **structural integrity** or physical condition of the **state-controlled road** or **road transport infrastructure**.	No acceptable outcome is prescribed.	
PO3 The location of the development does not obstruct **road transport infrastructure** or adversely impact the operating performance of the **state-controlled road**.	No acceptable outcome is prescribed.	
PO4 The location, placement, design and operation of advertising devices, visible from the **state-controlled road**, do not create a safety hazard for users of the **state-controlled road**.	No acceptable outcome is prescribed.	

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 road**.	**AO5.1** 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 thrown onto the **state-controlled road**.	**AO6.1** Road, pedestrian and bikeway bridges over the **state-controlled road** include throw protection screens in accordance with section 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 **AO7.3** 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.** AND **AO11.2** Development does not concentrate flows to a **state-controlled road**. AND **AO11.3** Stormwater run-off is discharged to a **lawful point of discharge**. AND	Complies with AO11.1, the site already discharges to the state-controlled road. Complies with AO11.2, the development will discharge to the existing kerb on the state-controlled road to no-more than peak residential levels. Complies with AO11.3, the state-controlled road is the 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. 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**. AND **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**.	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.
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 within 100 metres of a state-controlled road intersection		
PO15 The location, design and operation of a **new or changed access** to a **state-controlled road** does not compromise the safety of users of the **state-controlled road**.	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
PO16 The location, design and operation of a **new or changed access** does not adversely impact the **functional requirements** of the **state-controlled road**.	No acceptable outcome is prescribed.	
PO17 The location, design and operation of a **new or changed access** is consistent with the **future intent** of the **state-controlled road**.	No acceptable outcome is prescribed.	
PO18 New or changed access is consistent with 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.	No acceptable outcome is prescribed.	
PO19 New or changed access to a **local road** within 100 metres of an intersection with a **state-controlled road** does not compromise the safety of users of the **state-controlled road**.	No acceptable outcome is prescribed.	

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 safety of users of the **state-controlled road** network.	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
PO26 Development ensures **no net worsening** of the operating performance of the **state-controlled road** network.	No acceptable outcome is prescribed.	
PO27 Traffic movements are not directed onto a **state-controlled road** where they can be accommodated on the **local road** network.	No acceptable outcome is prescribed.	

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

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.	

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 residential lots adjacent to a state-controlled road or type 1 multi-modal corridor		
PO37 Development minimises free field noise intrusion from a **state-controlled road.**	**AO37.1** Development provides a 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 **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	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

Performance outcomes	Acceptable outcomes	Response
	full extent of the boundary closest to the **state-controlled road**.	
Involving the creation of 6 or more new residential lots adjacent to a state-controlled road or type 1 multi-modal corridor		
PO38 Reconfiguring a lot minimises free field noise intrusion from a **state-controlled road.**	**AO38.1** 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 a **state-controlled road** in **private open space**.	**AO39.1** Development provides a 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	

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 residential building** or **relocated building)** minimises noise intrusion from a **state-controlled road** in **habitable rooms** at the facade.	**AO40.1** Development (excluding a **relevant 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 (accommodation activity) adjacent to a state-controlled road or type 1 multi-modal corridor		
PO42 Balconies, podiums, and roof decks include: 1. a continuous **solid gap-free structure** or balustrade (excluding gaps required for drainage purposes to comply with the Building Code of Australia); 2. 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 change of use (other uses)		

Performance outcomes	Acceptable outcomes	Response
Ground floor level requirements (childcare centre, educational establishment, hospital) adjacent to a state-controlled road or type 1 multi-modal corridor		
PO44 Development: 1. provides a noise barrier or earth mound that is designed, sited and constructed: a. to achieve the maximum free field acoustic level in reference table 2 (item 2.3) for all **outdoor education areas** and **outdoor play areas**; b. in accordance with: i. 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; 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.	No acceptable outcome is provided.	
PO45 Development involving a **childcare centre** 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);	No acceptable outcome is provided.	

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 facade acoustic level in reference table 1 (item 1.2) by **alternative noise attenuation measures** where it is not practical to provide a noise barrier or earth mound.		
PO46 Development involving: 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).	No acceptable outcome is provided.	
Above ground floor level requirements (childcare centre, educational establishment, hospital) adjacent to a state-controlled road or type 1 multi-modal corridor		
PO47 Development involving a **childcare centre** 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: 1. a continuous **solid gap-free structure** or balustrade (excluding gaps required for	No acceptable outcome is provided.	

Performance outcomes	Acceptable outcomes	Response
drainage purposes to comply with the Building Code of Australia); 2. highly acoustically absorbent material treatment for the total area of the soffit above balconies or elevated **outdoor play areas**.		
PO48 Development including: 1. **indoor education areas** and **indoor play areas** in a **childcare centre** or **educational establishment**; or 2. sleeping rooms in a **childcare centre**; or 3. **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**. OR **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-modal corridor**, does not: 1. intrude into buildings during night hours (10pm to 6am); 2. create unreasonable disturbance during evening hours (6pm to 10pm).	No acceptable outcomes are prescribed.	

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

Performance outcomes	Acceptable outcomes	Response
PO52 Development does not impede delivery of a **future state-controlled road**.	**AO52.1** Development is not located in a **future state-controlled road**. OR ALL OF THE FOLLOWING APPLY: **AO52.2** Development does not involve filling and excavation of, or material changes to, a **future state-controlled road**. AND	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

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 changed access** does not create a safety hazard for users of a **future state-controlled road**.	**AO53.1** Development does not include **new or changed access** to a **future state-controlled road**.	
PO54 Filling, excavation, building foundations and **retaining structures** do not undermine, damage or cause subsidence of a **future state-controlled road**.	No acceptable outcome is prescribed.	
PO55 Development does not result in a material worsening of stormwater, flooding, overland flow or drainage impacts in a **future state-controlled road** or **road transport infrastructure**.	No acceptable outcome is prescribed.	
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	Date	Revision
CC-7330	September 2023	Revision A

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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 1395m^2 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 1395m^2 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 1230m^2 impervious and 160m^2 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 45m^2 crest level area, and 27m^2 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.

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.

Table 2.1 – XP-Storm Modelling Results

1	2	3	4	5	6	7	8	9	10	11
Storm AEP	Pre dev median peak flow (m3/s)	Pre dev median peak flow storm	Post dev median peak flow (m3/s)	Post dev median peak flow storm	Mitigated post dev median peak flow (m3/s)	Mitigated post dev median peak flow storm	Pre vs post dev diff (m3/s)	Pre vs mit post dev diff (m3/s)	Peak pre vs post dev diff (m3/s)	Peak pre vs mit post dev diff (m3/s)
	0.03112	ECN_0.5EY_10min_1	0.05270	ECN_0.5EY_10min_7	0.03342	ECN_0.5EY_10min_10	0.02158	0.00230		
	0.03347	ECN_0.5EY_15min_6	0.04957	ECN_0.5EY_15min_4	0.03289	ECN_0.5EY_15min_6	0.01610	-0.00058		
	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		
39%	0.03364	ECN_0.5EY_25min_6	0.04104	ECN_0.5EY_25min_3	0.03306	ECN_0.5EY_25min_7	0.00740	-0.00058	0.01802	-0.00124
	0.03468	ECN_0.5EY_30min_6	0.04219	ECN_0.5EY_30min_3	0.03140	ECN_0.5EY_30min_10	0.00751	-0.00328		
	0.02877	ECN_0.5EY_45min_2	0.03616	ECN_0.5EY_45min_4	0.02958	ECN_0.5EY_45min_2	0.00739	0.00081		
	0.02901	ECN_0.5EY_1hr_6	0.03288	ECN_0.5EY_1hr_4	0.02707	ECN_0.5EY_1hr_6	0.00387	-0.00194		
	0.04429	ECN_0.2EY_10min_1	0.06567	ECN_0.2EY_10min_7	0.04011	ECN_0.2EY_10min_10	0.02138	-0.00418		
	0.04349	ECN_0.2EY_15min_6	0.06273	ECN_0.2EY_15min_4	0.03989	ECN_0.2EY_15min_6	0.01924	-0.00360		
	0.04230	ECN_0.2EY_20min_4	0.05977	ECN_0.2EY_20min_9	0.03843	ECN_0.2EY_20min_5	0.01747	-0.00387		
18%	0.04388	ECN_0.2EY_25min_5	0.05116	ECN_0.2EY_25min_3	0.03880	ECN_0.2EY_25min_5	0.00728	-0.00508	0.01975	-0.00581
	0.04592	ECN_0.2EY_30min_10	0.05323	ECN_0.2EY_30min_4	0.03824	ECN_0.2EY_30min_10	0.00731	-0.00768		
	0.04106	ECN_0.2EY_45min_2	0.04722	ECN_0.2EY_45min_10	0.03561	ECN_0.2EY_45min_10	0.00616	-0.00545		
	0.03698	ECN_0.2EY_1hr_6	0.04186	ECN_0.2EY_1hr_6	0.03367	ECN_0.2EY_1hr_6	0.00488	-0.00331		
	0.05501	ECN_10pct_10min_6	0.07180	ECN_10pct_10min_1	0.04517	ECN_10pct_10min_6	0.01679	-0.00984		
	0.05277	ECN_10pct_15min_7	0.07182	ECN_10pct_15min_10	0.04489	ECN_10pct_15min_8	0.01905	-0.00788		
	0.05497	ECN_10pct_20min_6	0.06193	ECN_10pct_20min_1	0.04409	ECN_10pct_20min_1	0.00696	-0.01088		
10%	0.04844	ECN_10pct_25min_8	0.06845	ECN_10pct_25min_6	0.04188	ECN_10pct_25min_7	0.02001	-0.00656	0.01681	-0.00984
	0.05182	ECN_10pct_30min_8	0.05673	ECN_10pct_30min_1	0.04297	ECN_10pct_30min_9	0.00491	-0.00885		
	0.04918	ECN_10pct_45min_2	0.05414	ECN_10pct_45min_9	0.04027	ECN_10pct_45min_10	0.00496	-0.00891		
	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	-0.00810		
	0.06337	ECN_5pct_15min_8	0.08253	ECN_5pct_15min_10	0.05586	ECN_5pct_15min_7	0.01916	-0.00751		
	0.06410	ECN_5pct_20min_1	0.07193	ECN_5pct_20min_1	0.05446	ECN_5pct_20min_1	0.00783	-0.00964		
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	-0.00810
	0.05973	ECN_5pct_30min_8	0.06522	ECN_5pct_30min_1	0.05088	ECN_5pct_30min_9	0.00549	-0.00885		
	0.05731	ECN_5pct_45min_2	0.06251	ECN_5pct_45min_9	0.04587	ECN_5pct_45min_10	0.00520	-0.01144		
	0.04748	ECN_5pct_1hr_6	0.05660	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	0.07855	ECN_2pct_10min_7	0.01498	-0.00241		
	0.07788	ECN_2pct_15min_9	0.09735	ECN_2pct_15min_2	0.07694	ECN_2pct_15min_5	0.01947	-0.00094		
	0.07104	ECN_2pct_20min_6	0.08347	ECN_2pct_20min_5	0.06714	ECN_2pct_20min_1	0.01243	-0.00390		
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	0.00601	-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	0.04393	ECN_2pct_1hr_9	0.00563	-0.00932		
	0.09025	ECN_1pct_10min_7	0.10599	ECN_1pct_10min_8	0.08994	ECN_1pct_10min_7	0.01574	-0.00031		
	0.08629	ECN_1pct_15min_5	0.10776	ECN_1pct_15min_2	0.08585	ECN_1pct_15min_5	0.02147	-0.00044		
	0.07992	ECN_1pct_20min_6	0.09249	ECN_1pct_20min_9	0.07826	ECN_1pct_20min_6	0.01257	-0.00166		
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
	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	0.00541	-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_1pctCC_10min_7	0.12682	ECN_1pctCC_10min_8	0.11071	ECN_1pctCC_10min_7	0.01508	-0.00103		
	0.10357	ECN_1pctCC_15min_5	0.12965	ECN_1pctCC_15min_2	0.1035	ECN_1pctCC_15min_5	0.02608	-0.00007		
	0.09694	ECN_1pctCC_20min_10	0.1114	ECN_1pctCC_20min_9	0.09674	ECN_1pctCC_20min_6	0.01446	-0.00020		
1% +CC	0.09282	ECN_1pctCC_25min_8	0.10147	ECN_1pctCC_25min_10	0.09411	ECN_1pctCC_25min_8	0.00865	0.00129	0.01791	-0.00103
	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_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		

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.

Table 2.2 – XP Storm Model and Rational Method Flow Comparison

Scenario	Design Storm Event	Area (Ha)	f_i	$^1I_{10}$ (mm/h)	F_y	C_{10}	C_y	^tI_y (mm/h)	Q_y (m^3/s)	XP Peak Flow (m^3/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

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.

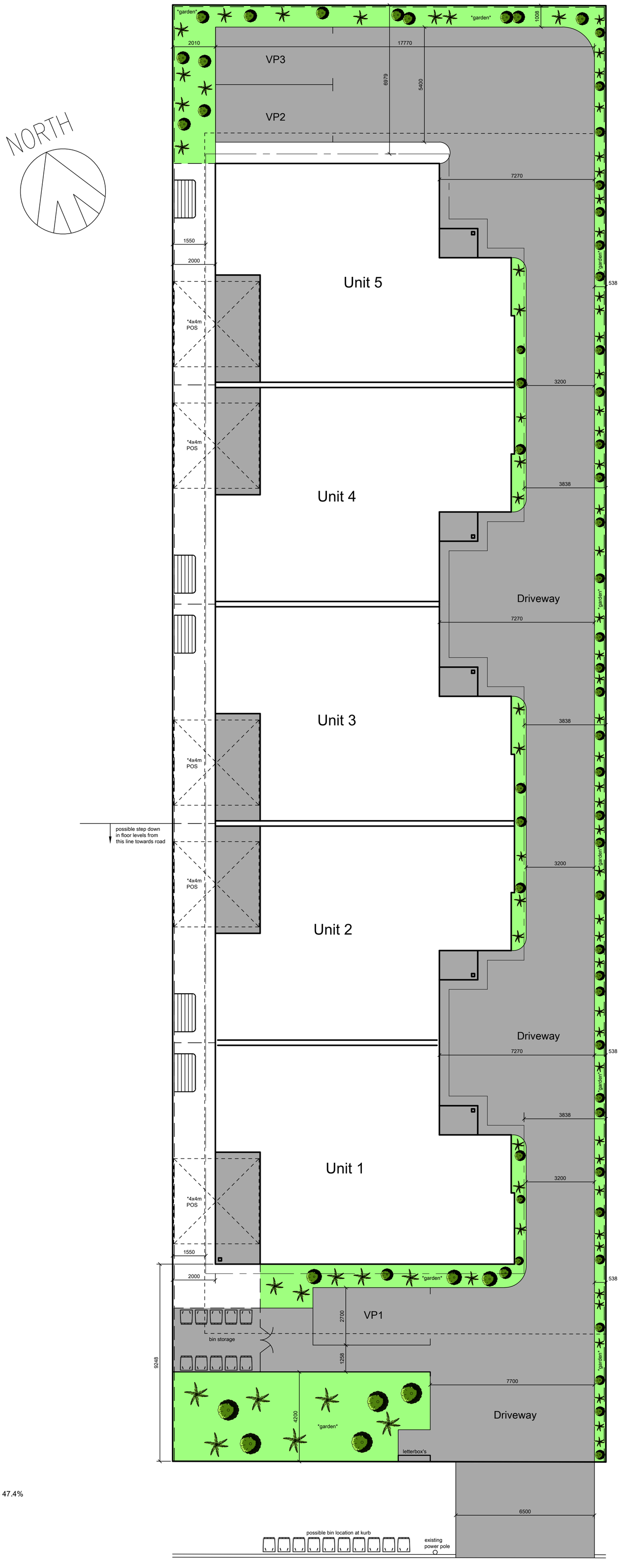
MacLean Street and George Street road reserves have been nominated as the lawful point of discharge for the development proposal.

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).

Institute of Public Works Engineering Australasia Queensland (IPWEAQ), 2017, *Queensland Urban Drainage Manual*, Fourth Edition 2016, Institute of Public Works Engineering Australasia, Queensland (IPWEAQ), Brisbane.

Appendix A – Development Site Plan prepared by Gatley Building Design



SITE PLAN

scale 1:100 @ A1

Site Cover - 47.4%

gatley. BUILDING DESIGN

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Site: NO. 22 DALGANGAL ROAD, GAYNDAH LOT 21 SP203242

Project: PROPOSED DWELLING
Client: T. Bosotas

Description: SITE PLAN.

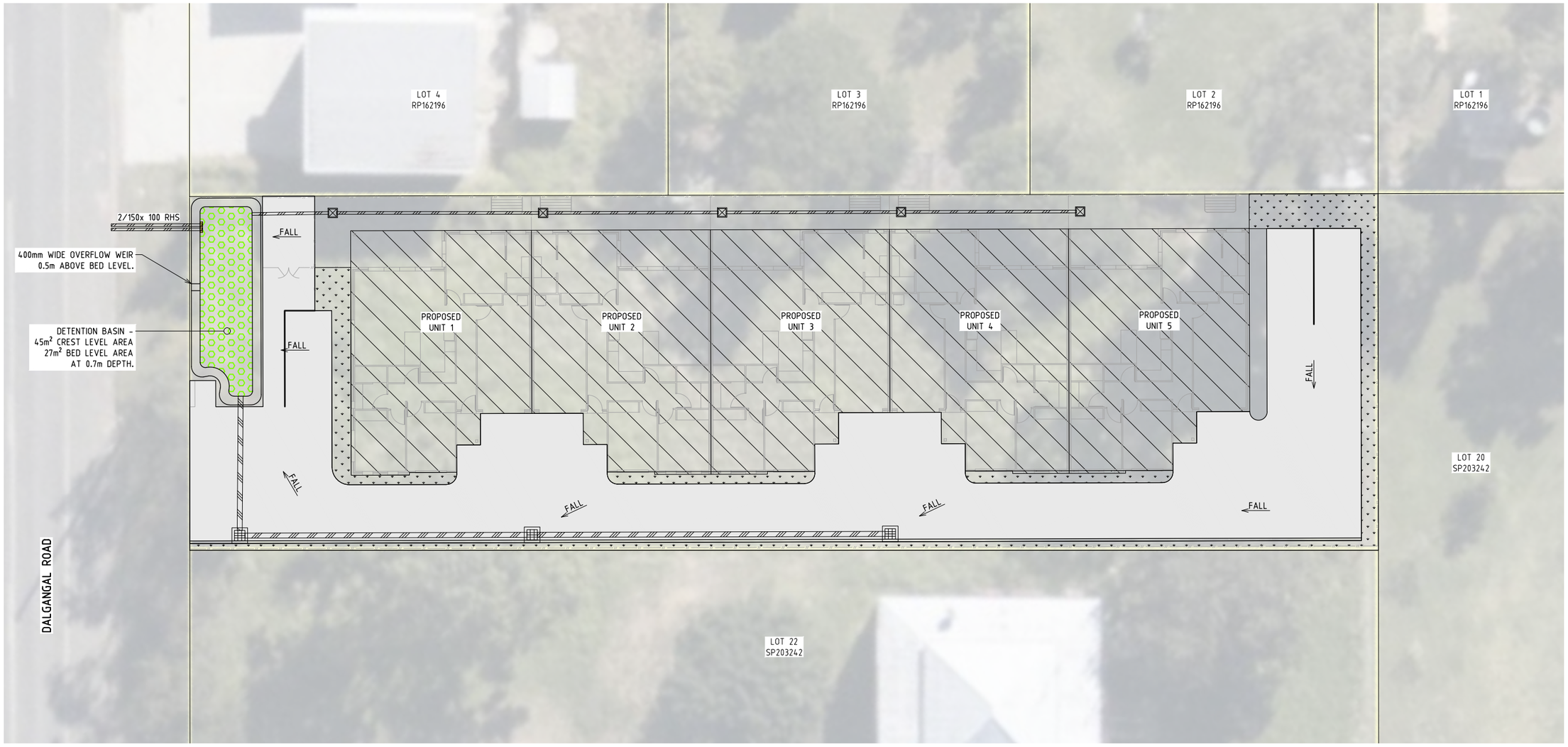
Rev	Description	Date
-	-	-

Issue: Preliminary
Date: 24/02/23

Design: R.B. Drawn: R.B. Approved: J.G.

Drawing No: 23131
Page: 01

Appendix B – Concept Stormwater Layout Plan



LEGEND

- PROPOSED SEALED PAVEMENT
- PROPOSED DETENTION BASIN
- PROPOSED LANDSCAPING BY OTHERS
- PROPOSED GRATED INLET PIT
- PROPOSED 450SQ INTERALLOTMENT DRAINAGE PIT
- PROPOSED STORMWATER PIPE

WARNING

THE LOCATION OF ALL EXISTING SERVICES (E.G. TELSTRA, ELECTRICITY, SEWERAGE, WATER & GAS) ARE SHOWN SCHEMATICALLY ON THE DRAWINGS. PRIOR TO AND DURING CONSTRUCTION OBTAIN THE PRECISE LOCATION OF ALL SERVICES (UNDERGROUND & OVERHEAD) FROM THE RELEVANT AUTHORITY RESPONSIBLE FOR THE SERVICE SHOWN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE TO EXISTING SERVICES WHETHER SHOWN ON THE DRAWINGS OR NOT.

PROJECT NORTH

SCALES
1:125 at A1
1:250 at A3
0 1.25 2.5 3.75 5 6.25m

STATUS
FOR INFORMATION

ISSUE	AMENDMENT	DATE	DFT
A	FOR INFORMATION	25.09.23	LJM

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2. FIGURED DIMENSIONS TAKE PRECEDENCE OVER SCALED.
3. VERIFY ALL DIMENSIONS ON SITE.

CLIENT: T & J BUILDERS
PROJECT: *PROPOSED 5 UNIT DEVELOPMENT*
NO. 22 DALGANGAL ROAD
GAYNDAH

DESIGNED: RGD | DRAWN: LJM | CHECKED: RAW
APPROVED:
ROSS WEGNER / RPEQ: 8042

TITLE: STORMWATER CONCEPT PLAN

DATE: SEPTEMBER 2023 | SCALE: AS SHOWN
PROJECT NO: CC-7330 | DRAWING NO: STM01 | REV: A