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ROCKHAMPTON REGIONAL COUNCIL
APPROVED PLANS
These plans are approved subject to the current conditions of approval associated with
Development Permit No.: D/142-2020
Dated: 28 May 2021

11 December 2020

Commercial-in-Confidence

Attention: Monishaa Prasad & Martin Crow

Rockhampton Regional Council
PO Box 1860, Rockhampton, QLD, 4700

Dear Monishaa & Martin

Alliance Hangar Hydraulic Impact Assessment Memo

1.0 Introduction

1.1 Project Background

AECOM Australia Pty Ltd (AECOM) has been commissioned by Rockhampton Regional Council (RRC) to undertake a flood impact assessment of proposed aircraft hangar at Rockhampton Airport.

The new hangar is expected to cater for the maintenance of A321 NEO aircraft (extended Code C aircraft) at Rockhampton airport, and the area between the existing apron and the new hangar apron (known as Bay 7) is to be designed to accommodate Code E (i.e. B777/A350) operations.

1.2 Project Objectives

The objectives of this assessment are to:

- Quantify hydraulic impacts (change in peak flood extents, velocities, TOS) associated with the proposed aircraft hangar for Fitzroy River and local catchment (West Rockhampton) flood mechanisms.
- Confirm the measure of impacts through a building impact assessment
- Assess and recommend arrangements for scour protection.
- Present the findings in a concise technical memo and map volume (this document).

1.3 Document Structure

The structure of this document is as follows:

- Section 2.0 describes the baseline models which have been adopted for this assessment.
- Section 3.0 describes the design inputs and model schematisation.
- Section 4.0 presents the results of the assessment and recommendations for scour treatment.
- Section 5.0 summarises the conclusions and outlines recommendations.

1.4 Limitations and Exclusions

The following limitations apply to this study:

- All design flood events for the local catchment were assessed for a single critical duration, based on an analysis of multiple storm durations for the 1% AEP event, which was completed in the Wandal and West Rockhampton Baseline Flood Assessment.
- Aerial survey data (in the form of LiDAR) used to develop the topography for the hydraulic model has a vertical accuracy of ± 0.15 m on clear, hard surfaces and a horizontal accuracy of ± 0.45 m.
- Assessment of the probability of coincident local rainfall and Fitzroy River flood events has not been undertaken.
- The hydraulic model has been previously calibrated to a single historical event which occurred as a result of Ex-TC Debbie in March 2017. No verification to other historical events has been undertaken, due to the lack of available data.

- The approach adopted assumes each catchment is independent of adjacent catchments. It does not allow for jointly occurring design events. The cross connections between catchments occur in the less frequent events, given this low likelihood of an event actually occurring, this approach was deemed acceptable for this study.
- Hydrologic and hydraulic modelling is based on methods and data outlined in Australian Rainfall and Runoff (AR&R) 1987. The 1987 revision has been adopted as per Council's request. Refer to the ARR, Data Management and Policy Review (AECOM, 2017) for details surrounding changes recommended in the 2016 revision.
- Any use which a third party makes of this document, or any reliance on or decision to be made based on it, is the responsibility of such third parties. AECOM accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this document.
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Whilst a detailed model development process has been undertaken for both the Fitzroy River and Local Catchment; it is important that the following fundamental themes are noted:

- All models are coarse simplifications of very complex processes. No model can therefore be perfect, and no model can represent all the important processes accurately.
- Model accuracy and reliability will always be limited by accuracy of terrain and other input data.
- Model accuracy and reliability will always be limited by the reliability / uncertainty of inflow data.
- No model is 'correct', results require interpretation and application of engineering judgement.
- A model developed for a specific purpose is probably unsuitable for another purpose without modification, adjustment, and recalibration. The responsibility must always remain with the modeler to determine whether the model is suitable for a given problem.
- Predicted design event water surface elevations and flood extents may not reflect actual flooding conditions.

2.0 Baseline Models

2.1 Fitzroy River LFC Model (2019)

The Fitzroy River Lower Fitzroy Catchment (LFC) Model was adopted for assessing riverine flood behaviour. This model was selected based on the following justification:

- Model extents cover the area of interest and the impacts anticipated within the assessment are not expected to be tempered by boundary conditions.
- The model resolution represents the best available detail for modelling flood behaviour within the Airport Precinct and broader Western Floodplain.
- The model has been previously calibrated and validated suitably to defend outcomes presented in this assessment.

No baseline updates were required to the model setup in order to progress the impact assessment. It is worth noting a new baseline scenario (E6) was modelled for the full flood wave in order to capture the Time of Duration within the site of interest.

Details regarding the model setup are presented in Table 1.

Table 1 LFC Model Setup Overview

Parameter	Lower Fitzroy Catchment Model
Completion Date	2019
AEP's Assessed	5%, 2%, 1% and 1% AEP + CC
Hydrologic Modelling	Flood quantiles from FFA (ARR19) using scaled historical flood hydrographs
Hydraulic Model Software	TUFLOW version 2018-03-AE-w64-iSP
Grid Size	8m
DEM (year flown)	2016
Roughness	Spatially varying and depth constant values.
Eddy Viscosity	Smagorinsky
Model Calibration	Calibrated to the 2017, 2011 and 1991 events.
Downstream Model Boundary	Tidal boundary on the south-western boundary. Mean High Water Springs used for Design Events.
Timesteps	Adaptive (HPC)
Sensitivity Testing	±15% Hydraulic Roughness and Climate Change
Major Floodplain Infrastructure	South Rockhampton Flood Levee included. Rockhampton Ring Road and Rockhampton Airport Levee excluded.

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2.2 Wandal & West Rockhampton Model (2018)

The Wandal and West Rockhampton (WW) Model was adopted for assessing local catchment flood behaviour. This model was selected based on the following justification:

- Model extents cover the area of interest and the impacts anticipated within the assessment are not expected to be tempered by boundary conditions.
- The model resolution represents the best available detail for modelling flood behaviour within the Airport Precinct.
- The model has been previously calibrated suitably to defend outcomes presented in this assessment.

Baseline updates included revision of the modelling methodology to TUFLOW GPU HPC to increase model performance to meet project delivery dates. Differences in baseline peak flood heights as a result of implementing HPC for the area of interest are presented in Figure 1. Differences for the 1% AEP event for the baseline scenario are in the order of -30mm and are not expected to influence the outcomes of the assessment.

Details regarding the model setup are presented in Table 2.

Table 2 WW Model Setup Overview

Parameter	Wandal & West Rockhampton Local Catchment Model
Completion Date	2017
AEP's Assessed	1 EY, 39%, 18%, 10%, 5%, 2%, 1%, and 1% AEP + CC
Hydrologic Modelling	Direct Rainfall Approach
Hydraulic Model Software	TUFLOW version 2018-03-AE-w64-iSP
Grid Size	3m
DEM (year flown)	2016
Roughness	Spatially varying and depth varying values.
Eddy Viscosity	Smagorinsky
Model Calibration	Calibrated to the 2017 event.
Downstream Model Boundary	1 height-time boundary on the western boundary, 5 height-time boundaries on the southern boundary, 6 rating curve boundary conditions, 1 static height-time boundary and 1 tidal boundary on the eastern boundary. Additional 2 height-time boundary conditions on the northern boundary and additional 2 inflow boundaries on the eastern boundary in PMF and external creek catchment sensitivity simulations.
Timesteps	Adaptive (HPC)
Sensitivity Testing	Stormwater Infrastructure Blockage (pits and cross drainage structures), ±15% Roughness and Climate Change

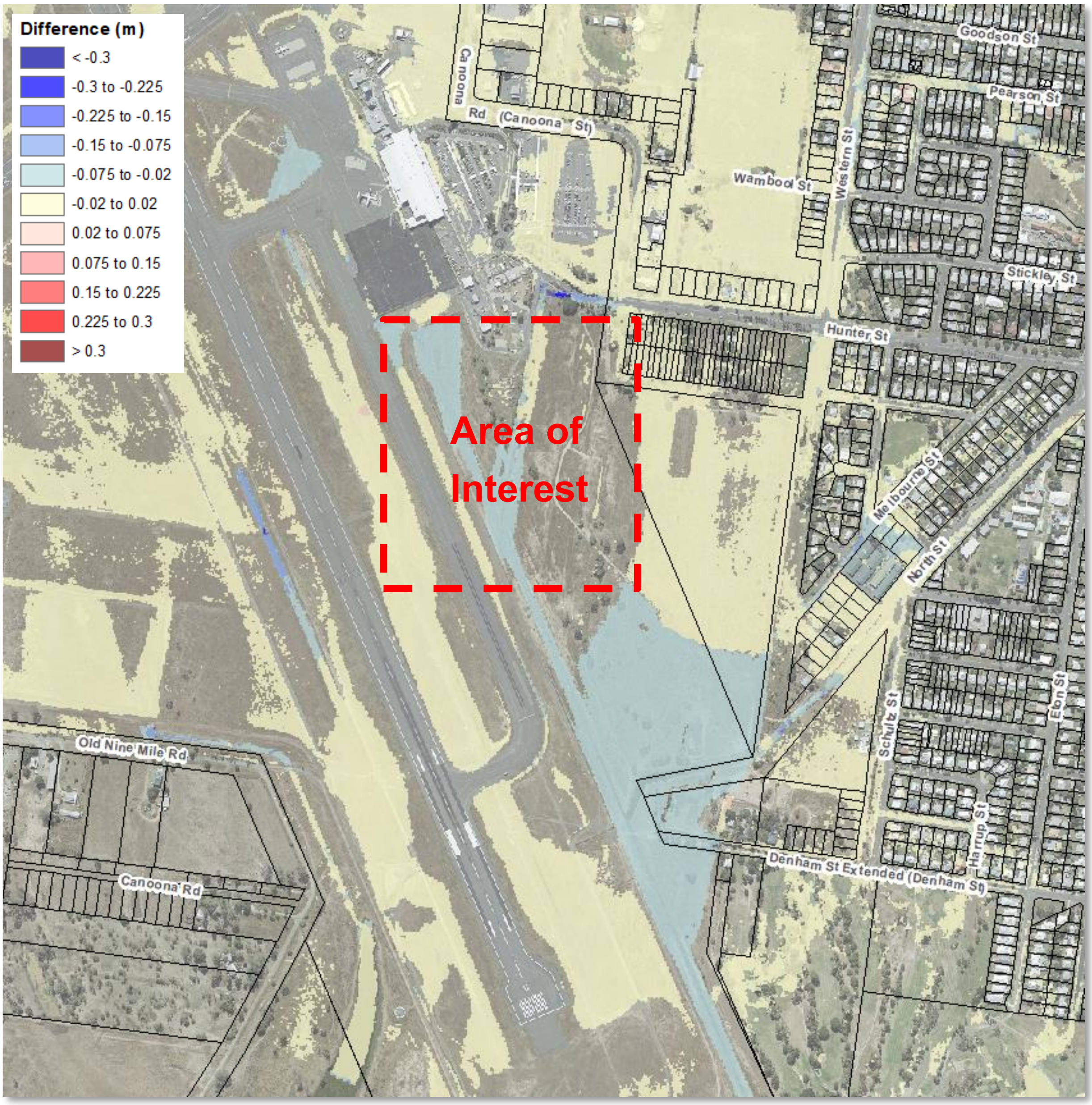

Figure 1 Baseline Comparison (HPC vs Classic)

3.0 Design Schematisation

3.1 Supplied Data

Design data was supplied in a DXF format and tinned in 12D to generate a 3D surface suitable for schematisation within TUFLOW. The proposed hangar design is shown in Figure 2. Upon reviewing the surface, several artificial depressions were observed where the apron met the hangar's southwest face. Following agreement with RRC, these depressions were removed from the surface to generate the final design surface presented in Figure 3.

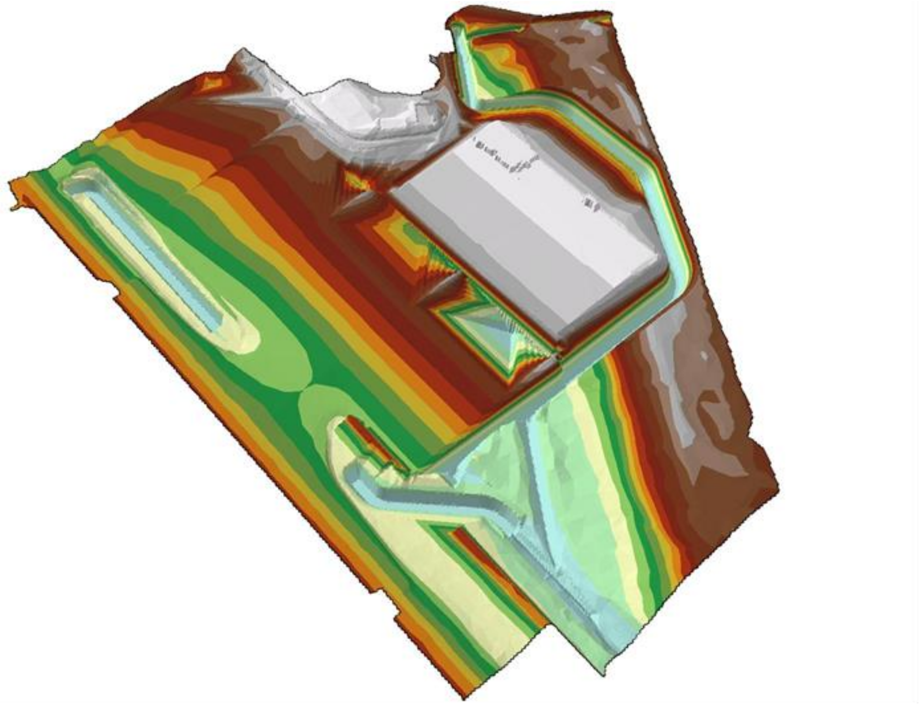

Figure 2 Supplied TIN 3D View (note depressions on apron adjacent hangar)

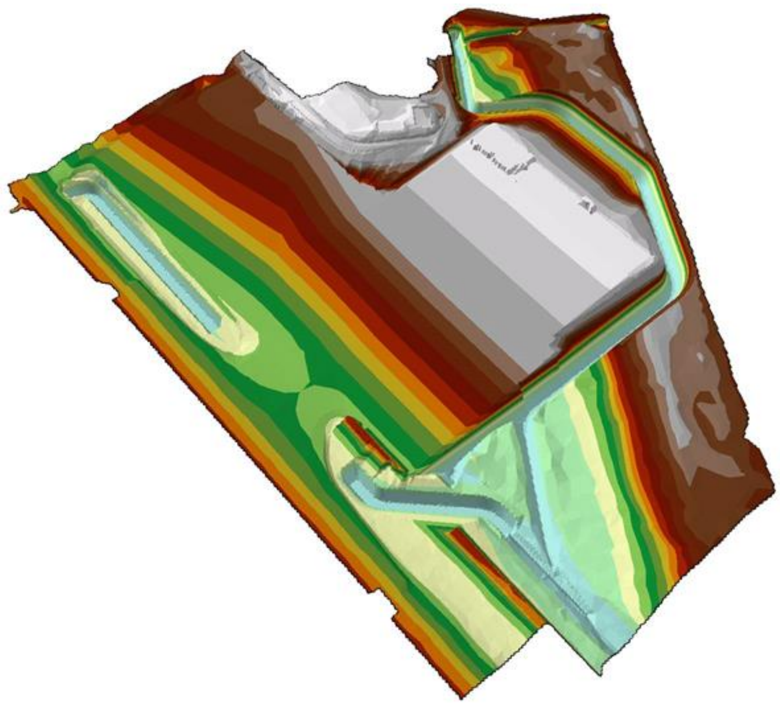

Figure 3 Amended TIN 3D View

In addition to the design surface, P50 concept drawings were also supplied. An excerpt from the key plan is included for referenced in Figure 4. This drawing package also included specifications for new and augmented hydraulic structures which were to be included in the model schematisation.

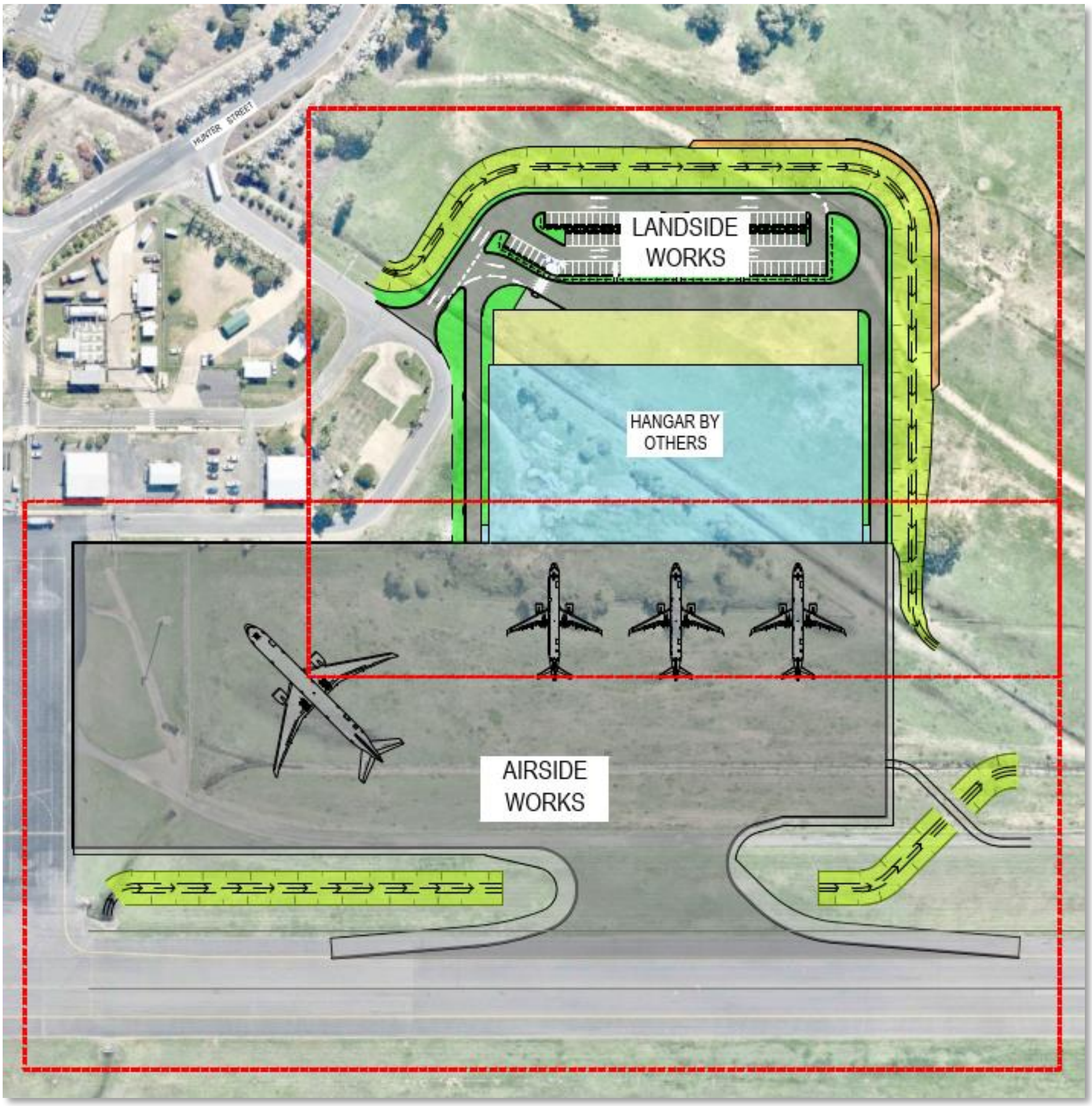

Figure 4 P50 Concept Key Plan (GHD, 2020)

3.2 Design Schematisation

In each model (LFC and WW) the design was schematised as per Table 3.

Table 3 Design Schematisation Summary

Element	Model	
	LFC	WW
Design Surface	1m DEM of tinned surface	
Hangar Doors and Cladding	2d_zsh glass wall (THIN)	
Roughness	Added apron / road / concrete for proposed extent. Revised extents of low / medium veg. Manning's 'n' = 0.030 assigned for concrete invert, grassed open channel in WW model.	
Existing Hydraulics Structures	Removed culverts within channels filled by proposed design (airside).	Removed culverts within channels filled by proposed design (airside). Extended minor subsurface drainage to new channel alignment as per P50 concept drawings.
New Hydraulics Structures	Digitised as 1d_nwk culvert as per P50 concept drawings.	
Channel Inverts	Stamped invert using 2d_zsh.	

3.3 Modelled Events

The proposed design (Scenario AAH02) was simulated as per Table 4.

Table 4 Modelled Events Summary

Event	Model	
	LFC	WW
1 EY	No[1]	Yes[2]
39% AEP	No[1]	Yes[2]
18% AEP	No[1]	Yes[2]
10% AEP	No[1]	Yes[2]
5% AEP	Yes	Yes[2]
2% AEP	Yes	Yes[2]
1% AEP	Yes	Yes[2]
1% AEP +CC[3]	Yes	Yes[2]

[1]*Area of interest not inundated for this magnitude.*

[2]*Critical duration of 180min selected based on Figure 17, Wandal & West Rockhampton Local Catchment Study: Baseline Flooding and Hazard Assessment – Volume 1 (AECOM, 2017).*

[3]*Modelled as a sensitivity only.*

4.0 Impact Assessment

4.1 Fitzroy River Results

Fitzroy River modelled results are presented in the enclosed map volume. Analysis of the flood results yielded the following observations:

- **Difference in Peak Flood Heights (Maps 04 – 06):**
  - Increases of up to 25mm are expected in a 1% AEP immediately north of the proposed hangar and annex structures. Increases above 20mm are limited within the airport precinct. Offsite increases in residential allotments are <5mm.
  - Negligible impacts in 2% and 5% AEP events.
- **Difference in Depth Averaged Peak Flood Velocities (Maps 07 – 09):**
  - Increases of up to 0.5m/s are anticipated across the new apron.
  - Increases of up to 1.9m/s are anticipated within the new landside channel. It is noted the highest increases are where the baseline flood velocity was very low (<0.1m/s).
  - A localised increase in the 1% AEP event is noted within the Canoona Road corridor directly north of the site. Detailed analysis of the flood behaviour indicates this is due to an increase in the road surface drainage flow, where baseline velocities were in the order of 0.3m/s and design case velocities increase to 1.3m/s. This may also be a result of changes in the adaptive timestep between scenarios.
- **Difference in Duration of Inundation (Maps 10 – 12):**
  - The duration of inundation is expected to increase locally around the area of interest where existing material is cut (e.g. realigned channel and apron).
  - Increases to duration of inundation are most sensitive in the 2% AEP event where the duration of inundated is expected to increase by up to 48-hours within the airport precinct (between Hunter Street and the proposed hangar carpark).
  - Increased duration of inundation of up to 12-hours is possibly expected within the Canoona Road Corridor.
  - Offsite impacts are not anticipated.
- **Difference in Peak Flood Hazard (Maps 13 – 14):**
  - Baseline conditions saw a peak flood hazard of H5 within overland channels in the area of interest.
  - The footprint of hazard class H5 is expected to increase across the proposed new apron and re-aligned drainage channels.
  - Negligible changes are expected outside of the airport precinct.

Based on the results comparison, the following conclusions can be drawn:

- Offsite impacts due to the design are not anticipated for the modelled events.
- Localised increases to velocity and duration of inundation are expected, although are within the airport precinct boundary.

4.2 Local Catchment Results

- **Difference in Peak Flood Heights (Maps 26 – 32):**
  - Redirection of flow through the high-capacity, concrete invert table drain (landside) results in minor reductions to flood heights upstream of the site in all modelled events.
  - Improvements to channel function and capacity on the airside also improve the efficiency of runoff originating from the airport runway, resulting in decreases in the order of 40-50mm across modelled events.

- Minor increases are noted within the downstream channel and storage area in the order of 10mm.

- **Difference in Depth Averaged Peak Flood Velocities (Maps 33 – 39):**
  - Changes to peak flood velocities within the study area are generally insignificant across the range of modelled events.
  - Notable increases are expected where channel realignment has occurred, or flow efficiency has improved.
  - Design case velocities (to inform the scour assessment) are as follows:
    - Existing channel from Hunter Street – up to 2.7m/s (previously 2.0m/s)
    - Landside channel adjacent carpark – up to 2.2m/s (previously dry)
    - Airside channel adjacent apron – up to 1.0m/s (previously dry)
    - Airside channel culvert (new) – up to 1.1m/s
    - Downstream channel (to Murray Lagoon) – up to 0.6m/s (previously 0.5m/s)
- **Difference in Peak Flood Hazard (Maps 40 – 43):**
  - Baseline conditions saw a peak flood hazard of H3-H4 within overland channels in the area of interest.
  - Where channel have been realigned peak flood hazard of up to H4 are expected.
  - Negligible changes are expected outside of the airport precinct.
  - Minor decreases in peak flood hazard classes H2 and H3 are expected in storage areas adjacent the runway.

Based on the results comparison, the following conclusions can be drawn:

- Channel and cross-drainage features are adequately sized to maintain the existing function of overland flow.
- Offsite impacts due to the design are not anticipated for the modelled events.
- Localised increases to velocity are expected within the re-aligned channels, with some requiring scour treatment.

4.3 Building Impact Assessment

The following approach has been adopted to determine the expected building impacts as a result of the proposed design for Fitzroy River and Local Catchment modelled results:

- A building database was adopted based on the latest available building database. The most up to date building database is the “RRR 20191106” point database prepared during the Rockhampton Ring Road BC Project in November 2019.
- Peak Flood Heights were extracted from the Baseline and Design Scenario model simulations at each of the buildings in the database, with incremental changes to flood heights analysed across the range of simulated flood events.
- The number of predicted buildings deemed to be impacted and benefited above / below floor by the proposed simulations was determined based on the impact classifications detailed below.

Building impacts were investigated to quantify the improvements or impacts resulting from the proposed design. Five categories have been defined to assess the benefit / consequence of the proposed mitigation options and are summarised in Table 5. This impact assessment approach is similar to method adopted for NRFMA, SRFL and the RRR BC projects.

Table 5 Building Impact Assessment - Categories

Category	Description
1	Category 1 – No Change / Building Not Flooded in Baseline or Developed Case (excluded from summary statistics)
2	Category 2 – Building inundated above floor level in Baseline, but not inundated above floor level in the Developed Case
3	Category 3 – Building inundated above floor level in Baseline and receives a flood depth decrease of >=10mm in the Developed Case
4	Category 4 – Building inundated above floor level in Baseline and receives a flood depth increase of >=10mm in the Developed Case
5	Category 5 – Building not inundated above floor level in Baseline, but is inundated above floor level in the Developed Case

Results of the building impact assessment are presented in Table 6 and Table 7. The findings indicate that for the simulated events no adverse impacts to above floor flooding are expected as a result of the proposed design.

Table 6 Fitzroy River - Building Impact Assessment

Category	5% AEP	2% AEP	1% AEP
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0

Table 7 Local Catchment - Building Impact Assessment

Category	1 EY	39% AEP	18% AEP	10% AEP	5% AEP	2% AEP	1% AEP
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0

4.4 Sensitivity Analysis

Sensitivity analysis has been undertaken for a range of alternate conditions for both the baseline and design case conditions. This comparative analysis will quantify the uncertainty in the impact analysis presented above.

- Fitzroy River Sensitivities:
  - Increase in roughness by 15% (Map 15) results in minor decrease to predicted impacts.
  - Decrease in roughness by 15% (Map 16) results in a similar magnitude of predicted impacts.
  - Possible future 1% AEP conditions due to Climate Change (Map 17) results in a minor increase to predicted impacts on the landside, though these remain within the precinct.
  - Revised design levels within the hangar carpark (Map 18) results in a minor increase (in the order of 5mm) to predicted impacts on the landside, though these remain within the precinct.
- Local Catchment Sensitivities:
  - Increase in roughness by 15% (Map 44) results in a similar magnitude of predicted impacts.
  - Decrease in roughness by 15% (Map 45) results in a similar magnitude of predicted impacts.

- Map 46 indicated a scenario where key culverts are blocked by 25% results in a slightly increased upstream benefit.
- Map 47 indicated a scenario where pit inlets are blocked by 50% results in a slightly decreased upstream benefit.
- Possible future 1% AEP conditions due to Climate Change (Map 48) significantly increase the runoff approaching the landside channel. Where this channel meets the hangar carpark and bends 90°, impacts of up to 0.10m are anticipated, though the extent of impacts is limited to Hunter Street. It is also noted the airside channel culverts have sufficient capacity to service the upstream catchment. It is worth noting hangar, annex and apron immunity are maintained in a 1% AEP + CC local catchment scenario.
- Revised design levels within the hangar carpark (Map 49 and 50) results in negligible change to predicted impacts.

Outcomes observed from this exercise indicate that the impact of the proposed design will remain consistent under varied conditions. Increased impacts may be expected under conditions worsened by climate change, or in very rare events (such as the 0.2% AEP) not modelled in this assessment.

4.5 Scour Assessment

Assessment of potential to scour focuses on the overland channels and culvert outlets within the extent of works. Based on the analysis made above for the Fitzroy River and local catchment flood mechanisms, the following scour treatments are recommended with reference to Figure 5:

- Landside Channel – reinforced turf from Hunter Street to southeast corner of Annex, unreinforced thereafter.
- Airside Channel – unreinforced turf.
- 4 / 1500 x 900 RCBC – minimum rock treatment of 200mm d_{50}, 1.6 x d_{50} depth (with filter cloth) for a length of 3m.

Figure 5 Channel Scour Treatment Overview

5.0 Conclusion

This assessment adopted Council's calibrated TUFLOW models for quantification of onsite and offsite impacts for the proposed design during Fitzroy River and Local Catchment (Wandal & West Rockhampton) flood events. A range of flood events up to the 1% AEP were modelled together with a range of sensitivities to provide a strong understanding of existing and modified flood behaviour.

The assessment revealed minor impacts within the airport precinct and local road corridor are expected as a result of the proposed hangar design. Offsite impacts are not expected, which was further confirmed through a building impact assessment. This outcome is due to a combination of placement (within an existing storage area) and adequate provision for overland flow in the realigned channels.

We recommend consideration of reinforced turf and minimum rock protection for new culverts is taken forward with the design to prevent erosion during Fitzroy River or Local Catchment events.

Yours faithfully
For AECOM Australia Pty Ltd

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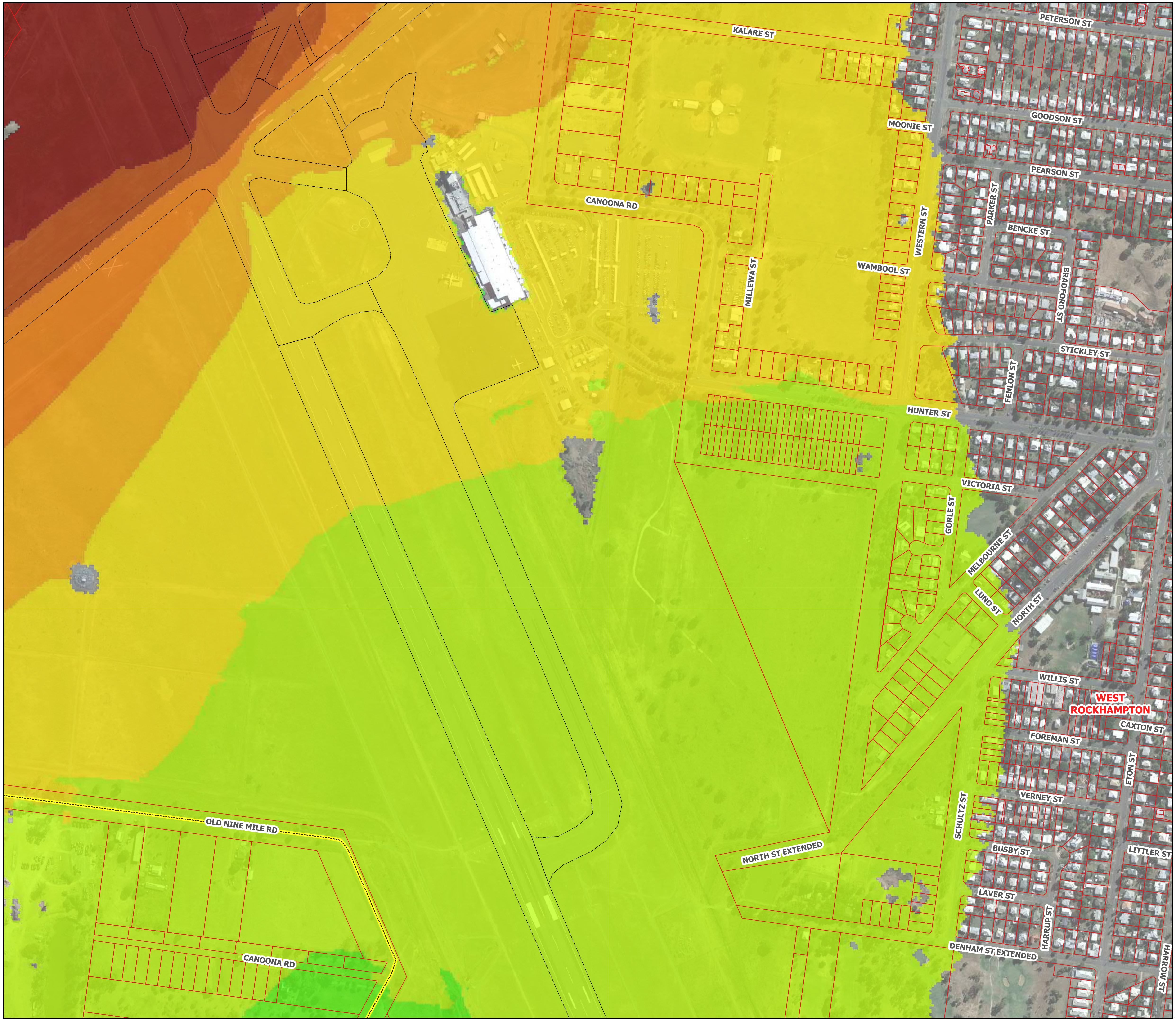

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Peak flood heights and Extents
Event - 1% AEP Flood Event

Scenario - Baseline

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LEGEND

- Airport
- Cadastre
- Model Extent

Peak Flood Height (mAHD)

- < 8.60
- 8.61 - 8.75
- 8.76 - 8.90
- 8.91 - 9.05
- 9.06 - 9.20
- 9.21 - 9.35
- 9.36 - 9.50
- 9.51 - 9.65
- 9.66 - 9.80
- 9.81 - 9.95
- 9.96 - 10.10
- 10.11 - 10.25
- 10.26 - 10.40
- 10.41 - 10.55
- 10.56 - 10.70
- > 10.71

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

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PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 1

A3 size

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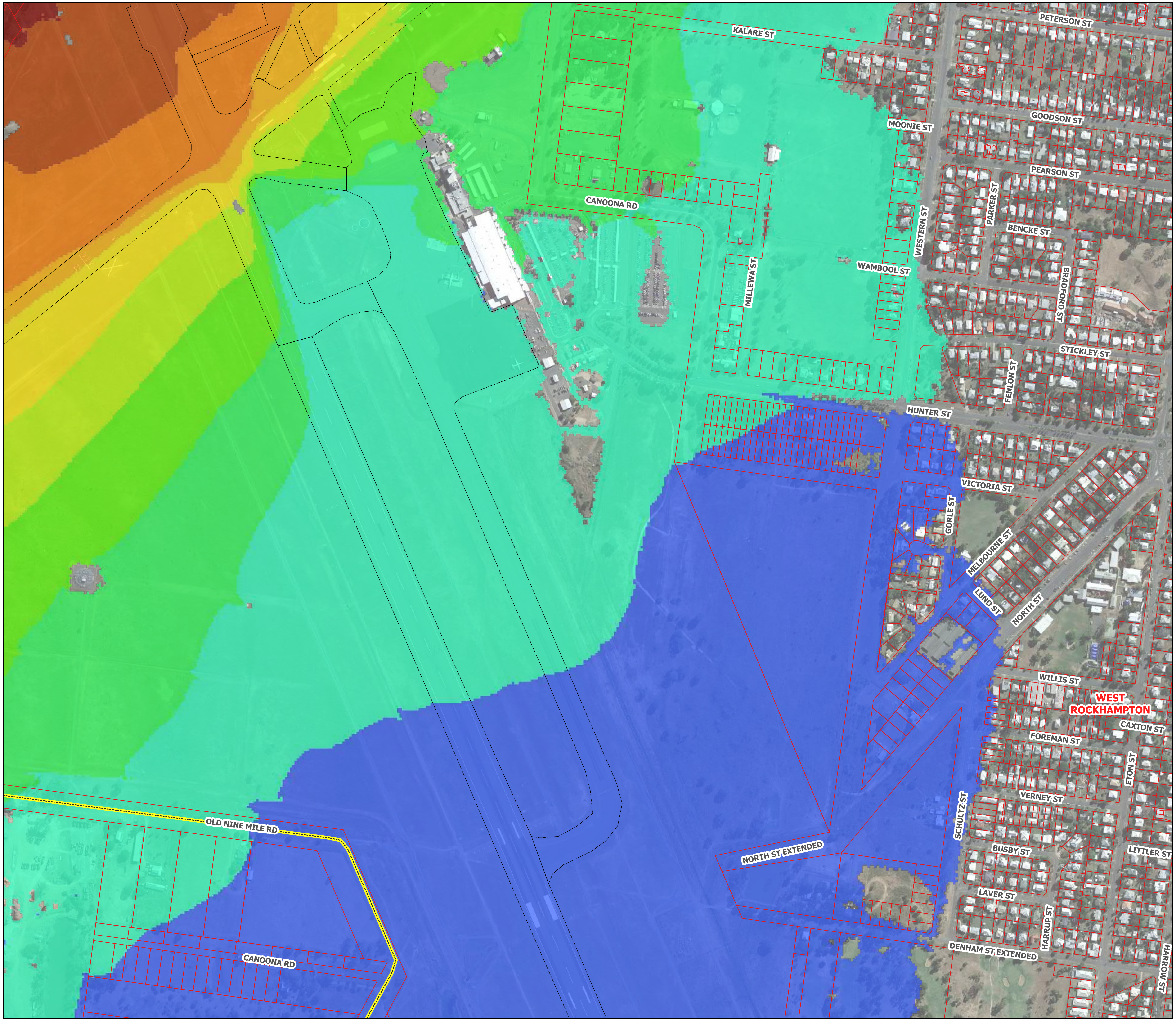

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Peak flood heights and Extents
Event - 2% AEP Flood Event

Scenario - Baseline

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Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent

Peak Flood Height (mAHD)

- < 8.60
- 8.61 - 8.75
- 8.76 - 8.90
- 8.91 - 9.05
- 9.06 - 9.20
- 9.21 - 9.35
- 9.36 - 9.50
- 9.51 - 9.65
- 9.66 - 9.80
- 9.81 - 9.95
- 9.96 - 10.10
- 10.11 - 10.25
- 10.26 - 10.40
- 10.41 - 10.55
- 10.56 - 10.70
- > 10.71

Data Sources:
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CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 2

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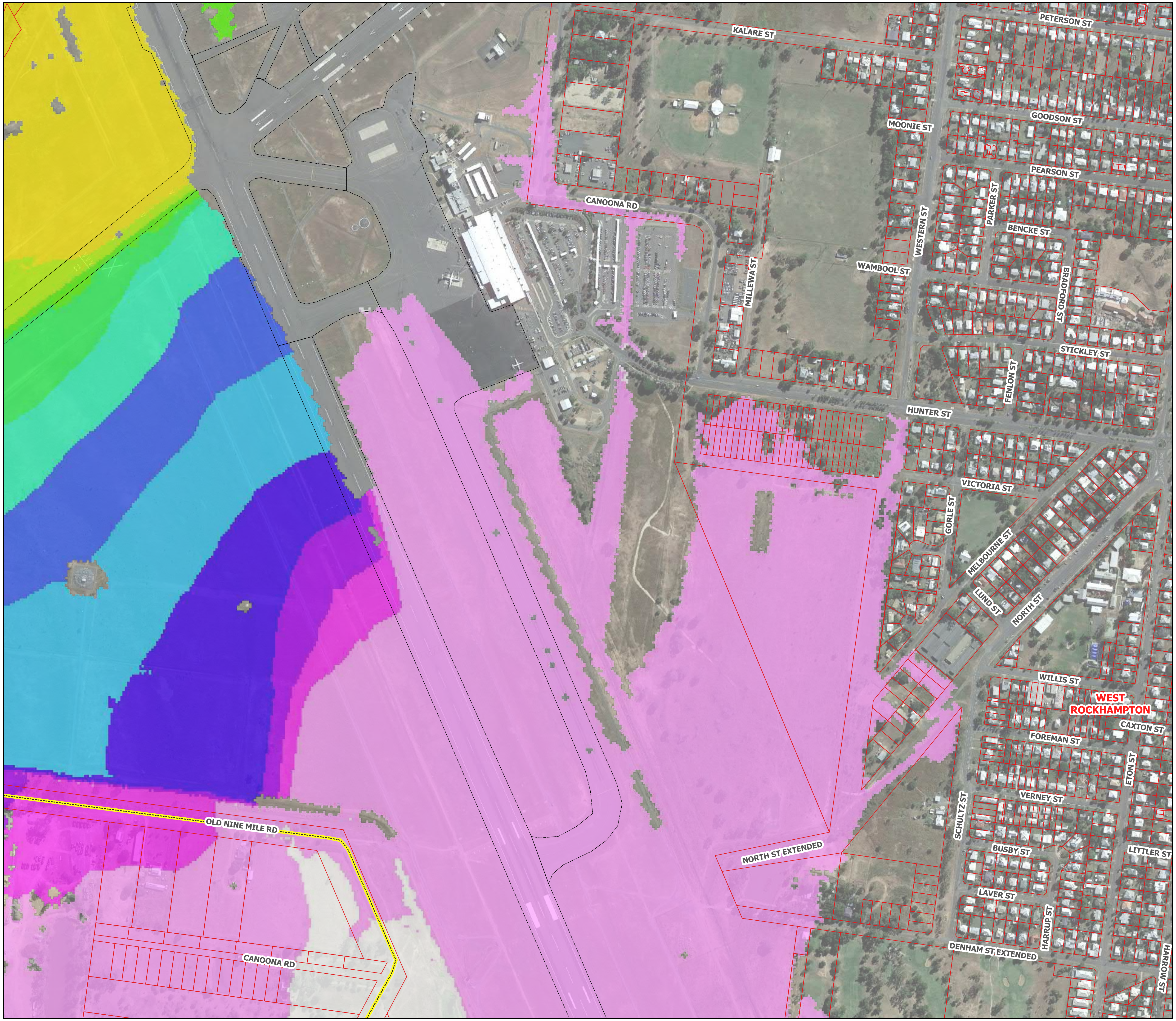

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Peak flood heights and Extents
Event - 5% AEP Flood Event

Scenario - Baseline

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LEGEND

- Airport
- Cadastre
- Model Extent

Peak Flood Height (mAHD)

- < 8.60
- 8.61 - 8.75
- 8.76 - 8.90
- 8.91 - 9.05
- 9.06 - 9.20
- 9.21 - 9.35
- 9.36 - 9.50
- 9.51 - 9.65
- 9.66 - 9.80
- 9.81 - 9.95
- 9.96 - 10.10
- 10.11 - 10.25
- 10.26 - 10.40
- 10.41 - 10.55
- 10.56 - 10.70
- > 10.71

Data Sources:
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PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 3

A3 size

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ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Flood Height
Event - 1% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

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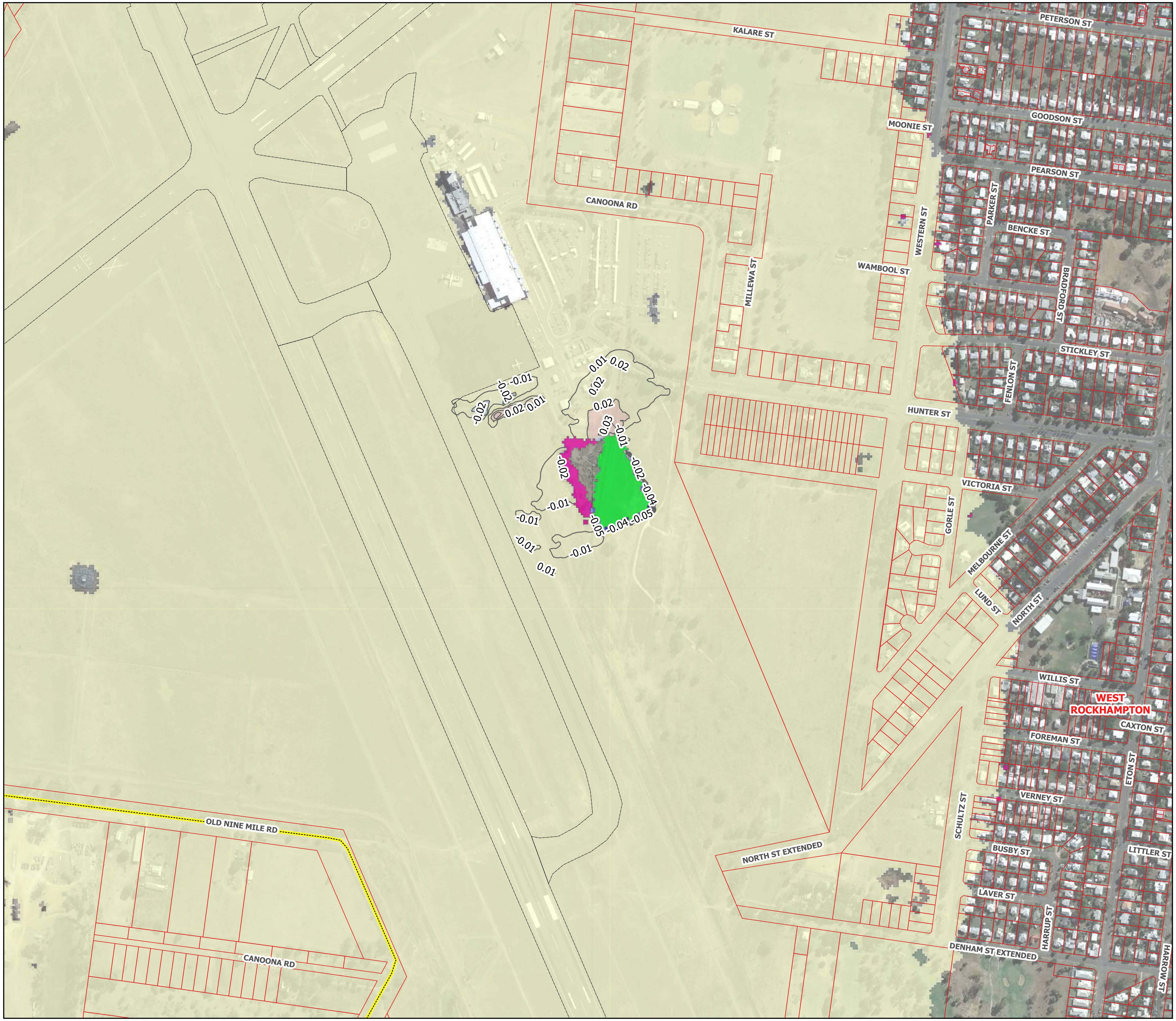

LEGEND

- Contours (0.01m)
- Airport
- Cadastre
- Model Extent

Difference in Height

- < -0.300m
- -0.300m to -0.225m
- -0.225m to -0.150m
- -0.150m to -0.075m
- -0.075m to -0.020m
- -0.020m to 0.020m
- 0.020m to 0.075m
- 0.075m to 0.150m
- 0.150m to 0.225m
- 0.225m to 0.300m
- > 0.300m
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

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DATUM GDA 1994, PROJECTION MGA ZONE 56

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LAST MODIFIED	04-12-2020
VERSION	01

Map 4

A3 size

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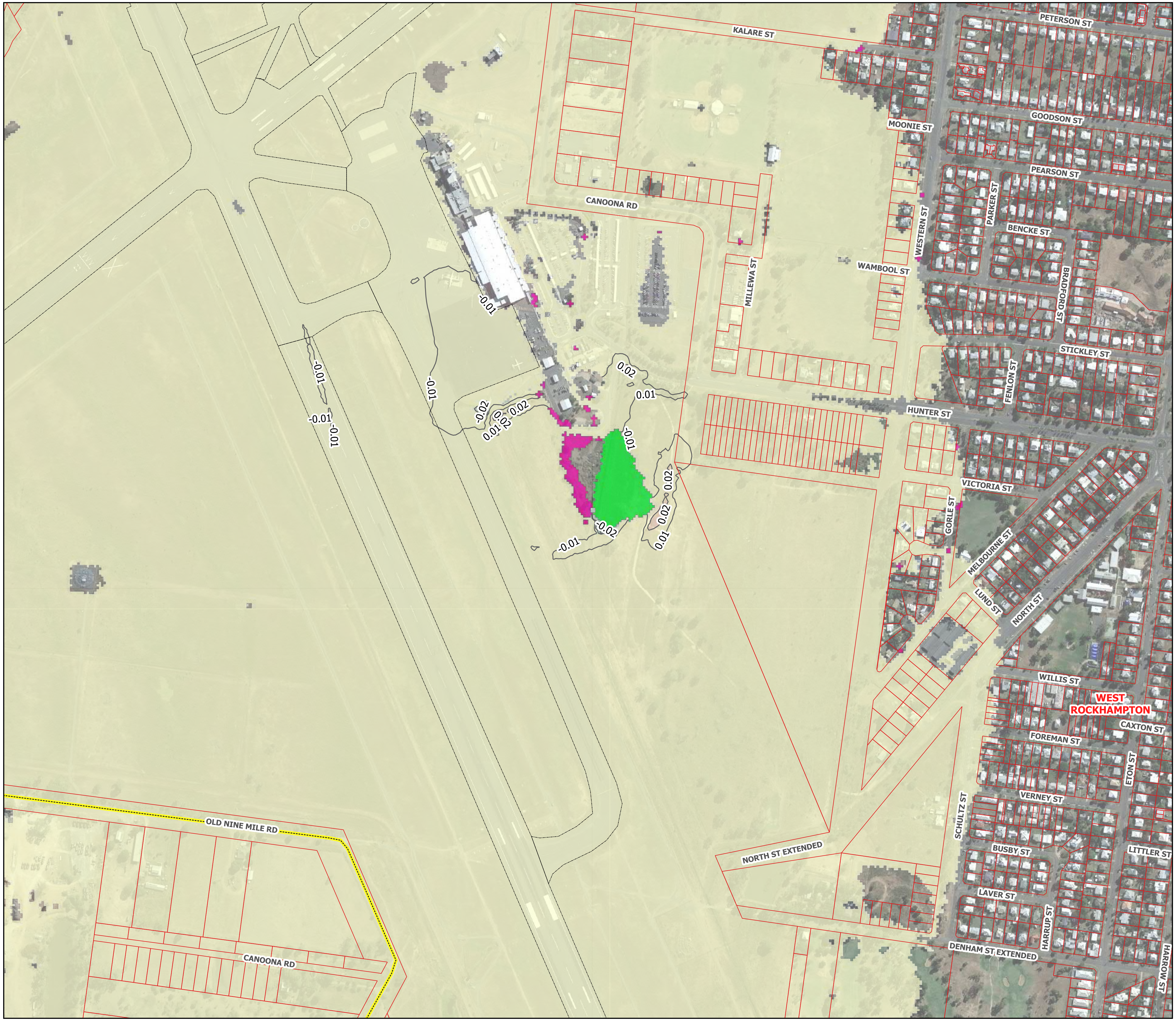

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Flood Height
Event - 2% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

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LEGEND

- Contours (0.01m)
- Airport
- Cadastre
- Model Extent

Difference in Height

- < -0.300m
- -0.300m to -0.225m
- -0.225m to -0.150m
- -0.150m to -0.075m
- -0.075m to -0.020m
- -0.020m to 0.020m
- 0.020m to 0.075m
- 0.075m to 0.150m
- 0.150m to 0.225m
- 0.225m to 0.300m
- > 0.300m
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

1:6000

(when printed at A3)

N

PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 5

A3 size

File Path P:\606x\60643962\900_CAD_GIS\920_GIS\QGIS

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Flood Height
Event - 5% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Contours (0.01m)
- Airport
- Cadastre
- Model Extent

Difference in Height

- < -0.300m
- -0.300m to -0.225m
- -0.225m to -0.150m
- -0.150m to -0.075m
- -0.075m to -0.020m
- -0.020m to 0.020m
- 0.020m to 0.075m
- 0.075m to 0.150m
- 0.150m to 0.225m
- 0.225m to 0.300m
- > 0.300m
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

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(when printed at A3)

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PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map
6

File Path P:\606x\60643962\900 CAD GIS\920 GIS\QGIS

A3 size

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Velocity
Event - 1% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent

Difference in Velocity

- <= -0.5
- -0.5 - -0.4
- -0.4 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:

DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

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N

PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 7

A3 size

File Path P:\606x\60643962\900 CAD GIS\920 GIS\QGIS

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Velocity
Event - 2% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent

Difference in Velocity

- <= -0.5
- -0.5 - -0.4
- -0.4 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:

DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

1:6000

(when printed at A3)

N

PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 8

A3 size

File Path P:\606x\60643962\900_CAD_GIS\920_GIS\QGIS

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Velocity
Event - 5% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent

Difference in Velocity

- <= -0.5
- -0.5 - -0.4
- -0.4 - -0.3
- -0.3 - -0.2
- -0.2 - -0.1
- -0.1 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- > 0.5
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

1:6000

(when printed at A3)

N

PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 9

A3 size

File Path P:\606x\60643962\900 CAD GIS\920 GIS\QGIS

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Duration of Inundation
Event - 1% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent

Change in TOS

- >12hrs less
- 6 - 12hrs less
- Negligible Change
- 6 - 12hrs more
- >12hrs more

Data Sources:

DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

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PROJECT ID	60643962
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VERSION	01

Map 10

A3 size

File Path P:\606x\60643962\900_CAD_GIS\920_GIS\QGIS

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File Path P:\606x\60643962\900 CAD GIS\920 GIS\QGIS

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Duration of Inundation
Event - 2% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent

Change in TOS

- >12hrs less
- 6 - 12hrs less
- Negligible Change
- 6 - 12hrs more
- >12hrs more

Data Sources:

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Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

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(when printed at A3)

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PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 11

A3 size

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Duration of Inundation
Event - 5% AEP Flood Event

Scenario - Design Case (AAH02) minus Baseline

AECOM
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Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent

Change in TOS

- >12hrs less
- 6 - 12hrs less
- Negligible Change
- 6 - 12hrs more
- >12hrs more

Data Sources:
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0 0.1 0.2 KM

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N

PROJECT ID	60643962
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LAST MODIFIED	04-12-2020
VERSION	01

Map 12

A3 size

File Path P:\606x\60643962\900 CAD GIS\920 GIS\QGIS

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Peak Flood Hazard
Event - 1% AEP Flood Event

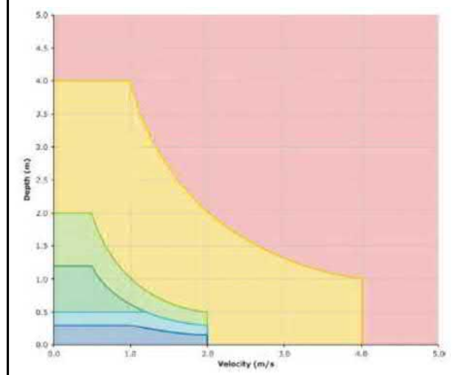
Scenario - Baseline

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent



Hazard Class	Description
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.
H5	Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
H4	Unsafe for all people and all vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H2	Unsafe for small vehicles.
H1	Relatively benign flow conditions. No vulnerability constraints.

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

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(when printed at A3)

N

PROJECT ID	60643962
CREATED BY	HuffM
LAST MODIFIED	04-12-2020
VERSION	01

Map 13

A3 size

File Path P:\606x\60643962\900 CAD GIS\920 GIS\QGIS

ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Peak Flood Hazard
Event - 1% AEP Flood Event

Scenario - Design Case (AAH02)

AECOM
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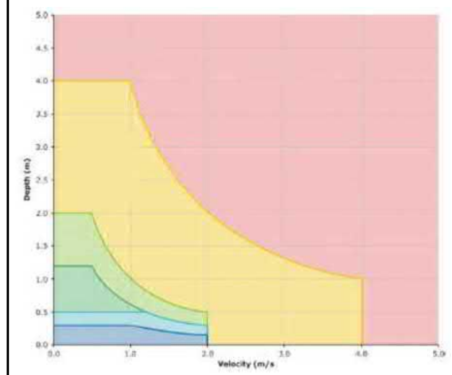
Rockhampton Regional Council

LEGEND

- Airport
- Cadastre
- Model Extent



Hazard Class		Description
	H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.
	H5	Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
	H4	Unsafe for all people and all vehicles.
	H3	Unsafe for all vehicles, children and the elderly.
	H2	Unsafe for small vehicles.
	H1	Relatively benign flow conditions. No vulnerability constraints.

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

1:6000

(when printed at A3)

N

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Map
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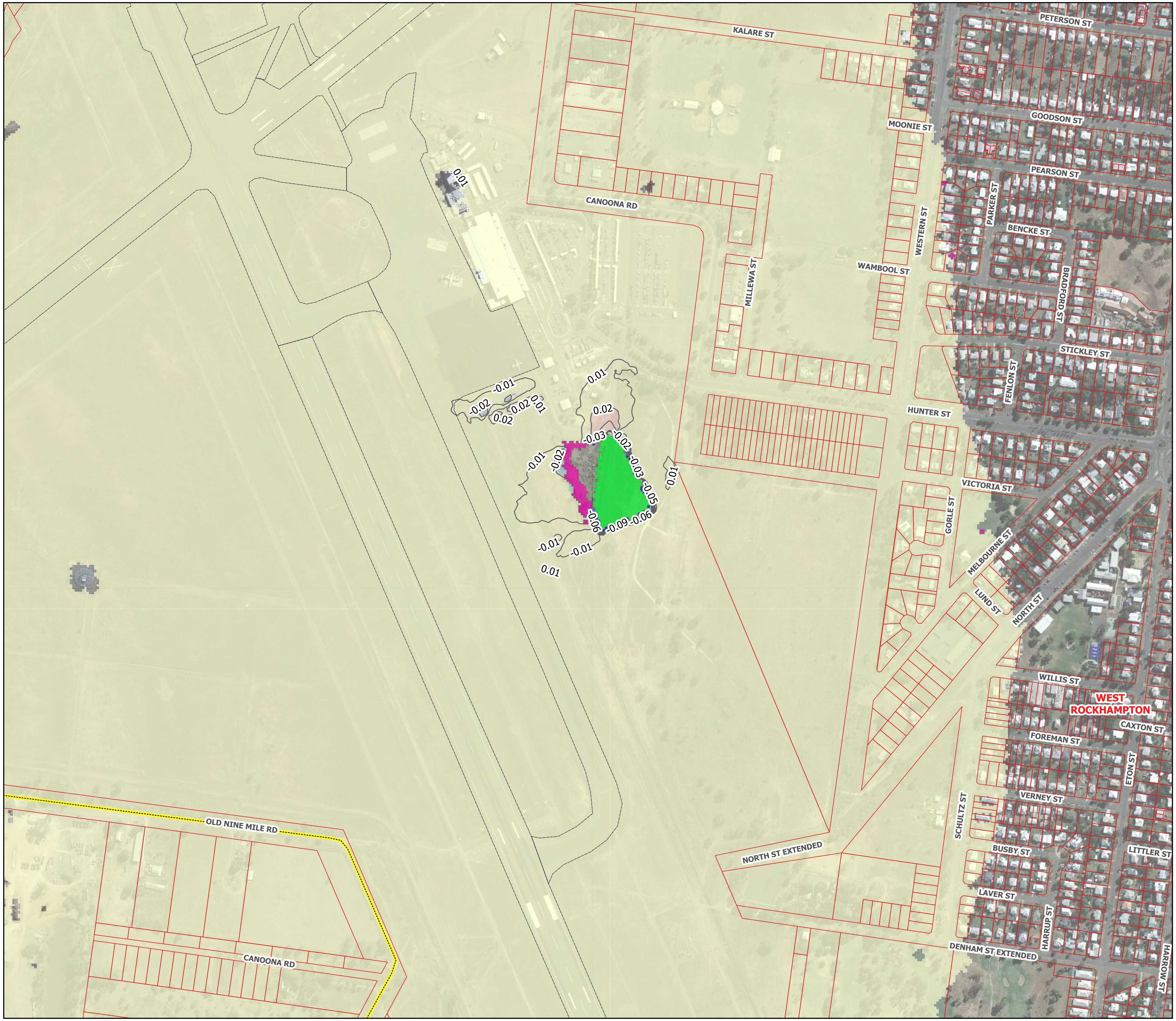
File Path P:\606x\60643962\900_CAD_GIS\920_GIS\QGIS

A3 size



ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Flood Height
Event - 1% AEP Flood Event

Scenario - Design Case [+15% Roughness] (AAHS1) minus Baseline [+15% Roughness] (E5S1)

AECOM
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Rockhampton Regional Council

LEGEND

- Contours (0.01m)
- Airport
- Cadastre
- Model Extent

Difference in Height

- < -0.300m
- -0.300m to -0.225m
- -0.225m to -0.150m
- -0.150m to -0.075m
- -0.075m to -0.020m
- -0.020m to 0.020m
- 0.020m to 0.075m
- 0.075m to 0.150m
- 0.150m to 0.225m
- 0.225m to 0.300m
- > 0.300m
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

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1:6000

(when printed at A3)

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PROJECT ID	60643962
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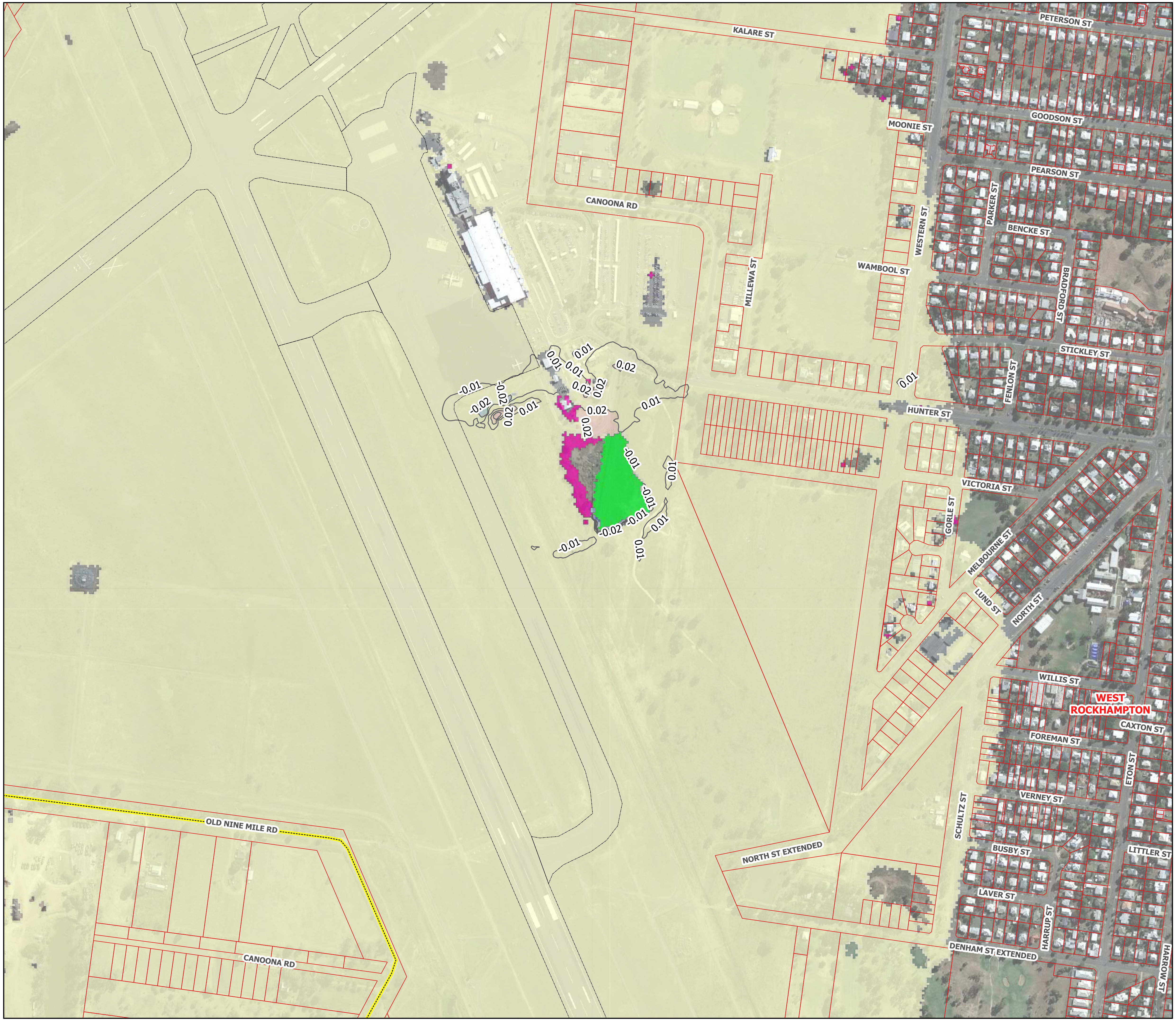
LAST MODIFIED	04-12-2020
VERSION	01

Map 15

A3 size

File Path P:\606x\60643962\900 CAD GIS\920 GIS\QGIS



ALLIANCE AIRPORT HANGAR

Flooding Mechanism - Fitzroy River
Map type - Difference in Peak Flood Height
Event - 1% AEP Flood Event

Scenario - Design Case [-15% Roughness] (AAHS2) minus Baseline [-15% Roughness] (E5S2)

AECOM
www.aecom.com

Rockhampton Regional Council

LEGEND

- Contours (0.01m)
- Airport
- Cadastre
- Model Extent

Difference in Height

- < -0.300m
- -0.300m to -0.225m
- -0.225m to -0.150m
- -0.150m to -0.075m
- -0.075m to -0.020m
- -0.020m to 0.020m
- 0.020m to 0.075m
- 0.075m to 0.150m
- 0.150m to 0.225m
- 0.225m to 0.300m
- > 0.300m
- Was Wet Now Dry
- Was Dry Now Wet

Data Sources:
DCDB (c) 2020 QLD Government
Imagery (c) 2020 Google

0 0.1 0.2 KM

DATUM GDA 1994, PROJECTION MGA ZONE 56

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PROJECT ID	60643962
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VERSION	01

Map 16

A3 size

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ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

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

Development Permit No.: D/142-2020

Dated: 28 May 2021

Alliance Airlines Pty Ltd

Alliance Maintenance Hangar Rockhampton Airport

Stormwater Management Strategy

November 2020

Table of contents

Appendices

1. Introduction

1.1 Project Background

GHD have been engaged by Alliance Airlines Pty Ltd to develop a Stormwater Management Strategy (SMS) for proposed expansion works at the Rockhampton Airport, Queensland. The proposed expansion consists of an extensive new external aircraft apron hardstand, an aircraft hanger, a new external at-grade car park and two separate landside and airside stormwater drainage channel diversions. The extent of proposed works is shown in Figure 1 below.

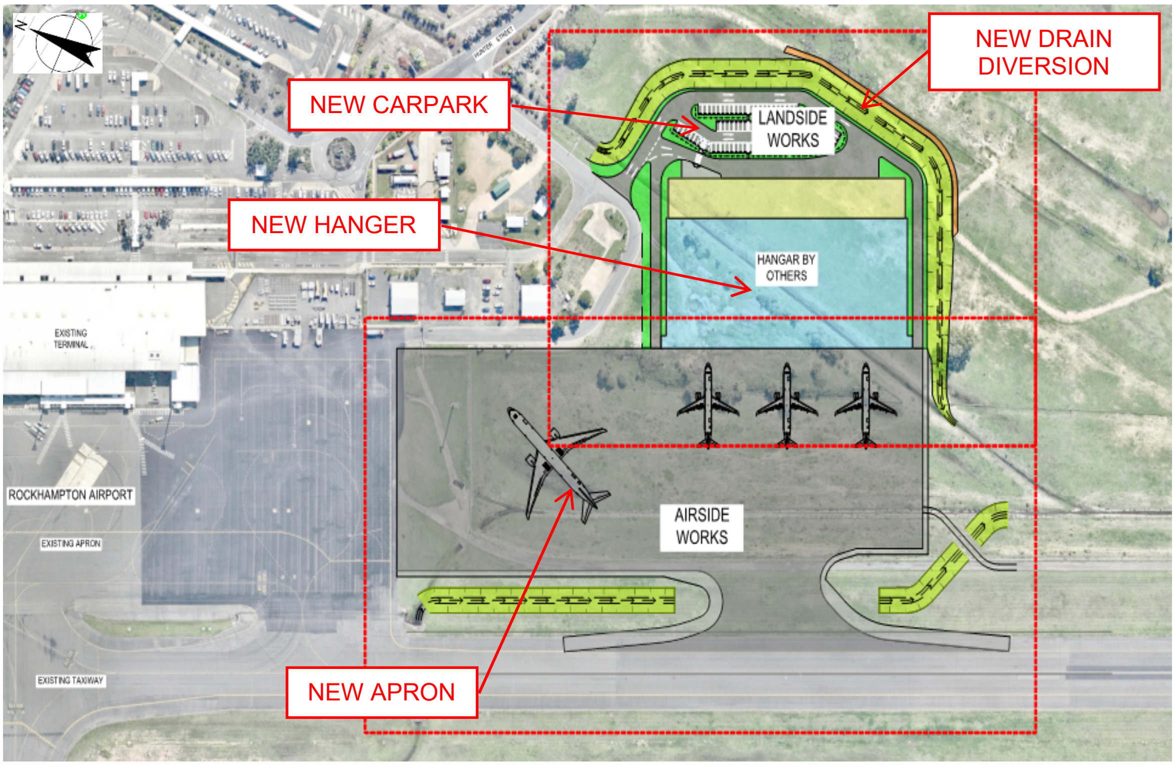


Figure 1 Extent of Proposed Works

1.2 Report scope and objectives

The purpose of this report is to describe the stormwater drainage strategy that will be designed as part of the proposed Airport expansion.

This report scope includes detail related to:

- Existing site conditions and existing stormwater drainage paths
- Proposed expansion and associated catchments
- Determination of discharge point(s)
- Stormwater quantity management
- Stormwater quality management

1.3 Guidelines Reference

The stormwater strategy for this project has been undertaken with consideration of the following codes and guidelines:

- Rockhampton Regional Council Planning Scheme

- Capricorn Municipal Development Guidelines (CMDG) – Stormwater Drainage Design (D5)
- Queensland Urban Drainage Manual (QUDM) (2017)

1.4 Report Limitations

1.4.1 General Report Limitations

This report: has been prepared by GHD for Alliance Airlines Pty Ltd and may only be used and relied on by Alliance Airlines Pty Ltd for the purpose agreed between GHD and the Alliance Airlines Pty Ltd.

GHD otherwise disclaims responsibility to any person other than Alliance Airlines Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described below. GHD disclaims liability arising from any of the assumptions being incorrect.

1.4.2 Project Specific Limitations and Assumptions

1. This report is not intended as a comprehensive Stormwater Management Plan for the proposed works. This report presents a concept level stormwater strategy that will be developed as part of the detailed design phase of this Airport Expansion project. This proposed stormwater strategy is qualitative only, and based on general best practice guidelines. No hydrological modelling, MUSIC modelling, water quality calculations or flood studies have been undertaken as part of this high level stormwater strategy. No greater catchment analysis or study of upstream backwater effects has been undertaken.
2. Based on previous discussions between the Alliance Airlines and Council, it is understood that Council will accept the increase in stormwater flows resulting from the proposed development, owing partly to the shorter time of concentration associated with the proposed works catchment to the downstream point of discharge. Consequently, no consideration of wetlands treatment, detention, retention or other management of these increased flows have been undertaken as part of the proposed stormwater strategy.
3. GHD has referenced the Bureau of Meteorology (BOM) Design Rainfall Data System to obtain rainfall Intensity Frequency Duration (IFD) data for various storm events at the proposed works location. The BOM no longer provides IFD data for a 2-year Average Recurrence Interval (ARI) (or 39% Annual Exceedance Probability (AEP)) storm event. Therefore, IFD data for the 50% AEP storm event will be used in lieu.

2. Existing Conditions

2.1 Site Conditions

The Rockhampton Airport site is located at the western end of Hunter Street in the Central Queensland town of Rockhampton. The proposed expansion and works area will occur at the southern end of the Rockhampton Airport terminal facility, both airside and landside.

The existing site in this vicinity of the airport is generally vacant with multiple open channel stormwater drainage outlets that convey the upstream airfield runoff towards a wetland system located south of main runway.

Figure 2 below shows the aerial image of the existing site where the proposed works are located.

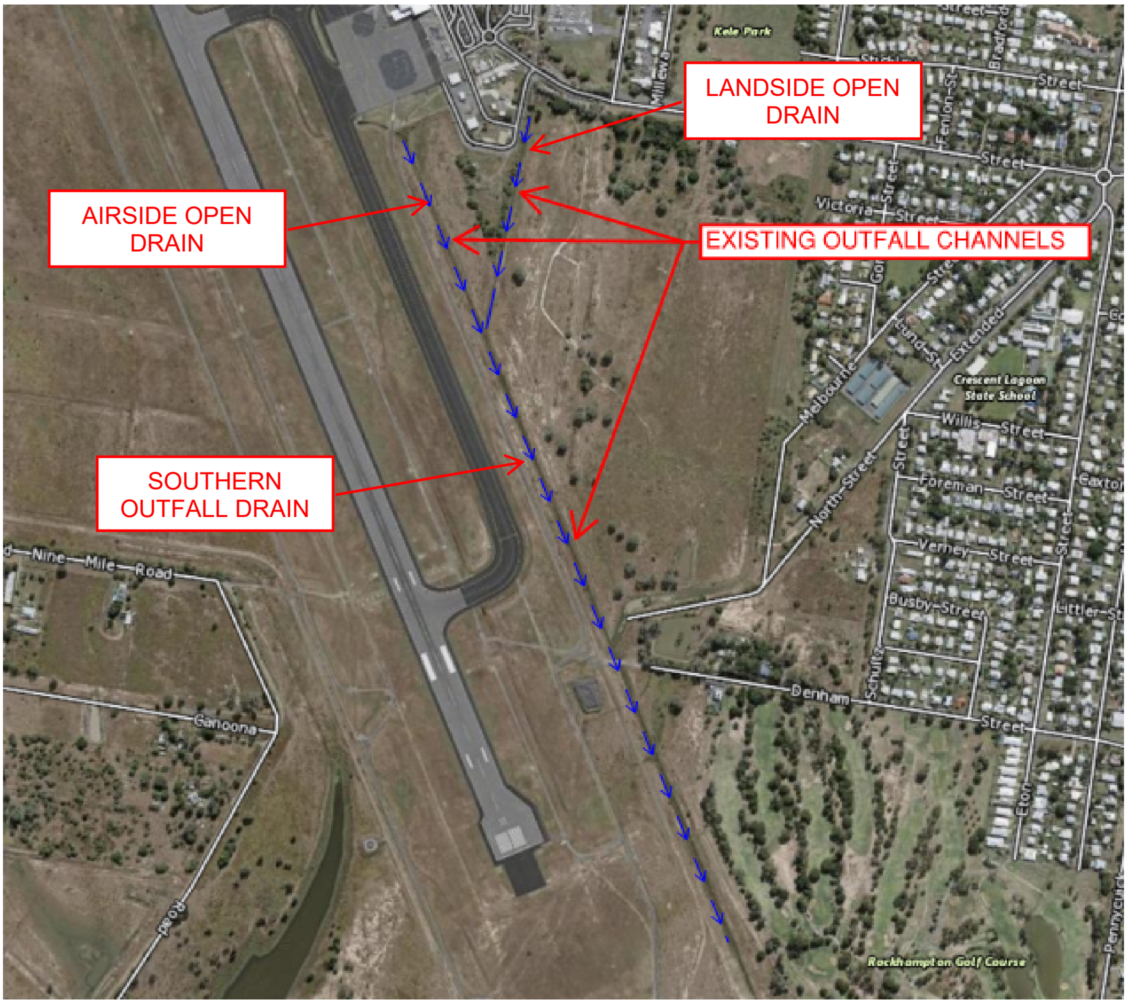


Figure 2 Existing Site Conditions and Outfall Drains

The site where the expansion works are proposed is generally flat with a slight fall towards the existing landside and airside open channel drains respectively, which combine and discharge to the south via a southern outfall drain. The existing drainage outlet channel that continues to the south has a variable invert grade with a fall of approximately 1:1000.

2.2 Legal Point of Discharge

The proposed point of discharge for both the landside and airside works is to the southern outfall drain as shown in Figure 2 above.

2.3 Existing Catchments

The true extent of existing upstream catchment to the airside and landside outfall channels is unknown, but appears to include a significant portion of the airfield, the existing terminal building and the existing landside car parks. An educated estimate of the upstream catchment has been undertaken by reviewing aerial imagery and the open drainage system and is shown indicatively in Figure 3 and Table 1 below. The estimated catchment area has been taken upstream of the point where the two existing open channels meet (shown as a red dot in Figure 3)

Figure 3 Indicative Contributing Upstream Catchment

Table 1 Existing Upstream Catchment Area

Contributing Existing Catchment	Total Area (approximate)	Approximate Impervious %	Approximate Impervious Area
Airside (including terminal building) and **Landside** (including public car parks)	Between 700,000 & 1,000,000 m^2	Between 25% and 40%	175,000 to 400,000 m^2
Total (Assumed)	**850,000 m^2**	**30%**	**255,000 m^2**

Table D05.04.1 of the CMDG D5 Stormwater Drainage Design manual stipulates the minor storm event design criteria for an industrial area shall be the 2 year ARI. While the airport would be considered a commercial site in nature, the proposed expansion is materially industrial in nature and has therefore been classified as “industrial” for the purposes of this stormwater strategy. Therefore, the existing upstream catchment flows have been calculated based on a storm event commensurate of a 2 year ARI storm event (refer 1.4.2 of this report).

The estimated existing flows that are conveyed to the respective outfall channels is summarised in Table 2 below.

Table 2 Existing Upstream Catchment Flows for 50% AEP Storm Event

Contributing Existing Catchment	Upstream Catchment Area (approximate)	Proposed Development Catchment Area*	Intensity (mm/hr)	Flow (m3/s)
Landside (including public car parks) *Contributing to Landside Open Drain*	403,000 m^2	27,000 m^2	66	4.79
Airside (including terminal building) *Contributing to Airside Open Drain*	367,000 m^2	53,000 m^2	72	5.21
SubTotal	**770,000 m^2**	**80,000 m^2**		
Total (Contributing to Southern Outfall Drain)	**850,000 m^2**			**9.58**

**Refer also* Table 4 *for further breakdown*

Detailed catchment and flow calculations are provided in Appendix A

2.4 Existing Drainage Channel Capacity

The following table summarises the existing capacity of the each of the three drains labelled in Figure 2. Capacities are provided for actual drain channel profile and also for the surrounding adjacent flow path profile in columns 2 and 3 respectively.

Table 3 Existing Upstream Catchment Area

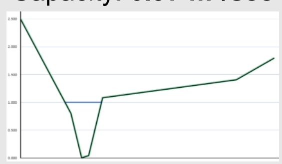
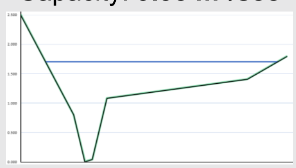
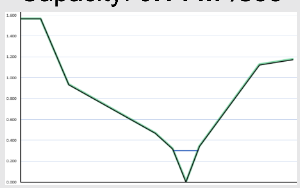
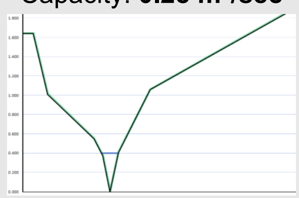
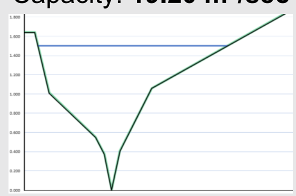
Open Channel Description	Drain Capacity (Flows Contained in Channel Only)	Drain Capacity (Including adjacent overland flood route)	Contributing Flow (50% AEP storm event)
Landside Open Drain Approx. Longitudinal Grade = 0.05%	Flow Depth: 0.8 m Capacity: **0.97 m^3/sec** 	Flow Depth: 1.7 m Capacity: **9.35 m^3/sec** 	**4.79 m^3/sec**
Airside Open Drain Approx. Longitudinal Grade = 0.10%	Flow Depth: 0.3 m Capacity: **0.14 m^3/sec** 	Flow Depth: 1.1 m Capacity: **7.90 m^3/sec** 	**5.21 m^3/sec**
Southern Outfall Drain Approx. Longitudinal Grade = 0.10%	Flow Depth: 0.4 m Capacity: **0.28 m^3/sec** 	Flow Depth: 1.5 m Capacity: **19.20 m^3/sec** 	**9.58 m^3/sec**

Table 3 reveals the three existing channels that will be impacted by the proposed works (refer Figure 2) do not currently have capacity to contain a 50% AEP (1.44 ARI equivalent) storm event flow given the assumed upstream catchments presented in Table 2.

However, each of the three open channels are surrounded by vacant landscape that currently falls towards the drains to create a widened overland flow path as illustrated in column 3 of Table 3. These widened overland flow paths appear to have capacity to contain the assumed existing 50% AEP flows.

Detailed channel capacity calculations are provided in Appendix A.

2.5 Flood Impact

In 2014 AECOM undertook flood modelling for the Fitzroy River catchment for Rockhampton Regional Council for the areas in and around the Rockhampton region. According to the flood inundation mapping prepared as part of that study, the Rockhampton Airport, and importantly, the site nominated for the proposed expansion works, are situated within a predicted flood inundation zone for the 1% Annual Exceedance Probability (AEP) storm event. An extract from AECOM's 2014 TUFLOW flood model 1% AEP Peak Flood Depths mapping is provided in Figure 4, with an indication of the proposed site works location and the relative flood depth range legend.

The proposed hanger annex building finished floor levels (FFL) of RL 10.10 m AHD have been provided to GHD. We understand these FFLs to both habitable spaces and dangerous goods storage have considered this flood impact.

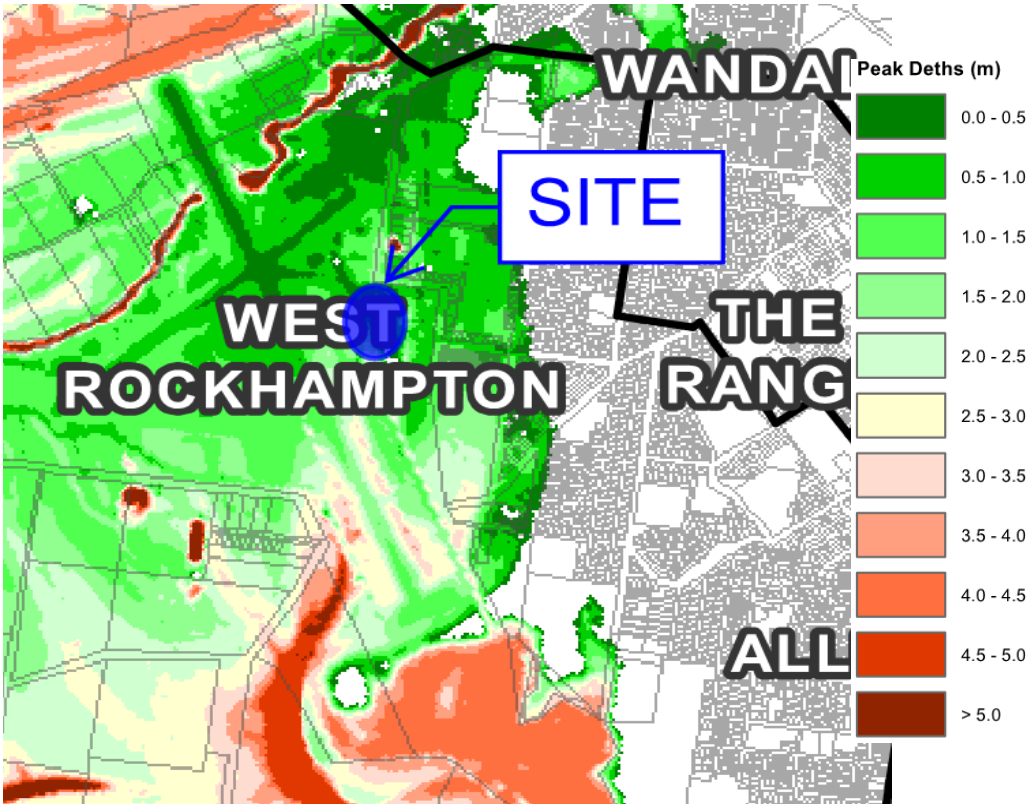


Figure 4 2014 Indicative Peak Flood Depths (1% AEP)

Source: Rockhampton Regional Council 2014 Fitzroy River Flood Modelling (by AECOM)

Figure 5 shows an extract from the Rockhampton Regional Council Planning Scheme aerial flood imagery taken in early 2011 following a major flood event throughout Rockhampton. This image confirms the modelling outputs undertaken as part of historic flood studies for the region and demonstrates the inundation that may be experienced at the proposed expansion site in a major storm and flood event if no further flood mitigation works are undertaken by the airport.

Figure 5 2011 Aerial Image of Flooding Extent - Rockhampton Airport

Source: Rockhampton Regional Council Planning Scheme

In the current situation, it is likely the proposed expansion site will be inundated during a major storm event. GHD have also been made aware that a separate study is being considered to mitigate broader flood impacts at the Rockhampton Airport site to prevent future flooding.

Therefore, no further analysis for the major storm event (> 50% AEP) has been undertaken as part of this high-level stormwater strategy for the proposed expansion works.

3. Proposed Development

3.1 Stormwater Management Strategy

3.1.1 Landside Drainage Strategy

The proposed hanger, building and carpark drainage will be conveyed via a new pit and pipe network to a diverted landside open drain, before transferring flows to the existing southern outfall drain. The existing landside open drain will be diverted around the eastern side of the new 80 space external car park, extending an existing 240 m long segment of the drain to approximately 360 m in length.

The roof drainage will be collected in rainwater tanks (for greywater and irrigation reuse) and overflowed to a new pit and pipe network that will discharge at multiple points along the length of the diverted open drain. Runoff generated by the car park will also be collected in these new drainage systems via kerb inlet pits and conveyed to the diverted open channel.

3.1.2 Airside Drainage Strategy

The new external apron and taxiway connection pavement proposed as part of the airport expansion will be graded to fall away from the proposed hanger and towards the existing airside open drain. Reconstruction of the existing airside open drain will take place inclusive of new culverts beneath the proposed taxiway connection to the apron. Flows within this channel will be conveyed south to discharge to the southern outfall drain.

3.2 Hydraulic Analysis

Table D05.04.1 of the CMDG D5 Stormwater Drainage Design manual stipulates the minor storm event design criteria for an industrial area shall be the 2 year ARI. The proposed expansion is materially industrial in nature and has therefore been classified as “industrial” for the purposes of the stormwater design. Therefore, drainage infrastructure has been designed to convey a flows resulting from minor storm event commensurate of a 2 year ARI storm event (refer 1.4.2 of this report).

The proposed development consists of the following key impermeable surface areas:

Table 4 Proposed Expansion and Impervious Areas

Proposed Works	Approx. Catchment Area	Approximate Impervious %	Approximate Impervious Area
Landside Works			
Landside Open Drain (including access track)	5,450 m^2	8	460 m^2
Landside Carpark (80 parking bays)	8,700 m^2	70	6,000 m^2
New Hanger Building (including awning)	12,830 m^2	100	12,830 m^2
Subtotal	**27,000 m^2**	**70%**	**19,290 m^2**
Airside Works			
Airside Apron (including connection with Taxiway	53,000 m^2	75	41,170 m^2
Subtotal	**53,000 m^2**	**75**	**41,170 m^2**
Total	**80,000 m^2**	**75**	**60,480 m^2**

With reference to the existing upstream flows presented in Table 2, the post-developed resultant additional flows for the 50% AEP storm event are presented in Table 5 below for two scenarios as follows:

1. Development Area Only - Ignoring upstream catchment flows and times of concentration
2. Peak Flow Condition - Considering upstream catchment flows and times of concentration

Generally, peak flows from the contributing upstream catchments are expected to reach the southern outfall drain with a time of concentration much greater (ie. later) than the peak flow generated by the proposed airport expansion development area.

Table 5 Proposed Catchment Flows for 50% AEP Minor Storm Event

	Development Area Only (Not Reflective of Peak Flow)			Development Area & Upstream Catchments (Peak Flow Scenario)		
Proposed Works	**Pre-Developed Flow (m3/s)**	**Post-Developed Flow (m3/s)**	**Increased Flow (m3/s)**	**Pre-Developed Flow (m3/s)** (from Table 2)	**Post-Developed Flow (m3/s)**	**Increased Flow (m3/s)**
Landside Works	0.35	0.56	**0.21**	4.79	4.77	**-0.02**
Airside Works	0.69	1.13	**0.44**	5.21	5.37	**0.16**

Table 5 reveals that flows will increase for the new landside and airside catchments by approximately 0.21 m3/sec and 0.44 m3/sec respectively, as a result of the substantial additional impervious areas being developed.

However, when considering the upstream catchment flows and times of concentration, the increased flow at the projected peak time is comparably much less, and in fact, actually reduces for the landside catchment. This reduction in peak flow is a result of the longer length of diverted open channel and resultant increased time of concentration.

Detailed stormwater calculations are provided in Appendix A.

3.3 Landside Open Drain Diversion

The existing landside open drain has a cross-sectional capacity of approximately 0.97 m3/sec (refer Table 3). The proposed landside open drain diversion will be re-sized to take a peak post-developed flow of 4.77 m3/sec as presented in Table 5 above.

The proposed cross section and depth of the diverted channel is shown in Figure 6 below. An allowance for 300 mm freeboard has been provided which results in a capacity of approximately 5.0 m3/sec.

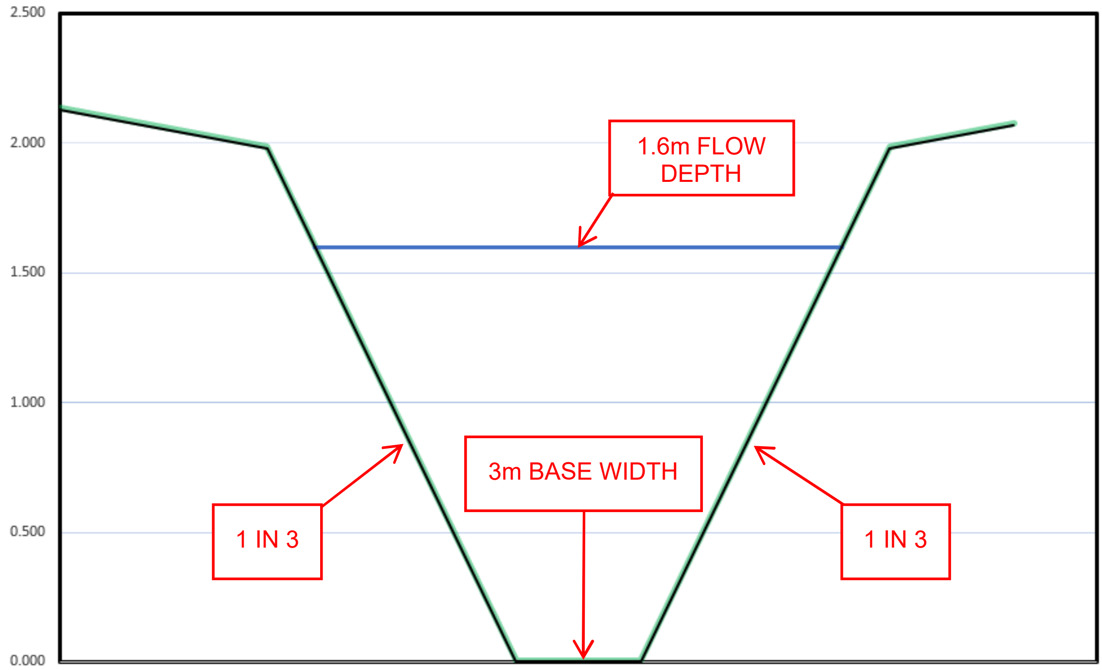


Figure 6 Landside Diversion Drain Profile

Channel sizing calculations are provided in Appendix A.

The exact sizing and length of all channel diversions and culverts will be undertaken as part of detailed design.

3.4 Airside Open Drain Diversion

The existing airside open drain does not currently have capacity to take the assumed 50% AEP upstream flow of approximately 5.21 m3/sec.

The proposed apron pavement footprint requires diversion of the existing airside open drain via culverts and a new open channel. The airside stormwater design will divert flows from existing pipe endwall outlets at the northern end of the new apron, via pipe culverts to a diverted open channel located between the apron and existing taxiway. The new pipe culverts beneath the apron pavement will be increased in size by one standard pipe size from the existing outlets to mitigate the risk of upstream backflow. The realigned channel will continue beneath the proposed apron entry pavement and will require box culverts to convey the flows. The proposed cross section and depth of the diverted channel is shown in Figure 7 below. An allowance for 300 mm freeboard has been provided which results in a capacity of approximately 5.5 m3/sec.

Preliminary calculations have been undertaken to determine approximate box culvert cell sizes and numbers. Approximately eight 600 mm (h) x 1200 mm (w) box culvert cells are required (in cross section) to convey a flow of 5.37 m3/sec beneath the proposed apron entry pavement.

Further downstream, another access track will cross over the proposed channel diversion, requiring culverts to convey flows beneath. Preliminary calculations estimate approximately five 900 mm (h) x 1200 mm (w) box culverts are required (in cross section) at this crossing.

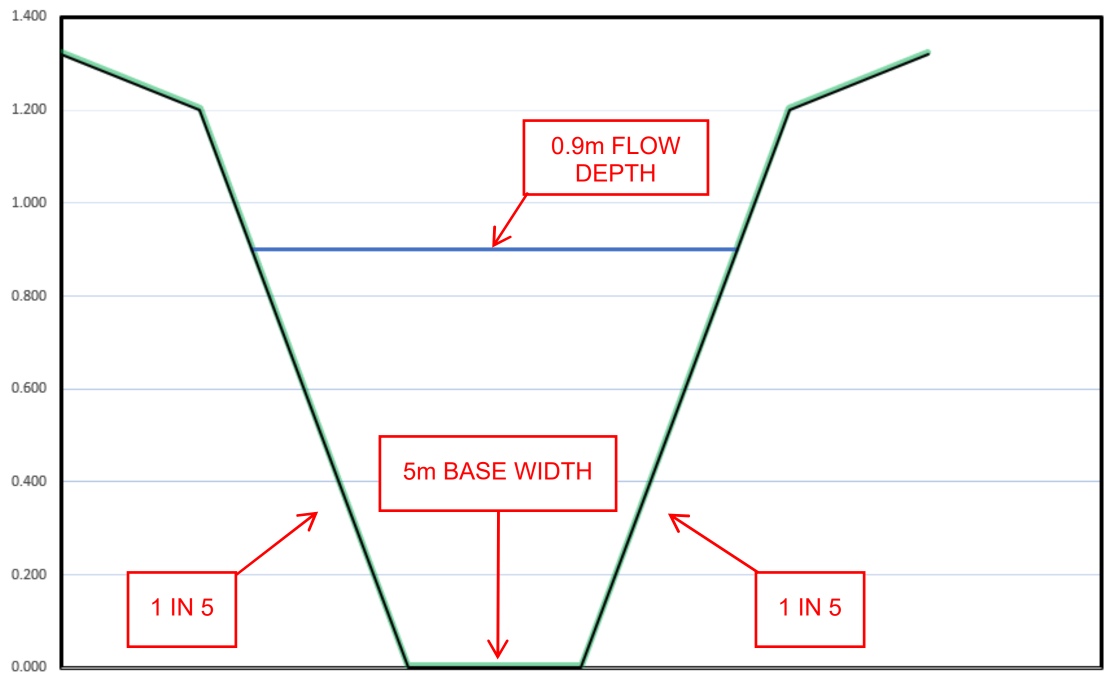


Figure 7 Airside Diversion Drain Profile

Channel and culvert sizing calculations are provided in Appendix A.

The exact sizing and length of all channel diversions and culverts will be undertaken as part of detailed design.

3.5 Stormwater Quality Management

Stormwater quality treatment will be provided in the form of best practice measures to reduce the impact of potential pollution to the downstream drainage network.

No consideration of wetlands treatment, detention, retention or other management of the minor increased flows have be undertaken as part of the proposed stormwater strategy due to the sites flooding characteristics and given future flood mitigation measures are currently being investigated and modelled by others to provide a holistic approach for the airport site.

To reduce the possibility of chemical and microbial contamination, all building downpipes will be equipped with rainwater first flush diverters (with trickle feed to landscaped areas) which then connect to rainwater re-use storage tanks prior to discharging to the proposed pit and pipe reticulation network. These diverters act as a first flush barrier to reduce contamination from reaching the downstream stormwater drainage system.

Runoff from the landside carpark area drains to landscaped swales before collection into the pit and pipes system.

The airside hangar pavement and airplane decanter zone runoff will be collected in grated trench systems and diverted to a proprietary inground stormwater treatment device located south of the decanter hardstand zone. The stormwater de-contamination treatment device will outlet to the downstream swale system and is subject to further detailed design.

Water quality from runoff from the Bay 7 and other apron hardstand areas that do not feed into this stormwater treatment device, will be managed by the natural linings of the airside open drains All diverted drainage channels will be natural earth lined and/or vegetated swales to provide pre-treatment of pollutants by way of slowing velocities for increased treatment efficiency and sediment infiltration over their extensive lengths.

Appendices

Appendix A – Stormwater Drainage Calculations

Project:	Alliance Maintenance Hanger - Rockhampton Airpo		Project No.	12536663
Designed:	S.Frewen-Lord	Checked:	J.Brown	Date: Nov-20

Location Details **(Input either Adress or Coordinates)**

Address:	Rockhampton Airport
City/Town:	Rockhampton
State:	Qld
Address Lat / Long:	.383076950000003,150.47213850960

Manual Coodinate Overide

Latitude	
Longitude	

Current Loaded IFD Data

Issued:	*17/11/2020*			
Requested coordinate:	*Latitude*	*-23.38308*	*Longitude*	*150.47214*
Nearest grid cell:	*Latitude*	*23.3875 (S)*	*Longitude*	*150.4625 (E)*

Site Parameters

	Minor	Major	Notes
Design Storm	**50%**	**1%**	*63%=1:1yr; 39%≈1:2yr; 18%≈1:5yr; 10%=1:10yr; 5%=1:20yr; 2%=1;50yr; 1%=1:100yr*
Fy Values	**0.85**	**1.20**	*Automatically Calculated based on Design Storm*

	C10	Cy Minor	Cy Major	Notes
Option A	0.71	**0.60**	**0.85**	Pre-developed
Option B	0.88	**0.748**	**1**	Post-Developed
Option C				
Option D				
Option E				

Default Values	
Roughness Coefficient (n)	0.035
Minimum TC	5

Notes:

Catchment Areas

Catchment	AREA (Ha)	C10 Value	Minor Storm (50% AEP)			Major Storm (1% AEP)		
			Fy	Cy	E.I.A (Ha)	Fy	Cy	E.I.A (Ha)
Total	96.700				57.885			81.272
US-LANDSIDE	40.300	0.71	0.9	0.6	24.321	1.2	0.9	34.336
US-AIRSIDE	37.700	0.71	0.9	0.6	22.752	1.2	0.9	32.120
EX-LANDSIDE	2.700	0.71	0.9	0.6	1.629	1.2	0.9	2.300
EX-AIRSIDE	5.300	0.71	0.9	0.6	3.199	1.2	0.9	4.516
DEV-LANDSIDE	2.700	0.88	0.9	0.7	2.020	1.2	1.0	2.700
DEV-AIRSIDE	5.300	0.88	0.9	0.7	3.964	1.2	1.0	5.300
CARPARK CATCHMENTS								
A								
B								
C	2.700							
D								

Tc Calculation Table

Design Point	Upstream TC		Overland Flowpath TC							Road/Channel Flow TC						Total TC (mins)
	Upstream Point	TC (min)	Method	Direct	Area (ha)	Length (m)	Grade (%)	Roughness Coefficient (n)	TC (min)	Method	Direct	Length (m)	Grade (%)	Velocity (m/s)	TC (min)	
EX1			Direct	15		~~100~~	~~2.00~~	~~0.035~~	15.0	Average Velocity		1500	~~2~~	2	12.5	27.5
EX2			Direct	15		~~50~~	~~1.00~~	~~0.035~~	15.0	Average Velocity		1000		2	8.3	23.3
EX3	EX1	27.5	~~Direct~~	~~15~~					~~15.0~~	Average Velocity		20		2	0.2	27.7
DEV1			Direct	15					15.0	Average Velocity		1610		2	13.4	28.4
DEV2			Direct	15					15.0	Average Velocity		1000		2	8.3	23.3
DEV3	DEV1	28.4	~~Direct~~	~~15~~					~~15.0~~	Average Velocity		20		2	0.2	28.6
EXLS			Friends			100	1.00	0.035	17.4	Average Velocity		320		2	2.7	20.0
DEVLS			Friends			80	1.00	0.015	6.9	Average Velocity		520		2	4.3	11.2
EXAS			Friends			100	1.00	0.035	17.4	Average Velocity		340		2	2.8	20.2
DEVAS			Friends			100	1.00	0.015	7.4	Average Velocity		340		2	2.8	10.3

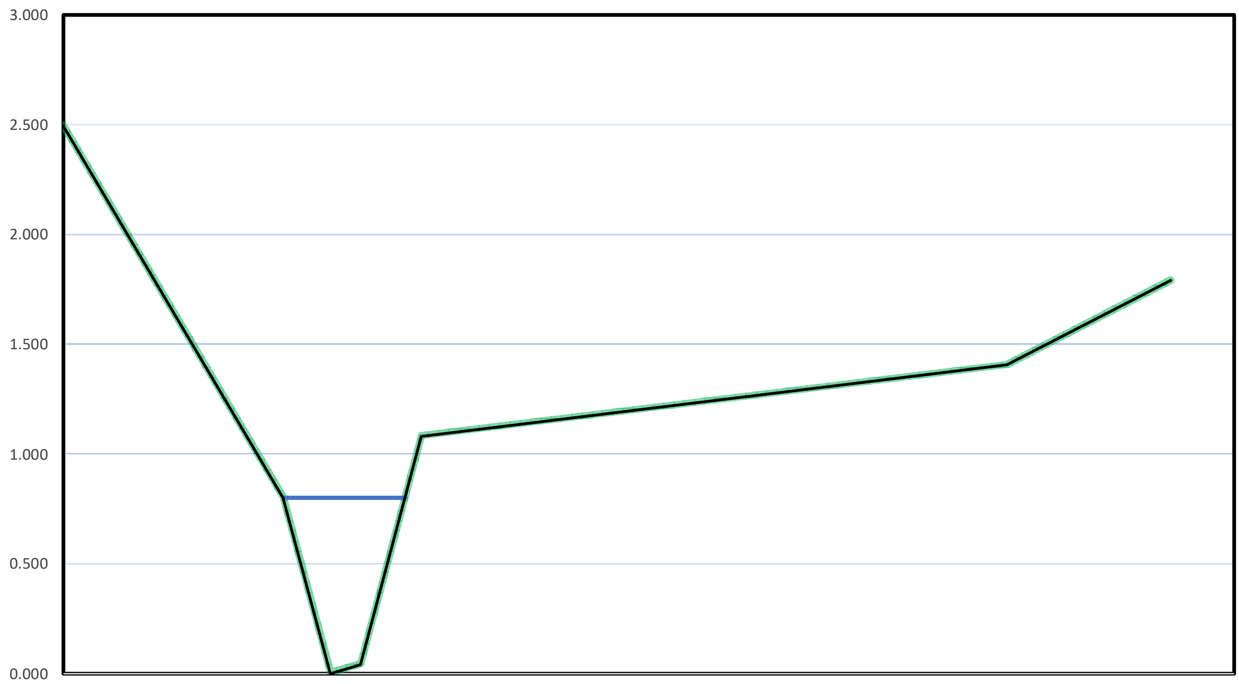
Storm Data Table

DESIGN POINT	Contributing Design Points & Catchments	Tc (mins)	Minor Storm (50% AEP) E.I.A (Ha)	Minor Storm (50% AEP) Depth (mm)	Minor Storm (50% AEP) Intensity (I) (mm/hr)	Minor Storm (50% AEP) **Flow (Q) (m^3/s)**	Major Storm (1% AEP) E.I.A (Ha)	Major Storm (1% AEP) Depth (mm)	Major Storm (1% AEP) Intensity (I) (mm/hr)	Major Storm (1% AEP) **Flow (Q) (m^3/s)**	NOTES
EX1	US-LANDSIDE EX-LANDSIDE	28	25.951	31	66	4.789	36.636	73	157	15.948	LANDSIDE OPEN DRAIN - EXISTING
EX2	US-AIRSIDE EX-AIRSIDE	24	25.951	29	72	5.214	36.636	68	170	17.335	AIRSIDE OPEN DRAIN - EXISTING
EX3	EX1 EX2	28	51.901	31	66	9.577	51.901	73	157	22.593	SOUTHERN OUTFALL OPEN DRAIN - EXISTING
DEV1	US-LANDSIDE DEV-LANDSIDE	29	26.341	31	65	4.765	37.036	74	154	15.810	LANDSIDE OPEN DRAIN - DEVELOPED
DEV2	US-AIRSIDE DEV-AIRSIDE	24	26.716	29	72	5.368	37.420	68	170	17.706	AIRSIDE OPEN DRAIN - DEVELOPED
DEV3	DEV1 DEV2	29	53.057	31	65	9.597	53.057	74	154	22.649	SOUTHERN OUTFALL OPEN DRAIN - DEVELOPED
EXLS	EX-LANDSIDE	21	1.629	27	78	0.351	2.300	64	182	1.166	
DEVLS	DEV-LANDSIDE	12	2.020	20	100	0.559	2.700	47	233	1.751	
EXAS	EX-AIRSIDE	21	3.199	27	78	0.689	4.516	64	182	2.289	
DEVAS	DEV-AIRSIDE	11	3.964	19	103	1.133	5.300	44	241	3.549	

Notes:	Project No: 12536663
OPEN DRAIN - EXISTING LANDSIDE	Project: Alliance Maintenance Hanger - Rockhampton Airport

Open Channel Flow - Manning's Equation
V = R2/3.S1/2/n   Q = A.V

$$n_{composite} = \left(\frac{\sum_{i=1}^{n} \left(P_i n_i^{1.5} \right)}{P_{total}} \right)^{\frac{2}{3}}$$



Capacity of Cross Section Q (m^3/s)	0.968
Average Velocity (m/s)	0.381
dg*Vave	0.305
Width of Flow (m)	5.203

Longitudinal Grade (%)	0.05	0.0005	*(Slope of Road (m/m))*
Depth of Flow (m)	0.800	2.492	*(Max allowable)*
Max Width of Flow (m)	47.3	47.3	*(Max allowable)*
Maximum velocity (m/s)	1		
Maximum velocity (m/s)	0.4		

☐ Duplicate this provile?

Width (m)	Height (m)	Xfall (%)	Name	Surface Type	Mannings n	Slope (m/m)	D_i (m)	W_i (m)	A_i (m^2)	P_i (m)	n_i ($P_i n_i^{1.5}$)
-	-	-	CL	-	-	0	0.000	0	0	0	0
9.4		-18	TOBL	Grass	0.035	-0.180	0.000	0.000	0.000	0.000	0.000
2		-40	IODL	Grass	0.035	-0.400	0.800	2.000	0.800	2.154	0.003
1.3		3	IODR	Grass	0.035	0.030	0.761	1.300	1.015	1.301	0.002
2.6		40	TODR	Grass	0.035	0.400	0.000	1.903	0.724	2.049	0.002
25		1.3	BOBR	Grass	0.035	0.013	0.000	0.000	0.000	0.000	0.000
7		5.5	TOBR	Grass	0.035	0.055	0.000	0.000	0.000	0.000	0.000

	W	A	P	$\sum n_i$
Totals :	5.203	2.539	5.504	0.007

Notes:

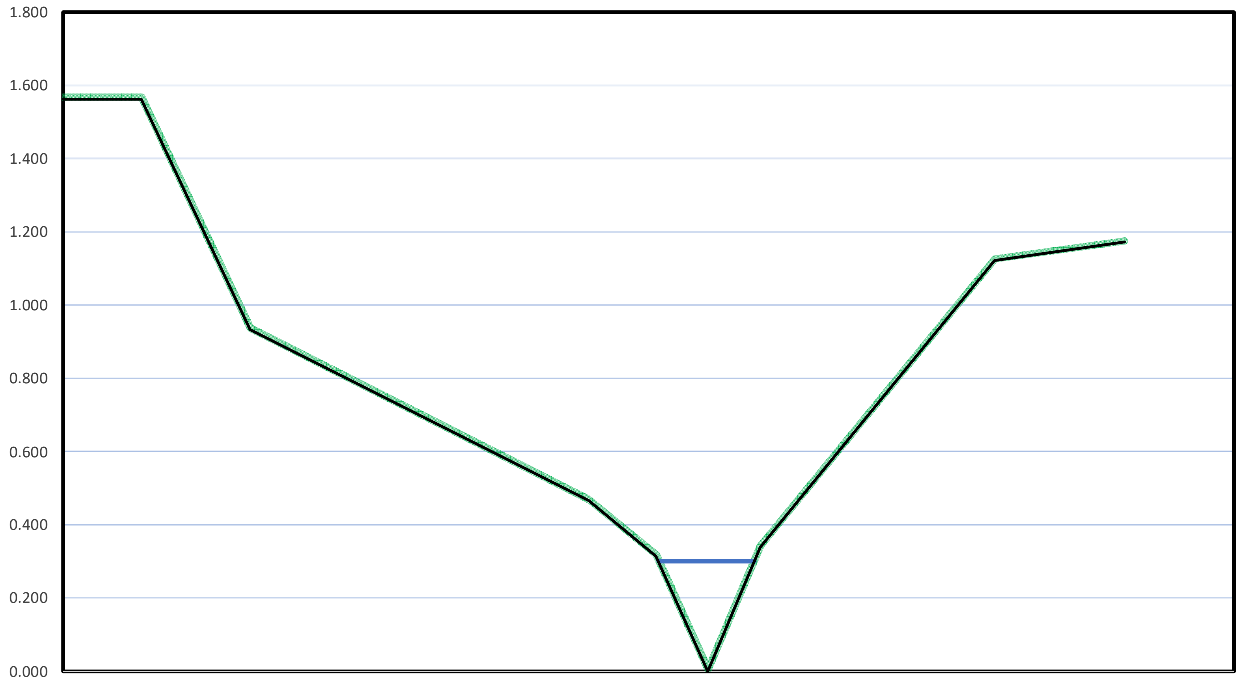
Composite n = ∑ni^2/3	0.035
Hydraulic Radius R (m)	0.461
Calculated V	0.381
Calculated Q	0.968

	Designed: S.Frewen-Lord	Date: 18/11/2020	Sheet: 1

Notes:	Project No: 12536663
OPEN DRAIN - EXISTING AIRSIDE	Project: Alliance Maintenance Hanger - Rockhampton Airport

Open Channel Flow - Manning's Equation
V = R2/3.S1/2/n   Q = A.V

$$n_{composite} = \left(\frac{\sum_{i=1}^{n} \left(P_i n_i^{1.5} \right)}{P_{total}} \right)^{\frac{2}{3}}$$



Capacity of Cross Section Q (m^3/s)	0.140
Average Velocity (m/s)	0.253
dg*Vave	0.076
Width of Flow (m)	3.686

Longitudinal Grade (%)	0.1	0.001	*(Slope of Road (m/m))*
Depth of Flow (m)	0.300	1.5628	*(Max allowable)*
Max Width of Flow (m)	40.8	40.8	*(Max allowable)*
Maximum velocity (m/s)	1		
Maximum velocity (m/s)	0.4	☐ Duplicate this provile?	

Width (m)	Height (m)	Xfall (%)	Name	Surface Type	Mannings n	Slope (m/m)	D_i (m)	W_i (m)	A_i (m^2)	P_i (m)	n_i ($P_i n_i^{1.5}$)
-	-	-	CL	-	-	0	0.000	0	0	0	0
3		0	TOBL	Grass	0.035	0.000	0.000	0.000	0.000	0.000	0.000
4.2		-15	BOBL	Grass	0.035	-0.150	0.000	0.000	0.000	0.000	0.000
13		-3.6	BRLL	Grass	0.035	-0.036	0.000	0.000	0.000	0.000	0.000
2.6		-5.8	TODR	Grass	0.035	-0.058	0.000	0.000	0.000	0.000	0.000
2		-15.7	IODL	Grass	0.035	-0.157	0.300	1.911	0.287	1.934	0.003
2		16.9	IODR	Grass	0.035	0.169	0.000	1.775	0.266	1.800	0.003
9		8.7	TODR	Grass	0.035	0.087	0.000	0.000	0.000	0.000	0.000
5		1	END	Grass	0.035	0.010	0.000	0.000	0.000	0.000	0.000

	W	A	P	$\sum n_i$
Totals :	3.686	0.553	3.735	0.007

Notes:

Composite n = ∑ni^2/3	0.035
Hydraulic Radius R (m)	0.148
Calculated V	0.253
Calculated Q	0.140

	Designed: S.Frewen-Lord	Date: 18/11/2020	Sheet: 2

Notes:	Project No:	12536663
OPEN DRAIN - EXISTING SOUTHERN OUTFALL	Project:	Alliance Maintenance Hanger - Rockhampton Airport

Open Channel Flow - Manning's Equation
V = R2/3.S1/2/n   Q = A.V

$$n_{composite} = \left(\frac{\sum_{i=1}^{n} \left(P_i n_i^{1.5} \right)}{P_{total}} \right)^{\frac{2}{3}}$$

Capacity of Cross Section Q (m^3/s)	0.275
Average Velocity (m/s)	0.296
dg*Vave	0.118
Width of Flow (m)	4.883

Longitudinal Grade (%)	0.1	*0.001*	*(Slope of Road (m/m))*
Depth of Flow (m)	0.400	*1.8566*	*(Max allowable)*
Max Width of Flow (m)	77.1	*77.1*	*(Max allowable)*
Maximum velocity (m/s)	1		
Maximum velocity (m/s)	0.4	☐ Duplicate this provile?	

Width (m)	Height (m)	Xfall (%)	Name	Surface Type	Mannings n	Slope (m/m)	D_i (m)	W_i (m)	A_i (m^2)	P_i (m)	n_i ($P_i n_i^{1.5}$)
-	-	-	CL	-	-	0	0.000	0	0	0	0
3		0	TOBL	Grass	0.035	0.000	0.000	0.000	0.000	0.000	0.000
4.2		-15	BOBL	Grass	0.035	-0.150	0.000	0.000	0.000	0.000	0.000
13.5		-3.4	BRLL	Grass	0.035	-0.034	0.000	0.000	0.000	0.000	0.000
2.6		-6.8	TODR	Grass	0.035	-0.068	0.028	0.416	0.006	0.417	0.001
2.1		-17.7	IODL	Grass	0.035	-0.177	0.400	2.100	0.450	2.133	0.003
2.4		16.9	IODR	Grass	0.035	0.169	0.000	2.367	0.473	2.400	0.003
9.3		7	TODR	Grass	0.035	0.070	0.000	0.000	0.000	0.000	0.000
40		2	END	Grass	0.035	0.020	0.000	0.000	0.000	0.000	0.000

Notes:

	W	A	P	$\sum n_i$
Totals :	4.883	0.929	4.950	0.007

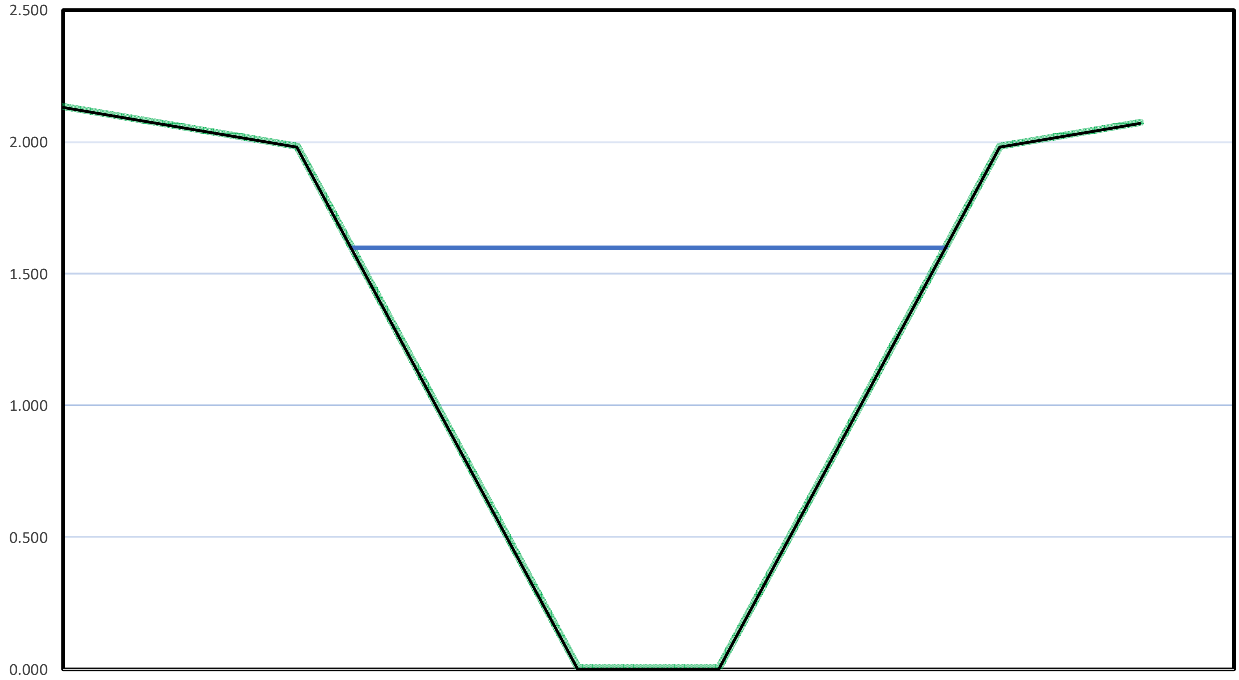
Composite n = ∑ni^2/3	0.035
Hydraulic Radius R (m)	0.188
Calculated V	0.296
Calculated Q	0.275

	Designed:	Date:	Sheet:
	S.Frewen-Lord	18/11/2020	3

Notes:	Project No:	12536663
OPEN DRAIN - PROPOSED LANDSIDE	Project:	Alliance Maintenance Hanger - Rockhampton Airport

Open Channel Flow - Manning's Equation
V = R2/3.S1/2/n   Q = A.V

$$n_{composite} = \left(\frac{\sum_{i=1}^{n} \left(P_i n_i^{1.5}\right)}{P_{total}} \right)^{\frac{2}{3}}$$



Capacity of Cross Section Q (m^3/s)	5.026
Average Velocity (m/s)	0.400
dg*Vave	0.640
Width of Flow (m)	12.697

WARNING !! - dg*Vave > 0.60

Longitudinal Grade (%)	0.021	0.00021	*(Slope of Road (m/m))*
Depth of Flow (m)	1.600	2.13	*(Max allowable)*
Max Width of Flow (m)	23	23	*(Max allowable)*
Maximum velocity (m/s)	1		
Maximum velocity (m/s)	0.4		

☐ Duplicate this provile?

Width (m)	Height (m)	Xfall (%)	Name	Surface Type	Mannings n	Slope (m/m)	D_i (m)	W_i (m)	A_i (m^2)	P_i (m)	n_i ($P_i n_i^{1.5}$)
-	-	-	CL	-	-	0	0.000	0	0	0	0
5		-3	TOBL	Grass	0.035	-0.030	0.000	0.000	0.000	0.000	0.000
6		-33	IODL	Grass	0.035	-0.330	1.600	4.848	3.879	5.106	0.003
3		0	IODR	Grass	0.035	0.000	1.600	3.000	4.800	3.000	0.001
6		33	TODR	Grass	0.035	0.330	0.000	4.848	3.879	5.106	0.003
3		3	BOBR	Grass	0.035	0.030	0.000	0.000	0.000	0.000	0.000

	W	A	P	$\sum n_i$
Totals :	12.697	12.558	13.211	0.007

Notes:

Composite n = ∑ni^2/3	0.035
Hydraulic Radius R (m)	0.951
Calculated V	0.400
Calculated Q	5.026

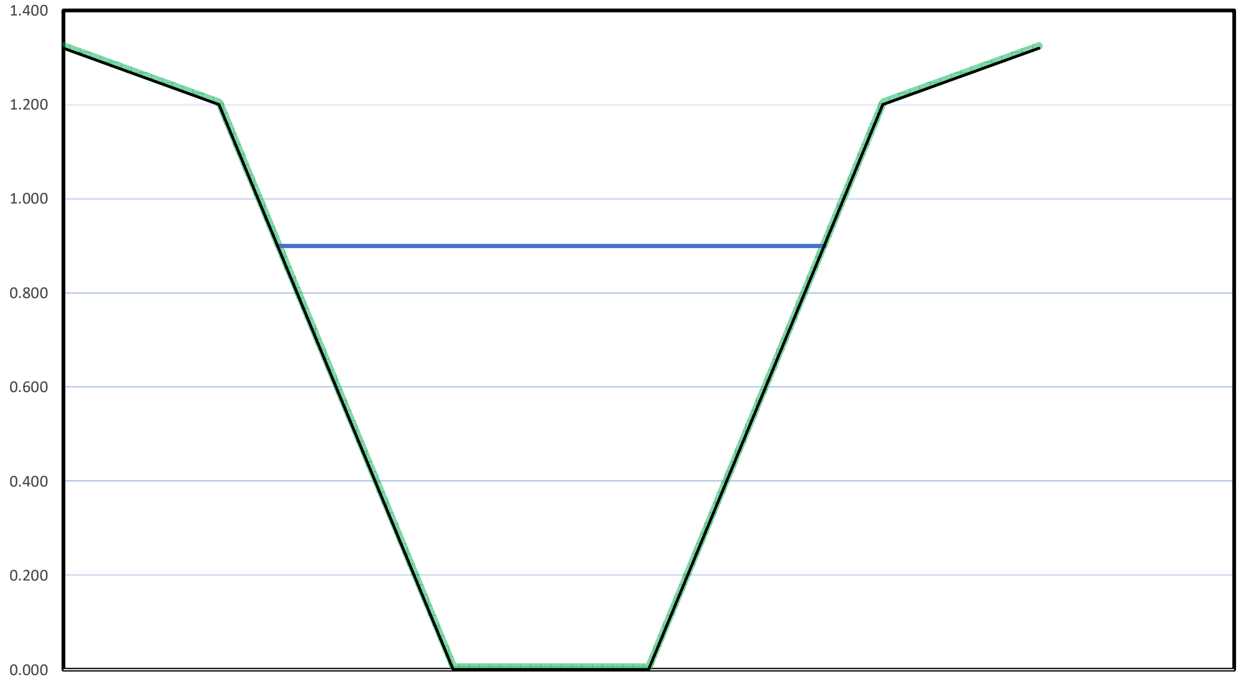
	Designed:	S.Frewen-Lord	Date:	18/11/2020	Sheet:	4

Notes: OPEN DRAIN - PROPOSED AIRSIDE	Project No: 12536663
	Project: Alliance Maintenance Hanger - Rockhampton Airport

Open Channel Flow - Manning's Equation

V = R2/3.S1/2/n Q = A.V

$$n_{composite} = \left(\frac{\sum_{i=1}^{n} \left(P_i n_i^{1.5} \right)}{P_{total}} \right)^{\frac{2}{3}}$$



Capacity of Cross Section Q (m^3/s)	5.514	
Average Velocity (m/s)	0.645	
dg*Vave	0.580	WARNING !! - dg*Vave > 0.40
Width of Flow (m)	14.000	

Longitudinal Grade (%)	0.1	0.001	(Slope of Road (m/m))
Depth of Flow (m)	0.900	1.32	(Max allowable)
Max Width of Flow (m)	25	25	(Max allowable)
Maximum velocity (m/s)	1		
Maximum velocity (m/s)	0.4	☐ Duplicate this provile?	

Width (m)	Height (m)	Xfall (%)	Name	Surface Type	Mannings n	Slope (m/m)	D_i (m)	W_i (m)	A_i (m^2)	P_i (m)	n_i ($P_i n_i^{1.5}$)
-	-	-	CL	-	-	0	0.000	0	0	0	0
4		-3	TOBL	Grass	0.035	-0.030	0.000	0.000	0.000	0.000	0.000
6		-20	IODL	Grass	0.035	-0.200	0.900	4.500	2.025	4.589	0.002
5		0	IODR	Grass	0.035	0.000	0.900	5.000	4.500	5.000	0.002
6		20	TODR	Grass	0.035	0.200	0.000	4.500	2.025	4.589	0.002
4		3	BOBR	Grass	0.035	0.030	0.000	0.000	0.000	0.000	0.000

	W	A	P	$\sum n_i$
Totals :	14.000	8.550	14.178	0.007

Notes:

Composite n = ∑ni^2/3	0.035
Hydraulic Radius R (m)	0.603
Calculated V	0.645
Calculated Q	5.514

	Designed: S.Frewen-Lord	Date: 18/11/2020	Sheet: 4

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	J. Brown	G. Applin	G. Applin*	G. Applin	G. Applin*	19/11/2020
2	J. Brown	G. Applin	G. Applin*	G. Applin	G. Applin*	30/11/2020

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Memorandum

09 December 2020

To	Alliance Airlines Pty Ltd		
Copy to			
From	Ian McNichol	Tel	+61 7 40442255
Subject	Traffic Impact Assessment	Job no.	12536663

1 Introduction

As part of the Alliance Maintenance Hangar Project at Rockhampton Airport, a traffic impact assessment is required to accompany the planning approvals for Rockhampton Regional Council (RRC). The traffic impact assessment has been undertaken to determine the current and future functionality of the road network to demonstrate to Council that any potential issues or conflicts have been considered.

The purpose of this memorandum is to detail the traffic impact assessment undertaken for the Apron Drive and Hunter Street intersection. The memorandum outlines the traffic information and assumptions, SIDRA analysis and results to demonstrate the impacts of the proposed development to Council.

1.1 Scope and overview of assessment

The scope of the assessment was limited to the Apron Drive and Hunter Street intersection. The assessment was a desktop level study as no traffic generation surveys were undertaken. In lieu of this, traffic volumes, intersection properties and assessment criteria were determined based off informed assumptions and clarified with the Client throughout the assessment.

The assessment scope included the predicted performance of the baseline network (including the Alliance Development), a 10-year planning horizon and a sensitivity analysis. These translate into three modelling scenarios that demonstrated the functionality of the intersection, based on the varied traffic volume. The three modelling scenarios were:

- Base case scenario (2037): The existing function of the airport with the forecasted passenger data for 2037 from the Rockhampton Airport Master Plan and the traffic impact from the proposed Alliance development.
- Future case scenario (2047): The 10-year planning horizon for the future year projection accounts for the traffic increase resulting from a nominated growth rate. The growth is not applied to the Alliance development associated traffic.
- Sensitivity check scenario: The sensitivity check is to demonstrate the functionality of the intersection with a realistic worst-case scenario.

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1.2 Modelling overview

The SIDRA Intersection 8 (SIDRA) analysis was undertaken by modelling the intersection with the three traffic scenarios. The intersection was modelled as an unsignalised two-way give-way/yield intersection. Lane geometry was determined from aerial imagery and SIDRA input parameters were verified using local knowledge and understanding of the Rockhampton airport's functionality.

The intersection was analysed and evaluated in terms of the Level of Service (LoS), Degree of Saturation (DoS), queuing length and delay. SIDRA provides two performance measures being the Network LoS, based on speed efficiency, travel time index and a congestion coefficient; and Lane LoS, based on queueing length and delays. Due to low traffic volumes and the basic layout of the intersections, the Lane LoS measure is more applicable as it considers parameters more relevant to the context of the intersection and was used in determining the 'network' LoS as reported below.

It must also be noted that SIDRA outputs have a 5% increase buffer on all traffic volumes. This is an inert function of the program applied to all intersection analysis to ensure a factor of safety.

2 Traffic information and assumptions

2.1 Traffic information

The traffic data was determined based on several assumptions and decisions. The sourced data that informed the assumptions were:

- Rockhampton Airport Master Plan forecast for peak hour passengers, which for the 2037 projection year was 334 for arrivals. (Refer to Figure 1)
- Proposed landside development traffic impact is 75 inbound and 75 outbound, assumed to coincide at the peak period.
- Assumed the sensitivity analysis to be a 50% increase of the traffic volume of the 10-year planning horizon.

This was used to formulate the traffic movements and volumes for the base case, the 10-year planning case and sensitivity case. No traffic data was provided by RRC and so the above information was the only traffic data to inform the models, however was deemed adequate.

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EXHIBIT 3-23
ROCKHAMPTON AIRPORT PEAK HOUR PASSENGER FORECASTS

PASSENGER FLOWS	2017	2022	2027	2032	2037
Arrivals	159	185	226	275	334
Departures	107	125	153	186	226

Figure 1 Extract from Rockhampton Airport Master Plan, Forecasted Peak Hour Passengers

2.2 Traffic movement assumptions

The assumptions and decisions made to inform the traffic movements and flow are as follows:

- All traffic movements to occur at the one peak period. i.e. no division of AM or PM peak has been accounted for.
- The traffic generated by the Alliance Development is 75 inbound and 75 outbound and are assumed to coincide to account for a shift change over.
- Development traffic inbound turns left onto Apron Drive from Hunter Street and outbound turns right onto Hunter Street from Apron Drive.
- Existing baseline traffic (outside of development traffic impact) is built off the 334 peak passenger forecast and has been assumed with the following breakdown.
- All traffic onto Apron Drive are taxi's (excluding the development traffic).
    - This assumption was drawn from google street view which identified a sign for taxi's into Apron Drive.
- 30% of inbound traffic (100) turns left onto Apron St.
    - 30% are taxis and proceed to kerb side pick-up/drop-off before then exiting via Hunter St.
    - For the purpose of the SIDRA analysis, a single vehicle was assumed to turn left onto Hunter St to proceed into the airport.
- 70% of inbound traffic (234) continues through on Hunter St into the airport.
    - 50% are kerb side drop off, and exit via Hunter St.
    - 50% park in short-term carpark and exit via Hunter St.
    - For the purpose of the SIDRA analysis, a single vehicle was assumed to turn right onto Apron Dr to utilise other facilities.
- Freight vehicles, maintenance vehicles and buses are inconsequential to the analysis because the number is minimal.
- 10-year planning horizon accounts for the projected traffic growth for the baseline traffic and the traffic resulting from the development.

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- The sensitivity analysis check increases the 10-year planning horizon traffic volumes by 50% and includes the traffic resulting from the development.

2.3 Projected traffic growth rate

Based on the Master Plan forecasted passenger volumes, a traffic growth rate of 1.4% has been applied to the 2037 baseline traffic to determine the 10-year projected traffic volumes for 2047.

2.4 Traffic volume inputs

The traffic volumes were determined for each intersection movement for input into the SIDRA intersection models. These are identified in Table 1 and in the traffic flow diagrams below.

Table 1 Traffic volume inputs for each SIDRA model scenario

Movement at Intersection	Base Case (2037)	10-year planning horizon (2047)	Sensitivity test
Hunter St Through (inbound)	234	328	491
Hunter St. Left (onto Apron Dr)	175	215	285
Apron Dr Right (onto Hunter St - outbound)	75	75	75
Apron Dr Left (onto Hunter St - inbound)	1	1	2
Hunter St Through (outbound)	334	468	701
Hunter St Right (onto Apron Dr)	1	1	2

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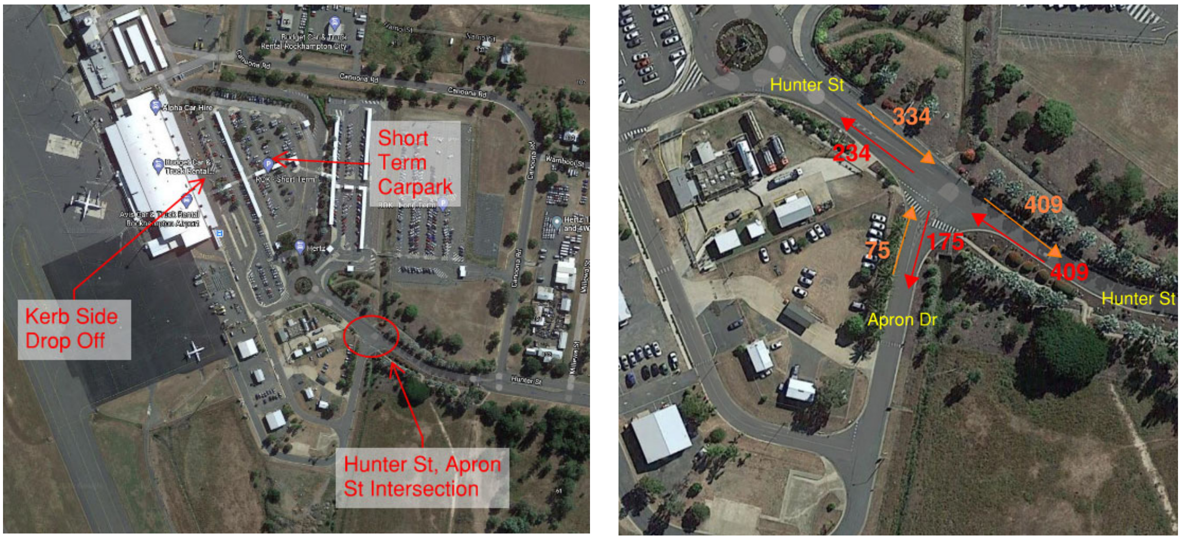

Figure 2 Traffic flow diagrams for the Base Case (2037)

3 Results and analysis

The SIDRA analysis identified that in the base case (2037) all lanes of the Apron Drive and Hunter Street intersection are achieving a Level of Service A. It is noted that the 10-year projection (2047) and sensitivity check traffic scenarios demonstrated a lane LoS B and C respectively in the Apron Drive lane, which is considered to still be operating at an acceptable level. However. it is noted that if the traffic volume continues to increase at this rate it may encounter lesser level of service that will impact the intersection to a level that requires intervention beyond 2047.

As identified in Table 2, Hunter Street in both the inbound and outbound lane, is demonstrating a Level of Service A for all traffic scenarios. This is because the intersection has been modelled as an unsignalised two-way give way/yield intersection, giving the priority movement the major road which in this case is Hunter Street. As a result, it is expected that there will be a high LoS for the Hunter St lanes in each traffic scenario, as there is no opportunity to cause delay or queuing as the analysis favours this movement.

Table 2 Lane Level of Service for traffic scenarios

Scenario	Apron Drive	Hunter St East	Hunter St West
Base Case	A	A	A
10-year planning horizon	A	A	B
Sensitivity test	A	A	C

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Despite the traffic scenarios demonstrating a high level of functionality, there are some differences between performance-based criteria including queuing and lane delay that justify the reduced lane LoS on the Apron Drive intersection. These are detailed in the tables below.

3.1 Relevant performance-based criteria results

Performance criteria:

- Queue (average): This performance criteria gives the average back of queue distance in metres for any lane.
- Queue (percentile): This performance criteria gives the largest 95% back of queue distance in number of vehicles for any lane.
  - Note: In the context of this analysis, the only lane that is impacted is the Apron Drive, noted in SIDRA as the south lane. This is the only lane referenced in the table below.
- Delay (control): This performance criteria determines the average control delay per vehicle in seconds.

Table 3 Queuing results for traffic scenarios

Scenario	Queue Distance (average) (metres)	Queue Distance (%) (vehicles)
Base Case	2.8	0.4
10-year planning horizon	3.8	0.5
Sensitivity test	9	1.3

Table 4 Delay control results for traffic scenarios (seconds)

	Apron Drive	Hunter St East	Hunter St West
Base Case	8.1	2	1.7
10-year planning horizon	10.7	1.8	1.7
Sensitivity test	24.5	1.3	2.1

As can be seen in Table 2 and 3, as the traffic volumes are increased, the queuing and delays are increased. This is an expected result. It is also expected that Apron Drive is experiencing the highest of delay and queuing as it is not the priority movement. In the context of safe and efficient traffic operation, the increases in queuing delay at the intersection are considered immaterial to the performance of the intersection, and therefore are acceptable.

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4 Recommendations

The traffic impact assessment undertaken has identified that the existing Apron Drive and Hunter Street intersection will function satisfactorily for the forecasted 2037 passenger demands (base case) and with the proposed development impact. The analysis also identified that in a worse-case scenario, the intersection still has high functionality and level of service, with some potential impacts on the Apron Drive lane. If traffic were to continue to increase at this rate, consideration should be given to the impacts on Apron Drive. However, it is not considered to be an impact at this current stage and for the near future, only for the worst-case scenario.

Therefore, it can be concluded that the proposed development for the Alliance Maintenance Hangar at Rockhampton Airport will have negligible negative impact on the current and future function of the road network.

Regards

Ian McNichol
Market Leader Transport

Attachments

SIDRA Outputs

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MOVEMENT SUMMARY

Site: 101 [Hunter St Intersection - Base Case]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Apron Dr												
1	L2	1	0.0	0.122	5.4	LOS A	0.4	2.8	0.52	0.78	0.52	31.6
3	R2	79	0.0	0.122	8.1	LOS A	0.4	2.8	0.52	0.78	0.52	30.7
Approach		80	0.0	0.122	8.1	LOS A	0.4	2.8	0.52	0.78	0.52	30.7
East: Hunter St East												
4	L2	184	0.0	0.226	4.6	LOS A	0.0	0.0	0.00	0.23	0.00	42.6
5	T1	246	0.0	0.226	0.0	LOS A	0.0	0.0	0.00	0.23	0.00	44.3
Approach		431	0.0	0.226	2.0	NA	0.0	0.0	0.00	0.23	0.00	43.5
West: Hunter St West												
11	T1	352	0.0	0.181	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	49.9
12	R2	1	0.0	0.181	6.5	LOS A	0.0	0.1	0.00	0.00	0.00	45.5
Approach		353	0.0	0.181	0.0	NA	0.0	0.1	0.00	0.00	0.00	49.9
All Vehicles		863	0.0	0.226	1.7	NA	0.4	2.8	0.05	0.19	0.05	44.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Hunter St Intersection - Development Case]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Apron Dr												
1	L2	1	0.0	0.170	5.8	LOS A	0.5	3.8	0.67	0.85	0.67	28.5
3	R2	79	0.0	0.170	10.7	LOS B	0.5	3.8	0.67	0.85	0.67	27.8
Approach		80	0.0	0.170	10.7	LOS B	0.5	3.8	0.67	0.85	0.67	27.8
East: Hunter St East												
4	L2	226	0.0	0.299	4.6	LOS A	0.0	0.0	0.00	0.21	0.00	42.9
5	T1	345	0.0	0.299	0.0	LOS A	0.0	0.0	0.00	0.21	0.00	44.7
Approach		572	0.0	0.299	1.8	NA	0.0	0.0	0.00	0.21	0.00	44.0
West: Hunter St West												
11	T1	493	0.0	0.254	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	49.9
12	R2	1	0.0	0.254	7.8	LOS A	0.0	0.1	0.00	0.00	0.00	45.5
Approach		494	0.0	0.254	0.0	NA	0.0	0.1	0.00	0.00	0.00	49.9
All Vehicles		1145	0.0	0.299	1.7	NA	0.5	3.8	0.05	0.17	0.05	44.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Hunter St Intersection - Sensitivity]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Apron Dr												
1	L2	2	0.0	0.390	11.6	LOS B	1.3	9.0	0.89	1.01	1.11	18.8
3	R2	79	0.0	0.390	24.8	LOS C	1.3	9.0	0.89	1.01	1.11	18.4
Approach		81	0.0	0.390	24.5	LOS C	1.3	9.0	0.89	1.01	1.11	18.5
East: Hunter St East												
4	L2	300	0.0	0.540	4.6	LOS A	0.0	0.0	0.00	0.16	0.00	44.0
5	T1	738	0.0	0.540	0.0	LOS A	0.0	0.0	0.00	0.16	0.00	45.9
Approach		1038	0.0	0.540	1.3	NA	0.0	0.0	0.00	0.16	0.00	45.4
West: Hunter St West												
11	T1	517	0.0	0.270	0.1	LOS A	0.1	0.7	0.02	0.00	0.02	49.3
12	R2	2	0.0	0.270	15.8	LOS C	0.1	0.7	0.02	0.00	0.02	45.1
Approach		519	0.0	0.270	0.2	NA	0.1	0.7	0.02	0.00	0.02	49.3
All Vehicles		1638	0.0	0.540	2.1	NA	1.3	9.0	0.05	0.15	0.06	43.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
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HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.