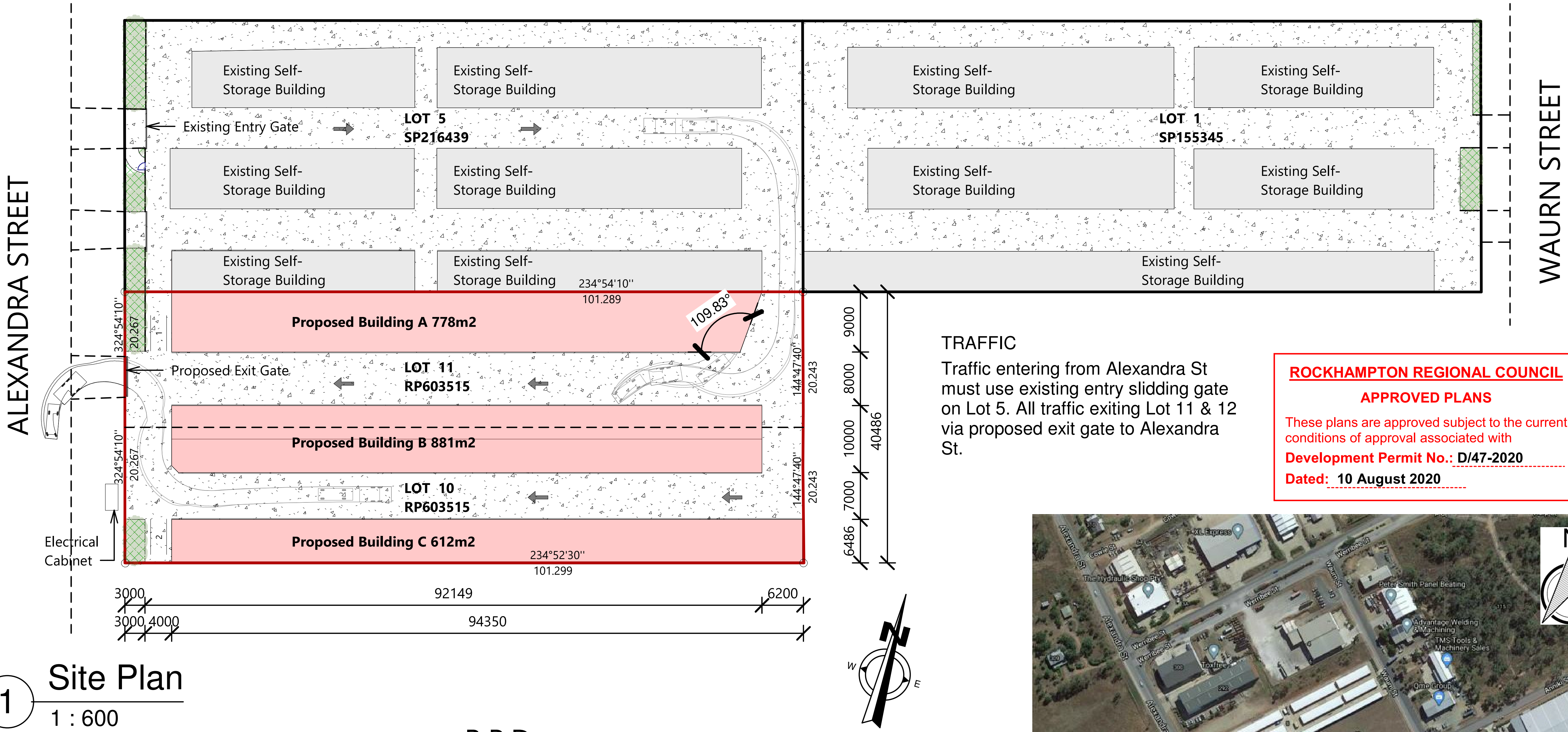

Site Plan

1 : 600

TRAFFIC

Traffic entering from Alexandra St must use existing entry slidding gate on Lot 5. All traffic exiting Lot 11 & 12 via proposed exit gate to Alexandra St.

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/47-2020

Dated: 10 August 2020

GFA SCHEDULE	
Building A	778m²
Building B	881m²
Building C	612m²
Total	**2271m²**

R.P.D

LOT #	11 & 10
R.P.	603515
STREET	284 ALEXANDRA STREET
SUBURB	KAWANA 4701
LOCAL AUTHORITY	ROCKHAMPTON REGIONAL COUNCIL
LOT AREA	(10=2051.7m² & 11=2051.8m²)=4103.5
GROSS FLOOR AREA	2271m²
SITE COVER RATIO	55%
CAR SPACES PROVIDED	2
LANDSCAPING	46.15m²

LOCALITY PLAN

STORCAD
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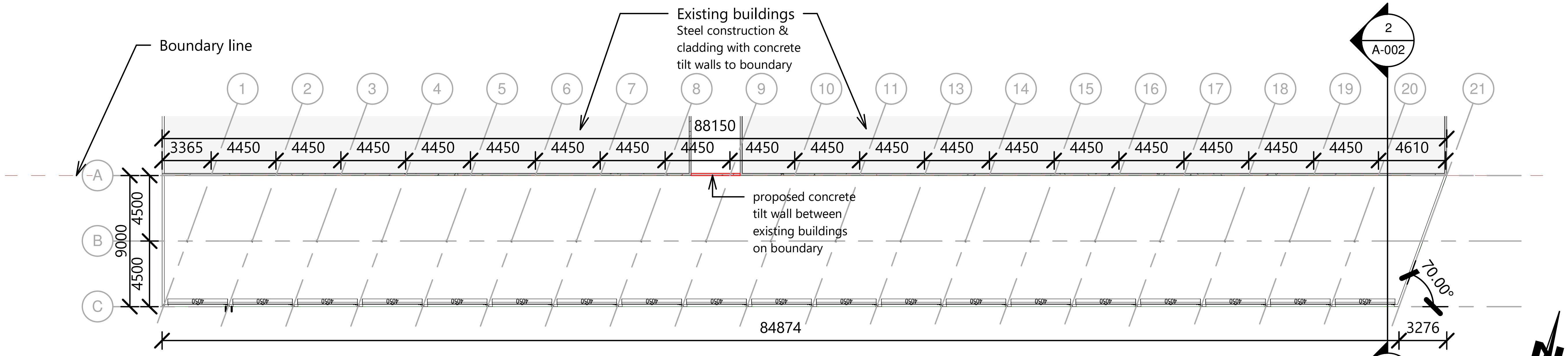
No.	Description	by	Date
1	Initial Concept for review	JR	31/03/20
2	Floor plans & elevation added	JR	17/04/20

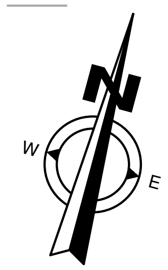
Fort Knox Rockhampton

284 Alexandra St, Kawana
QLD 4701

Site Plan

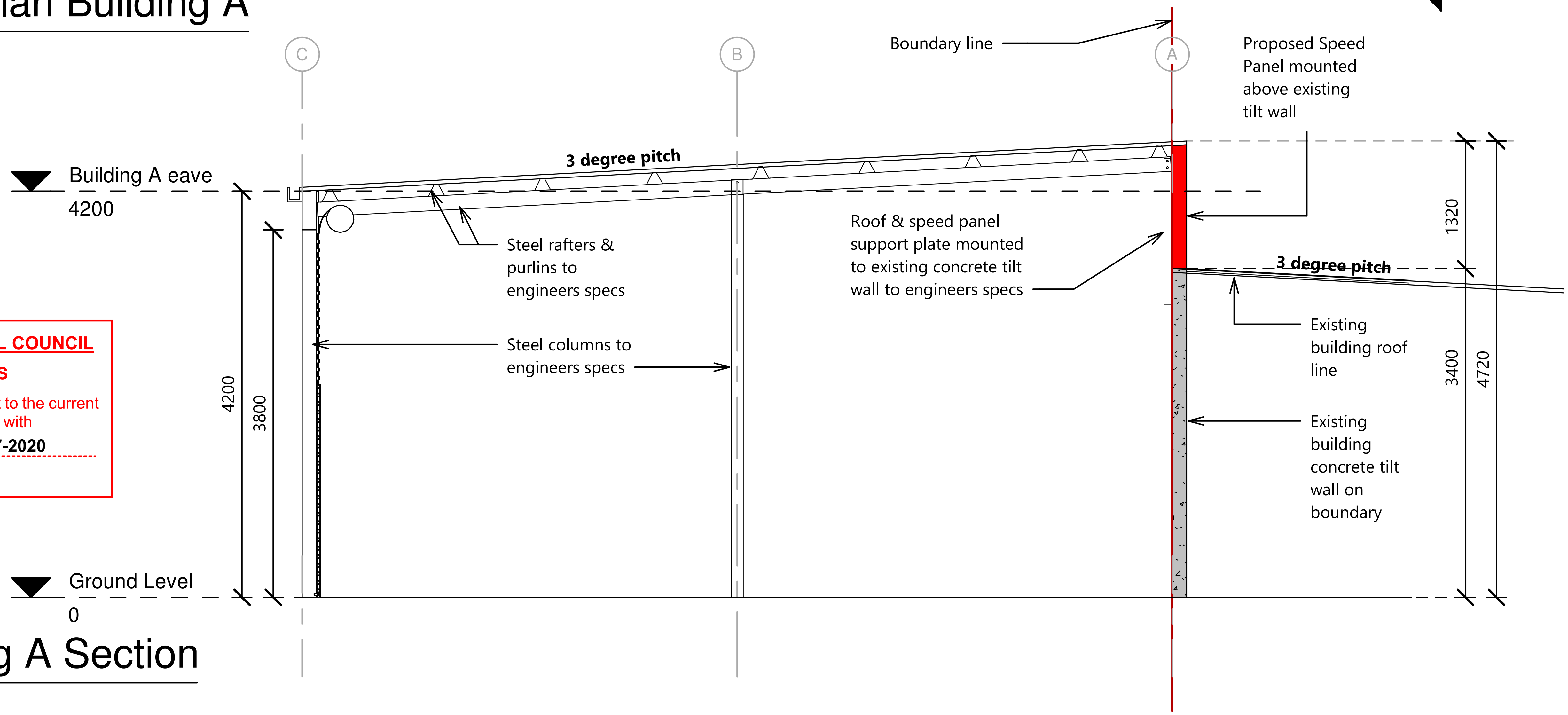
Project number	176-1	A-001	
Date	17/04/2020		
Drawn by	JR	Scale	1 : 600





1 Floor Plan Building A

1 : 300



ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/47-2020

Dated: 10 August 2020

2 Building A Section

1 : 50

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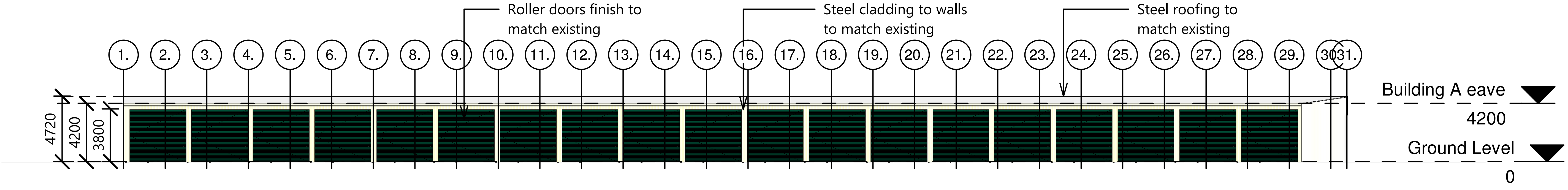
No.	Description	by	Date
1	Initial Concept for review	JR	31/03/20
2	Floor plans & elevation added	JR	17/04/20

Fort Knox Rockhampton

284 Alexandra St, Kawana
QLD 4701

Building A Floor/Section Plan

Project number	176-1	A-002
Date	17/04/2020	
Drawn by	JR	Scale: As indicated



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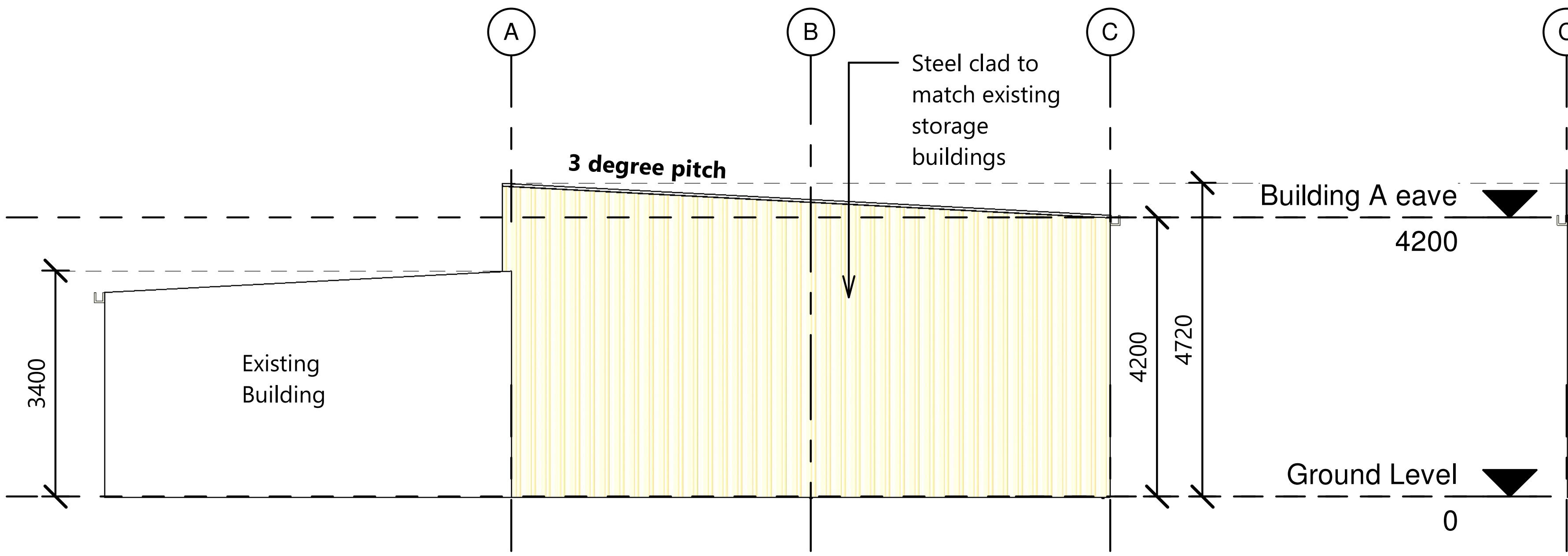

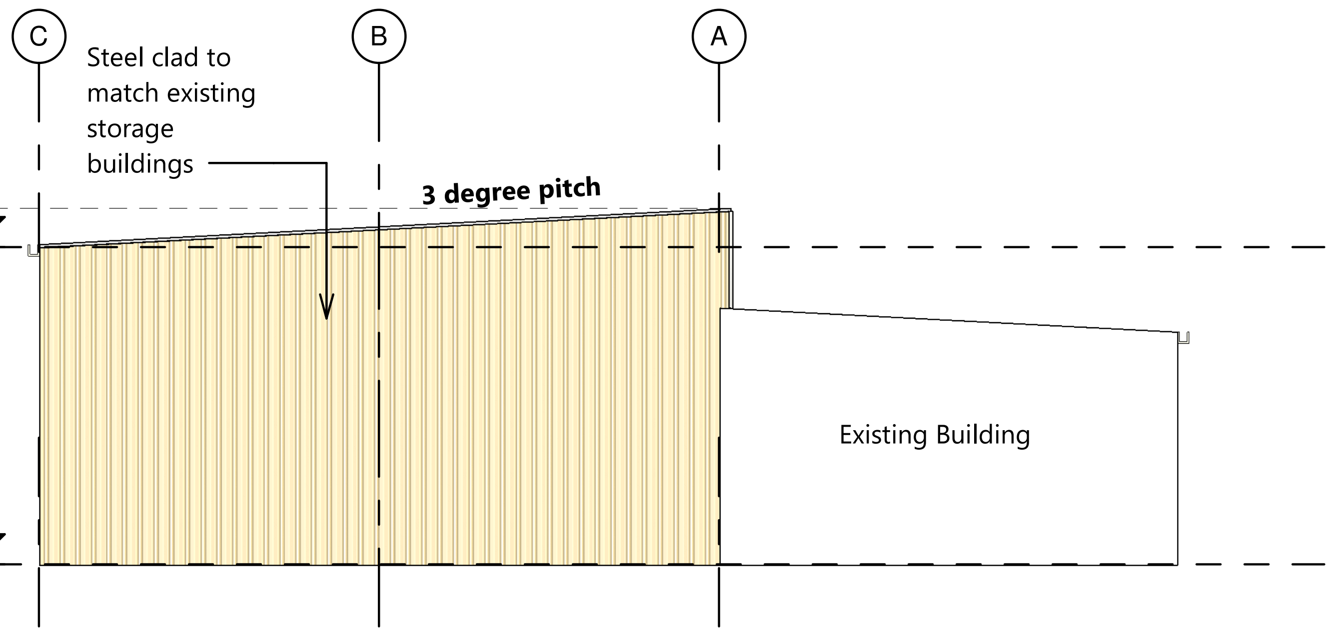

2 Building A West
1 : 100

3 Building A East
1 : 100

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Development Permit No.: D/47-2020
Dated: 10 August 2020

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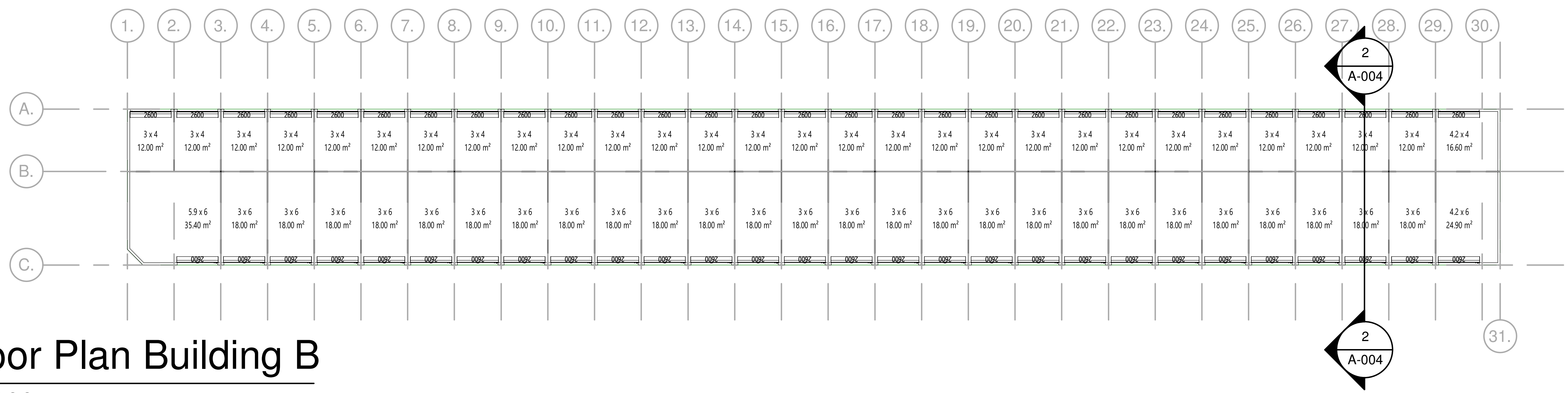
No.	Description	by	Date
1	Initial Concept for review	JR	31/03/20
2	Floor plans & elevation added	JR	17/04/20

Fort Knox Rockhampton
284 Alexandra St, Kawana
QLD 4701

Building A Elevations

Project number	176-1	A-003	
Date	17/04/2020		
Drawn by	JR	Scale	As indicated



1 Floor Plan Building B

1 : 300

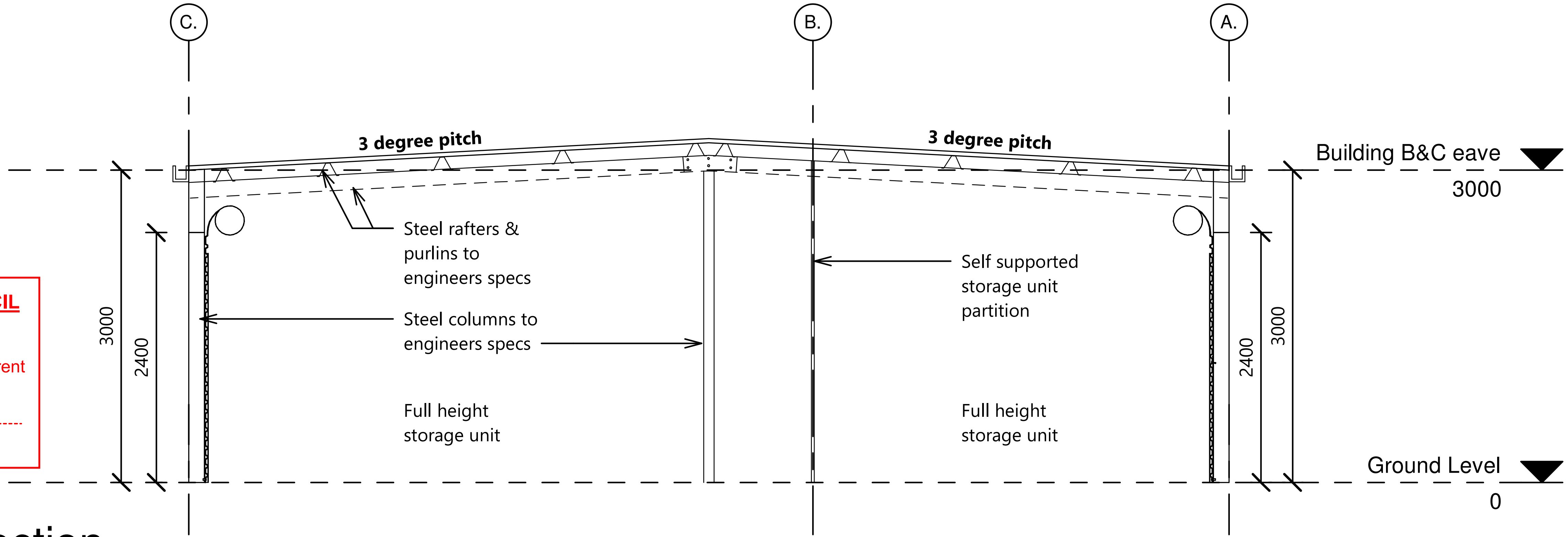
ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/47-2020

Dated: 10 August 2020



2 Building B Section

1 : 50

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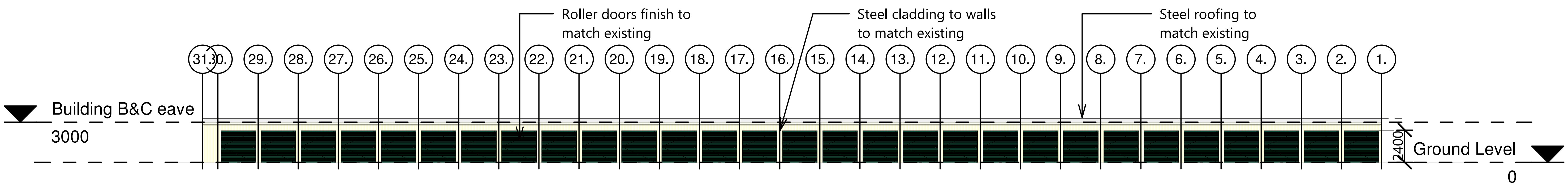
No.	Description	by	Date
2	Floor plans & elevation added	JR	17/04/20

Fort Knox Rockhampton

284 Alexandra St, Kawana QLD 4701

Building B Floor/Section Plan

Project number	176-1	A-004	
Date	17/04/2020		
Drawn by	JR	Scale	As indicated



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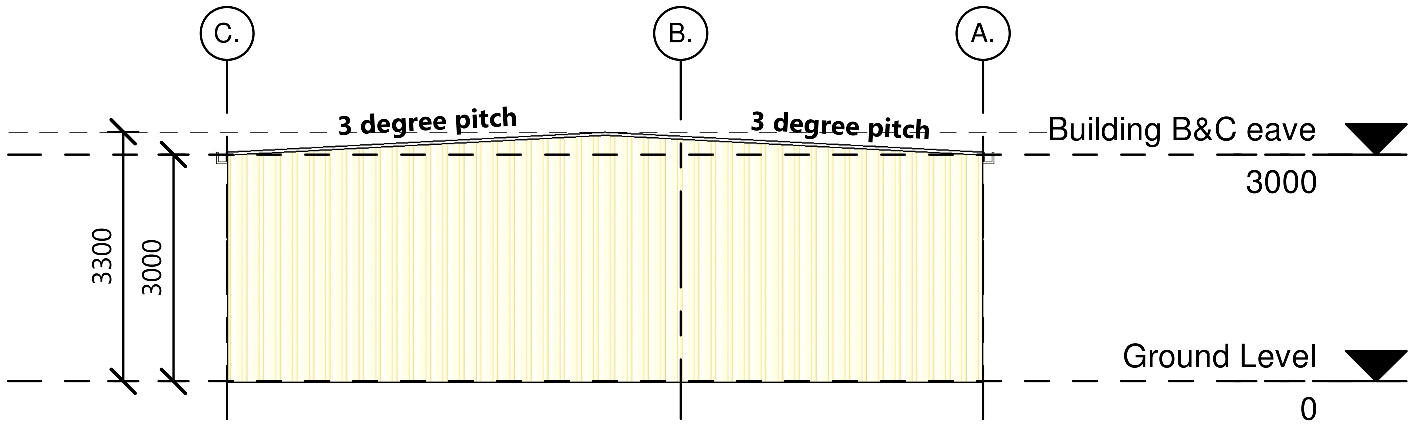
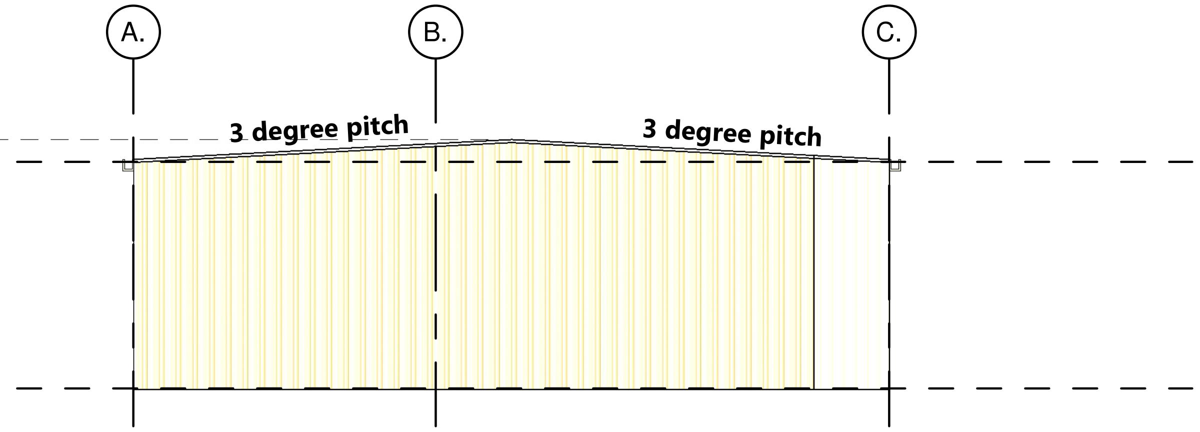


2 Building B East

1 : 100



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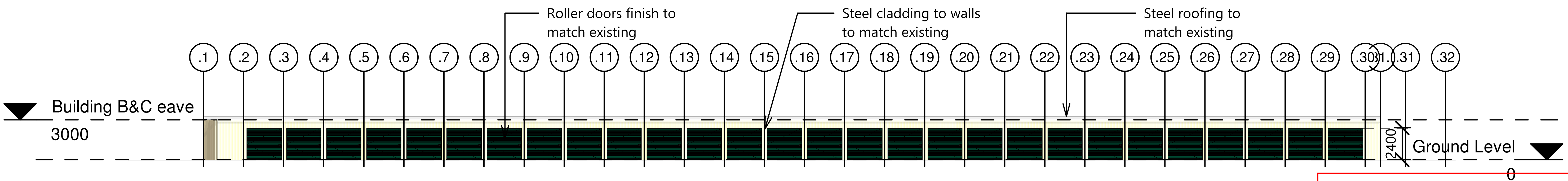
1 : 100



4 Building B South

1 : 300

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APPROVED PLANS

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Development Permit No.: D/47-2020

Dated: 10 August 2020

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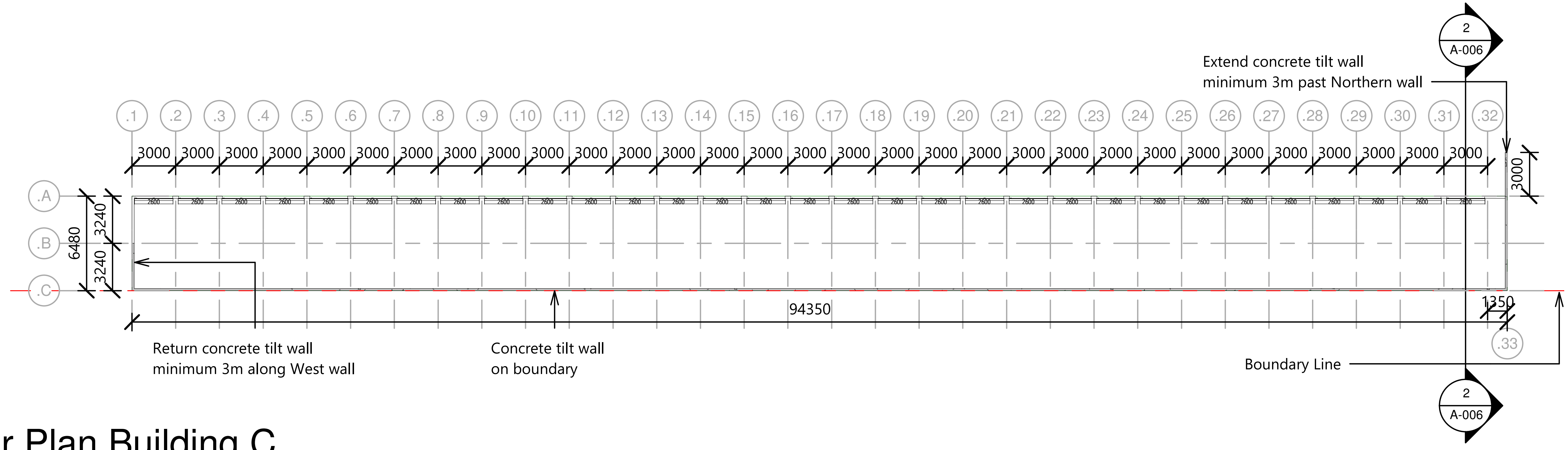
No.	Description	by	Date
2	Floor plans & elevation added	JR	17/04/20

Fort Knox Rockhampton

284 Alexandra St, Kawana
QLD 4701

Building B Elevations

Project number	176-1	A-005	
Date	17/04/2020		
Drawn by	JR	Scale	As indicated



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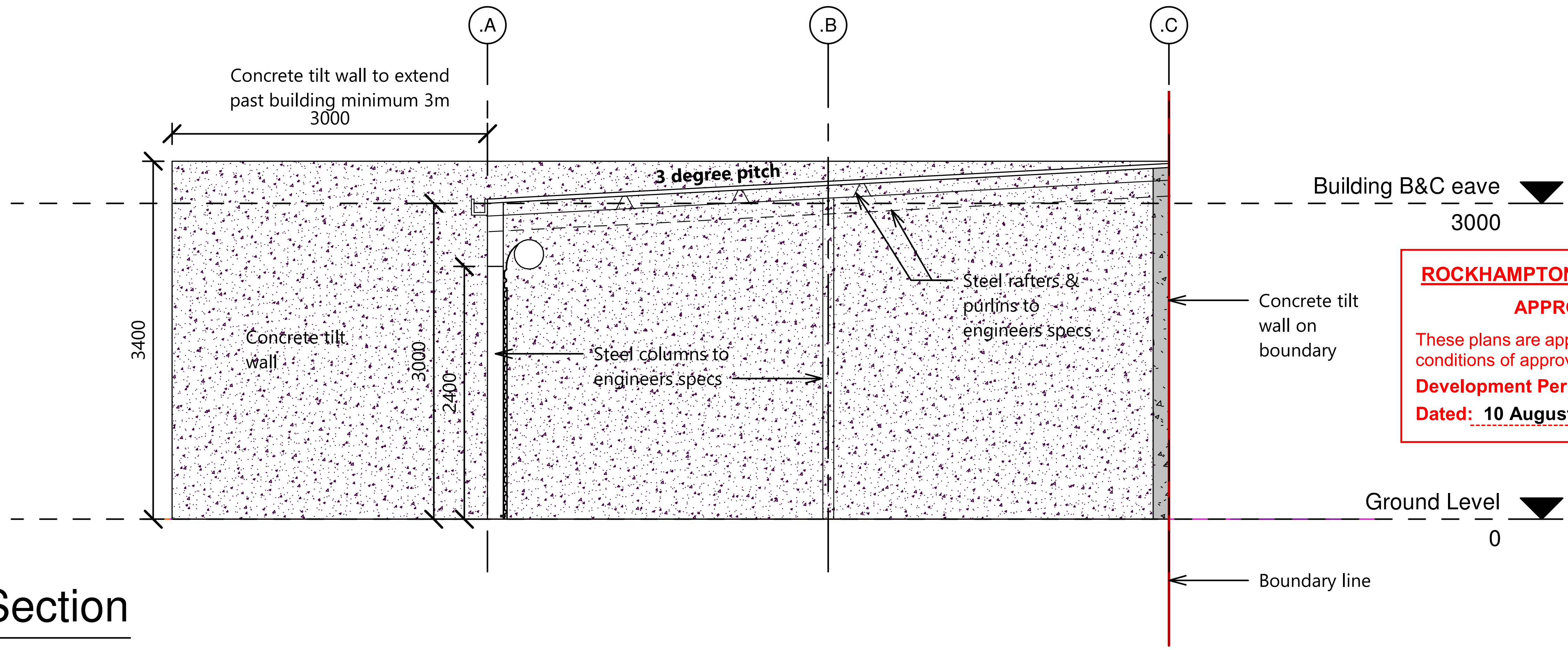

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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Development Permit No.: D/47-2020

Dated: 10 August 2020

2 Building C Section

1 : 50

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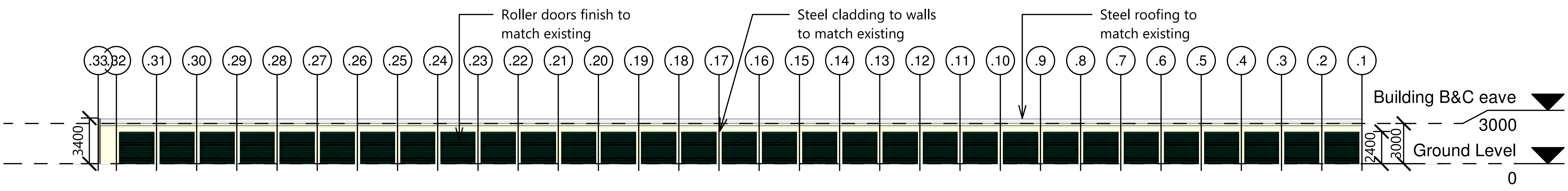
No.	Description	by	Date
1	Initial Concept for review	JR	31/03/20
2	Floor plans & elevation added	JR	17/04/20

Fort Knox Rockhampton

284 Alexandra St, Kawana
QLD 4701

Building C Floor/Section Plan

Project number	176-1	A-006	
Date	17/04/2020		
Drawn by	JR	Scale	As indicated



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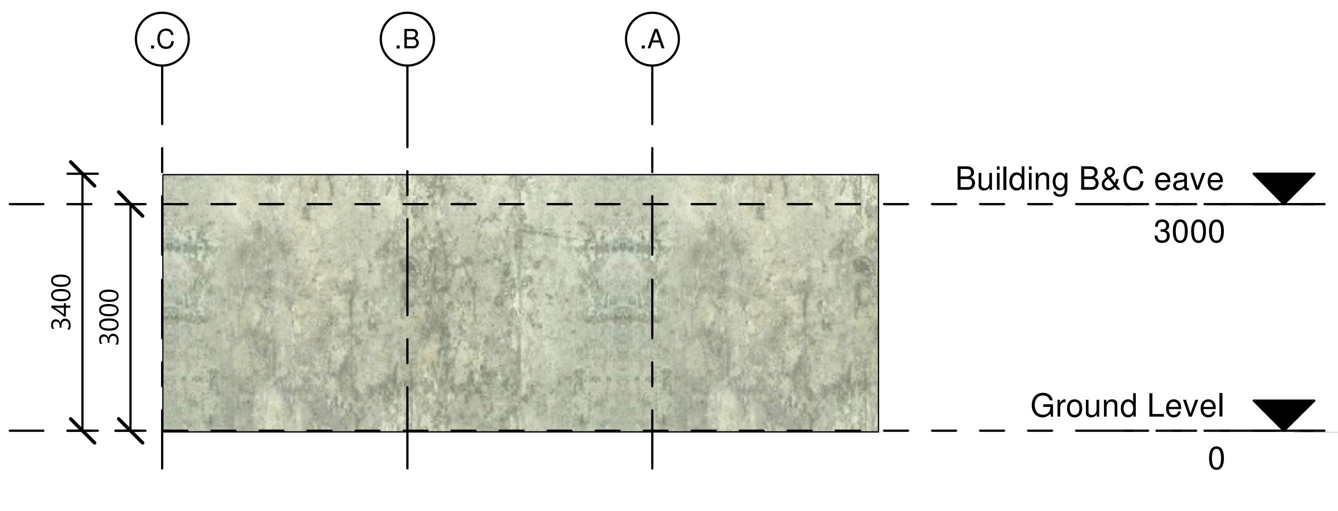

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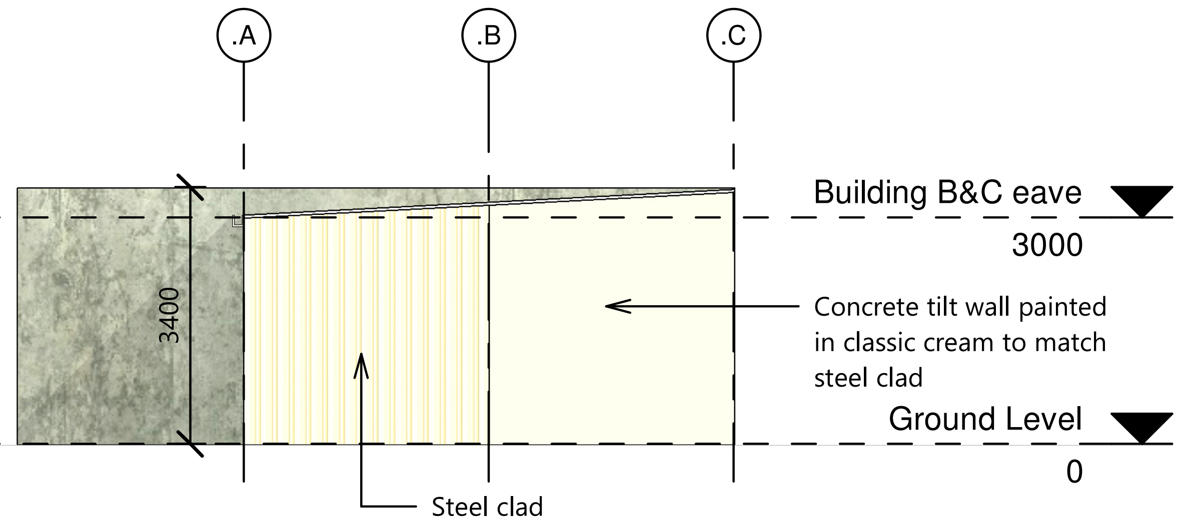

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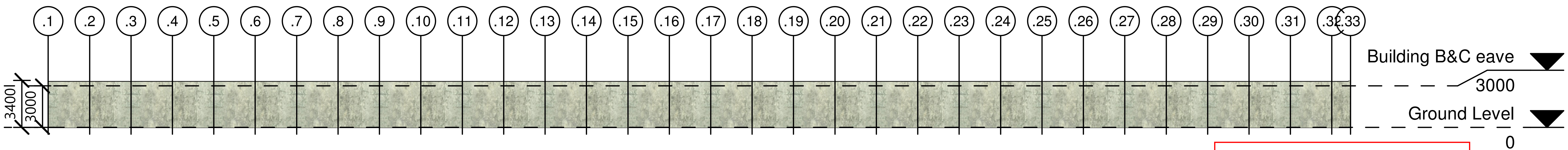

4 Building C South
1 : 300

ROCKHAMPTON REGIONAL COUNCIL
APPROVED PLANS
These plans are approved subject to the current conditions of approval associated with
Development Permit No.: D/47-2020
Dated: 10 August 2020

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No.	Description	by	Date
2	Floor plans & elevation added	JR	17/04/20

Fort Knox Rockhampton
284 Alexandra St, Kawana
QLD 4701

Building C Elevations

Project number	176-1	A-007	
Date	17/04/2020		
Drawn by	JR	Scale	As indicated

July 2020

MNCE Ref: S12451

SITE BASED STORMWATER MANAGEMENT PLAN

284 Alexandra Street, Kawana

Commissioned By
Giles Construction Group P/L

ROCKHAMPTON REGIONAL COUNCIL
APPROVED PLANS
These plans are approved subject to the current conditions of approval associated with
Development Permit No.: D/47-2020
Dated: 10 August 2020

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MILANOVIC NEALE
CONSULTING ENGINEERS

REPORT CONTROL SHEET

MNCE Ref. No.:	S12451
Site:	284 Alexandra Street, Kawana
Report Title:	Site Based Stormwater Management Plan
Report Author:	Richard Dudgell

Revision / Checking

Rev No.	Date	Issued By	Signed	Authorised By	Signed
A	07/07/20	RDu	RDudgell	DH	

Distribution *(CR-Courier; P-Post; H-Hand Delivered; CL-Collected; F-Fax; E-Email)

Destination	Date Sent	By*	Revision Number / Number of Copies Sent							
			Draft	A	B	C	D	E	F	G
MNCE File	-	-		1						
Giles Construction Group	07/07/20	E		1						

Model File Reference

Rev No.	MUSIC File Name	XP-RAFTS File Name	Rational Method File Name
A	S12451-200619-CALCS-REVA	S12451-200619-CALCS-REVA	S12451-200619-CALCS-REVA

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Overview and Background

A development application for a material change of use has been lodged over Lot 10 and 11 on RP603515 at 284 Alexandra Street, Kawana. The site is located within the Rockhampton Regional Council local government area and has a total area of approximately 0.410ha. Figure 1.1 below provides an aerial locality of the site and adjacent areas.

Figure 1.1: Subject Site bound by Alexandra Street to the west (Rockhampton Regional Council Interactive Mapping – 2017 Imagery)

The proposed development involves a warehouse (self-storage facility) being an extension to the complex to the north, and includes associated driveway and landscaping areas. Refer Appendix A for proposed development layout.

The site generally falls in a south-westerly direction towards the Alexandra Street carriageway on a grade of approximately 1%. There isn't any stormwater infrastructure evident on the site itself however Council's as constructed information indicates there is a 1050mm stormwater main present within the carriageway fronting the site. Refer Figure 1.2 on the following page.

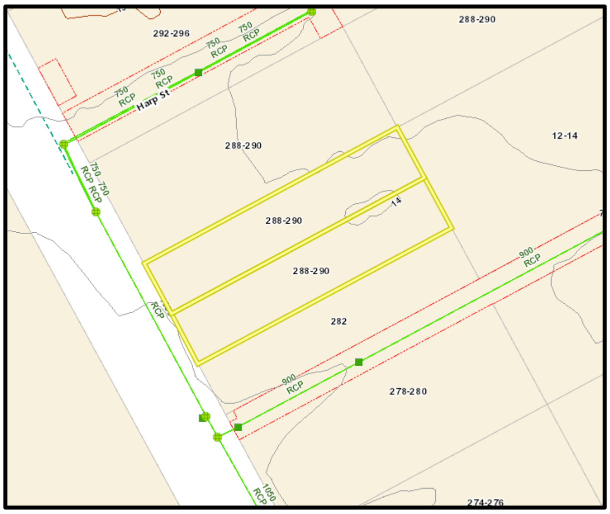


Figure 1.2: Rockhampton Regional Council Interactive Mapping – Stormwater

Rockhampton Regional Council overlay maps indicate that the site is not affected by creek or river flooding. Refer Figure 1.3 and 1.4 below.

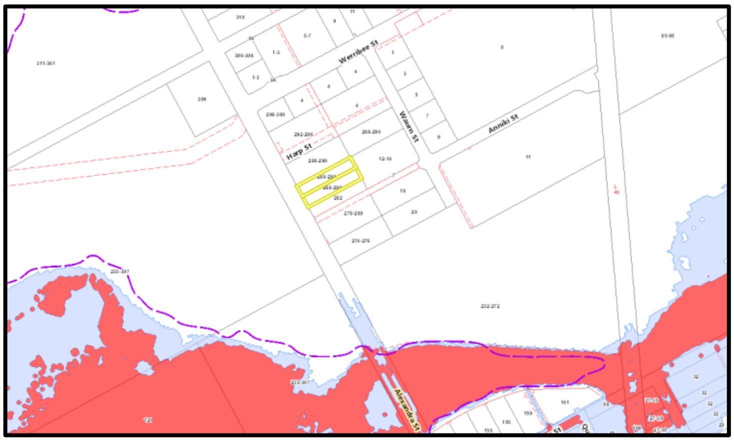


Figure 1.3: Rockhampton Regional Planning Scheme - Creek Catchment Flood

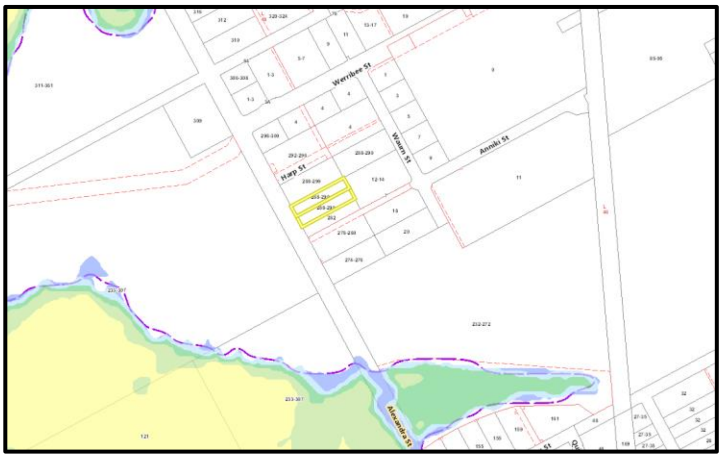


Figure 1.4: Rockhampton Regional Planning Scheme - Fitzroy River Flood

1.2 Objectives and Scope

Milanovic Neale Consulting Engineers have been commissioned by Giles Construction Group to undertake an assessment of stormwater quality and quantity impacts associated with the proposed development. Stormwater management strategies are also to be identified for the proposed development as required.

The scope of works undertaken for this project is summarized below:

1. Assessment of the development against State and Local Government legislation to identify water quality management measures to be adopted for the proposed development.

2. Undertake pollutant export modelling of anticipated pre and post development pollutant concentrations and loads and conceptual design of water quality improvement devices.

3. Assessment of the pre and post development stormwater discharge and undertake preliminary design and commentary of any mitigation devices required to control site discharge if required.

This report also aims to respond to an information request, dated 28 May 2020, reference D/47-2020, from Rockhampton Region Council, which necessitates the following:

1. Please submit a stormwater drainage strategy for the subject development, prepared by a suitably qualified registered engineer that clearly demonstrates how the post-development runoff for the site will be limited to the pre-development scenario and conveyed to a lawful point of discharge in accordance with the requirements of the Queensland Urban Drainage Manual.

   It is acknowledged that the application has stated that these details will be provided at Operational Works stage however Council requires this information at MCU stage in order to be able to identify any issues prior to the Operational Works submission.

2. Please demonstrate how the proposal meets the water quality objectives of the Queensland Water Quality Guidelines and the State Planning Policy.

2 DATA

2.1 State and Local Government Policies

The *Stormwater Management Planning Scheme Policy* and *Stormwater Management Code* from *Rockhampton Regional Council's Planning Scheme*, the *Urban Stormwater Quality Planning Guidelines 2010* and the *State Planning Policy – July 2017* have been used as a guide to establish the required stormwater objectives and requirements for the development.

2.2 Level and Modelling Data

Contour information for the site and adjacent properties was obtained from Council records which comprise surface level contours at 1.0m intervals.

As-Constructed information of existing hydraulic infrastructure has been sourced from Rockhampton Regional Council records in regard to pipe diameters and invert levels.

Rainfall data for the Rockhampton Region was extracted from AR&R 2016 through the IFD tool on the Bureau of Meteorology website.

The *Music Modelling Guidelines 2018*, the *Queensland Urban Drainage Manual (QUDM)* and the *Australian Rainfall and Runoff, A Guide to Flood Estimation* have been used as a guide to establish the modelling inputs and methodologies applicable for the development.

3 OPPORTUNITIES AND CONSTRAINTS

3.1 Site Opportunities

Currently there are no stormwater quality measures on site, thus there are some opportunities to improve the quality of the stormwater leaving the site before discharge through stormwater treatment devices.

3.2 Site Constraints

Due to the developments space restrictions, limited area is available to implement large-scale water quality treatment measures. Since the site is undeveloped under existing conditions, a large volume of detention may be required to limit post-development runoff to the pre-development scenario. The site is also relatively flat, the implementation of underground detention or treatment devices may be difficult. The size of infrastructure fronting the site (to be utilised as a discharge location) would however indicate enough depth for a connection.

4 WATER QUALITY MANAGEMENT

This section of the report will provide an assessment of the development against State and Local Government legislation to identify water quality management measures to be adopted for the proposed development.

Pollutant export modelling will also be undertaken of anticipated pre and post development pollutant concentrations and loads and conceptual design of water quality improvement devices.

4.1 Risk Category

The *State Planning Policy – July 2017* identifies developments as high risk with respect to stormwater quality if any of the following criteria are triggered:

1. Material change of use urban purposes that involves a land area greater than 2,500m^2 that:
    a. Will result in an impervious area greater than 25 percent of the net developable area; or
    b. Will result in six or more dwellings, or
2. Reconfiguring a Lot for urban purposes that involves a land area greater than 2,500m^2 and will result in 6 or more Lots: or
3. Operational work for urban purposes that involves disturbing more than 2,500m^2 of land;

With respect to the above, the Policy can be applied to the material change of use component of the site due to point 1a being triggered.

4.2 Water Quality Objectives

4.2.1 Construction Phase

The *Urban Stormwater Quality Guidelines 2010* identify that eroded soils and litter are major pollutant sources during construction activity. There is also potential for hydro-modification of streams due to increased run-off coefficients when subsoils are exposed, for longer term major developments. Water sensitive urban design principles and reducing erosion during construction are fundamental to achieving water quality objectives in relevant waterways.

It is therefore proposed to prepare an erosion and sediment management plan during the operational works phase of the development which will incorporate a range of control measures to be implemented during the construction phase of the project.

4.2.2 Operational Phase

Stormwater quality management design objectives for the operational phase of the development are identified in the following table in accordance with the *Urban Stormwater Quality Guidelines 2018.* These objectives provide an emphasis on the reduction of mean annual loadings associated with suspended sediments and nutrients.

Table 4.1: Stormwater Quality Objectives

Region	**Minimum Reductions in Mean Annual Loads from Unmitigated Development (%)**			
	Total Suspended Solids (TSS)	Total Phosphorus (TP)	Total Nitrogen (TN)	Gross Pollutants > 5mm (GP)
Central Queensland (South)	85	60	45	90

4.3 Pollutant Export Modelling

4.3.1 Model Selection

In order to determine on site pollutant generation, discharge concentrations of target pollutants and the effectiveness of Stormwater Quality Improvement Devices the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) has been used to model the development proposal.

4.3.2 MUSIC Model Configuration

The following sections identify the modelling parameters used in the configuration of the MUSIC Model adopted for the development. The following figure provides a screenshot of the MUSIC model schematic for reference.

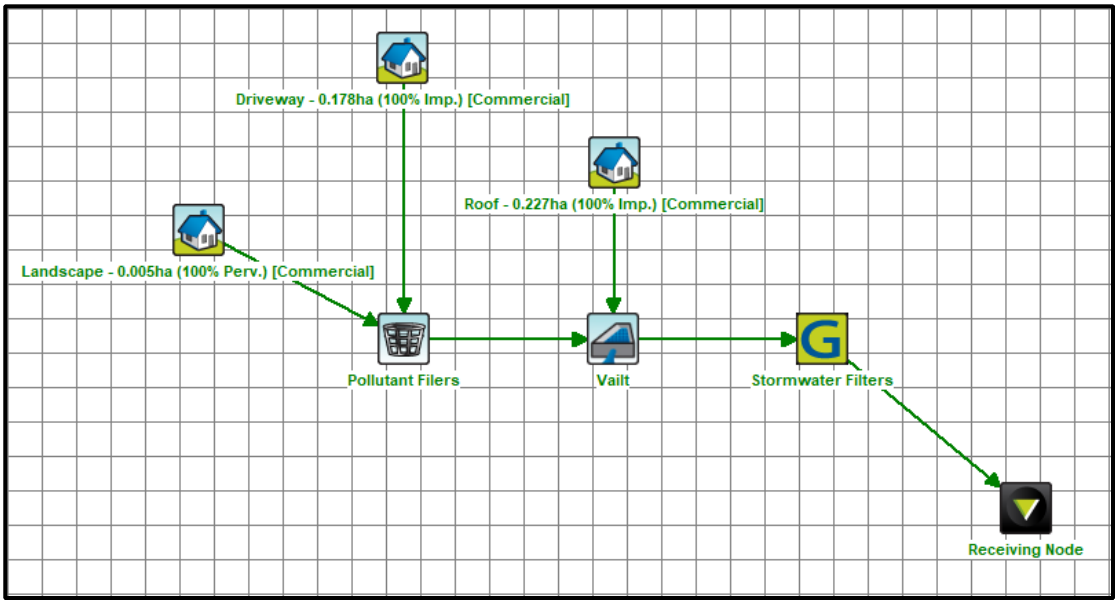


Figure 4.1: MUSIC Model Layout

4.3.2.1 Meteorological and Time Step

Meteorological Data used in the MUSIC model incorporates the following parameters:

Rainfall Period: 1/01/1980 12:00 AM to 31/12/1989 11:54 PM

Rainfall Station: 39083 ROCKHAMPTON

A model time step of 6 minutes has also been adopted as recommended in Section 3.2 of the *MUSIC Modelling Guidelines 2018.*

4.3.2.2 Catchment Properties

The MUSIC model for the development adopts a split catchment approach, whereby the site has been broken down into various catchments in accordance with site specific land uses. The following table provides a summary of the catchment data used in the MUSIC analysis.

Table 4.2: MUSIC Catchment Parameters

Catchment Name	Area (ha)	Fraction Impervious (%)	MUSIC Source Node
Roof	0.227	100	Urban
Driveway	0.178	100	Urban
Landscape	0.005	0	Urban

4.3.2.3 Rainfall Runoff Parameters

The following table provides a summary of the rainfall runoff parameters adopted for the source nodes used in the MUSIC analysis which has been extracted from Table 3.9 of the *MUSIC Modelling Guidelines 2018.*

Table 4.3: MUSIC Source Node Base and Storm Flow Concentration Parameters

Land Use	Parameter	Total Suspended Solids (Log_{10} mg/L)		Total Phosphorus (Log_{10} mg/L)		Total Nitrogen (Log_{10} mg/L)	
Roof	Mean	N/A	1.30	N/A	-0.89	N/A	0.37
	Std Deviation	N/A	0.38	N/A	0.34	N/A	0.34
Roads	Mean	0.78	2.43	-0.60	-0.30	0.32	0.37
	Std Deviation	0.39	0.38	0.50	0.34	0.30	0.34
Ground Level	Mean	0.78	2.16	-0.60	-0.39	0.32	0.37
	Std Deviation	0.39	0.38	0.50	0.34	0.30	0.34

4.3.2.4 Pollutant Export Parameters

The following table provides a summary of the pollutant export parameters for split catchment surface types which have been adopted for the source nodes used in the MUSIC analysis. This information has been extracted from Table 3.8 of the *MUSIC Modelling Guidelines 2018.*

Table 4.4: MUSIC Catchment Parameters

Parameter	Quantity
Rainfall Threshold (mm)	1
Soil Storage Capacity (mm)	18
Initial Storage (%)	10
Field Capacity (mm)	80
Infiltration Capacity Coefficient a	243
Infiltration Capacity Coefficient b	0.60
Daily Recharge Rate (%)	0
Daily Base-Flow Rate (%)	31
Daily Seepage Rate (%)	0

4.3.3 Developed Unmitigated Conditions

MUSIC Modelling has been performed to determine the pollutant export and corresponding concentrations from the development site under the proposed conditions. The mean annual loads that have been estimated for proposed unmitigated conditions are given in Table 4.4 below, also shown are the mean annual load percentage reductions required to meet current State Planning Policy objectives.

Table 4.5: MUSIC Unmitigated Mean Annual Loads (kg/yr)

Pollutant	Unmitigated Mean Annual Load (kg/yr)	Reduction required to meet Council Requirements (%)
Total Suspended Solids (TSS)	525	85
Total Phosphorous (TP)	1.11	60
Total Nitrogen (TN)	8.83	45
Gross Pollutants (GP)	70.5	90

Refer Appendix B for MUSIC summary report.

4.3.4 Developed Mitigated Conditions

The scale of the development is large enough to support the implementation of effective water quality design measures. Therefore, a consideration of a variety of best management measures has been given with a focus on water quality treatment measures and reducing polluted runoff volumes from the site.

Key elements of the proposed stormwater management plan are as follows:

- Capture and treatment of sheet flow from the paved and landscaping areas via OceanGuard 200 at source pollutant filters (or SPEL Stormsacks) installed in grated inlets.
- Runoff from all roofed and ground surface areas are to be down piped/directed into an underground compartment containing nine 690mm StormFilter cartridges (or four catchment SPEL Filter) to treat stormwater before discharging into the proposed infrastructure off site.

The table below demonstrates that the required pollutant reductions have been achieved through the implementation of the proposed stormwater treatment train.

Table 4.6: MUSIC Model Removal Efficiencies

Pollutant	Unmitigated Mean Annual Load (kg/yr)	Mitigated Mean Annual Load (kg/yr)	Reduction required to meet Council Requirements (%)	Removal Efficiency Achieved (%)
Total Suspended Solids (TSS)	525	50.3	85	90.4
Total Phosphorous (TP)	1.11	0.344	60	68.9
Total Nitrogen (TN)	8.83	4.82	45	45.4
Gross Pollutants (GP)	70.5	0	90	100

5 WATER QUANTITY MANAGEMENT

This section of the report will provide an assessment of the pre and post development stormwater discharge and undertake preliminary design and commentary of any mitigation devices required to control site discharge.

5.1 Existing Conditions

This section of the report will analyse and comment on the existing site stormwater discharge conditions. The XP-RAFTS modelling software, utilising the Laurenson Routing Method will be used to generate the hydrographs and peak flows from the site for all storm events up to an including the 1% AEP storm event.

5.2 Existing Hydrologic Model

5.2.1 Catchment Definition

An examination of the existing site land topography and land use was undertaken to quantify the number of sub catchments and sub catchment areas applicable for the site. It was established that since the existing site comprises of an undeveloped lot, there is only one fundamental sub catchment applicable for the existing site being (1) a pervious ground surface. Refer Table 5.1 below for existing site catchment details.

The sub catchment roughness for the ground surface has been defined using a manning's 'n' value of 0.03 which is reasonable for a maintained grassed catchment. Refer Table 5.1 below.

The catchment slope has been achieved by reviewing Council records contours.

Table 5.1: Catchment Data Summary Table

Catchment	Sub Catchment	Area (ha)	Impervious (%)	Slope (%)	Manning's 'n'
Ground	N/A	0.410	0	1	0.03

5.2.2 Rainfall Parameters and Losses

As indicated in Section 2.2 above, Rainfall data for the Rockhampton Region has been extracted from AR&R 2016 through the IFD tool on the Bureau of Meteorology website.

The uniform loss method was adopted to account for rainfall losses throughout the existing catchment. Based on guidance provided in *Australian Rainfall and Runoff Data Hub*, initial and continuing loss coefficients adopted for pervious catchments have been tabulated below.

Table 5.2: Initial and Continuing Loss Parameters

Parameter	Value (mm)
Initial Loss (Pervious)	35.0
Continuing Loss (Pervious)	1.7

Temporal patters applicable to east Coast north have been adopted in accordance with the *Australian Rainfall and Runoff, A Guide to Flood Estimation*.

5.2.3 Existing Hydrological Results

The following table provides a summary of the peak discharge from the existing site that was estimated by the XP-RAFTS model for all storm events up to and including the 1% AEP storm event.

Table 5.3: Existing Site Peak Discharges

Storm Event	XP-RAFTS Peak Runoff (m^3/s)
39% AEP	0.022
10% AEP	0.063
5% AEP	0.086
2% AEP	0.108
1% AEP	0.128

5.2.4 Runoff Comparison

QUDM Section 4.1.3 recommends hydrologic models are calibrated with actual flow data rather than to an alternate runoff routing model. In the absence of such data, Section 4.1.3 continues to state that as an alternative, model results may be compared with the results to a Rational Method peak discharge for catchments less than 500ha.

Based on the methods outlined in *QUDM*, the following parameters were used to estimate the peak runoff from the upstream catchment affecting the site. Refer Appendix D for detailed rational method calculation summary.

Table 5.4: Rational Method Parameters

Area (ha)	Runoff Coefficient (C10)	Time of Concentration (mins)
0.410	0.70	15

It is note that the time of concentration was based on runoff from suburban lots to nearest gully pit utilising standard inlet times as well as non-concentrated overland sheet flow utilising the Friends Equation.

The following table provides a comparison of the results of both the Rational Method and XP-RAFTS Model for peak discharges up to and including the 1% AEP storm event.

Table 5.5: Existing Site Peak Discharge Comparison

Storm Event	XP-RAFTS Peak Runoff (m^3/s)	Rational Method Peak Runoff (m^3/s)	Difference	
			+/-	%
39% AEP	0.022	0.069	0.047	68
10% AEP	0.063	0.114	0.051	45
5% AEP	0.086	0.138	0.052	38
2% AEP	0.108	0.179	0.071	40
1% AEP	0.128	0.209	0.081	39

As can be seen above, the Laurenson Routing Method established from the XP-RAFTS model generates peak flows that are on average 46% lower than what is estimated by the Rational Method. This may be explained by the conservative approached adopted in the Laurenson calculation in relation to the loss coefficients used. Hence the initial loss (pervious) was revised to **15mm** based on experience and guidance provided in *Australian Rainfall and Runoff, A Guide to Flood Estimation*.

The following table provides a revised comparison of the results of both the Rational Method and XP-RAFTS Model results for peak discharges up to and including the 1% AEP storm event.

Table 5.6: Existing Site Peak Discharge Comparison

Storm Event	XP-RAFTS Peak Runoff (m^3/s)	Rational Method Peak Runoff (m^3/s)	Difference	
			+/-	%
39% AEP	0.039	0.069	0.030	44
10% AEP	0.095	0.114	0.019	17
5% AEP	0.117	0.138	0.021	15
2% AEP	0.146	0.179	0.033	18
1% AEP	0.171	0.209	0.038	18

As can be seen above, the Laurenson Routing Method established from the XP-RAFTS model generates peak flows that are within 18% of what is estimated by the Rational Method, with the exception of the minor 39% AEP storm event. Hence the scenario that has been modelled and applied to the site is considered more appropriate.

5.3 Developed Conditions

This section of the report will analyse and comment on the developed site stormwater discharge conditions. The XP-RAFTS modelling software, utilising the Laurenson Routing Method will be used to generate the hydrographs and peak flows from the site for all storm events up to an including the 1% AEP storm event.

5.4 Developed Unmitigated Model

5.4.1 Catchment Definition

An examination of the developed site land topography and land use was undertaken to quantify the number of sub catchments and sub catchment areas applicable for the site. It was established that since the developed site comprises of multiple structures on a lot, there are three fundamental sub catchments applicable for the developed site being (1) an impervious roof area, (2) an impervious driveway/road area, and (3) a pervious ground surface. Refer Table 5.7 below for developed site catchment details.

The sub catchment roughness for the pervious surface has been defined using a manning's 'n' value of 0.05 which is reasonable for a moderately vegetated catchment consisting of bush. The roughness value for the impervious area adopts a manning's 'n' value of 0.012 which is reasonable for steel/tile roofs and concrete driveways. Refer Table 5.7 below.

The catchment slope has been achieved by reviewing Council records contours.

Table 5.7: Catchment Data Summary Table

Catchment	Sub Catchment	Area (ha)	Impervious (%)	Slope (%)	Manning's 'n'
Roof	N/A	0.227	100	10	0.012
Driveway	N/A	0.178	100	1	0.012
Landscape	N/A	0.005	0	1	0.050

5.4.2 Rainfall Parameters and Losses

The uniform loss method was adopted to account for rainfall losses throughout the existing catchment. Based on experience and guidance provided in *Australian Rainfall and Runoff Data Hub*, and *Australian Rainfall and Runoff, A Guide to Flood Estimation*, initial and continuing loss coefficients adopted for the impervious and pervious sub catchments have been tabulated below.

Table 5.8: Initial and Continuing Loss Parameters

Parameter	Value (mm)
Initial Loss (Pervious)	15.0
Continuing Loss (Pervious)	1.7
Initial Loss (Impervious)	1.0
Continuing Loss (Impervious)	0.0

Temporal patters applicable to east Coast north have been adopted in accordance with the *Australian Rainfall and Runoff, A Guide to Flood Estimation*.

5.4.3 Developed Hydrological Results

The following table provides a summary of the peak discharge from the developed site that was estimated by the XP-RAFTS model for all storm events up to and including the 1% AEP storm event.

Table 5.9: Developed Site Peak Discharges

Storm Event	XP-RAFTS Peak Runoff (m^3/s)
39% AEP	0.133
10% AEP	0.222
5% AEP	0.256
2% AEP	0.288
1% AEP	0.319

5.4.4 Runoff Comparison

As noted in Section 5.2.4 of this report, a comparison between the XP-RAFTS discharge and Rational Method peak discharge is recommended to be undertaken by *QUDM*.

Based on the methods outlined in *QUDM*, the following parameters were used to estimate the peak runoff from the upstream catchment affecting the site. Refer Appendix D for detailed rational method calculation summary.

Table 5.10: Rational Method Parameters

Area (ha)	Runoff Coefficient (C10)	Time of Concentration (mins)
0.410	0.88	5

The following table provides a comparison of the results of both the Rational Method and XP-RAFTS Model results for peak discharges up to and including the 1% AEP storm event.

Table 5.11: Developed Site Peak Discharge Comparison

Storm Event	XP-RAFTS Peak Runoff (m^3/s)	Rational Method Peak Runoff (m^3/s)	Difference	
			+/-	%
39% AEP	0.133	0.122	-0.011	-9
10% AEP	0.222	0.201	-0.021	-10
5% AEP	0.256	0.243	-0.013	-5
2% AEP	0.288	0.309	0.021	7
1% AEP	0.319	0.345	0.026	8

As can be seen above, the Laurenson Routing Method established from the XP-RAFTS model generates peak flows that are within 10% of what is estimated by the Rational Method. Hence the scenario that has been modelled and applied to the site is considered more appropriate.

5.5 Potential Impacts of Development

The following table provides a summary of the peak runoff from the site under both existing and developed scenarios.

Table 5.12: Runoff Comparison

Storm Event	Existing Peak Runoff (m³/s)	Developed Peak Runoff (m³/s)	Difference	
			+/-	%
39% AEP	0.039	0.133	0.094	71
10% AEP	0.095	0.222	0.127	57
5% AEP	0.117	0.256	0.139	54
2% AEP	0.146	0.288	0.142	49
1% AEP	0.171	0.319	0.148	46

The proposed development has increased the proportion of the site that is impervious, consequently the runoff characteristics from the site will be altered as a result of the development. As demonstrated above, the development has increased runoff volumes and peak flow rates downstream in comparison to the existing conditions.

5.6 Stormwater Management Strategy

Despite the fact that the development is generating a higher peak flow, if the total catchment containing the site was developed to its full potential, stormwater detention on the subject site would not be of benefit as catchment flows can be contained within existing infrastructure.

Figure 5.1: External Catchment

Based on the methods outlined in *QUDM*, the following parameters were used to estimate the peak runoff from the upstream catchment affecting the site. Refer Appendix E for detailed rational method calculation summary.

Table 5.13: Rational Method Parameters

Area (ha)	Runoff Coefficient (C10)	Time of Concentration (mins)
17.8	0.88	20

The catchment produces a flow rate of 3.29m^3/s in the 39% AEP storm event. It is noted that the time of concentration was based on runoff from suburban lots to nearest gully pit utilising standard inlet times as well as pipe flow using pipe flow equations.

The mains downstream of the catchment are 1050mm and 1200mm in diameter. Assuming they are laid on grade with the natural surface above, they have a capacity of 3.47m^3/s and 3.96m^3/s respectively.

As can be seen then, flows from the developed unmitigated catchment containing the site can be contained within existing infrastructure. It is also envisaged that some of the existing industrial premises' within the catchment may already be constructed with detention basins, further creating a buffer between catchment flows and infrastructure capacity. As a result, no on-site detention is believed to be required for the development site.

It should also be noted that this infrastructure appears to discharge into a tributary of the Fitzroy River. Downstream of the discharge location appears to be a ponded area that will naturally detain flows from the catchment.

Furthermore, the direction of sheet flow from the site does not enter into any of the neighbouring properties; therefore no immediate consequences of the development will be noticed by neighbours.

It is hence proposed to extend a stormwater main from the existing stormwater main fronting the site via a proposed manhole. Detail survey shall be required of the Alexandra Street carriageway and all corresponding infrastructure prior to detailed design. The proposed discharging stormwater main shall be designed to cater for the 39% AEP storm event from the subject site.

6 INTERPRETATION AND CONCLUSIONS

The proposed development if unmitigated would have a negative effect on runoff water quality from the site. Best practices in water quality design have been implemented to improve the quality of the stormwater runoff generated on the site.

The predicted pollutant export load concentrations for the mitigated conditions as determined by the MUSIC model show that the proposed water quality treatment measures comply with Council's mean annual load reduction requirements for total suspended solids (TSS), total phosphorous (TP), total nitrogen (TN) and gross pollutants (GP).

Key elements of the proposed stormwater management plan are as follows:

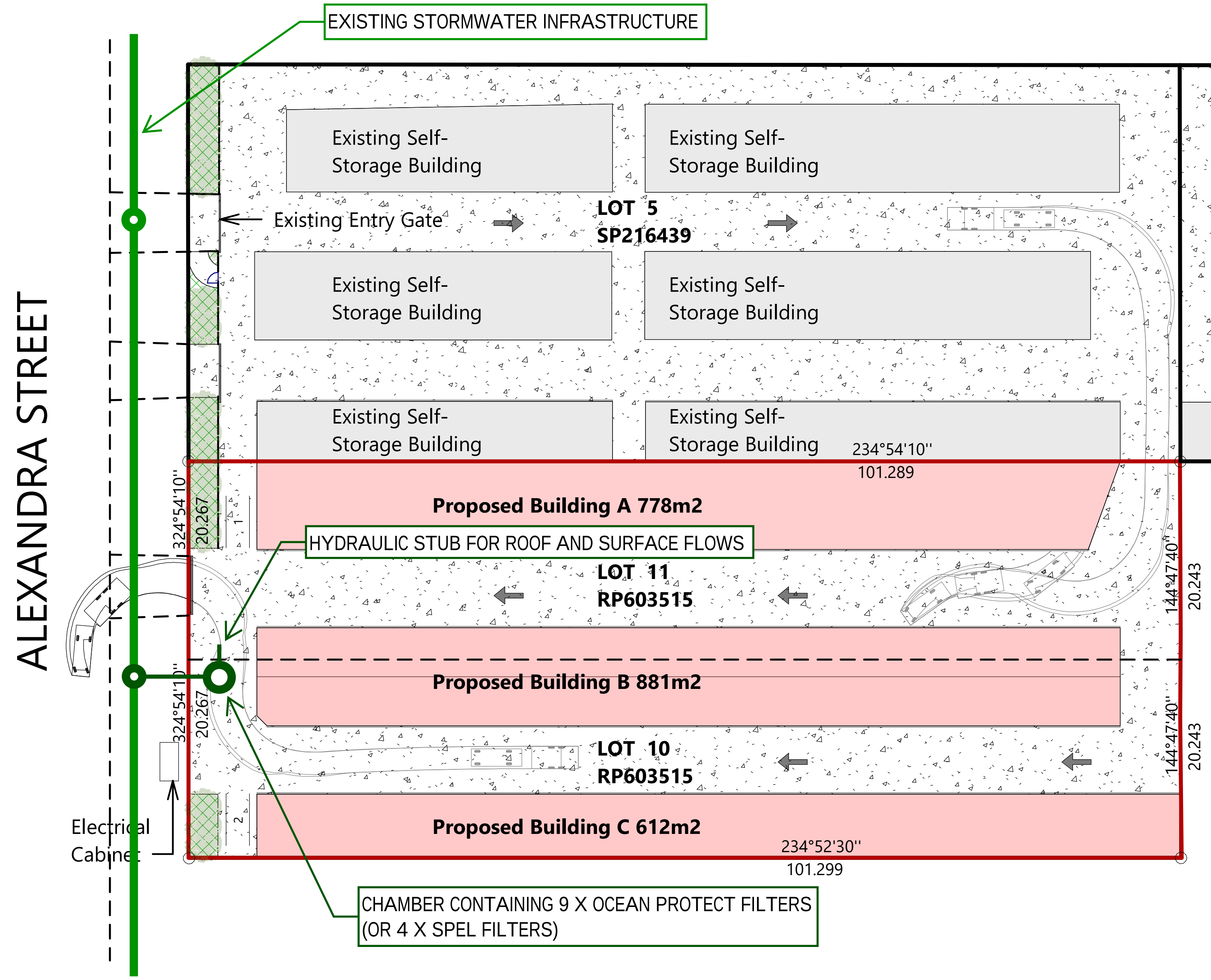
- Capture and treatment of sheet flow from the paved and landscaping areas via OceanGuard 200 at source pollutant filters (or SPEL Stormsacks) installed in grated inlets.
- Runoff from all roofed and ground surface areas are to be down piped/directed into an underground compartment containing nine 690mm StormFilter cartridges (or four catchment SPEL Filter) to treat stormwater before discharging into the proposed infrastructure off site.

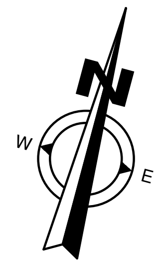
It is proposed to prepare an erosion and sediment management plan during the operational works phase of the development which will incorporate a range of control measures to be implemented during the construction phase of the project.

The development has increased runoff volumes and peak flow rates downstream in comparison to the existing conditions. Despite this, it is believed that stormwater detention on the subject site would not be of benefit as flows from the developed unmitigated catchment containing the site can be contained within existing infrastructure for minor storm events. This infrastructure appears to discharge into a tributary of the Fitzroy River with ponded areas that will naturally detain flows from the catchment.

Refer Appendix A for the proposed stormwater management layout.

APPENDIX A: Proposed Development Layout





Site Plan

1

1 : 600

LOCALITY PLAN

MILANOVIC NEALE
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STORMWATER MANAGEMENT PLAN
S12451-SK01-REVA
DATE: 07/07/20
BY: RDu

APPENDIX B: MUSIC Model Summary Report

Source nodes
Location,Roof - 0.227ha (100% Imp.),Driveway - 0.178ha (100% Imp.),Landscape - 0.005ha (100% Perv.)
ID,1,2,3
Node Type,UrbanSourceNode,UrbanSourceNode,UrbanSourceNode
Zoning Surface Type,Commercial,Commercial,Commercial
Total Area (ha),0.227,0.178,0.005
Area Impervious (ha),0.227,0.178,0
Area Pervious (ha),0,0,0.005
Field Capacity (mm),80,80,80
Pervious Area Infiltration Capacity coefficient - a,243,243,243
Pervious Area Infiltration Capacity exponent - b,0.6,0.6,0.6
Impervious Area Rainfall Threshold (mm/day),1,1,1
Pervious Area Soil Storage Capacity (mm),18,18,18
Pervious Area Soil Initial Storage (% of Capacity),10,10,10
Groundwater Initial Depth (mm),50,50,50
Groundwater Daily Recharge Rate (%),0,0,0
Groundwater Daily Baseflow Rate (%),31,31,31
Groundwater Daily Deep Seepage Rate (%),0,0,0
Stormflow Total Suspended Solids Mean (log mg/L),1.3,2.43,2.16
Stormflow Total Suspended Solids Standard Deviation (log mg/L),0.38,0.38,0.38
Stormflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic
Stormflow Total Suspended Solids Serial Correlation,0,0,0
Stormflow Total Phosphorus Mean (log mg/L),-0.89,-0.3,-0.39
Stormflow Total Phosphorus Standard Deviation (log mg/L),0.34,0.34,0.34
Stormflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic
Stormflow Total Phosphorus Serial Correlation,0,0,0
Stormflow Total Nitrogen Mean (log mg/L),0.37,0.37,0.37
Stormflow Total Nitrogen Standard Deviation (log mg/L),0.34,0.34,0.34
Stormflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic
Stormflow Total Nitrogen Serial Correlation,0,0,0
Baseflow Total Suspended Solids Mean (log mg/L),0,0.78,0.78
Baseflow Total Suspended Solids Standard Deviation (log mg/L),0,0.39,0.39
Baseflow Total Suspended Solids Estimation Method,Stochastic,Stochastic,Stochastic
Baseflow Total Suspended Solids Serial Correlation,0,0,0
Baseflow Total Phosphorus Mean (log mg/L),0,-0.6,-0.6
Baseflow Total Phosphorus Standard Deviation (log mg/L),0,0.5,0.5
Baseflow Total Phosphorus Estimation Method,Stochastic,Stochastic,Stochastic
Baseflow Total Phosphorus Serial Correlation,0,0,0
Baseflow Total Nitrogen Mean (log mg/L),0,0.32,0.32
Baseflow Total Nitrogen Standard Deviation (log mg/L),0,0.3,0.3
Baseflow Total Nitrogen Estimation Method,Stochastic,Stochastic,Stochastic
Baseflow Total Nitrogen Serial Correlation,0,0,0
Flow based constituent generation - enabled,Off,Off,Off
Flow based constituent generation - flow file, , ,
Flow based constituent generation - base flow column, , ,
Flow based constituent generation - pervious flow column, , ,
Flow based constituent generation - impervious flow column, , ,
Flow based constituent generation - unit, , ,
OUT - Mean Annual Flow (ML/yr),1.56,1.22,16.0E-3
OUT - TSS Mean Annual Load (kg/yr),48.5,473,3.18
OUT - TP Mean Annual Load (kg/yr),0.274,0.826,8.72E-3
OUT - TN Mean Annual Load (kg/yr),4.85,3.93,51.1E-3
OUT - Gross Pollutant Mean Annual Load (kg/yr),39.5,31.0,0.00

Rain In (ML/yr),1.72105,1.34955,0.0379086
ET Loss (ML/yr),0.15912,0.124773,0.0219574
Deep Seepage Loss (ML/yr),0,0,0
Baseflow Out (ML/yr),0,0,0
Imp. Stormflow Out (ML/yr),1.56193,1.22477,0
Perv. Stormflow Out (ML/yr),0,0,0.016009
Total Stormflow Out (ML/yr),1.56193,1.22477,0.016009
Total Outflow (ML/yr),1.56193,1.22477,0.016009
Change in Soil Storage (ML/yr),0,0,-5.77E-5
TSS Baseflow Out (kg/yr),0,0,0
TSS Total Stormflow Out (kg/yr),48.5372,473.034,3.18034
TSS Total Outflow (kg/yr),48.5372,473.034,3.18034
TP Baseflow Out (kg/yr),0,0,0
TP Total Stormflow Out (kg/yr),0.273831,0.825812,0.0087162
TP Total Outflow (kg/yr),0.273831,0.825812,0.0087162
TN Baseflow Out (kg/yr),0,0,0
TN Total Stormflow Out (kg/yr),4.84561,3.93141,0.0510729
TN Total Outflow (kg/yr),4.84561,3.93141,0.0510729
GP Total Outflow (kg/yr),39.5152,30.9855,0

No Imported Data Source nodes

USTM treatment nodes
Location,SF Chamber
ID,6
Node Type,SedimentationBasinNode
Lo-flow bypass rate (cum/sec),0
Hi-flow bypass rate (cum/sec),100
Inlet pond volume,0
Area (sqm),4.1
Initial Volume (m^3),0
Extended detention depth (m),0.77
Number of Rainwater tanks,
Permanent Pool Volume (cubic metres),0
Proportion vegetated,0
Equivalent Pipe Diameter (mm),61
Overflow weir width (m),2
Notional Detention Time (hrs),0.115
Orifice Discharge Coefficient,0.6
Weir Coefficient,1.7
Number of CSTR Cells,1
Total Suspended Solids - k (m/yr),1
Total Suspended Solids - C* (mg/L),20
Total Suspended Solids - C** (mg/L),20
Total Phosphorus - k (m/yr),1
Total Phosphorus - C* (mg/L),0.13
Total Phosphorus - C** (mg/L),0.13
Total Nitrogen - k (m/yr),1
Total Nitrogen - C* (mg/L),1.4
Total Nitrogen - C** (mg/L),1.4
Threshold Hydraulic Loading for C** (m/yr),3500
Horizontal Flow Coefficient,
Reuse Enabled,Off
Max drawdown height (m),
Annual Demand Enabled,Off
Annual Demand Value (ML/year),

Annual Demand Distribution,
Annual Demand Monthly Distribution: Jan,
Annual Demand Monthly Distribution: Feb,
Annual Demand Monthly Distribution: Mar,
Annual Demand Monthly Distribution: Apr,
Annual Demand Monthly Distribution: May,
Annual Demand Monthly Distribution: Jun,
Annual Demand Monthly Distribution: Jul,
Annual Demand Monthly Distribution: Aug,
Annual Demand Monthly Distribution: Sep,
Annual Demand Monthly Distribution: Oct,
Annual Demand Monthly Distribution: Nov,
Annual Demand Monthly Distribution: Dec,
Daily Demand Enabled,Off
Daily Demand Value (ML/day),
Custom Demand Enabled,Off
Custom Demand Time Series File,
Custom Demand Time Series Units,
Filter area (sqm),
Filter perimeter (m),
Filter depth (m),
Filter Median Particle Diameter (mm),
Saturated Hydraulic Conductivity (mm/hr),
Infiltration Media Porosity,
Length (m),
Bed slope,
Base Width (m),
Top width (m),
Vegetation height (m),
Vegetation Type,
Total Nitrogen Content in Filter (mg/kg),
Orthophosphate Content in Filter (mg/kg),
Is Base Lined?,
Is Underdrain Present?,
Is Submerged Zone Present?,
Submerged Zone Depth (m),
B for Media Soil Texture,-9999
Proportion of upstream impervious area treated,
Exfiltration Rate (mm/hr),0
Evaporative Loss as % of PET,0
Depth in metres below the drain pipe,
TSS A Coefficient,
TSS B Coefficient,
TP A Coefficient,
TP B Coefficient,
TN A Coefficient,
TN B Coefficient,
Sfc,
S*,
Sw,
Sh,
Emax (m/day),
Ew (m/day),
IN - Mean Annual Flow (ML/yr),2.80
IN - TSS Mean Annual Load (kg/yr),133
IN - TP Mean Annual Load (kg/yr),0.858

IN - TN Mean Annual Load (kg/yr),7.99
IN - Gross Pollutant Mean Annual Load (kg/yr),39.5
OUT - Mean Annual Flow (ML/yr),2.80
OUT - TSS Mean Annual Load (kg/yr),133
OUT - TP Mean Annual Load (kg/yr),0.851
OUT - TN Mean Annual Load (kg/yr),7.91
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
Flow In (ML/yr),2.80244
ET Loss (ML/yr),0
Infiltration Loss (ML/yr),0
Low Flow Bypass Out (ML/yr),0
High Flow Bypass Out (ML/yr),0
Orifice / Filter Out (ML/yr),1.88078
Weir Out (ML/yr),0.921856
Transfer Function Out (ML/yr),0
Reuse Supplied (ML/yr),0
Reuse Requested (ML/yr),0
% Reuse Demand Met,0
% Load Reduction,-0.00699391
TSS Flow In (kg/yr),133.42
TSS ET Loss (kg/yr),0
TSS Infiltration Loss (kg/yr),0
TSS Low Flow Bypass Out (kg/yr),0
TSS High Flow Bypass Out (kg/yr),0
TSS Orifice / Filter Out (kg/yr),88.3011
TSS Weir Out (kg/yr),44.6015
TSS Transfer Function Out (kg/yr),0
TSS Reuse Supplied (kg/yr),0
TSS Reuse Requested (kg/yr),0
TSS % Reuse Demand Met,0
TSS % Load Reduction,0.387798
TP Flow In (kg/yr),0.858008
TP ET Loss (kg/yr),0
TP Infiltration Loss (kg/yr),0
TP Low Flow Bypass Out (kg/yr),0
TP High Flow Bypass Out (kg/yr),0
TP Orifice / Filter Out (kg/yr),0.568883
TP Weir Out (kg/yr),0.282237
TP Transfer Function Out (kg/yr),0
TP Reuse Supplied (kg/yr),0
TP Reuse Requested (kg/yr),0
TP % Reuse Demand Met,0
TP % Load Reduction,0.80279
TN Flow In (kg/yr),7.99178
TN ET Loss (kg/yr),0
TN Infiltration Loss (kg/yr),0
TN Low Flow Bypass Out (kg/yr),0
TN High Flow Bypass Out (kg/yr),0
TN Orifice / Filter Out (kg/yr),5.3421
TN Weir Out (kg/yr),2.57028
TN Transfer Function Out (kg/yr),0
TN Reuse Supplied (kg/yr),0
TN Reuse Requested (kg/yr),0
TN % Reuse Demand Met,0
TN % Load Reduction,0.993521
GP Flow In (kg/yr),39.5152

GP ET Loss (kg/yr),0
GP Infiltration Loss (kg/yr),0
GP Low Flow Bypass Out (kg/yr),0
GP High Flow Bypass Out (kg/yr),0
GP Orifice / Filter Out (kg/yr),0
GP Weir Out (kg/yr),0
GP Transfer Function Out (kg/yr),0
GP Reuse Supplied (kg/yr),0
GP Reuse Requested (kg/yr),0
GP % Reuse Demand Met,0
GP % Load Reduction,100
PET Scaling Factor,

Generic treatment nodes
Location,4 x OceanGuard 200,9 x 690mm PSorb (MCC Brisbane)
ID,4,7
Node Type,GPTNode,GenericNode
Lo-flow bypass rate (cum/sec),0,0
Hi-flow bypass rate (cum/sec),0.08,0.0081
Flow Transfer Function
Input (cum/sec),0,0
Output (cum/sec),0,0
Input (cum/sec),10,10
Output (cum/sec),10,10
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Input (cum/sec), ,
Output (cum/sec), ,
Gross Pollutant Transfer Function
Enabled,True,True
Input (kg/ML),0,0
Output (kg/ML),0,0
Input (kg/ML),14.99,14.99
Output (kg/ML),0,0
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,

Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Input (kg/ML), ,
Output (kg/ML), ,
Total Nitrogen Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),50,100
Output (mg/L),39.5,44.1
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Total Phosphorus Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),10,10
Output (mg/L),7,1.39
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
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Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Total Suspended Solids Transfer Function
Enabled,True,True
Input (mg/L),0,0
Output (mg/L),0,0
Input (mg/L),20.8,1000
Output (mg/L),8,96

Input (mg/L),40.3,
Output (mg/L),14.1,
Input (mg/L),60.6,
Output (mg/L),19.3,
Input (mg/L),79.3,
Output (mg/L),23.4,
Input (mg/L),99.9,
Output (mg/L),26.9,
Input (mg/L),121,
Output (mg/L),30,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
Input (mg/L), ,
Output (mg/L), ,
TSS Flow based Efficiency Enabled,Off,Off
TSS Flow based Efficiency, ,
TP Flow based Efficiency Enabled,Off,Off
TP Flow based Efficiency, ,
TN Flow based Efficiency Enabled,Off,Off
TN Flow based Efficiency, ,
GP Flow based Efficiency Enabled,On,On
GP Flow based Efficiency,[0:1];[1:1],[0:1];[1:1]
IN - Mean Annual Flow (ML/yr),1.24,2.80
IN - TSS Mean Annual Load (kg/yr),476,133
IN - TP Mean Annual Load (kg/yr),0.835,0.851
IN - TN Mean Annual Load (kg/yr),3.98,7.91
IN - Gross Pollutant Mean Annual Load (kg/yr),31.0,0.00
OUT - Mean Annual Flow (ML/yr),1.24,2.80
OUT - TSS Mean Annual Load (kg/yr),84.9,50.3
OUT - TP Mean Annual Load (kg/yr),0.584,0.344
OUT - TN Mean Annual Load (kg/yr),3.15,4.82
OUT - Gross Pollutant Mean Annual Load (kg/yr),2.74E-6,0.00
Flow In (ML/yr),1.24081,2.80256
ET Loss (ML/yr),0,0
Infiltration Loss (ML/yr),0,0
Low Flow Bypass Out (ML/yr),0,0
High Flow Bypass Out (ML/yr),2.11E-5,0.856702
Orifice / Filter Out (ML/yr),0,0
Weir Out (ML/yr),0,0
Transfer Function Out (ML/yr),1.24078,1.94594
Reuse Supplied (ML/yr),0,0
Reuse Requested (ML/yr),0,0
% Reuse Demand Met,0,0
% Load Reduction,8.05928E-6,-0.00285096
TSS Flow In (kg/yr),476.215,132.903
TSS ET Loss (kg/yr),0,0
TSS Infiltration Loss (kg/yr),0,0
TSS Low Flow Bypass Out (kg/yr),0,0
TSS High Flow Bypass Out (kg/yr),0.0093263,41.5299
TSS Orifice / Filter Out (kg/yr),0,0
TSS Weir Out (kg/yr),0,0
TSS Transfer Function Out (kg/yr),84.8741,8.77177
TSS Reuse Supplied (kg/yr),0,0
TSS Reuse Requested (kg/yr),0,0

TSS % Reuse Demand Met,0,0
TSS % Load Reduction,82.1754,62.1516
TP Flow In (kg/yr),0.834527,0.851119
TP ET Loss (kg/yr),0,0
TP Infiltration Loss (kg/yr),0,0
TP Low Flow Bypass Out (kg/yr),0,0
TP High Flow Bypass Out (kg/yr),2.19E-5,0.262497
TP Orifice / Filter Out (kg/yr),0,0
TP Weir Out (kg/yr),0,0
TP Transfer Function Out (kg/yr),0.584155,0.0818185
TP Reuse Supplied (kg/yr),0,0
TP Reuse Requested (kg/yr),0,0
TP % Reuse Demand Met,0,0
TP % Load Reduction,29.9991,59.5455
TN Flow In (kg/yr),3.98248,7.91238
TN ET Loss (kg/yr),0,0
TN Infiltration Loss (kg/yr),0,0
TN Low Flow Bypass Out (kg/yr),0,0
TN High Flow Bypass Out (kg/yr),6.01E-5,2.38519
TN Orifice / Filter Out (kg/yr),0,0
TN Weir Out (kg/yr),0,0
TN Transfer Function Out (kg/yr),3.14612,2.43749
TN Reuse Supplied (kg/yr),0,0
TN Reuse Requested (kg/yr),0,0
TN % Reuse Demand Met,0,0
TN % Load Reduction,20.9995,39.0489
GP Flow In (kg/yr),30.9861,0
GP ET Loss (kg/yr),0,0
GP Infiltration Loss (kg/yr),0,0
GP Low Flow Bypass Out (kg/yr),0,0
GP High Flow Bypass Out (kg/yr),2.7E-6,0
GP Orifice / Filter Out (kg/yr),0,0
GP Weir Out (kg/yr),0,0
GP Transfer Function Out (kg/yr),0,0
GP Reuse Supplied (kg/yr),0,0
GP Reuse Requested (kg/yr),0,0
GP % Reuse Demand Met,0,0
GP % Load Reduction,100,100

Other nodes
Location,Receiving Node
ID,5
Node Type,ReceivingNode
IN - Mean Annual Flow (ML/yr),2.80
IN - TSS Mean Annual Load (kg/yr),50.3
IN - TP Mean Annual Load (kg/yr),0.344
IN - TN Mean Annual Load (kg/yr),4.82
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00
OUT - Mean Annual Flow (ML/yr),2.80
OUT - TSS Mean Annual Load (kg/yr),50.3
OUT - TP Mean Annual Load (kg/yr),0.344
OUT - TN Mean Annual Load (kg/yr),4.82
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00
% Load Reduction,162E-6
TSS % Load Reduction,90.4
TN % Load Reduction,45.4

TP % Load Reduction,68.9
GP % Load Reduction,100

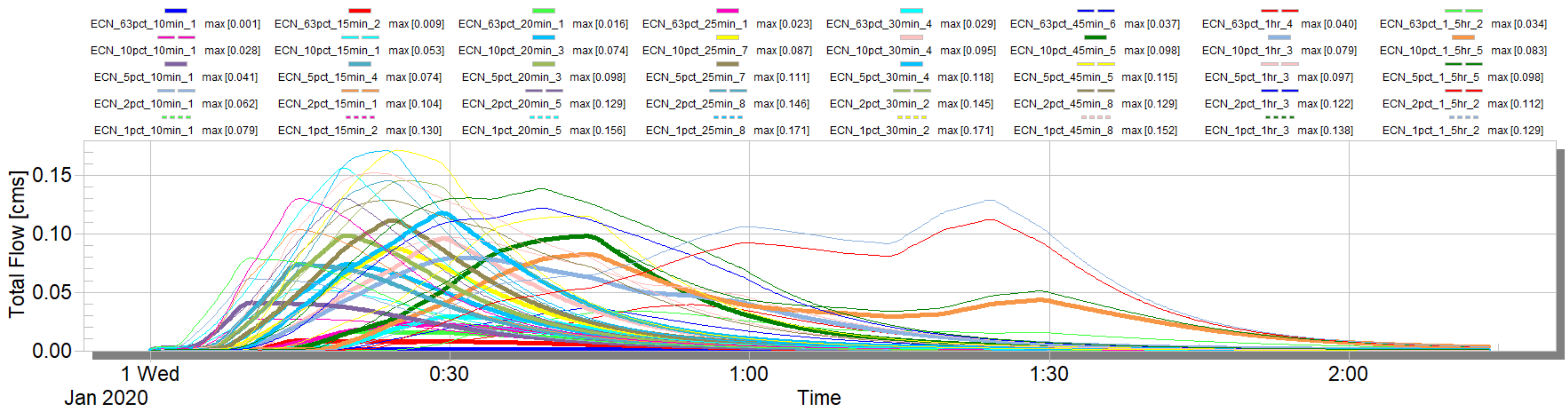
Links
Location,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link,Drainage Link
Source node ID,3,2,4,6,1,7
Target node ID,4,4,6,7,6,5
Muskingum-Cunge Routing,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed,Not Routed
Muskingum K, , , , , ,
Muskingum theta, , , , , ,
IN - Mean Annual Flow (ML/yr),16.0E-3,1.22,1.24,2.80,1.56,2.80
IN - TSS Mean Annual Load (kg/yr),3.18,473,84.9,133,48.5,50.3
IN - TP Mean Annual Load (kg/yr),8.72E-3,0.826,0.584,0.851,0.274,0.344
IN - TN Mean Annual Load (kg/yr),51.1E-3,3.93,3.15,7.91,4.85,4.82
IN - Gross Pollutant Mean Annual Load (kg/yr),0.00,31.0,2.74E-6,0.00,39.5,0.00
OUT - Mean Annual Flow (ML/yr),16.0E-3,1.22,1.24,2.80,1.56,2.80
OUT - TSS Mean Annual Load (kg/yr),3.18,473,84.9,133,48.5,50.3
OUT - TP Mean Annual Load (kg/yr),8.72E-3,0.826,0.584,0.851,0.274,0.344
OUT - TN Mean Annual Load (kg/yr),51.1E-3,3.93,3.15,7.91,4.85,4.82
OUT - Gross Pollutant Mean Annual Load (kg/yr),0.00,31.0,2.74E-6,0.00,39.5,0.00

Catchment Details
Catchment Name,S12451-200619-CALCS-REVA-OCEAN
Timestep,6 Minutes
Start Date,1/01/1980
End Date,31/12/1989 11:54:00 PM
Rainfall Station, 39083 ROCKHAMPTON
ET Station,User-defined monthly PET
Mean Annual Rainfall (mm), 762
Mean Annual ET (mm), 1702

APPENDIX C: XP-RAFTS Hydrographs

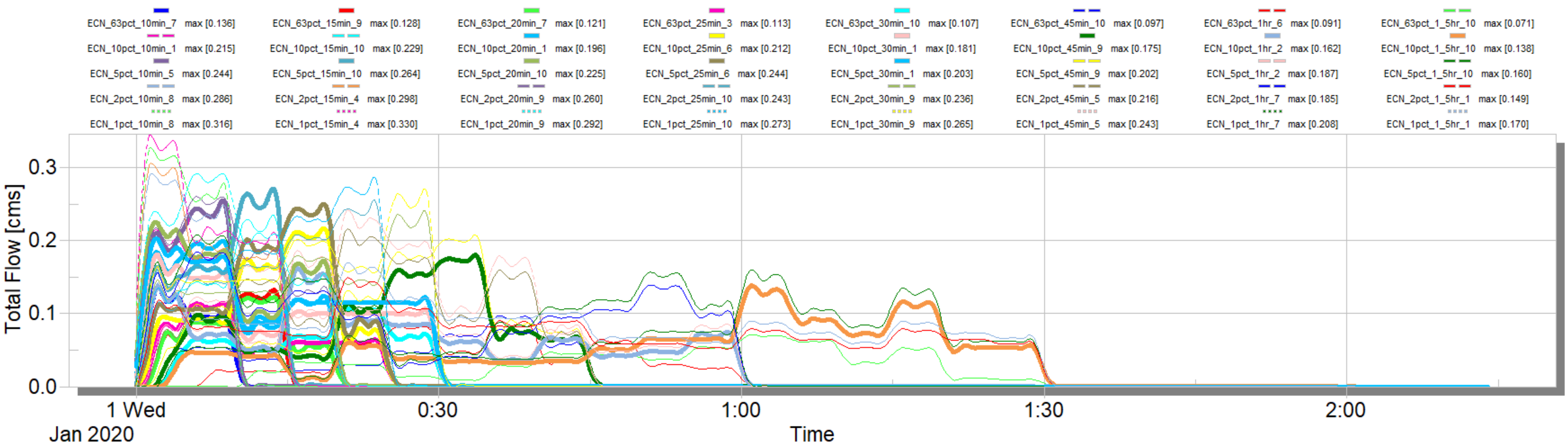
EX [ALL STORMS]

Total Flow



PR [ALL STORMS]

Total Flow



APPENDIX D: Rational Method Calculation Summary

RATIONAL METHOD CALCULATIONS - EXISTING SITE

Job Reference	S12451
Site Address	284 Alexandra Street, Kawana
Council	Rockhampton Regional Council

Number of Sub-Catchments	1	
Minor Storm Event	10% AEP	*(As per QUDM Table 7.02.1)*
Major Storm Event	1% AEP	*(As per QUDM Table 7.02.1)*

Subcatchment Summary Table

Number	*Catchment Name*	*Catchment Description*	C_{10}	*tc*
1	Existing	Open Space (eg parks)	0.70	15

Site C_{10} 0.70

Catchment Calculations (Major and Minor Storm ARI's)

Number	*Area*	*C10*	*I10*	*10% AEP*	*C100*	*I100*	*1% AEP*
	ha		*mm/hr*	m^3/s		*mm/hr*	m^3/s
1	0.410	0.70	143	0.114	0.84	218	0.209

Total Runoff	Minor	0.114	m^3/s
	Major	0.209	m^3/s
Total Area		0.410	*ha*

Overland Flow Calculations

Trunk SW Infrastructure		
Pipe Diameter	N/A	*m*
Number of Pipes		
Grade		*m/m*
mannings		
Pipe Capacity		*m^3/s*
Pipe Velocity		*m/s*
Capacity @ 3m/s		*m^3/s*
Overland Flow		*m^3/s*

Runoff Summary

Freq.	*Peak Discharge*	
4 EY	0.026	*m^3/s*
63% AEP	0.053	*m^3/s*
39% AEP	0.069	*m^3/s*
15% AEP	0.094	*m^3/s*
10% AEP	0.114	*m^3/s*
5% AEP	0.138	*m^3/s*
2% AEP	0.179	*m^3/s*
1% AEP	0.209	*m^3/s*

RATIONAL METHOD CALCULATIONS - DEVELOPED SITE

Job Reference	S12451
Site Address	284 Alexandra Street, Kawana
Council	Rockhampton Regional Council

Number of Sub-Catchments	1	
Minor Storm Event	10% AEP	*(As per QUDM Table 7.02.1)*
Major Storm Event	1% AEP	*(As per QUDM Table 7.02.1)*

Subcatchment Summary Table

Number	*Catchment Name*	*Catchment Description*	*C_{10}*	*tc*
1	Developed	Commercial and Industrial	0.88	5

Site C_{10} 0.88

Catchment Calculations (Major and Minor Storm ARI's)

Number	*Area*	*C10*	*I10*	*10% AEP*	*C100*	*I100*	*1% AEP*
	ha		*mm/hr*	*m^3/s*		*mm/hr*	*m^3/s*
1	0.410	0.88	201	0.201	1.00	303	0.345

Total Runoff	Minor	0.201	*m^3/s*
	Major	0.345	*m^3/s*
Total Area		0.410	*ha*

Overland Flow Calculations

Trunk SW Infrastructure		
Pipe Diameter	N/A	*m*
Number of Pipes		
Grade		*m/m*
mannings		
Pipe Capacity		*m^3/s*
Pipe Velocity		*m/s*
Capacity @ 3m/s		*m^3/s*
Overland Flow		*m^3/s*

Runoff Summary

Freq.	*Peak Discharge*	
4 EY	0.047	*m^3/s*
63% AEP	0.093	*m^3/s*
39% AEP	0.122	*m^3/s*
15% AEP	0.167	*m^3/s*
10% AEP	0.201	*m^3/s*
5% AEP	0.243	*m^3/s*
2% AEP	0.309	*m^3/s*
1% AEP	0.345	*m^3/s*

APPENDIX E: Rational Method External Calculation Summary

RATIONAL METHOD CALCULATIONS - DEVELOPED SITE

Job Reference	S12451
Site Address	284 Alexandra Street, Kawana
Council	Rockhampton Regional Council

Number of Sub-Catchments	1	
Minor Storm Event	39% AEP	*(As per QUDM Table 7.02.1)*
Major Storm Event	1% AEP	*(As per QUDM Table 7.02.1)*

Subcatchment Summary Table

Number	*Catchment Name*	*Catchment Description*	*C_{10}*	*tc*
1	Developed	Commercial and Industrial	0.88	20

Site C_{10} 0.88

Catchment Calculations (Major and Minor Storm ARI's)

Number	*Area*	*C2*	*I2*	*39% AEP*	*C100*	*I100*	*1% AEP*
	ha		*mm/hr*	*m^3/s*		*mm/hr*	*m^3/s*
1	17.800	0.75	89	3.292	1.00	191	9.444

Total Runoff	Minor	3.292	*m^3/s*
	Major	9.444	*m^3/s*
Total Area		17.800	*ha*

Overland Flow Calculations

Trunk SW Infrastructure		
Pipe Diameter	N/A	*m*
Number of Pipes		
Grade		*m/m*
mannings		
Pipe Capacity		*m^3/s*
Pipe Velocity		*m/s*
Capacity @ 3m/s		*m^3/s*
Overland Flow		*m^3/s*

Runoff Summary

Freq.	*Peak Discharge*	
4 EY	1.255	*m^3/s*
63% AEP	2.510	*m^3/s*
39% AEP	3.292	*m^3/s*
15% AEP	4.506	*m^3/s*
10% AEP	5.439	*m^3/s*
5% AEP	6.579	*m^3/s*
2% AEP	8.406	*m^3/s*
1% AEP	9.444	*m^3/s*