Rockhampton Ring Road

Technical Note - Hydraulics of Wetland Connectivity

1167108-DJV-0HF00-TNE-000004 | 2

22 October 2021

Department of Transport and Main Roads

Document history and status

Revision	Date	Description	Author	Reviewer	Approver
01	21/05/2021	Draft	M.L.	T.O.	E.V.D.
02	23/06/2021	Final	M.L.	T.O.	E.V.D.
03	22/07/2021	Reviewed	T.O.	M.Z.	E.V.D.
04	22/10/2021	Incorporating DAWE comments	T.O.	M.Z.	E.V.D.

Definitions

Reference	Definition
Project or RRR	Rockhampton Ring Road
AEP	Annual Exceedance Probability
ARR	Australian Rainfall and Runoff
BoM	Bureau of Meteorology
Ch	Chainage
CPU	Central Processing Unit, of a computer
Datum	GDA94/MGA 56, all coordinates herein refer this datum
DBC	Detailed Business Case
DD	Detailed Design
Design Package	Collation of Design Documents for submission for an element or aspect of the Works at a particular design Stage.
Design Stage	Defined stages in the development of the design as follows: Scope Confirmation and Initial Design 15% Preliminary Design 50% Detailed Design 85% Final Design 100%
DJV / JSDJV	Jacobs SMEC Design Join Venture
DTMR	Department of Transport and Main Roads
EY	Exceedances per Year
FBA	Fitzroy Basin Association
GPU	Graphical Processing Unit, of a computer
HPC	Heavily Parallelised Compute, an engine of TUFLOW which uses a computer's GPU capability to achieve runtimes in excess of those using CPU alone
PD	Preliminary Design
Project Works	New works, upgrade works, property works, local road works, utility works and temporary works.
Project Area	The Project Area aligns with the gazetted road corridor. It is the area proposed to be disturbed, altered, or used for the construction of the Rockhampton Ring Road. Relocation of Public Utility Services may occur outside of the Project Area.
Project Footprint	The Project Footprint is located with the Project Area. It is the area proposed to be used for the operation of the Rockhampton Ring Road.
RAC	Rockhampton Airport Channel, an off-line mitigation option proposed in DBC
RCBC	Reinforced Concrete Box Culvert
RCP	Reinforced Concrete Pipe
RCP	Representative Concentration Pathway (Climate Change Scenario)
RCR	Rockhampton Connector Road
RGD	Rockhampton to Gracemere Duplication Project

Reference	Definition
SGS	Sub-grid Sampling, an enhancement of TUFLOW modelling
SLBC	Slab Link Box Culvert
State	State of Queensland
Technical Brief Detailed Design or TBDD	CN-14783 Project Brief and Functional Specification – Preliminary and Detailed Design Services
Temporary Works	Works required for the purpose of constructing the WUC that do not form part of the permanent Works or in-service loading. Design for Temporary Works includes design for construction configurations whether or not the design results in additional works being specified.
TUFLOW	Hydraulic Model Software
WSL	Water Surface Level
WUC	Works Under Contract

ARR Adopted Terminology

This technical note uses the terminology Annual Exceedance Probability (AEP) to define the likelihood of design flood events occurring, i.e., the probability of a flood event occurring or being exceeded within a year. Average Recurrence Interval (ARI) was a term used previously to define the probability of design flood events and was defined as the average period between occurrences equalling or exceeding a given value. For events more frequent than 50% AEP, expressing frequency in terms of annual exceedance probability is not meaningful and misleading, and hence Exceedances per Year (EY) are clearer.

In the revision of Australian Rainfall and Runoff (ARR) (Ball, et al., 2019), the adopted terminology to define design flood probabilities has been changed to AEP. The Bureau of Meteorology (BoM) has similarly adopted this terminology in publishing the revised rainfall Intensity-Frequency-Duration (IFD) curves for Australia (Australian Government. Bureau of Meteorology, 2016).

For clarity of understanding, the adopted and previously used terminology is shown in the following table with blue shading indicating ARR preferred terminology and navy outline indicating that adopted for this technical note.

Terminology used in this technical note

EY (per year)	AEP (%)	AEP (1 in x)	ARI (years)
2	86.5	1.16	0.5
1	63.2	1.58	1
0.69	50	2	1.44
0.22	20	5	4.48
0.11	10	10	9.49
0.05	5	20	19.5
0.02	2	50	49.5
0.01	1	100	100
0.0005	0.05	2000	2000

1. Introduction

1.1 Project Description

The RRR is the key piece of road infrastructure recommended in the Fitzroy River Floodplain and Road Planning Study, which investigated long-term solutions for flooding impacts on freight, road and rail transport in and around the city of Rockhampton.

The RRR Project will provide a western road link of the Bruce Highway to the west of Rockhampton, with key linkages into the city at the Capricorn Highway, West Rockhampton, Alexandra Street and Yaamba Road (Rockhampton – Yeppoon Road).

The Project Footprint will integrate with major infrastructure already completed, including Yeppen North and Yeppen South, as well as current works in development including the Rockhampton Northern Access Upgrade and Capricorn Highway Duplication (Rockhampton – Gracemere).

The RRR project commences on the Capricorn Highway approximately 2 km west of the intersection of the Bruce and Capricorn Highways at the Yeppen Roundabout and its alignment traverses north through the Western Yeppen Floodplain, sweeping around the Rockhampton Airport at Pink Lily and connecting to West Rockhampton near Ridgelands Road before crossing the Fitzroy River north of Limestone Creek. After crossing the Fitzroy River, the RRR intersects Alexandra Street in Parkhurst and connects with the Bruce Highway at the Bruce Highway and Rockhampton - Yeppoon Road intersection.

The total combined length of the Project is 17 km (including the West Rockhampton Connector Road). The length of the Project from the Capricorn Highway intersection to the Yeppoon Road intersection is 14.7 km (excluding the West Rockhampton Connector Road). Refer to **Figure 1-1** for the project layout.

Figure 1-1: Project Layout (DBC)

The project is a joint initiative of the Australian and State governments and intends to:

- Improve road safety and provide strength to the region's economy by improving freight efficiency and flood resilience
- Strengthen connectivity between key employment, leisure, tourism and residential growth areas of Rockhampton and the wider region
- Provide job opportunities for residents of Central Queensland and surrounding regions, along with providing opportunities for local businesses to help deliver the Project.

1.2 Fitzroy River Wetlands

The Fitzroy River Floodplain includes several lagoons that interact with the Project Area. Description of these lagoons can be found in the EPBC Preliminary Documentation report of the DJV (Jacobs SMEC Design Joint Venture, Oct 2021). The wetlands of the Fitzroy River floodplain in the vicinity of the Rockhampton Ring Road (RRR) Project Area are considered areas of High Ecological Significance. The areas of natural wetland provide habitat for migratory bird species. The *Environmental Protection and Biodiversity Conservation Act* (1999) considers that an action is likely to have a significant impact if there is a real chance or possibility that it will substantially modify, destroy or isolate an area of important habitat for a migratory species. The presence of the Project Footprint and associated development has potential to modify the hydraulic mechanisms of the wetland habitat. It is important that these changes to the hydrological characteristics do not negatively impact the wetland connectivity and undermine ecosystem health.

2. Analysis

2.1 Study Purpose

This technical note has been prepared to outline the methodology and findings of the wetland connectivity hydraulic analysis. Modelling has been used to quantitively assess changes to wetland flows, volumes, velocities and water levels that will likely occur due to the Project Footprint. The analysis demonstrates that the design maintains wetland connectivity and is unlikely to substantially modify, destroy or isolate an area of important habitat. The design is therefore compliant with the requirements of the EPBC Act (1999).

2.2 Model Runs Undertaken

This analysis uses TUFLOW HPC version 2020-AA-10, an industry standard hydrodynamic flood modelling package. The TUFLOW model is based on the Detailed Business Case (DBC) model (AECOM Australia Pty Ltd, April 2020) and has been updated by the DJV, refer details in the Basis of Design Report (Jacobs SMEC Design Joint Venture, Mar 2021). The model incorporates the entire Rockhampton floodplain where it interacts with the Project Footprint and was developed to assess flood risk for a range of events. Due to the geographical coverage of the model, it is relatively course in its use of an 8m grid but uses sub-grid sampling that increases the resolution of the floodplain terrain to 1m. The model can separately assess flooding from the Fitzroy River and flooding from the local creek catchments. For assessment of wetland connectivity, the model has been slightly modified to ensure it is fit for purpose. For further information on the flood modelling carried out as part of the Detailed Design refer to the Hydraulic Analysis Design Report (Jacobs SMEC Design Joint Venture, Apr 2021).

2.3 Flood Immunity and Flood Consideration

The Hydraulic Analysis Design Report has been developed to document the hydraulic assessment of the Project. The hydraulic assessment considered all aspects of the design relevant to flooding requirements for the design. Hydraulic modelling has been undertaken to:

- Assess flood immunity of the upgraded infrastructure;
- Assess and ensure hydraulic impacts on adjacent properties as a result of the new road alignment are within acceptable limits;
- Undertake bridge scour[1] assessment to identify potential for scour and ensure bridge foundations are designed accordingly;
- Assess operation of hydraulic structures and limit state loading; and

[1] The potential for scour in relation to bridges is the result of the erosive action of water, excavating and carrying away material from the bed and banks of streams and from around the piers and abutments due to contraction, pressure and localised vortices against the bridge elements.

- Quantify flood conditions in major design flood events to facilitate structural design of road embankment, bridges and culverts.

The hydraulic assessment shows that the Rockhampton Ring Road and Rockhampton Connector Road have an immunity of no less than a 1% AEP flood event. Local road connections have lower flood immunity.

The scale of floods, velocity and scour for the hydraulic assessment is for the full range of probabilities from small to large (10% AEP to a 1% AEP event) plus rarer 1 in 2000 AEP for limit state design and is inclusive of both local catchment rainfall events and Fitzroy River breakout events across the floodplain. The hydraulic assessment also focuses on the peak of the flood where the levels, velocities and scour can be expected to be maximal.

There is no published information available on the probability of the flood that should be used for assessing and minimising possible environmental damage to a stream or waterbody from the construction of a road crossing. Each site should be investigated for possible problems that might occur with a range of flood events, with emphasis on the more frequent events. The factors assessed include:

- control of roadside drainage, where it enters the stream, to limit bank erosion;
- provision of an adequate waterway opening to limit backwater effects and excessive localised bed scour;
- provision of adequate waterway openings to maintain a natural supply of flood water to wetland areas;
- provision of an adequate number of waterway openings, in wide flood areas in arid regions, to ensure that water is not prevented from reaching areas downstream from the road, which could lead to the death of vegetation;
- protection of banks from erosion resulting from the redirection of flow and turbulence, or from excessive increase in velocity; and
- protection of natural vegetation, especially where it protects or stabilises natural banks.

The scale of floods, velocity and scour/erosion for environmental assessment is thus for frequent probabilities (2 exceedances per year to 10% AEP). Additionally, the environmental assessment has been broadened from just the peak of the flood to look at the characteristics after the flood has passed through the floodplain, to assess post-flood changes.

To assess the wetland connectivity several minor local events have been simulated using a wetland scenario. This scenario extends the model run times and includes flow reporting points and lines immediately upstream and downstream of the Project Footprint within the wetland zones of high ecological significance. The reporting locations are shown in **Figure 2-1** and **Figure 2-2**, and capture flow (discharge) and flow volume moving perpendicular through the lines and localised level and velocity at points. The points have been chosen on lagoon banks in the locale of bird habitat. **Appendix A** references these reporting locations for the flow hydrographs discussed further in **Section 3**.

The wetland scenario was also set up to output water level elevations at the end of the flood. The End of Flood has been defined as the model simulation time in which approximately 95% of flood volume has passed the Bruce Highway bridges at Yeppen Yeppen Lagoon (both northbound low level bridge and southbound high level bridge south of Jellicoe Street). The End of Flood time therefore changes depending on the event as follows.

- 10% AEP event: 75 hours
- 20% AEP event: 87 hours
- 50% AEP event: 122 hours
- 63.2% AEP event: 133 hours

- 86.5% AEP event: 138 hours

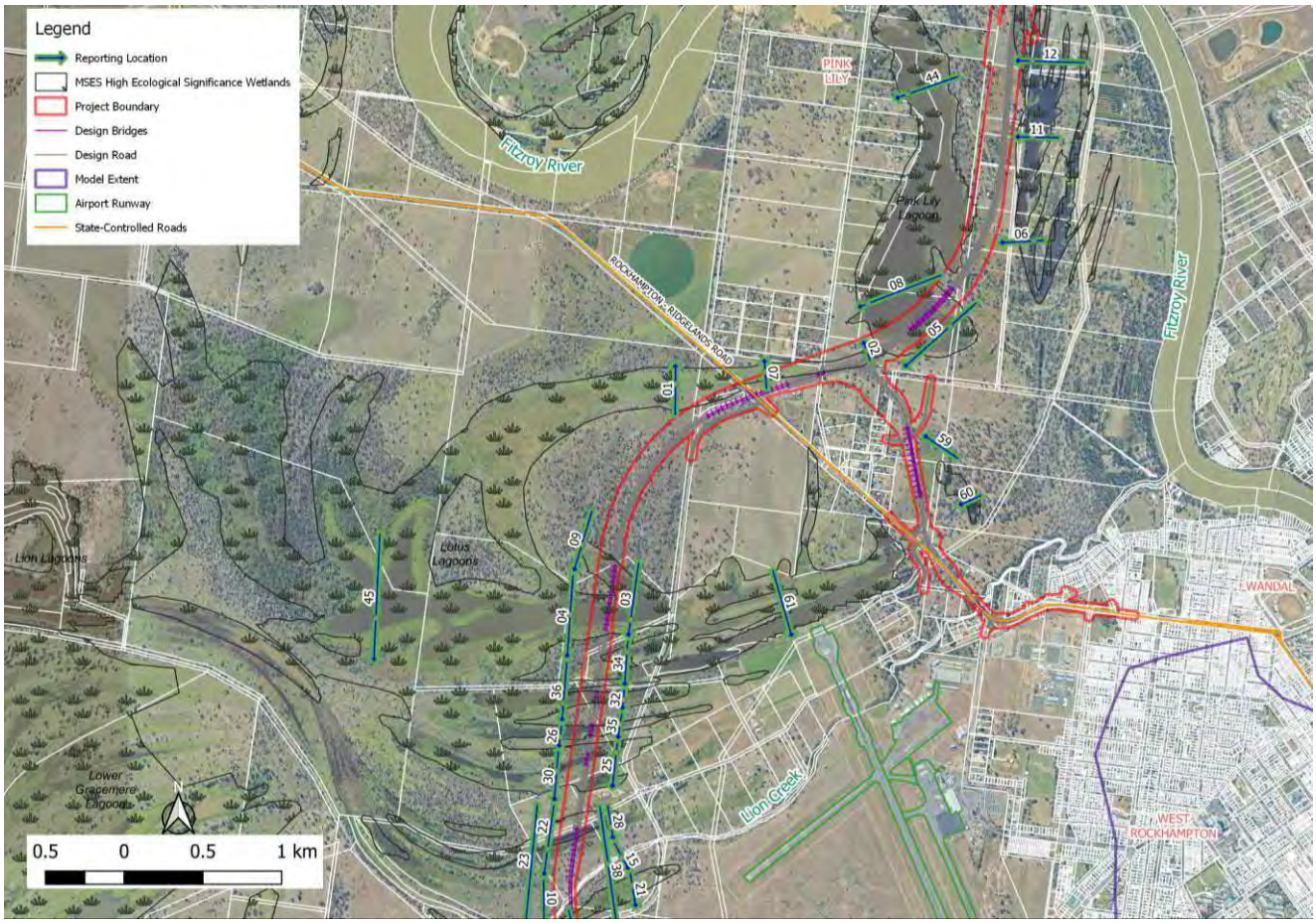


Figure 2-1: Wetland Connectivity Reporting Locations[2] (Northern Floodplain)

During a flood water depth, level, discharge and velocity all varying and reach a peak before once again receding. Velocities at the peak are a measure of the erosivity of the flood. Following recession, depth, level, discharge and velocity tend towards their Pre Flood state with End of Flood discharge and level and Post Flood volume indicators of change in flood behaviour, that is change to the hydrological characteristics.

[2] Volume/Flow/Level/Velocity

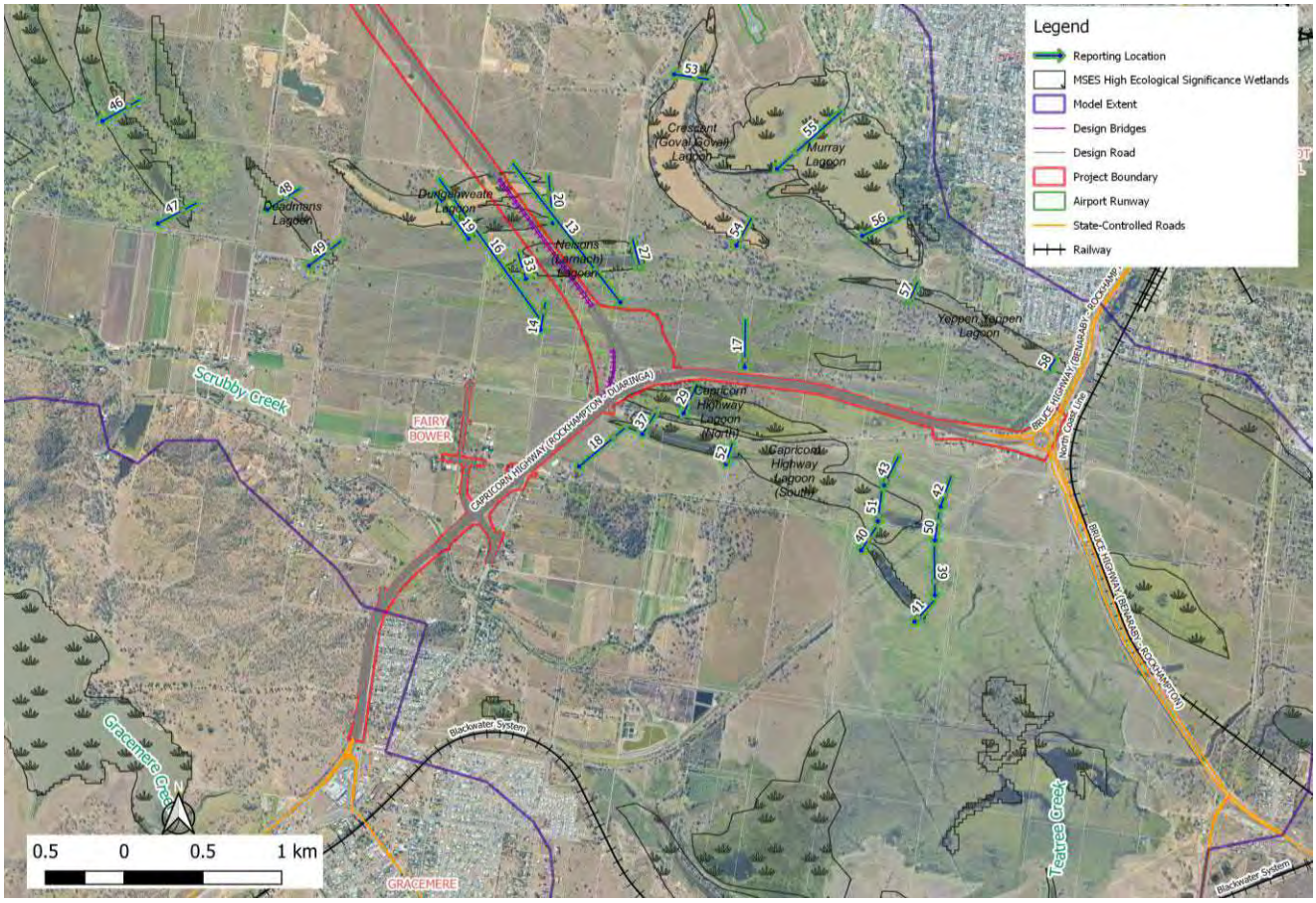


Figure 2-2: Wetland Connectivity Reporting Locations[2] (Southern Floodplain)

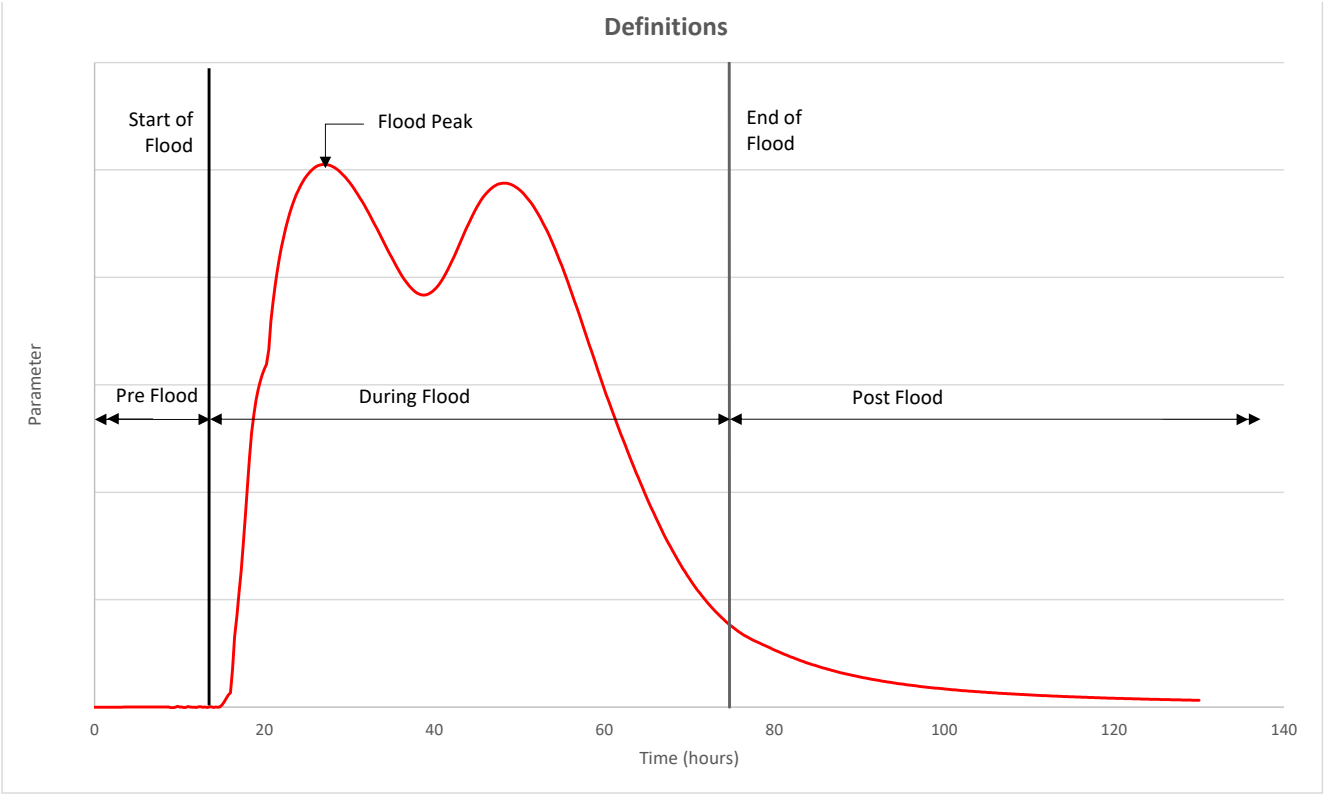


Figure 2-3: Definition of End of Flood

By extracting the water levels following each flood event, at End of Flood defined above, these results can be used as a proxy to the longer-term lagoon water levels between rainfall events. The above events were simulated for the Base Case Wetland model scenario and the Design Case Wetland model scenario to assess change in flow, volume, peak velocity and flood levels. The Design Case model includes the RRR, RCR and associated connection roads, defined as the Project Footprint. The Design Case model also impact assesses the RGD that was not included in the Base Case, at the request of DTMR. Further details of the Base Case and Design Case model development are available in the Basis of Design Hydraulic Analysis Report (Jacobs SMEC Design Joint Venture, Mar 2021), and the Hydraulic Analysis Design Report (Jacobs SMEC Design Joint Venture, Apr 2021).

2.4 Limitations of the Flood Model

There are several limitations of the flood model in application to an analysis of wetland connectivity and modification of the hydrologic regime of lagoons. Whilst the hydraulic model developed is validated to ensure it is an appropriate tool for its purpose in accordance with the *Functional Specification* (Department of Transport and Main Roads, 2020), it is important to recognise its limitations:

1. All hydraulic models have limits to their accuracy and reliability and this model is no different.

2. The focus of this study is the proposed highway, and the hydraulics of that highway in large flood events. For this highway, ground feature survey has identified all hydraulic controls within the Project Area. Significant effort has been expended on inflow boundaries, levee and channel enforcement in the vicinity of the project in rivers and creeks to ensure the model depicts the correct flows arriving at that Project Footprint in those design events. Less effort has been spent on areas of the model downstream.

3. Calibration has been done for medium to large Fitzroy River flood events, partial calibration to the 2017 event was carried out for the local catchment runoff scenario. Hence there may be less accuracy in absolute flow and levels when using this flood model for investigations of smaller local events. This risk is mitigated through the assessment of multiple events and a focus on comparative rather than absolute flood levels and flows.

4. The adopted 8m grid size utilises sub-grid sampling to improve the topographic resolution to a finer scale. This is appropriate for the wetland connectivity assessment but there may still be very small drainage channels or bunds that the model approach does not capture. Due to the large size of the model, a smaller grid is not practical.

5. Note that there are limitations related to the model's ability to represent fine-scale topographical features, particularly at existing local roads outside the Project Area.

6. This model does not account for groundwater infiltration or evaporation which may play a role in the balancing of wetland connectivity. The wetlands are not considered a groundwater dependent ecosystem. Ground water quality and availability is governed by surface water hydrology, as such if above-ground flow characteristics are maintained, impacts to ground water are minimal. Further details on local groundwater conditions can be found in the EPBC Preliminary Documentation report of the DJV (Jacobs SMEC Design Joint Venture, Oct 2021).

7. Bathymetric survey was sourced from Fitzroy Basin Authority as part of the model build but not all lagoons within the model extent have bathymetric survey. In fact, only Dunganweate, Crescent, Murray and Yeppen Yeppen lagoons do, as shown in **Figure 2-4**. Lagoons without bathymetric survey rely on 2016 LiDAR Survey which may have captured the elevation of standing water in the lagoons instead of the lagoon bed levels. These higher levels may underestimate lagoon depths and volumes.

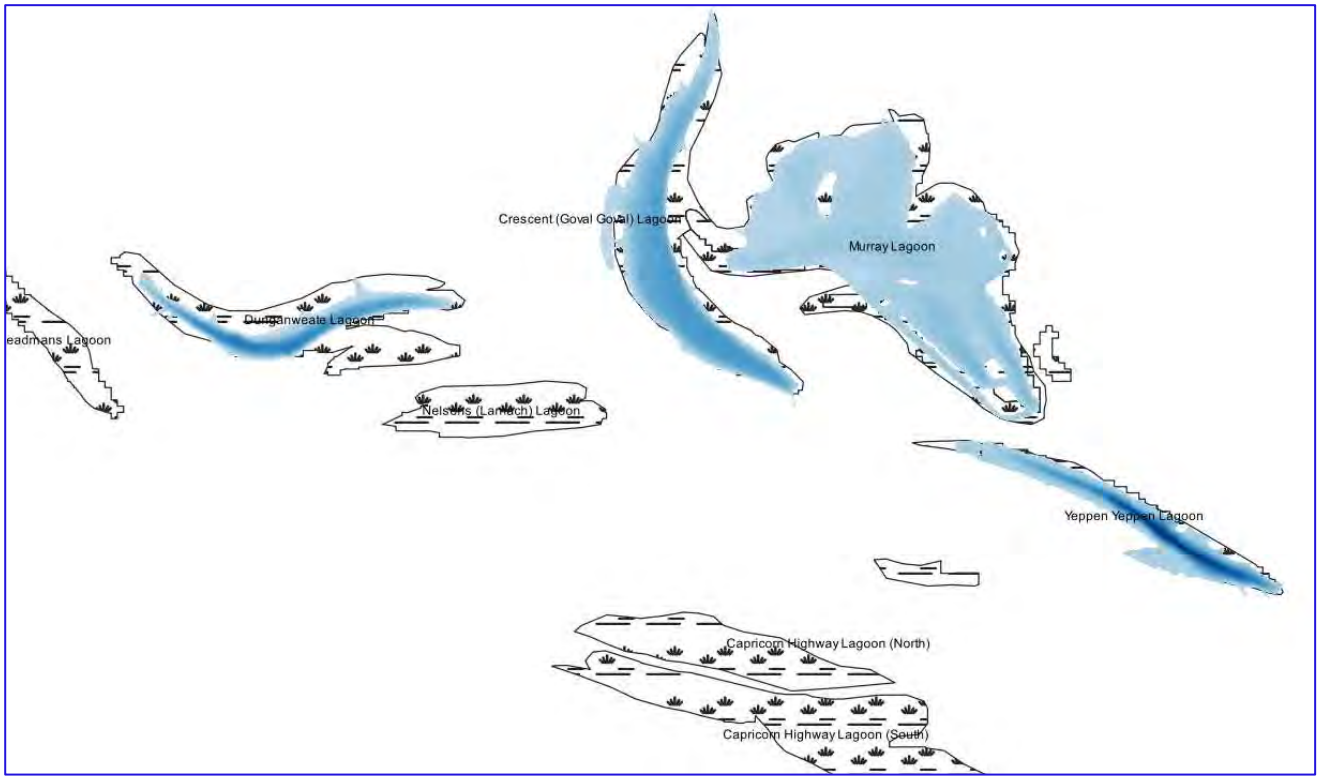


Figure 2-4: Bathymetry within Model at Lagoons

3. Results

3.1 Mapped Results

End of Flood afflux is defined as the drained water surface or ponded extent left across the floodplain in the Design Case less that in the Base Case post-flood. Positive values indicate locations where the Project Footprint has modified minor flow paths to downstream lagoons. Negative values indicate locations where water is diverted away from those lagoons.

The End of Flood afflux mapping is shown in **Appendix B** for the events outlined in **Section 2.2**. These maps represent the final results of an iterative process that has required the inclusion of mitigation structures and design alterations to satisfy the wetland requirements. Initial model results demonstrated that without mitigation several hundred millimetres of afflux could be expected in Murray Lagoon, Crescent Lagoon, Pink Lily Lagoon and disruption to connectivity in Lotus Lagoon[3]. Most notably approximately 1.4m of afflux terminated in Crescent Lagoon during the 86.5% AEP event, when flows are not sufficient to spill into Murray Lagoon. The Design Case model results in this technical note include the following mitigation to be included in the Project Detailed Design Package:

- Three new banks of culverts under the Rockhampton Ring Road embankment between Bridge 3 and Bridge 4. These are:
  - 9/1050mm dia RCP
  - 9/1200mm x 900mm SLBC; and
  - 9/1500mm x 900mm SLBC.

[3] Refer to Section 7.2.3 of the Preliminary Design version of the Hydraulic Analysis Design Report (Jacobs SMEC Design Joint Venture, Apr 2021)

- A new 900mm dia RCP culvert north of Bridge 20.

- Adding wide table drain north of the embankment slope at the Rockhampton Connector Road roundabout to Pink Lily Lagoon from Six Mile Road.

- Ensuring no guardrail in the Design Case on Six Mile Road was included in the model.

- Ensuring the design road crest levels match the base case crest levels on local roads that are critical to the spill between Lotus Lagoons and Pink Lily Lagoon below the Project Footprint at Six Mile Road and Ridgelands Road.

The mapped results indicate that the design case post-flood water levels have been returned to the base case post flood water levels for much of the Fitzroy River floodplain, thereby demonstrating that wetland connectivity has been maintained. A few areas of minor afflux can still be observed in some locations. All these areas result in less than 100mm of flood level change, with most locations also being much less than this. Further equalisation of flood waters in these areas are impractical and the flood level differences are very minor.

3.2 Reporting Locations

Percentage change in net flow volume through the reporting locations are shown in **Appendix C.1** for the 10%, 50% and 86.5% AEP local events. The percentage differences represent change in net volume between the Base Case and Design Case Scenarios as at the date of this Technical Note. Locations showing a lone dash (-) indicate that no flow passes through the reporting location for the event. Where an absolute value of zero is shown in the Base Case or Design columns, this has been rounded.

The majority of reporting locations demonstrate a negligible change in the volumes of flow moving through the wetlands. A few locations demonstrate a more noticeable change in the volumes passing through the flow reporting lines. This is not entirely unexpected as the presence of the project will have some influence on the hydraulic behaviour of flood waters around it. Reporting locations immediately upstream and downstream of bridge locations are more likely to experience a modest increase in flow volume as the bridge openings funnel flow to these reporting locations. Conversely, reporting locations immediately adjacent to the Rockhampton Ring Road embankment are more likely to experience a modest reduction in flow volume. Many of the reporting locations that experience a larger percentage change in volume have very low Base Case and Design Case absolute volumes meaning overall wetland connectivity is insensitive to changes at these locations for those particular events.

To assist in further understanding of the wetland connectivity, **Appendix C.2** includes a similar table to that in **Appendix C.1** but compares the absolute peak flow through the reporting locations. **Appendix C.3** records the peak velocities and End of Flood water levels at bank location points along the reporting location lines. Peak velocities, or change in peak velocities is an indicator of a change in erosion or sedimentation potential. If peak velocity is reduced in any area, floods are more likely to be depositional in nature. If peak velocity is increased in any area, floods are more likely to cause scour and erosion at the bank location. As can be seen from the table in **Appendix C.3**, there is little change in peak velocities on the lagoon banks attributed to the Project Footprint, with the greatest change being a reduction by 4% only upstream of the Bridge BR04 southern abutment in low lying floodplain channel adjacent the Capricorn Highway, not in mapped wetland or in any lagoon. Across all floods assessed (86.5% AEP to 10% AEP Local Catchments Wetland Scenario) there are 13 reporting points where percentage velocity changes greater than 10% result from the action (where the absolute velocity is greater than 0.1 m/s), that is where there is increase in erosion/deposition potential. As the resultant velocity is everywhere less than 0.6m/s in the Design Case, that potential is only weakly damaging environmentally.

Appendix A presents flow hydrographs for a selection of reporting locations near key wetland lagoons for the 10%, 50% and 86.5% AEP local events. Where the Base Case dashed lines are not visible, no divergence in flow is observed. These hydrographs demonstrate that while some locations and flood events have divergence in flow at the peak between the Base Case and Design Case Scenarios, the rising and falling limbs of the hydrographs typically converge at lower flows. This indicates that following a flood event, the environmental flows that remain in the wetland lagoons will be largely unaffected by the presence of the Project Footprint.

These hydrographs have been presented to demonstrate flow patterns and relative change between scenarios and should not be considered inclusive of all flow entering and/ or exiting the wetland lagoons.

4. Conclusions

Whilst the Hydraulic Analysis Design Report draws conclusions on flooding, depths, velocities and flood scour applicable at the peak of large to extreme events, this technical note focuses on more frequent events and post flood hydraulic characteristics on the floodplain, more applicable to investigating environmental damage and specifically erosion and deposition in relation to wetland connectivity and fragmentation.

Mitigation measures, as outlined in **Section 3.1**, have been incorporated into the Rockhampton Ring Road design to assist wetland connectivity within the Lagoon Wetlands of the Fitzroy River Floodplain. Initial investigations demonstrated some wetland lagoons could have experienced several hundred millimetres of flood level increase following a minor flood event. These changes to the post flood wetland conditions may have presented a threat to native bird life and eco-system health. With the inclusion of substantial openings in the Project Footprint plus additional design elements in place as described in **Section 3.1**, changes to the wetland flow patterns have been minimised and post flood affluxes in the wetland are kept below 100mm in all events tested. Further afflux reductions are likely to be impractical and may require a higher level of precision than this investigation can provide, as per the limitations outlined in **Section 2.4**. This investigation does not account for all wetland connectivity mechanisms. These mechanisms would assist the wetlands in finding a hydraulic equilibrium. The results of this investigation can therefore be considered a conservative approximation of post-flood wetland conditions.

This technical note is limited to investigation of changes to surface hydrology (flooding, sedimentation and erosion) to habitat in the proposed action area and surrounding areas. Indirect impact can be inferred from this conclusion on:

- increased water table;
- increased dissolved salt content; and
- the potential of reduction of the extent of foraging habitat for migratory bird species.

With little to no impact on flooding, sedimentation and erosion, the same conclusion could be drawn for the other issues.

5. References

AECOM Australia Pty Ltd. (April 2020). *Hydraulic Assessment Report: Rockhampton Ring Road - Detailed Business Case.* Rockhampton: Queensland Department of Transport and Main Roads.

Australian Government. Bureau of Meteorology. (2016). *Design Rainfall Data System (2016)*. Retrieved March 01, 2021, from http://www.bom.gov.au/water/designRainfalls/revised-ifd/

Austroads. (2013). *Guide to Road Design Part 5: Drainage - General and Hydrology Considerations.* Sydney: Austroads.

Austroads. (2013). *Guide to Road Design Part 5B: Drainage - Open Channels, Culverts and Floodways.* Sydney: Austroads.

Austroads. (2018). *Guide to Bridge Technology Part 8 - Hydraulic Design of Waterway Structures.* Sydney: Austroads.

Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., & Testoni, I. (Eds.). (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Commonwealth of Australia (Geoscience Australia).

Department of Fisheries. (1st October 2018). *'Appendix 2 - Queensland Waterways for Waterway Barriers Works spatial data layer' in Fisheries Queensland (Eds.) Accepted development requirements for operational work that is constructing or raising waterway barrier works (p 56).* Brisbane: Queensland Government.

Department of Transport and Main Roads. (2019). *Road Drainage Manual.* Brisbane: Queensland Government.

Department of Transport and Main Roads. (2020). *Design Criteria for Bridges and Other Structures.* Brisbane: Queensland Government.

Department of Transport and Main Roads. (2020). *Rockhampton Ring Road Functional Specification: C7524 - Detailed Design.* Rockhampton: State of Queensland.

Department of Transport and Main Roads. (October 2019). *Technical Guideline - Hydrologic and Hydraulic Modelling.* Brisbane: Queensland Government. Retrieved 05 20, 2019

Institute of Public Works Engineering Australasia. (2016). *Queensland Urban Drainage Manual.* Brisbane.

Jacobs SMEC Design Joint Venture. (Apr 2021). *Hydraulic Analysis Design Report (1167108-DJV-0HF00-RPT-000002_01).* Brisbane.

Jacobs SMEC Design Joint Venture. (Jan 2021). *Report - Options.* Brisbane.

Jacobs SMEC Design Joint Venture. (Jun 2021). *Report - Preliminary Documentation (EPBC 20208628).* Brisbane.

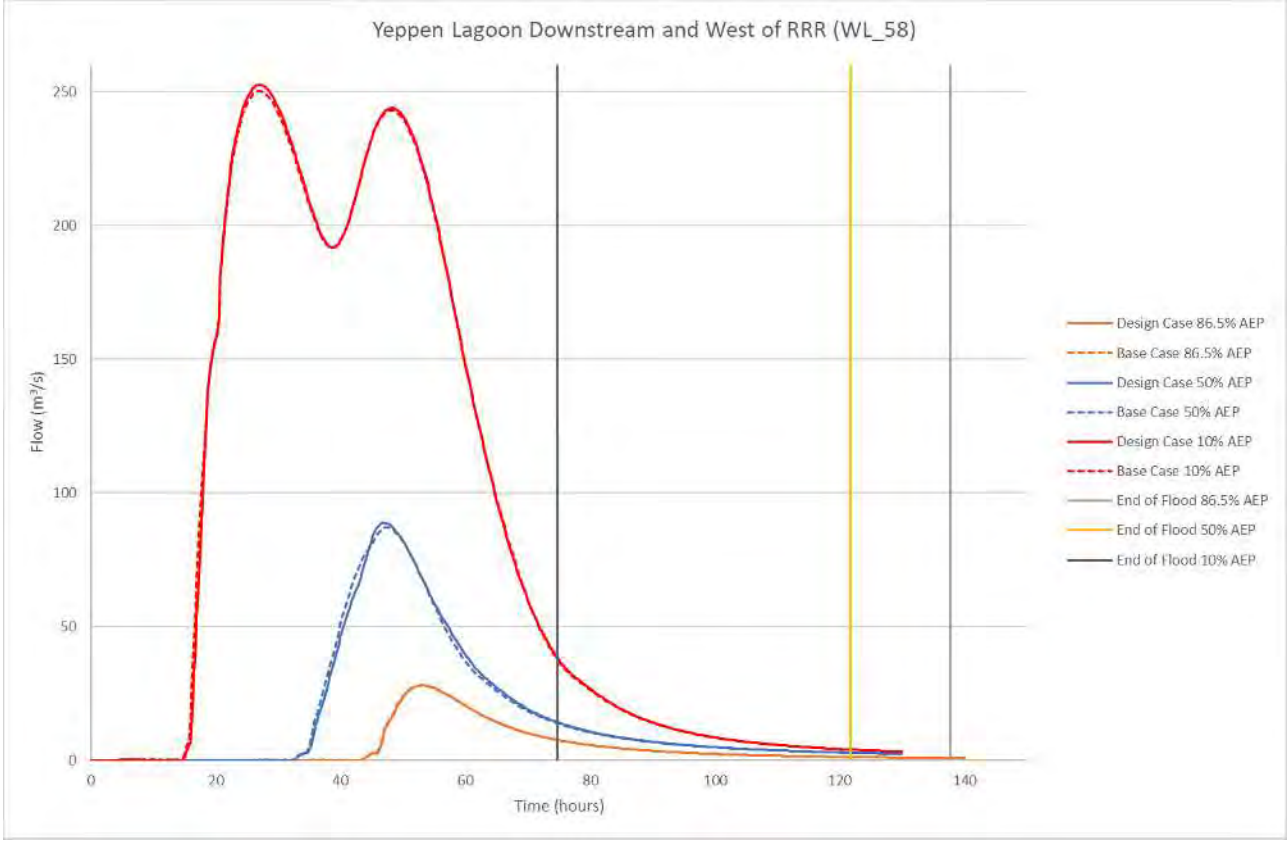
Jacobs SMEC Design Joint Venture. (Mar 2021). *Basis of Design - Hydraulic Analysis.* Brisbane.

Queensland Government. (Undated). *Project Brief - Rockhampton Ring Road Detailed Design.*

TUFLOW. (2020). *TUFLOW Classic and HPC 2020-01 and 2020-10 Release Notes.* Retrieved October 31, 2020, from https://downloads.tuflow.com/TUFLOW/Releases/2020-10/TUFLOW%20Release%20Notes.2020-10-AA.pdf

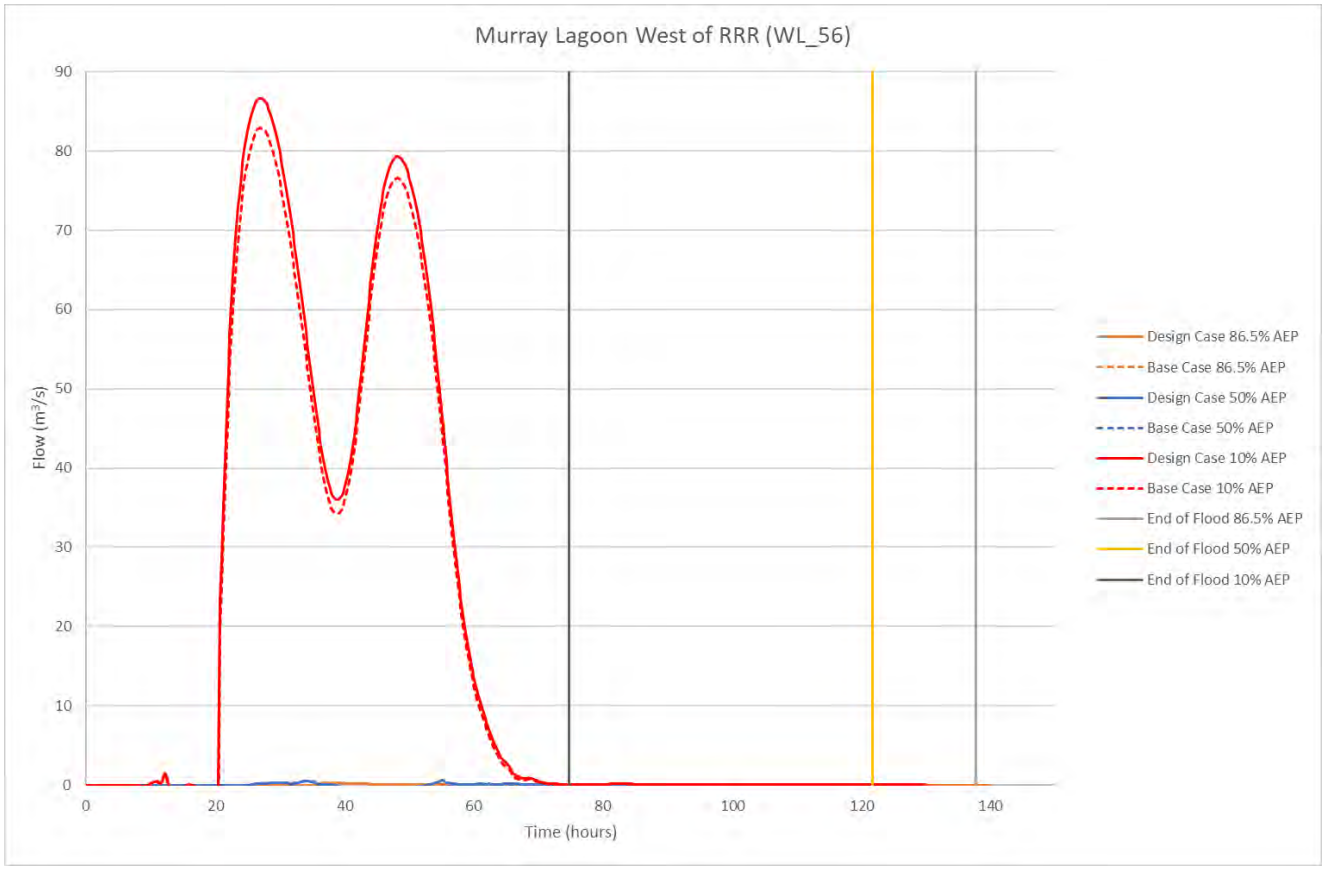
Appendix A. Flow Hydrographs

A.1 Wetland Connectivity Lagoon Flow Hydrographs

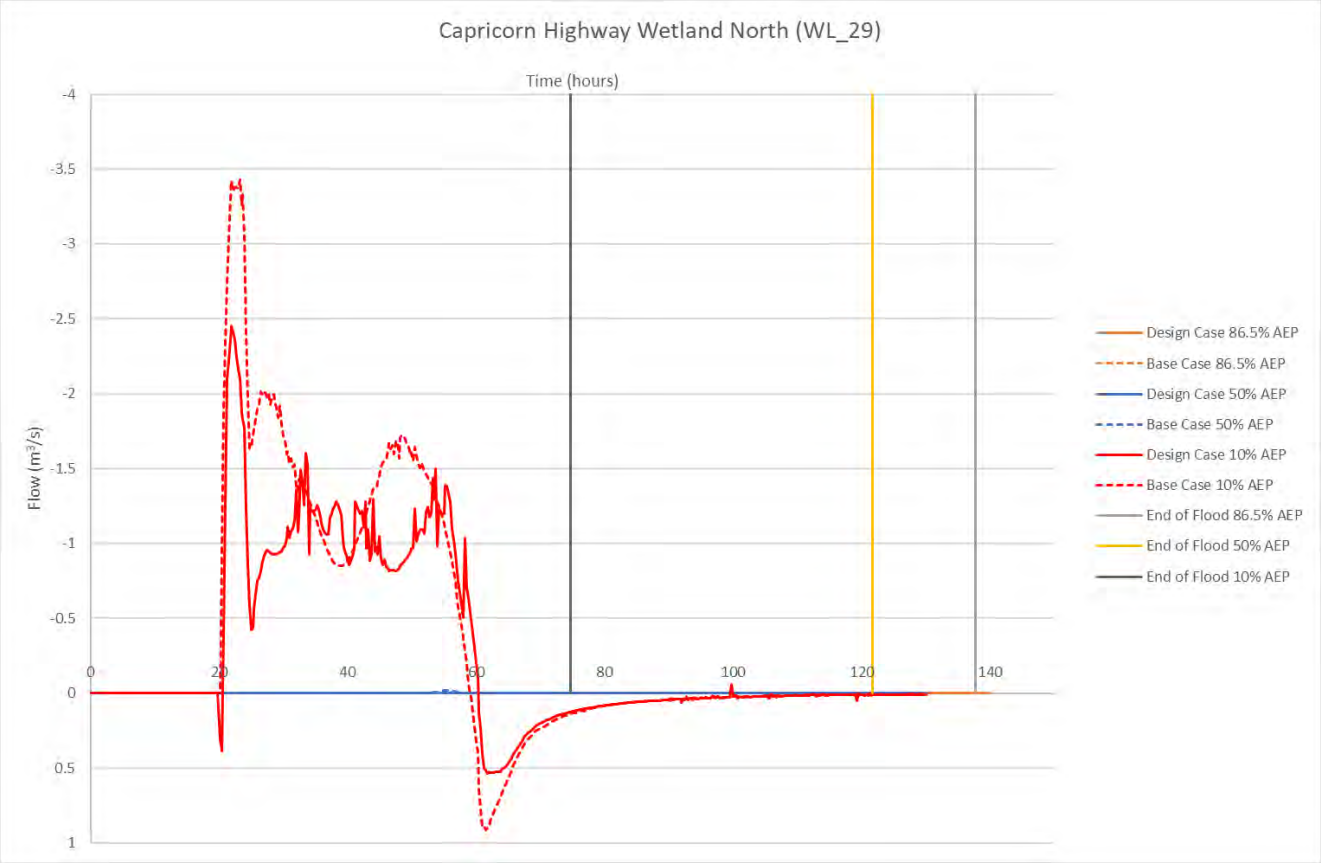


Appendix Figure A-1: Flow Hydrographs – Yeppen Lagoon Downstream of Project Area

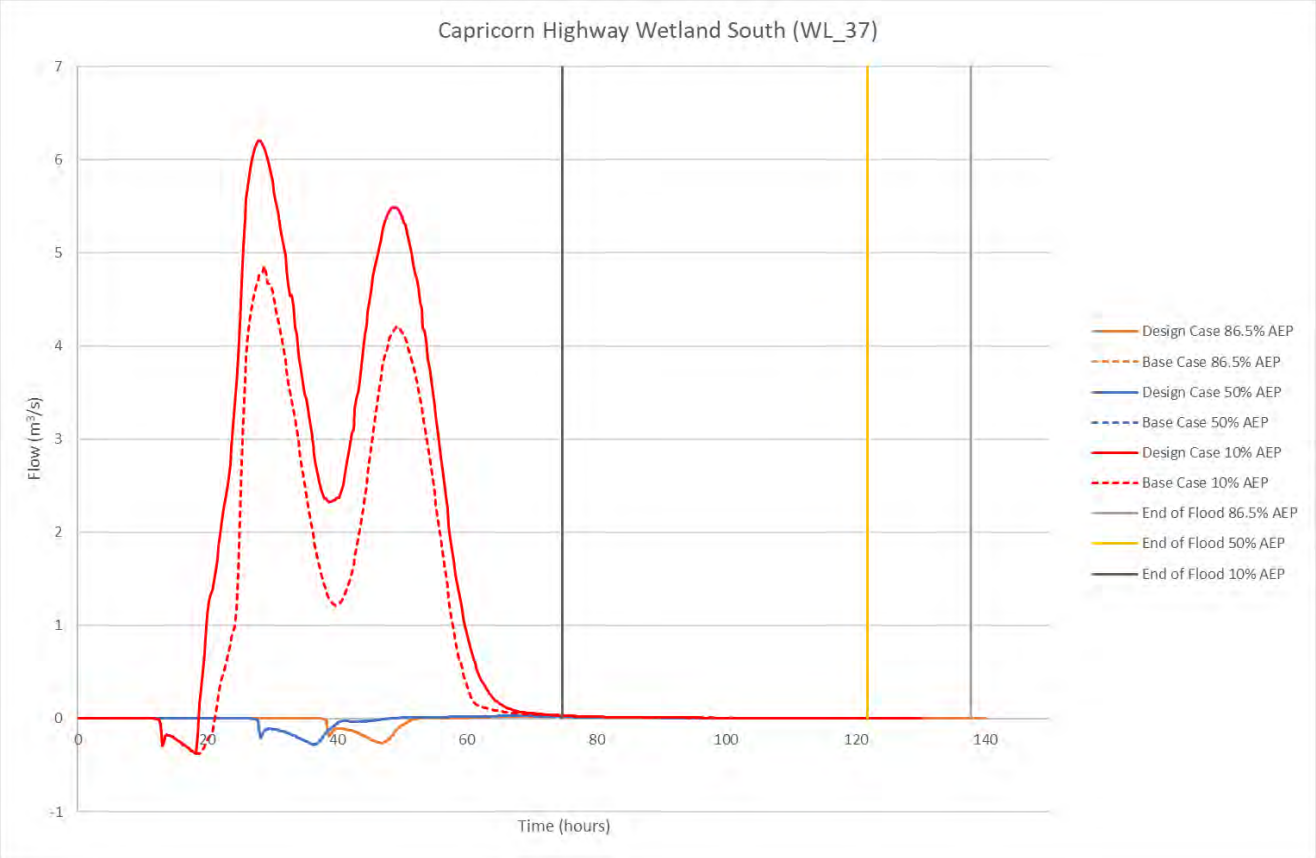
Appendix Figure A-2: Flow Hydrographs – Crescent Lagoon Downstream of Project Area



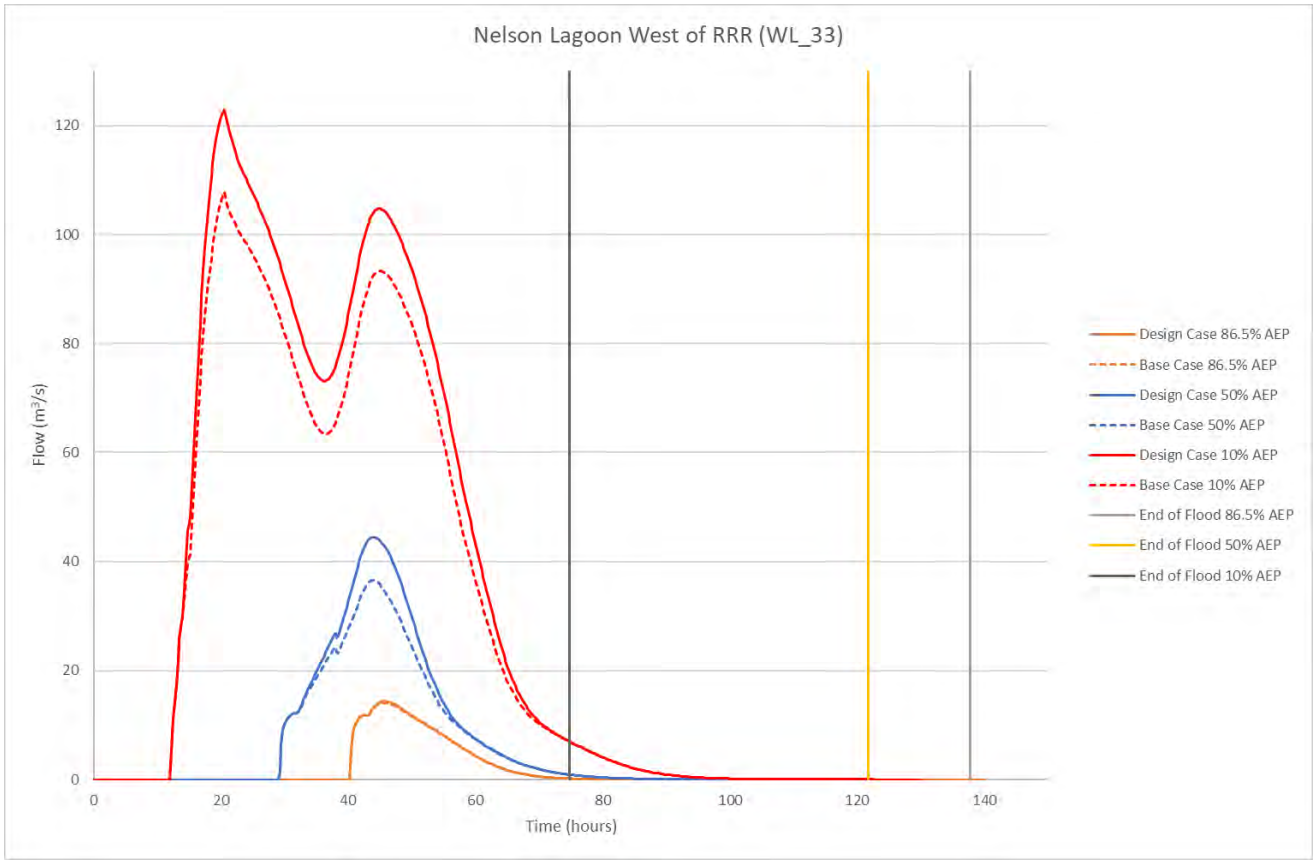
Appendix Figure A-3: Flow Hydrographs – Murray Lagoon Downstream of RAC



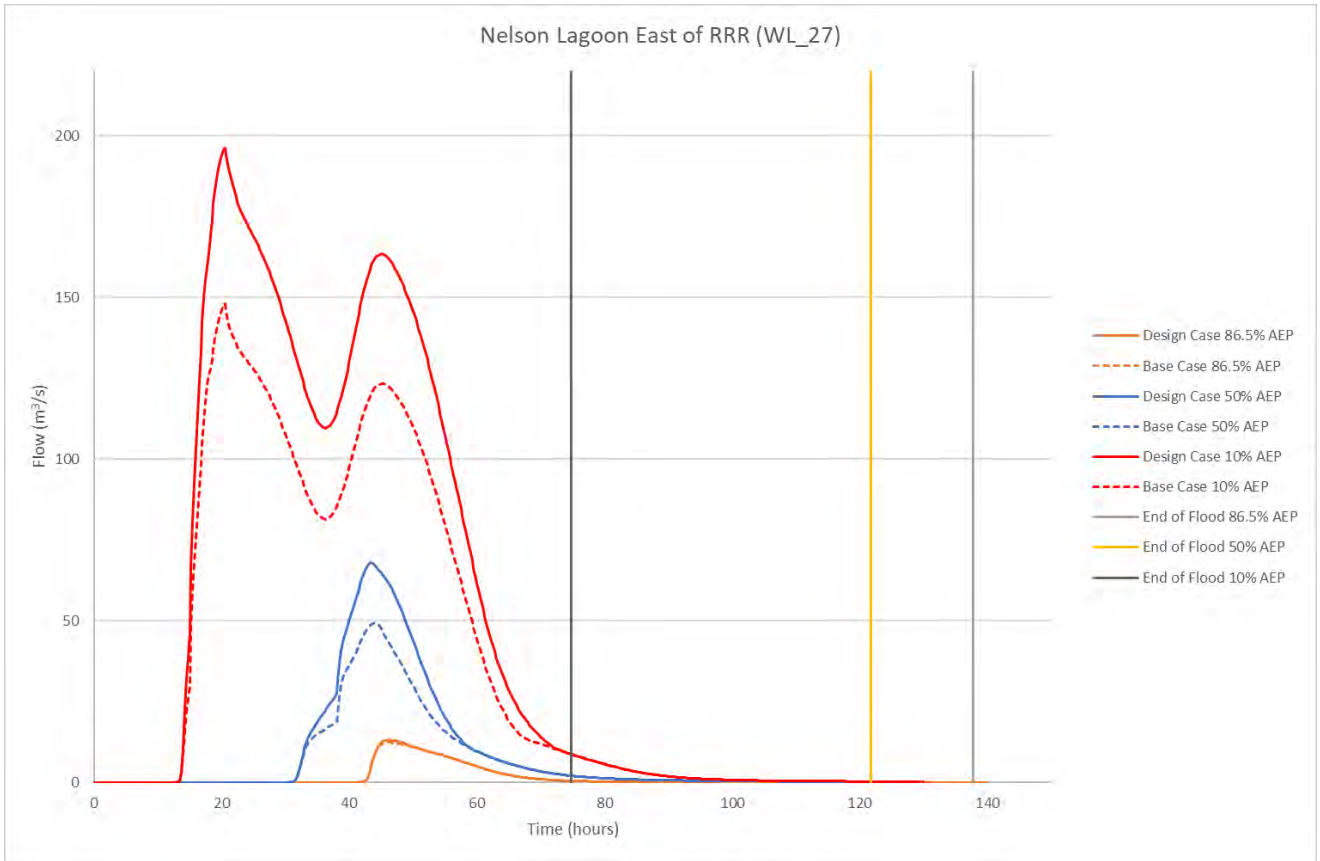
Appendix Figure A-4: Flow Hydrographs – Capricorn Highway Wetland Downstream of Capricorn Highway (North of Old Capricorn Highway)



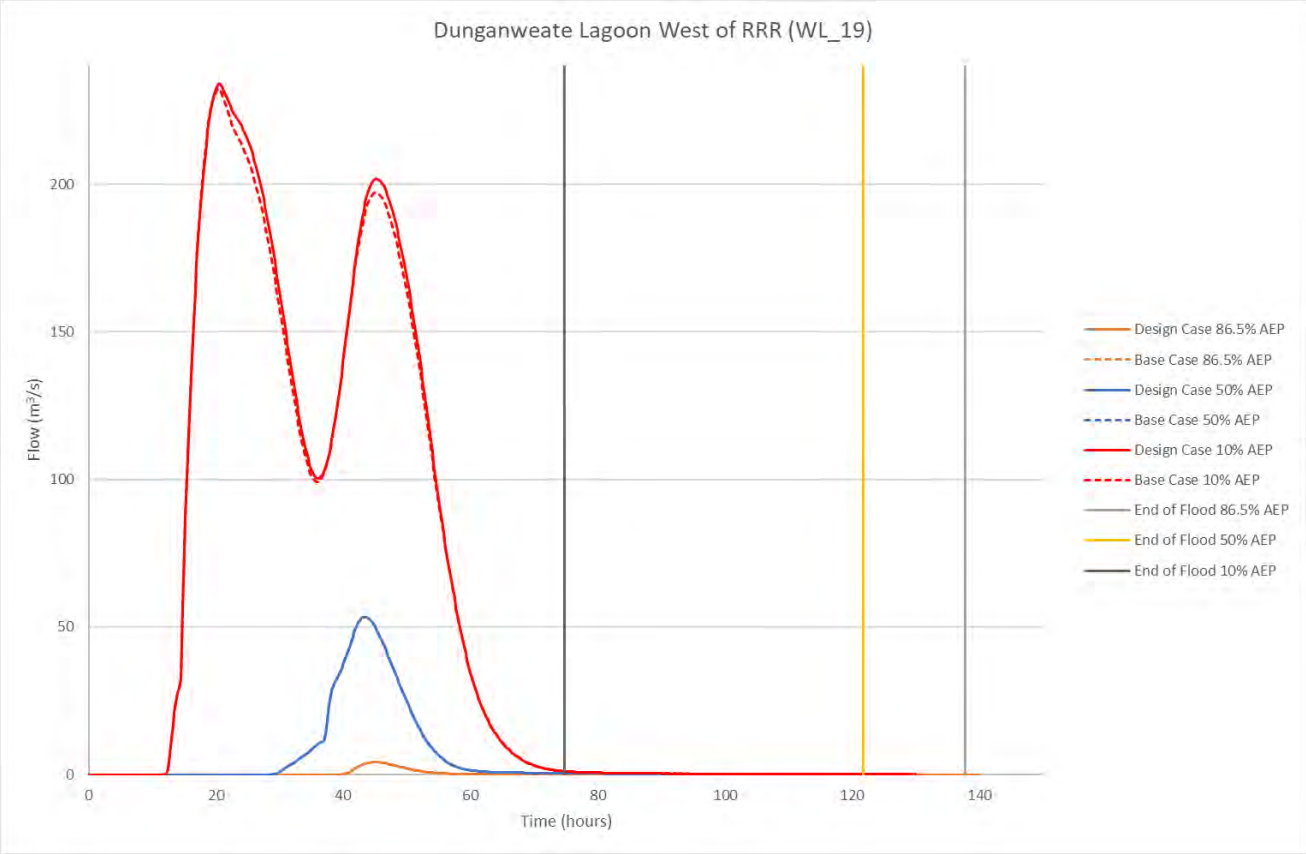
Appendix Figure A-5: Flow Hydrographs – Capricorn Highway Wetland Downstream of Capricorn Highway (South of Old Capricorn Highway)



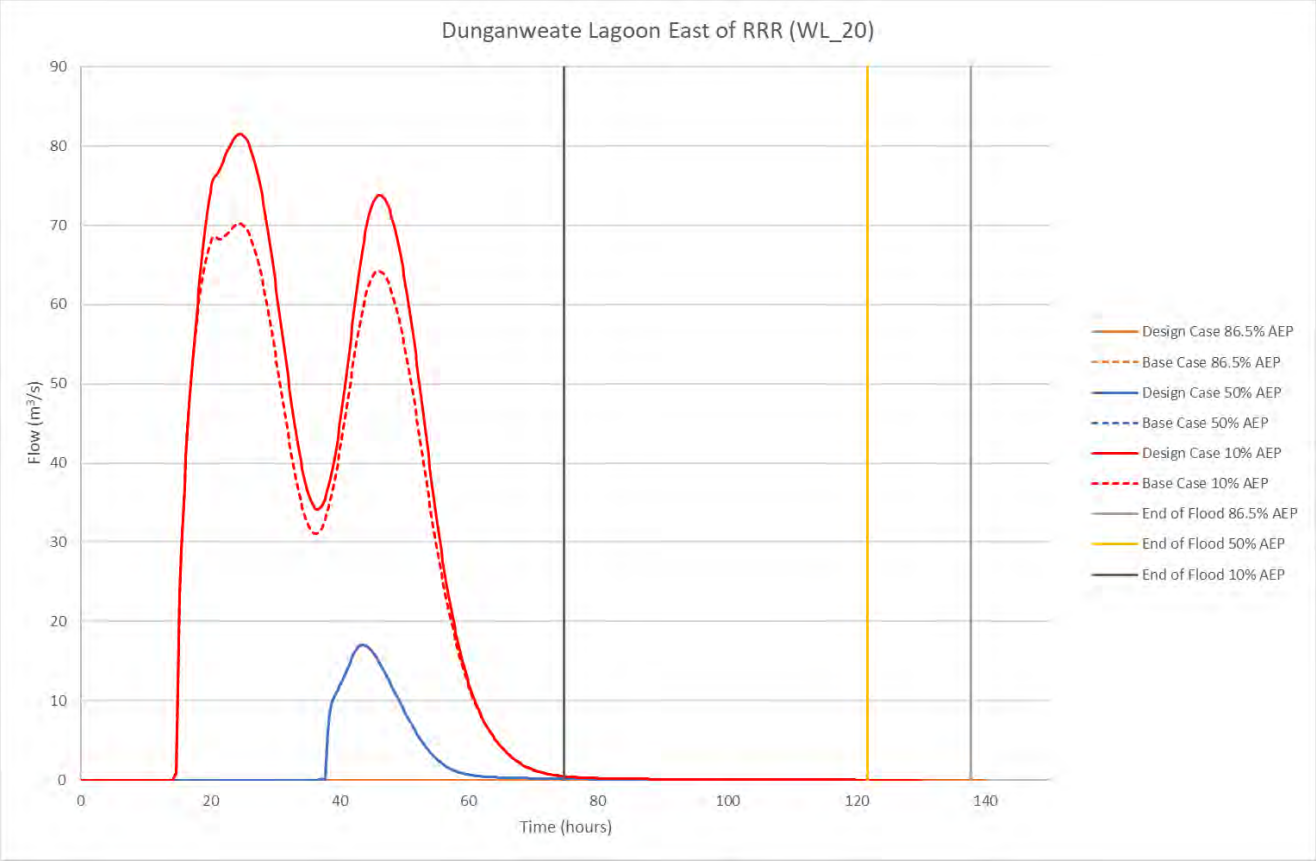
Appendix Figure A-6: Flow Hydrographs – Nelson Lagoon Upstream of Project Area



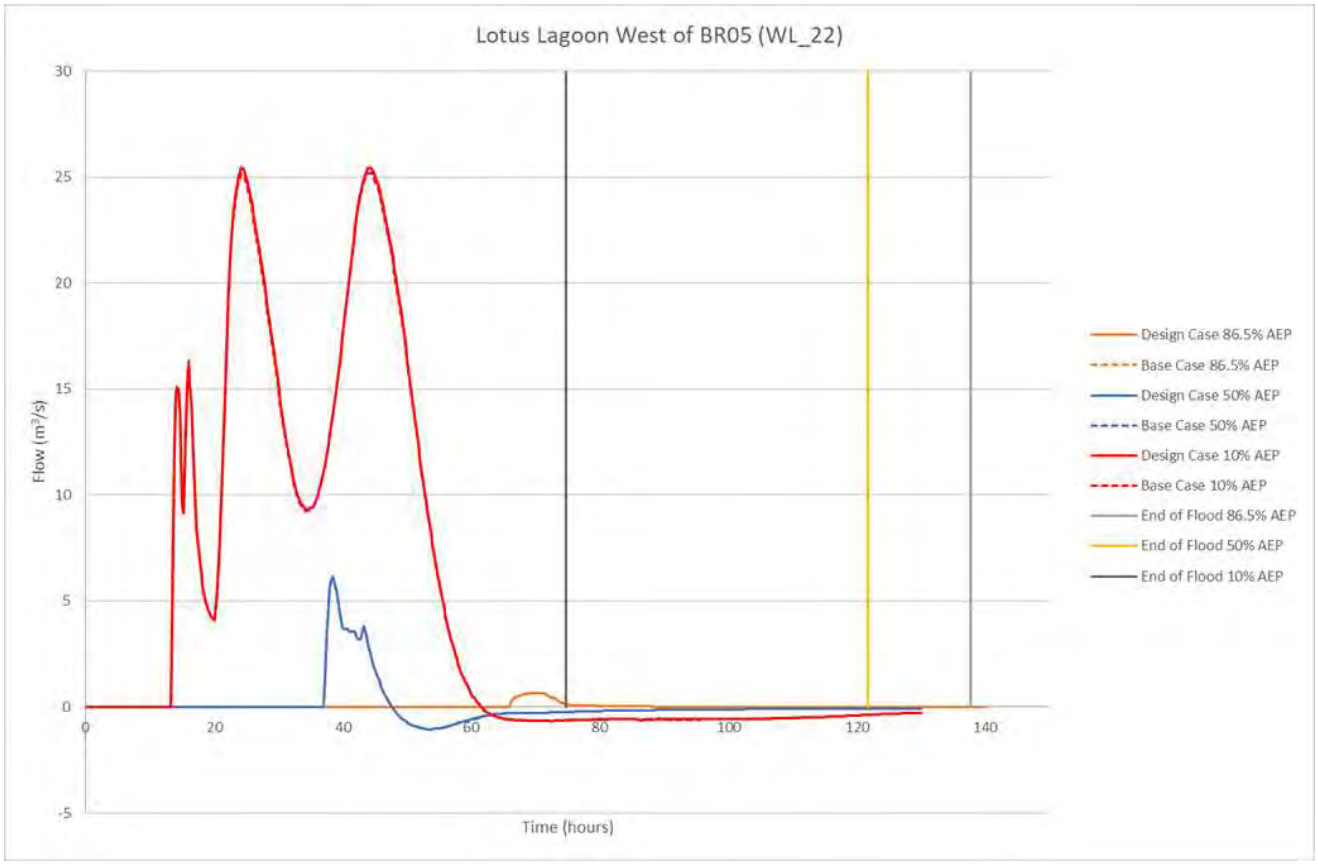
Appendix Figure A-7: Flow Hydrographs – Nelson Lagoon Downstream of Project Area



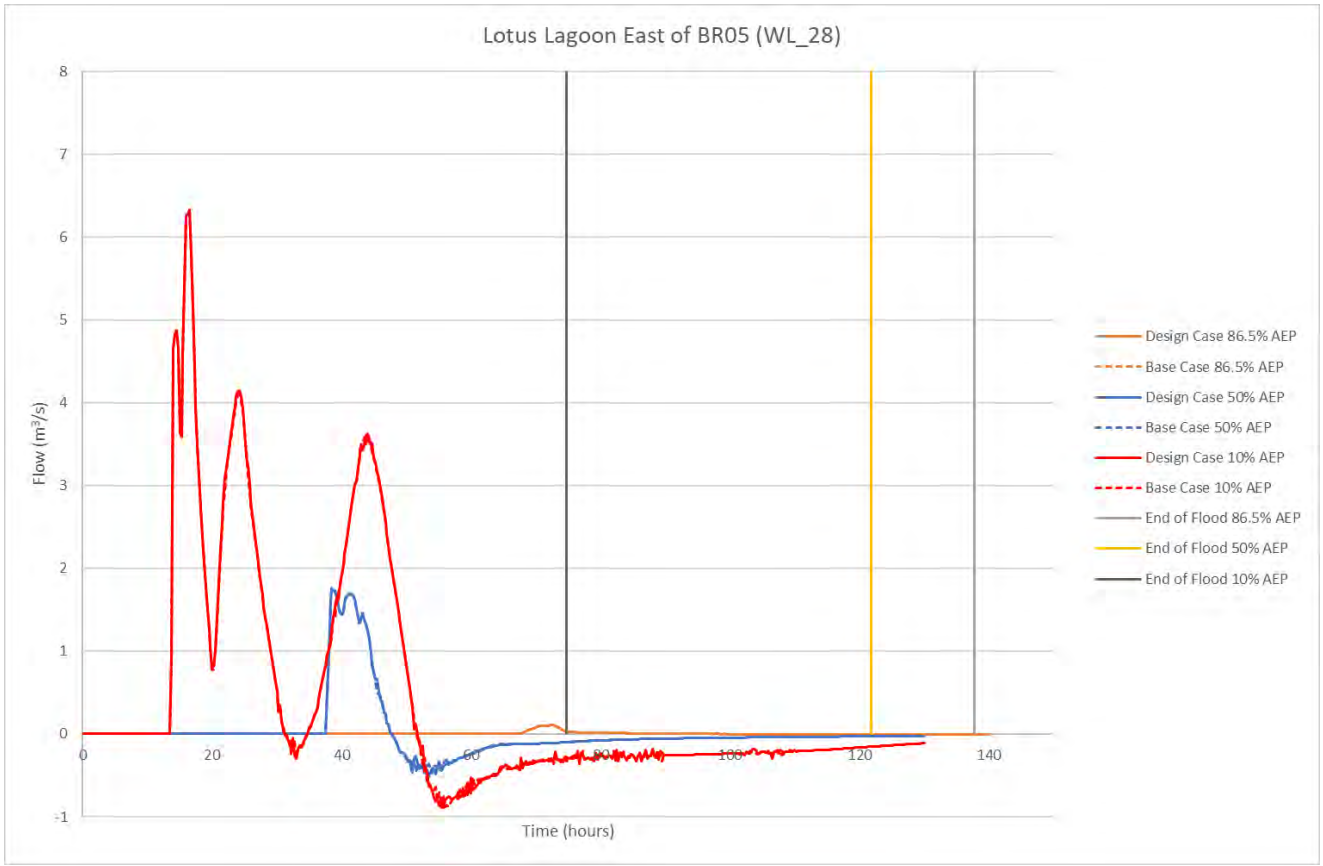
Appendix Figure A-8: Flow Hydrographs – Dunganweate Lagoon Upstream of Project Area



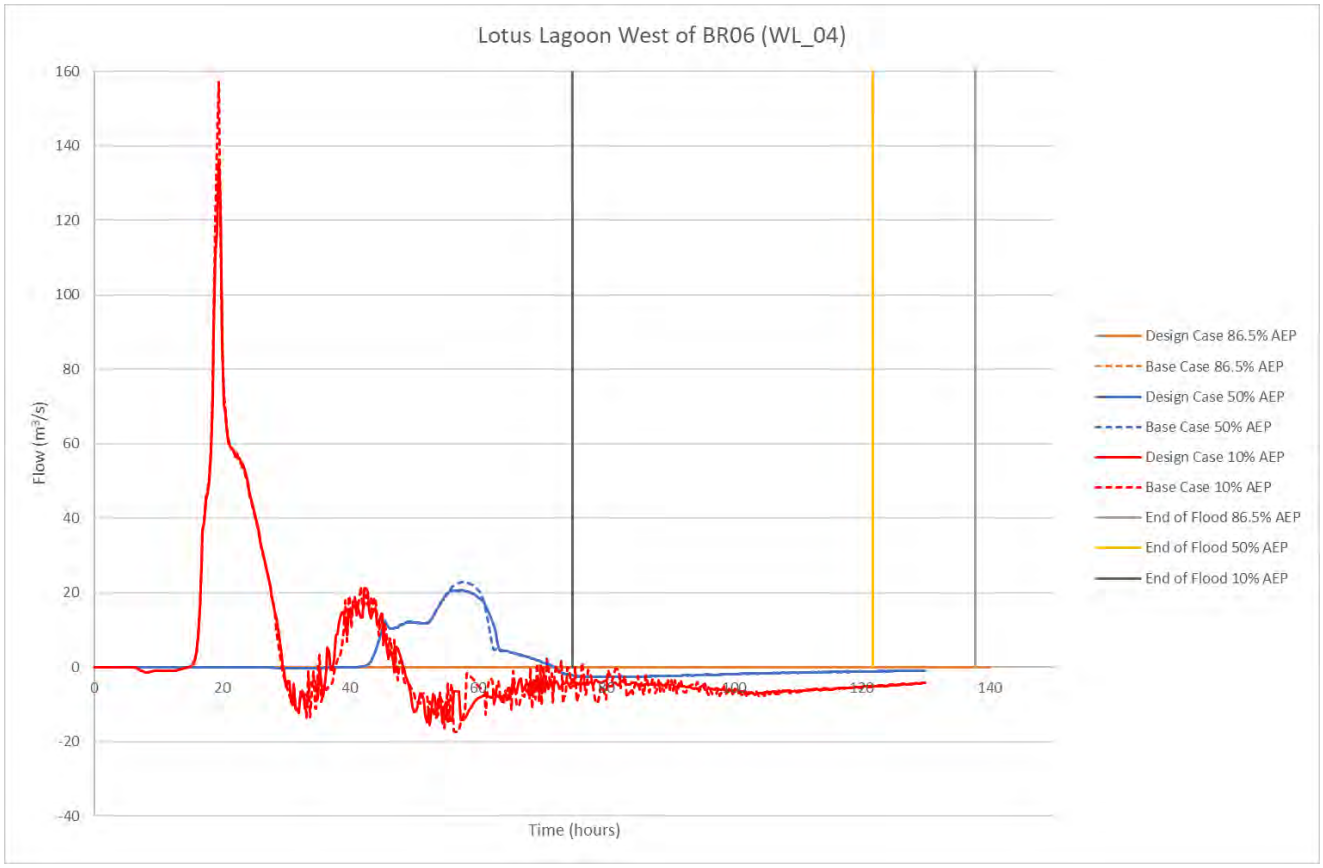
Appendix Figure A-9: Flow Hydrographs – Dunganweate Lagoon Downstream of Project Area



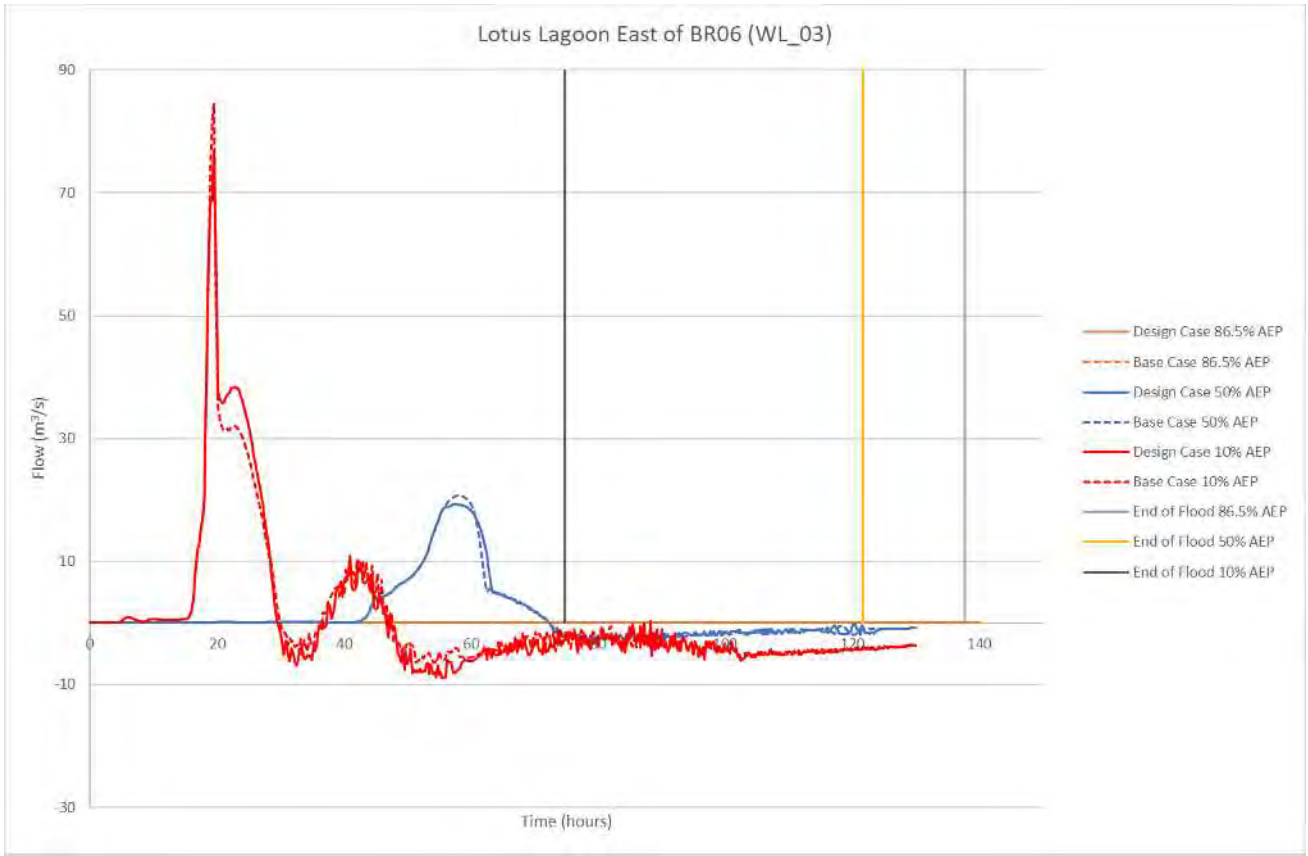
Appendix Figure A-10: Flow Hydrographs – Lotus Lagoon Upstream of Bridge 5



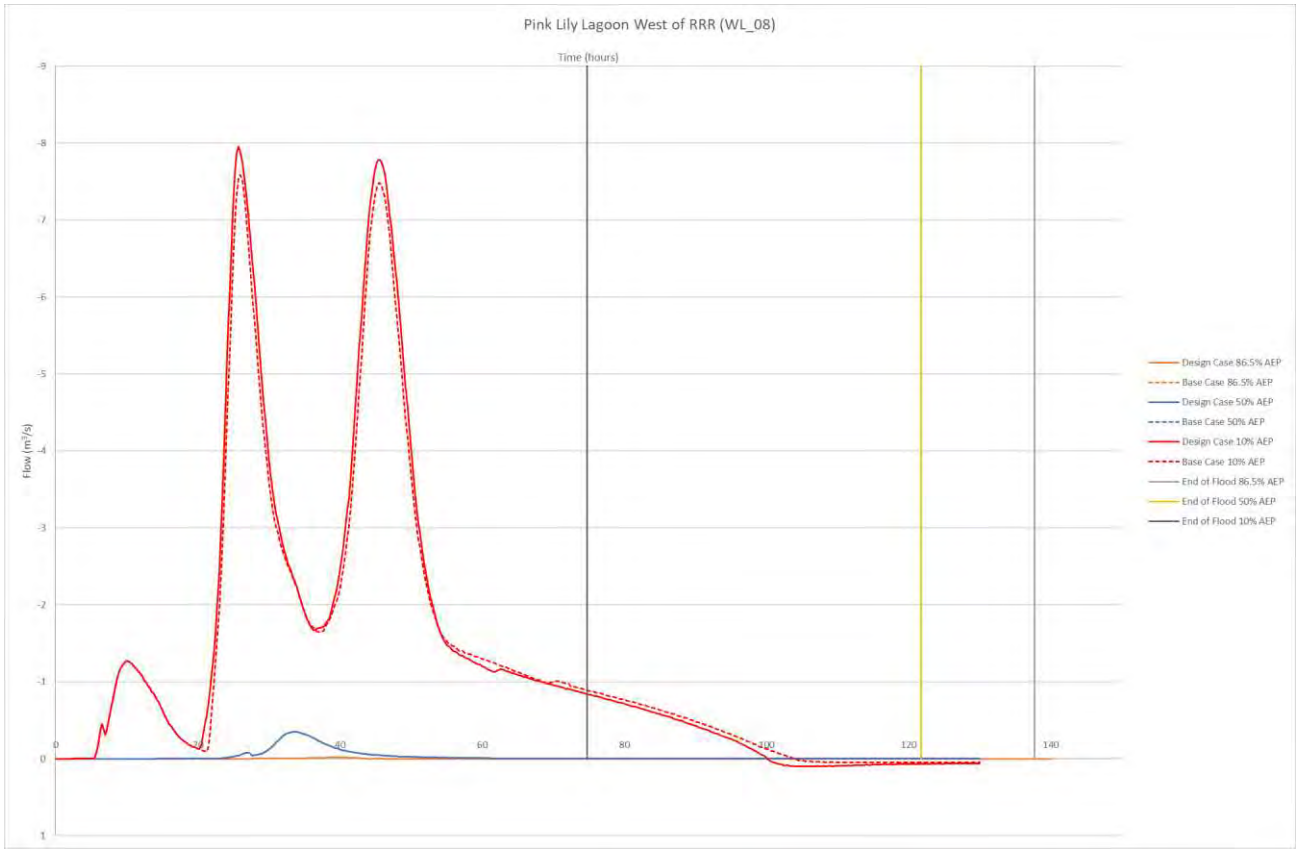
Appendix Figure A-11: Flow Hydrographs – Lotus Lagoon Downstream of Bridge 5



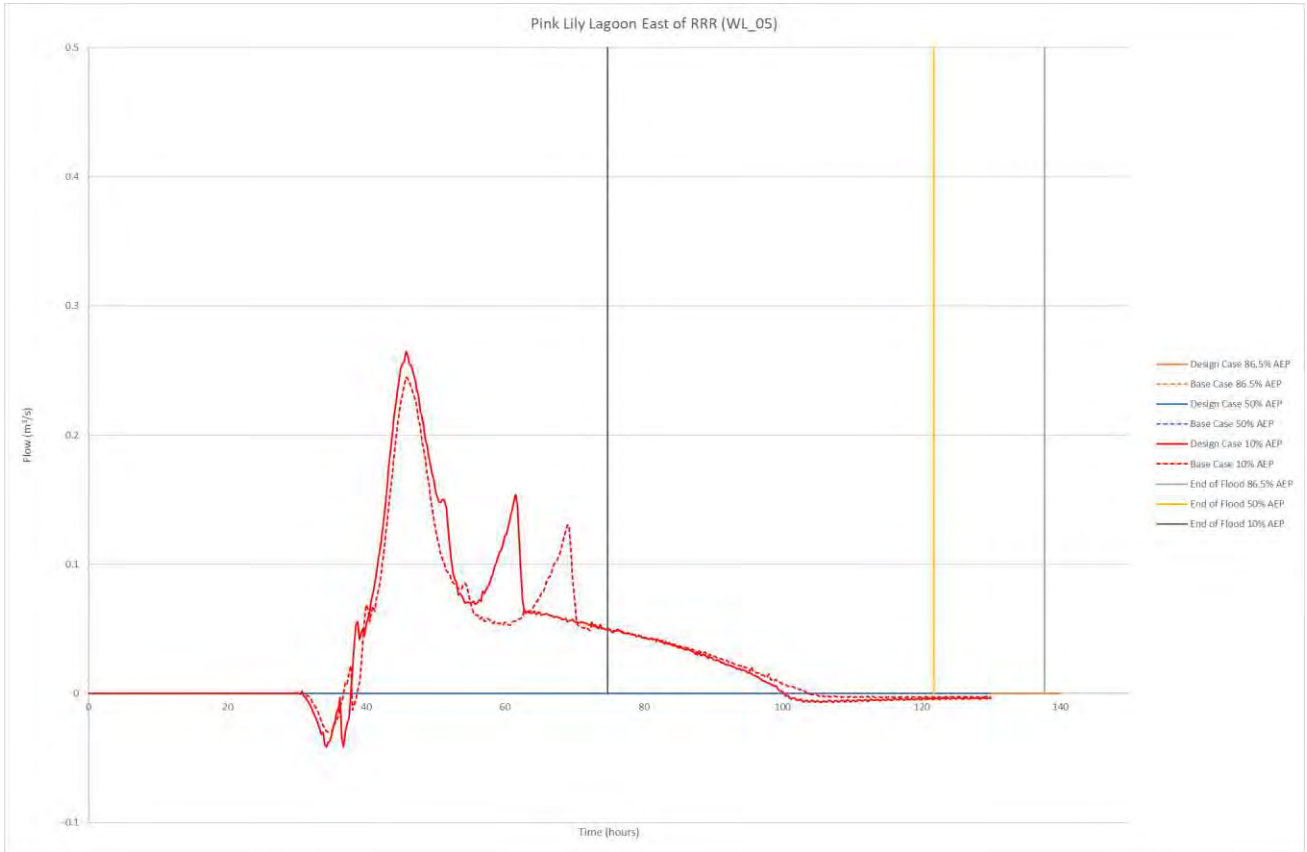
Appendix Figure A-12: Flow Hydrographs – Lotus Lagoon Upstream of Bridge 6



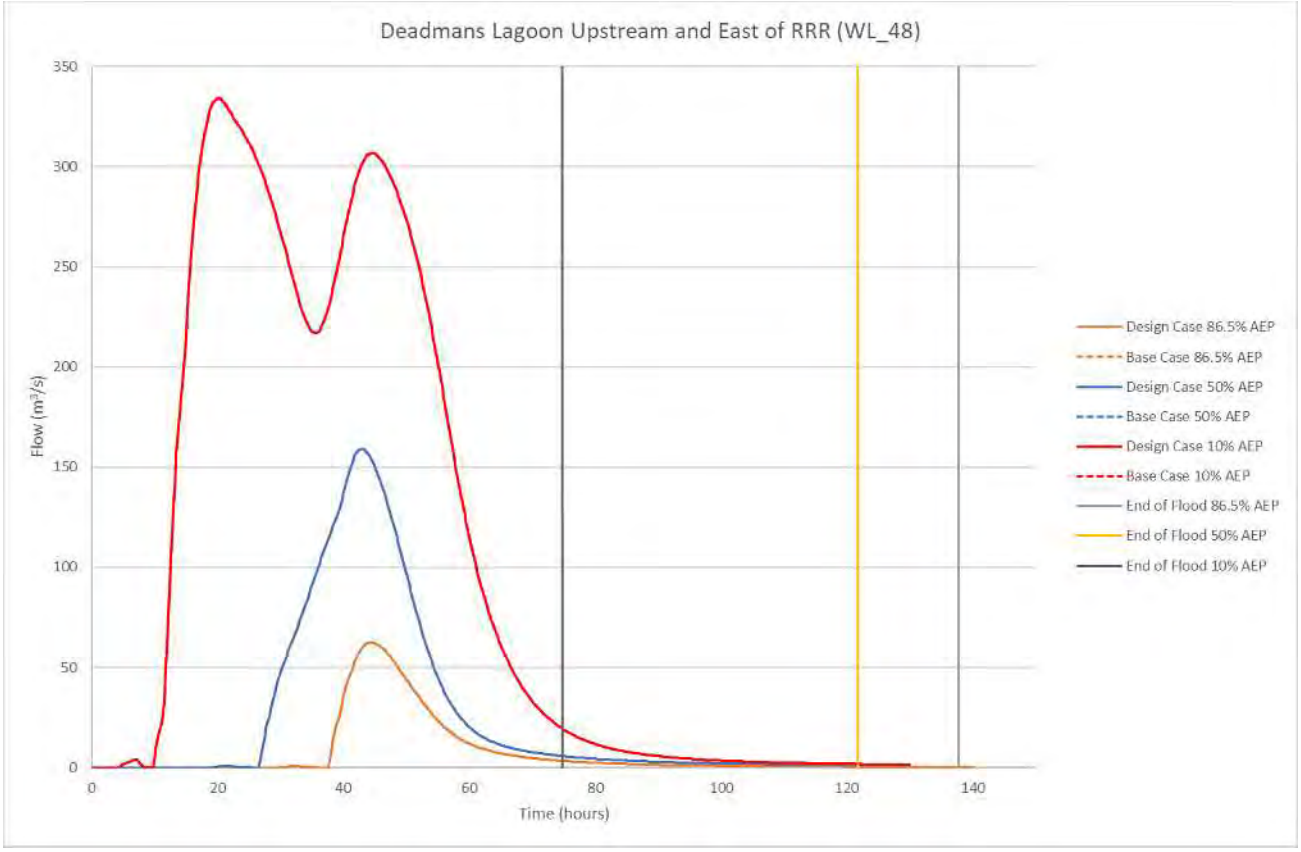
Appendix Figure A-13: Flow Hydrographs – Lotus Lagoon Downstream of Bridge 6



Appendix Figure A-14: Flow Hydrographs – Pink Lily Lagoon Upstream of Project Area

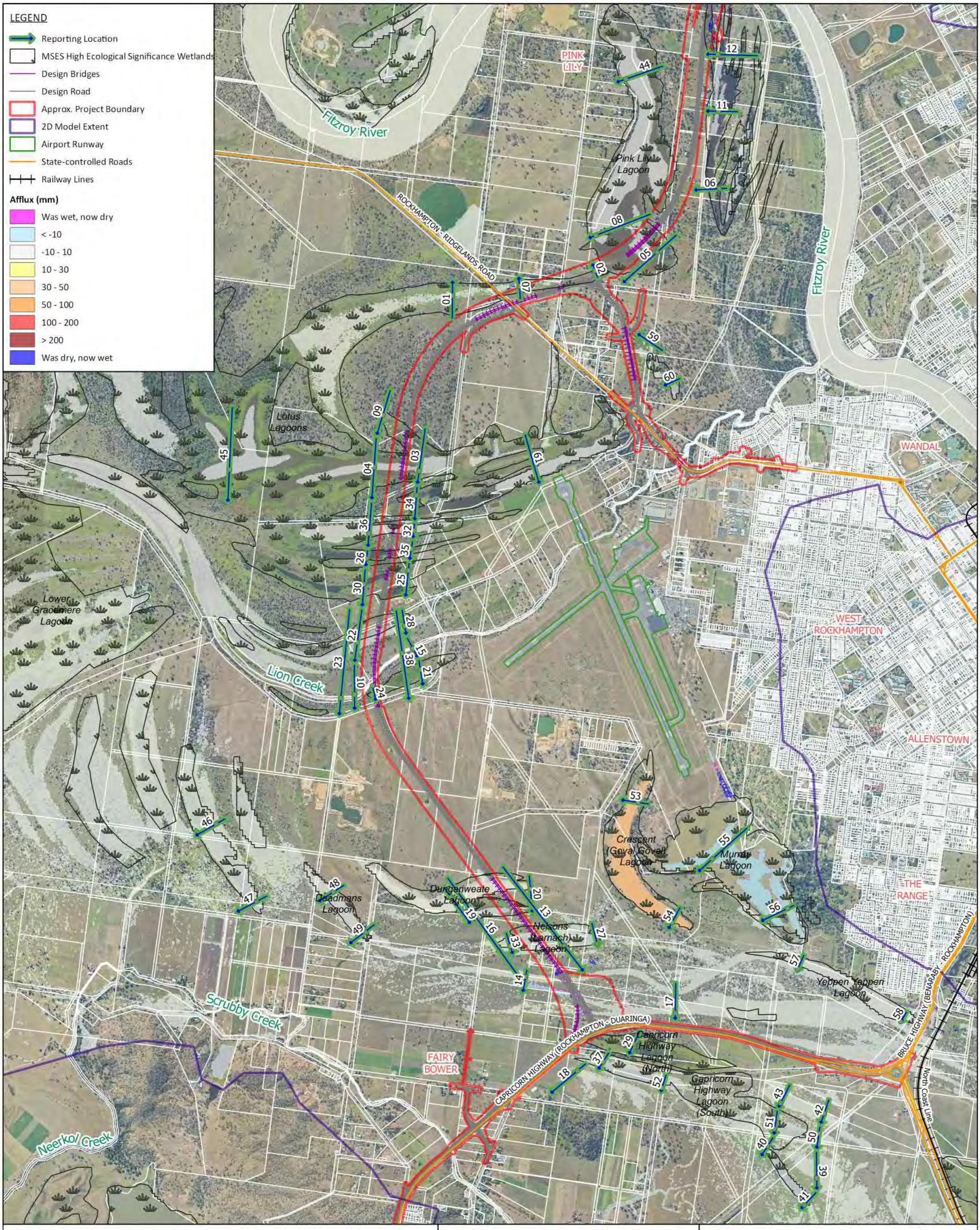


Appendix Figure A-15: Flow Hydrographs – Pink Lily Lagoon Downstream of Project Area



Appendix Figure A-16: Flow Hydrographs – Deadmans Lagoon Upstream of Project Area

Appendix B. End of Flood Afflux Mapping



PROJECT TITLE:	Rockhampton Ring Road
PROJECT NO:	1167108
MAP TITLE:	Wetland Connectivity Afflux - End of Flood - Local Catchments - 86.5% AEP
MAP NO:	B.1

0 600 1200 1800 2400 m

N

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

REVISION:	01	DATE:	11/05/2021
STATUS:	DRAFT		
AUTHOR:	M.L.	SOURCES:	QLD Globe
CHECKED:	T.O.	CRS:	GDA94 / MGA56

CLIENT:

Queensland Government
Department of Transport and Main Roads

CONSULTANT:

Jacobs SMEC

File path: \\OneDrive\C:\Users\toconnell\Jacobs\Rockhampton Ring Road - HF Hydrology and Flooding\GIS\Workspace\RRR_Mapping_DD_Wetland_01.qgs

LEGEND

- Reporting Location
- MSES High Ecological Significance Wetlands
- Design Bridges
- Design Road
- Approx. Project Boundary
- 2D Model Extent
- Airport Runway
- State-controlled Roads
- Railway Lines

Afflux (mm)

- Was wet, now dry
- < -10
- -10 - 10
- 10 - 30
- 30 - 50
- 50 - 100
- 100 - 200
- > 200
- Was dry, now wet

Fitzroy River
PINK LILY
Pink Lily Lagoon
ROCKHAMPTON - RIDGELANDS ROAD
Fitzroy River
Lotus Lagoons
WANDAL
Lower Gracemere Lagoon
WEST ROCKHAMPTON
Lion Creek
ALLENSTOWN
Crescent (Goval Goyal) Lagoon
Murray Lagoon
THE RANGE
Durganweate Lagoon
Deadmans Lagoon
Nelsons (Barnach) Lagoon
Yeppen Yeppen Lagoon
Scrubby Creek
CAPRICORN HIGHWAY (ROCKHAMPTON - DUARINGA)
FAIRY BOWER
Capricorn Highway Lagoon (North)
Capricorn Highway Lagoon (South)
BRUCE HIGHWAY (BENARABY - ROCKHAMPTON)
North Coast Line
Neerkol Creek

PROJECT TITLE:	Rockhampton Ring Road
PROJECT NO:	1167108
MAP TITLE:	Wetland Connectivity Afflux - End of Flood - Local Catchments - 63.2% AEP
MAP NO:	B.1
MAP NOTES:	[GENERAL_NOTE]

0 600 1200 1800 2400 m

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

REVISION:	01	DATE:	11/05/2021
STATUS:	DRAFT		
AUTHOR:	M.L.	SOURCES:	QLD Globe
CHECKED:	T.O.	CRS:	GDA94 / MGA56

CLIENT: Queensland Government
Department of Transport and Main Roads

CONSULTANT: Jacobs SMEC

File path: \\OneDrive\C:\Users\toconnell\Jacobs\Rockhampton Ring Road - HF Hydrology and Flooding\GIS\Workspace\RRR_Mapping_DD_Wetland_01.qgs

LEGEND

- Reporting Location
- MSES High Ecological Significance Wetlands
- Design Bridges
- Design Road
- Approx. Project Boundary
- 2D Model Extent
- Airport Runway
- State-controlled Roads
- Railway Lines

Afflux (mm)

- Was wet, now dry
- < -10
- -10 - 10
- 10 - 30
- 30 - 50
- 50 - 100
- 100 - 200
- > 200
- Was dry, now wet

Fitzroy River
PINK LILY
Pink Lily Lagoon
ROCKHAMPTON - RIDGELANDS ROAD
Fitzroy River
Lotus Lagoons
WANDAL
Lower Gracemere Lagoon
Lion Creek
WEST ROCKHAMPTON
ALLENSTOWN
Crescent (Goval Goveh) Lagoon
Murray Lagoon
THE RANGE
Durganweate Lagoon
Deadmans Lagoon
Nelsons (Yarnach) Lagoon
Yeppen Yeppen Lagoon
Scrubby Creek
FAIRY BOWER
CAPRICORN HIGHWAY (ROCKHAMPTON - DUARINGA)
Capricorn Highway Lagoon (North)
Capricorn Highway Lagoon (South)
BRUCE HIGHWAY (BENARABY - ROCKHAMPTON)
North Coast Line
Neerkol Creek

PROJECT TITLE:	Rockhampton Ring Road
PROJECT NO:	1167108
MAP TITLE:	Wetland Connectivity Afflux - End of Flood - Local Catchments - 50% AEP
MAP NO:	B.1
MAP NOTES:	[GENERAL_NOTE]

0 600 1200 1800 2400 m

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

REVISION:	01	DATE:	11/05/2021
STATUS:	DRAFT		
AUTHOR:	M.L.	SOURCES:	QLD Globe
CHECKED:	T.O.	CRS:	GDA94 / MGA56

CLIENT: Queensland Government
Department of Transport and Main Roads

CONSULTANT: Jacobs SMEC

File path: \\OneDrive\C:\Users\toconnell\Jacobs\Rockhampton Ring Road - HF Hydrology and Flooding\GIS\Workspace\RRR_Mapping_DD_Wetland_01.qgs

LEGEND

- Reporting Location
- MSES High Ecological Significance Wetlands
- Design Bridges
- Design Road
- Approx. Project Boundary
- 2D Model Extent
- Airport Runway
- State-controlled Roads
- Railway Lines

Afflux (mm)

- Was wet, now dry
- < -10
- -10 - 10
- 10 - 30
- 30 - 50
- 50 - 100
- 100 - 200
- > 200
- Was dry, now wet

Fitzroy River
PINK LILY
Pink Lily Lagoon
ROCKHAMPTON - RIDGELANDS ROAD
Fitzroy River
Lotus Lagoons
WANDAL
Lower Gracemere Lagoon
Lion Creek
WEST ROCKHAMPTON
ALLENSTOWN
Crescent (Goval Goval) Lagoon
Murray Lagoon
THE RANGE
Durganweate Lagoon
Deadmans Lagoon
Nelsons (Barnach) Lagoon
Yeppen Yeppen Lagoon
Scrubby Creek
FAIRY BOWER
CAPRICORN HIGHWAY (ROCKHAMPTON - DUARINGA)
Capricorn Highway Lagoon (North)
Capricorn Highway Lagoon (South)
BRUCE HIGHWAY (BENARABY - ROCKHAMPTON)
North Coast Line
Neerkol Creek

PROJECT TITLE:	Rockhampton Ring Road
PROJECT NO:	1167108
MAP TITLE:	Wetland Connectivity Afflux - End of Flood - Local Catchments - 20% AEP
MAP NO:	B.1
MAP NOTES:	[GENERAL_NOTE]

0 600 1200 1800 2400 m

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

REVISION:	01	DATE:	11/05/2021
STATUS:	DRAFT		
AUTHOR:	M.L.	SOURCES:	QLD Globe
CHECKED:	T.O.	CRS:	GDA94 / MGA56

CLIENT: Queensland Government
Department of Transport and Main Roads

CONSULTANT: Jacobs SMEC

File path: \\OneDrive\C:\Users\toconnell\Jacobs\Rockhampton Ring Road - HF Hydrology and Flooding\GIS\Workspace\RRR_Mapping_DD_Wetland_01.qgs

LEGEND

- Reporting Location
- MSES High Ecological Significance Wetlands
- Design Bridges
- Design Road
- Approx. Project Boundary
- 2D Model Extent
- Airport Runway
- State-controlled Roads
- Railway Lines

Afflux (mm)

- Was wet, now dry
- < -10
- -10 - 10
- 10 - 30
- 30 - 50
- 50 - 100
- 100 - 200
- > 200
- Was dry, now wet

Fitzroy River
PINK LILY
Pink Lily Lagoon
ROCKHAMPTON - RIDGELANDS ROAD
Fitzroy River
Lotus Lagoons
WANDAL
Lower Gracemere Lagoon
WEST ROCKHAMPTON
Lion Creek
ALLENSTOWN
Crescent (Goval Goval) Lagoon
Murray Lagoon
THE RANGE
Durganweate Lagoon
Deadmans Lagoon
Nelsons (Barnach) Lagoon
Yeppen Yeppen Lagoon
Scrubby Creek
CAPRICORN HIGHWAY (ROCKHAMPTON - DUARINGA)
Capricorn Highway Lagoon (North)
Capricorn Highway Lagoon (South)
FAIRY BOWER
BRUCE HIGHWAY (BENARABY - ROCKHAMPTON)
North Coast Line
Neerkol Creek

PROJECT TITLE:	Rockhampton Ring Road
PROJECT NO:	1167108
MAP TITLE:	Wetland Connectivity Afflux - End of Flood - Local Catchments - 10% AEP
MAP NO:	B.1
MAP NOTES:	[GENERAL_NOTE]

0 600 1200 1800 2400 m

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

REVISION:	01	DATE:	11/05/2021
STATUS:	DRAFT		
AUTHOR:	M.L.	SOURCES:	QLD Globe
CHECKED:	T.O.	CRS:	GDA94 / MGA56

CLIENT: Queensland Government
Department of Transport and Main Roads

CONSULTANT: Jacobs SMEC

File path: \\OneDrive\C:\Users\toconnell\Jacobs\Rockhampton Ring Road - HF Hydrology and Flooding\GIS\Workspace\RRR_Mapping_DD_Wetland_01.qgs

Appendix C. Tables of Results

C.1 Wetland Connectivity Volume

Percentage Post Flood volume changes greater than 10% where the absolute volume is greater than 1000m^3, i.e. where there is significant increase in flow volume, are highlighted in red.

Percentage Post Flood volume changes less than 10% where the absolute volume is greater than 1000m^3, i.e. where there is significant decrease in flow volume, are highlighted in green.

Appendix Table C-1: Wetland Connectivity Volume

Reporting Location	86.5% AEP Local Event						50% AEP Local Event						10% AEP Local Event					
	During Flood Volume (m^3)			Post Flood Volume (m^3)			During Flood Volume (m^3)			Post Flood Volume (m^3)			During Flood Volume (m^3)			Post Flood Volume (m^3)		
	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff
WL_01	8347	8379	0.40%	55	56	1.30%	70020	69941	0.10%	783	791	1.00%	476325	506345	6.30%	52699	63125	19.80%
WL_02	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	673024	718537	6.80%	61467	47175	23.30%
WL_03 - Lotus Lagoon at BR06 (East)	2422	2429	0.30%	Dry	Dry	Dry	601451	609372	1.30%	26214	30557	16.60%	1097321	1002109	8.70%	764956	765323	0.00%
WL_04 - Lotus Lagoon at BR06 (West)	3394	3392	0.00%	Dry	Dry	Dry	735247	725961	1.30%	31283	31069	0.70%	1869580	1816033	2.90%	1116845	1069709	4.20%
WL_05 - Pink Lily Lagoon (East)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	12250	13633	11.30%	2621	2143	18.30%
WL_06	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	16175	16174	0.00%	3734	3736	0.10%
WL_07	3167	3027	4.40%	Dry	0	Dry	16156	15126	6.40%	4	4	11.40%	635264	664623	4.60%	31115	19773	36.50%
WL_08 - Pink Lily Lagoon (West)	431	432	0.30%	Dry	0	Dry	13366	13360	0.00%	29	29	0.30%	573915	604535	5.30%	45255	34859	23.00%
WL_09	9127	9145	0.20%	Dry	Dry	Dry	35841	35749	0.30%	Dry	Dry	Dry	144570	118672	17.90%	14334	13130	8.40%
WL_10	163751	163740	0.00%	4609	4611	0.00%	8588213	8595267	0.10%	283912	284185	0.10%	15758589	15734398	0.20%	10212895	10190805	0.20%
WL_11	1089	1089	0.10%	Dry	Dry	Dry	5916	5962	0.80%	1	1	27.30%	19665	19406	1.30%	2736	2746	0.30%
WL_12	290	459	58.00%	10	1	107.40%	4440	4842	9.00%	3	2	42.90%	13307	14034	5.50%	646	662	2.30%
WL_13	812973	809925	0.40%	86	71	17.80%	4608143	6311958	37.00%	3935	3924	0.30%	36897444	49938803	35.30%	325123	321370	1.20%
WL_14	2330304	2259104	3.10%	2833	2837	0.10%	5373998	4803208	10.60%	37510	37507	0.00%	15999999	13136047	17.90%	860910	863432	0.30%
WL_15	159253	159285	0.00%	4627	4628	0.00%	8560863	8567154	0.10%	285134	285412	0.10%	17260104	17232424	0.20%	10286478	10264375	0.20%
WL_16	3124475	3043952	2.60%	2786	2792	0.20%	9846817	9886478	0.40%	39047	39035	0.00%	51068909	53877312	5.50%	1106305	1104581	0.20%
WL_17	2054402	2054038	0.00%	3220	3208	0.40%	6440381	5847577	9.20%	40633	40526	0.30%	25774106	24085263	6.60%	909263	922865	1.50%
WL_18	151	152	0.70%	3	2	3.60%	287	290	0.80%	12	12	3.80%	239525	340554	42.20%	315	348	10.30%
WL_19 - Dunganweate Lagoon (West)	131099	131082	0.00%	113	116	1.90%	2394188	2393593	0.00%	730	723	0.90%	25474646	25941893	1.80%	52189	51967	0.40%
WL_20 - Dunganweate Lagoon (East)	11	10	10.30%	Dry	0	Dry	720460	719911	0.10%	17	17	0.00%	8071541	9062848	12.30%	15414	15319	0.60%
WL_21	Dry	Dry	Dry	Dry	Dry	Dry	313	381	21.90%	Dry	Dry	Dry	463466	466745	0.70%	5533	5558	0.40%
WL_22 - Lotus Lagoon at BR05 (West)	16837	16841	0.00%	73	73	0.10%	41138	41202	0.20%	1998	1999	0.10%	2344043	2362165	0.80%	101463	100857	0.60%
WL_23	184008	184008	0.00%	4518	4520	0.00%	8638073	8645138	0.10%	281439	281739	0.10%	18112500	18110342	0.00%	10072892	10051465	0.20%
WL_24	Dry	Dry	Dry	Dry	Dry	Dry	11499	12168	5.80%	Dry	Dry	Dry	2715536	2739147	0.90%	30817	30067	2.40%
WL_25 - Lotus Lagoon at BR18 (East)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	7642	4568	40.20%	1666	1598	4.10%
WL_26 - Lotus Lagoon at BR19 (West)	Dry	Dry	Dry	Dry	Dry	Dry	27077	28049	3.60%	427	395	192.50%	47544	36158	23.90%	118826	125669	5.80%
WL_27- Nelson Lagoon (East)	676070	690137	2.10%	115	114	0.90%	3000032	3978402	32.60%	4392	4388	0.10%	17869951	23863935	33.50%	327646	327074	0.20%

Reporting Location	86.5% AEP Local Event						50% AEP Local Event						10% AEP Local Event					
	During Flood Volume (m^3)			Post Flood Volume (m^3)			During Flood Volume (m^3)			Post Flood Volume (m^3)			During Flood Volume (m^3)			Post Flood Volume (m^3)		
	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff
WL_28 - Lotus Lagoon at BR05 (East)	2219	2220	0.00%	19	20	0.50%	10967	10821	1.30%	794	796	0.30%	241196	243060	0.80%	43059	43205	0.30%
WL_29 - North Cap Hwy Lagoon	Dry	Dry	Dry	Dry	Dry	Dry	201	Dry	100.00%	Dry	Dry	Dry	184359	138559	24.80%	6533	6573	0.60%
WL_30 - Lotus Lagoon at BR18 (West)	Dry	Dry	Dry	Dry	Dry	Dry	2263	2234	1.30%	60	60	0.10%	48457	44914	7.30%	20260	19688	2.80%
WL_32 - Lotus Lagoon at BR20 (East)	3864	3879	0.40%	12	13	6.60%	39641	31215	21.30%	560	2047	265.80%	539628	578377	7.20%	149915	195875	30.70%
WL_33 - Nelson Lagoon (West)	800014	806275	0.80%	11	16	40.00%	2539304	2917254	14.90%	201	197	1.90%	13889140	15737837	13.30%	194391	194011	0.20%
WL_34	Dry	Dry	Dry	Dry	Dry	Dry	125214	120317	3.90%	4159	4836	16.30%	521578	313297	39.90%	38208	53439	39.90%
WL_35 - Lotus Lagoon at BR19 (East)	Dry	Dry	Dry	Dry	Dry	Dry	7287	7276	0.20%	237	239	0.80%	9233	6749	26.90%	127621	129521	1.50%
WL_36 - Lotus Lagoon at BR20 (West)	16232	16056	1.10%	39	38	2.10%	50992	48780	4.30%	3616	4298	18.90%	175086	90185	48.50%	221751	212591	4.10%
WL_37 - South Cap Hwy Lagoon	4548	4568	0.40%	24	24	1.50%	4732	4726	0.10%	119	118	0.60%	363266	556644	53.20%	1820	1924	5.70%
WL_38	163371	163326	0.00%	4600	4600	0.00%	8579764	8586077	0.10%	284042	284307	0.10%	17995946	17976615	0.10%	10217736	10195599	0.20%
WL_39	252664	252680	0.00%	751	750	0.10%	434496	434475	0.00%	3666	3664	0.10%	970836	966493	0.40%	73809	74265	0.60%
WL_40	87161	87147	0.00%	302	302	0.20%	141861	141858	0.00%	1326	1324	0.10%	433210	452472	4.40%	19800	19899	0.50%
WL_41	174063	174072	0.00%	382	383	0.00%	313300	313310	0.00%	1659	1656	0.20%	920459	910219	1.10%	26975	27075	0.40%
WL_42	139133	139122	0.00%	173	171	1.10%	263614	263629	0.00%	914	916	0.20%	1107956	1072480	3.20%	30357	30677	1.10%
WL_43	154744	154756	0.00%	105	105	0.20%	292955	292973	0.00%	596	589	1.10%	1646235	1632405	0.80%	24929	25178	1.00%
WL_44	238	237	0.30%	Dry	0	Dry	1839	1834	0.20%	6	7	4.20%	107704	114352	6.20%	9049	7091	21.60%
WL_45	10613	10613	0.00%	8	8	3.30%	1397651	1390521	0.50%	81001	81141	0.20%	5674602	5676609	0.00%	2382889	2370756	0.50%
WL_46	2268537	2268525	0.00%	1564	1564	0.00%	7956211	7956192	0.00%	31563	31562	0.00%	31617652	31622009	0.00%	757344	756254	0.10%
WL_47	579298	579314	0.00%	24	23	3.00%	1915115	1915114	0.00%	1733	1732	0.10%	9674466	9683582	0.10%	106991	106785	0.20%
WL_48 - Deadmans Lagoon	3584366	3584347	0.00%	2366	2366	0.00%	11386283	11386090	0.00%	34850	34877	0.10%	47332056	47287825	0.10%	950374	948912	0.20%
WL_49	3447151	3447126	0.00%	2629	2629	0.00%	10776623	10775952	0.00%	36301	36304	0.00%	44535876	44439596	0.20%	963210	961705	0.20%
WL_50	28597	28591	0.00%	150	152	1.10%	16614	16636	0.10%	846	847	0.10%	478248	477411	0.20%	20628	20756	0.60%
WL_51	197894	197915	0.00%	485	482	0.80%	304721	304714	0.00%	2277	2273	0.20%	826933	850802	2.90%	41888	42078	0.50%
WL_52	33638	33652	0.00%	138	137	0.50%	32549	32600	0.20%	646	645	0.20%	541619	750928	38.60%	9136	9515	4.10%
WL_53	4496	4078	9.30%	0	2	260.00%	24707	25185	1.90%	431	432	0.20%	48413	48387	0.10%	17768	18040	1.50%
WL_54 - Crescent Lagoon	5405	5760	6.60%	Dry	1	Dry	748528	1278338	70.80%	2946	2949	0.10%	12465189	14397429	15.50%	141074	142385	0.90%
WL_55 - Nelson Lagoon (West)	71781	69347	3.40%	37	37	2.50%	7179	4378	161.00%	2047	2206	7.80%	4887458	5250633	7.40%	55454	57657	4.00%
WL_56 - Nelson Lagoon (East)	6024	6045	0.40%	85	89	5.50%	65632	26571	59.50%	60	124	107.20%	8010569	8447857	5.50%	7641	8167	6.90%
WL_57	1223605	1217374	0.50%	3114	3114	0.00%	4193993	4281147	2.10%	34595	33922	1.90%	20192456	20299030	0.50%	1056687	1066838	1.00%
WL_58 - Yeppen Lagoon	2391205	2385912	0.20%	6001	5966	0.60%	7640207	7638387	0.00%	72651	73103	0.60%	37275686	37280786	0.00%	2181867	2204229	1.00%

C.2 Wetland Connectivity Flow

Percentage End of Flood flow changes greater than 10% where the absolute discharge is greater than 1m^3/s, i.e. where there is significant increase in flow, are highlighted in red.

Percentage End of Flood flow changes less than 10% where the absolute discharge is greater than 1m^3/s, i.e. where there is significant decrease in flow, are highlighted in green.

Appendix Table C-2: Wetland Connectivity Flow

Reporting Location	86.5% AEP Local Event						50% AEP Local Event						10% AEP Local Event					
	Peak Flood Flow (m^3/s)			End of Flood Flow (m^3/s)			Peak Flood Flow (m^3/s)			End of Flood Flow (m^3/s)			Peak Flood Flow (m^3/s)			End of Flood Flow (m^3/s)		
	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff
WL_01	0.1	0.1	3.5%	Dry	0.0	Dry	1.1	1.0	6.2%	0.0	0.0	Dry	19.6	19.6	0.1%	0.2	0.1	51.4%
WL_02	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	9.7	10.1	4.0%	1.2	1.1	2.2%
WL_03 - Lotus Lagoon at BR06 (East)	0.2	0.2	0.1%	Dry	Dry	Dry	20.7	19.3	6.8%	1.0	1.5	46.3%	84.5	76.8	9.1%	2.9	1.6	44.3%
WL_04 - Lotus Lagoon at BR06 (West)	0.2	0.2	0.0%	Dry	Dry	Dry	22.8	20.6	9.4%	1.2	1.3	8.5%	157.3	136.3	13.3%	5.3	5.2	1.6%
WL_05 - Pink Lily Lagoon (East)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.2	0.3	8.3%	0.0	0.1	4.2%
WL_06	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.2	0.2	0.0%	0.0	0.0	1.3%
WL_07	0.1	0.1	5.9%	Dry	0.0	Dry	0.3	0.2	28.6%	0.0	0.0	0.0%	9.1	9.4	3.5%	1.0	1.0	4.7%
WL_08 - Pink Lily Lagoon (West)	0.0	0.0	0.0%	Dry	Dry	Dry	0.3	0.3	0.0%	0.0	0.0	0.0%	7.6	8.0	4.8%	0.9	0.8	5.7%
WL_09	0.3	0.3	1.3%	Dry	Dry	Dry	0.8	0.8	3.1%	Dry	Dry	Dry	5.2	4.7	10.2%	0.1	0.1	24.6%
WL_10	0.7	0.7	0.0%	Dry	0.6	Dry	56.2	56.1	0.2%	10.6	10.6	0.1%	92.2	92.1	0.2%	67.1	66.9	0.3%
WL_11	0.1	0.1	0.0%	Dry	Dry	Dry	0.1	0.1	0.1%	0.0	Dry	Dry	0.6	0.6	1.7%	0.0	0.0	Dry
WL_12	0.0	0.0	0.0%	Dry	0.0	Dry	0.2	0.2	20.4%	0.0	0.0	Dry	0.5	0.6	11.1%	0.0	0.0	Dry
WL_13	15.1	15.8	4.8%	Dry	0.0	Dry	83.4	117.1	40.4%	0.2	0.2	0.7%	297.8	403.7	35.6%	9.5	9.4	0.9%
WL_14	36.1	33.6	6.8%	Dry	0.4	Dry	56.8	47.6	16.2%	1.4	1.4	0.0%	120.1	97.1	19.2%	14.6	14.5	1.0%
WL_15	0.7	0.7	0.0%	Dry	0.6	Dry	55.4	55.3	0.1%	10.6	10.6	0.0%	94.6	94.7	0.0%	67.7	67.5	0.3%
WL_16	50.6	48.0	5.2%	0.0	0.4	10.0%	140.6	145.7	3.6%	1.5	1.5	0.0%	414.7	436.9	5.4%	21.9	21.6	1.6%
WL_17	33.7	32.9	2.3%	Dry	0.4	Dry	84.2	74.0	12.2%	1.5	1.5	0.2%	203.4	190.5	6.3%	15.7	16.5	5.1%
WL_18	0.0	0.0	0.0%	Dry	0.0	Dry	0.0	0.0	Dry	0.0	0.0	Dry	3.3	4.3	29.7%	0.0	0.0	Dry
WL_19 - Dunganweate Lagoon (West)	4.2	4.2	0.0%	0.0	0.0	0.0%	53.4	53.4	0.0%	0.0	0.0	Dry	232.3	234.1	0.8%	1.1	1.1	0.5%
WL_20 - Dunganweate Lagoon (East)	0.0	0.0	0.0%	Dry	Dry	Dry	17.1	17.0	0.3%	0.0	0.0	Dry	70.3	81.5	16.0%	0.4	0.4	1.0%
WL_21	Dry	Dry	Dry	Dry	Dry	Dry	0.0	0.0	Dry	Dry	Dry	Dry	7.6	7.7	0.2%	0.1	0.1	0.4%
WL_22 - Lotus Lagoon at BR05 (West)	0.7	0.7	0.0%	Dry	0.0	Dry	6.1	6.1	0.0%	0.1	0.1	0.1%	25.2	25.4	0.9%	0.6	0.6	4.1%
WL_23	1.1	1.1	0.0%	Dry	0.6	Dry	57.2	57.1	0.2%	10.5	10.5	0.1%	111.1	110.9	0.1%	66.3	66.1	0.3%
WL_24	Dry	Dry	Dry	Dry	Dry	Dry	0.8	0.8	4.2%	Dry	Dry	Dry	21.7	21.9	1.1%	1.5	1.5	1.2%
WL_25 - Lotus Lagoon at BR18 (East)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	2.2	1.8	19.5%	0.0	0.0	Dry
WL_26 - Lotus Lagoon at BR19 (West)	Dry	Dry	Dry	Dry	Dry	Dry	3.2	2.5	21.0%	0.0	0.1	15.1%	18.5	16.0	13.8%	1.2	1.4	18.7%
WL_27- Nelson Lagoon (East)	12.3	13.1	6.3%	Dry	0.0	Dry	49.3	67.9	37.9%	0.2	0.2	0.1%	148.0	196.2	32.5%	8.5	8.5	0.0%
WL_28 - Lotus Lagoon at BR05 (East)	0.1	0.1	0.0%	Dry	0.0	Dry	1.8	1.8	0.1%	0.0	0.0	Dry	6.3	6.3	0.1%	0.3	0.3	3.9%
WL_29 - North Cap Hwy Lagoon	Dry	Dry	Dry	Dry	Dry	Dry	0.0	Dry	Dry	Dry	Dry	Dry	3.4	2.5	28.4%	0.1	0.1	9.7%
WL_30 - Lotus Lagoon at BR18 (West)	Dry	Dry	Dry	Dry	Dry	Dry	0.0	0.0	Dry	0.0	0.0	Dry	12.9	10.3	20.1%	0.3	0.2	22.4%

Reporting Location	86.5% AEP Local Event						50% AEP Local Event						10% AEP Local Event					
	Peak Flood Flow (m^3/s)			End of Flood Flow (m^3/s)			Peak Flood Flow (m^3/s)			End of Flood Flow (m^3/s)			Peak Flood Flow (m^3/s)			End of Flood Flow (m^3/s)		
	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff	Base Case	Design	Diff
WL_32 - Lotus Lagoon at BR20 (East)	0.1	0.1	1.7%	Dry	0.0	Dry	3.5	2.4	31.4%	0.6	0.7	17.1%	18.3	19.8	8.5%	0.0	4.0	Dry
WL_33 - Nelson Lagoon (West)	14.1	14.4	1.9%	Dry	0.0	Dry	36.6	44.4	21.4%	0.0	0.0	Dry	107.7	122.9	14.1%	6.9	6.9	0.1%
WL_34	Dry	Dry	Dry	Dry	Dry	Dry	13.0	10.7	18.2%	0.2	0.3	42.6%	52.1	34.5	33.8%	0.4	3.7	908.4%
WL_35 - Lotus Lagoon at BR19 (East)	Dry	Dry	Dry	Dry	Dry	Dry	1.3	1.1	15.8%	0.0	0.1	Dry	8.6	8.9	2.9%	2.0	1.5	26.3%
WL_36 - Lotus Lagoon at BR20 (West)	0.2	0.2	0.0%	Dry	0.0	Dry	12.7	9.9	21.9%	0.0	0.0	Dry	48.9	29.5	39.8%	0.0	0.2	Dry
WL_37 - South Cap Hwy Lagoon	0.3	0.3	0.9%	Dry	0.0	Dry	0.3	0.3	0.6%	0.0	0.0	Dry	4.9	6.2	27.5%	0.0	0.0	Dry
WL_38	0.7	0.7	0.0%	Dry	0.6	Dry	55.8	55.7	0.2%	10.6	10.6	0.1%	102.1	102.1	0.1%	67.2	67.0	0.3%
WL_39	2.1	2.1	0.0%	Dry	0.1	Dry	3.3	3.3	0.0%	0.1	0.1	0.1%	7.6	7.2	4.1%	1.1	1.1	1.8%
WL_40	0.8	0.8	0.0%	Dry	0.0	Dry	1.2	1.2	0.0%	0.1	0.1	0.6%	3.3	3.4	1.1%	0.3	0.3	0.6%
WL_41	2.0	2.0	0.0%	Dry	0.0	Dry	3.1	3.1	0.0%	0.1	0.1	0.3%	6.7	6.3	6.6%	0.5	0.5	1.5%
WL_42	1.4	1.4	0.0%	Dry	0.0	Dry	2.2	2.2	0.0%	0.0	0.0	Dry	9.1	8.4	8.0%	0.6	0.6	2.7%
WL_43	1.7	1.7	0.1%	Dry	0.0	Dry	2.6	2.6	0.0%	0.0	0.0	Dry	14.9	14.2	4.9%	0.6	0.6	2.9%
WL_44	0.0	0.0	0.0%	Dry	Dry	Dry	0.1	0.1	0.2%	0.0	0.0	Dry	1.4	1.5	4.5%	0.2	0.2	3.6%
WL_45	0.1	0.1	0.1%	Dry	0.0	Dry	51.1	51.1	0.0%	3.0	3.0	0.3%	307.3	304.9	0.8%	11.1	11.6	4.9%
WL_46	40.4	40.4	0.0%	Dry	0.2	Dry	110.9	110.9	0.0%	1.2	1.2	0.0%	230.7	230.7	0.0%	13.6	13.6	0.3%
WL_47	10.9	10.9	0.0%	Dry	0.0	Dry	27.1	27.1	0.0%	0.1	0.1	0.1%	83.2	83.2	0.0%	2.4	2.4	0.3%
WL_48 - Deadmans Lagoon	62.4	62.4	0.0%	Dry	0.3	Dry	159.1	159.1	0.0%	1.3	1.3	0.0%	334.3	333.9	0.1%	19.0	19.0	0.3%
WL_49	60.5	60.5	0.0%	Dry	0.3	Dry	148.7	148.7	0.0%	1.3	1.3	0.0%	320.2	319.3	0.3%	19.3	19.2	0.3%
WL_50	0.4	0.4	0.2%	Dry	0.0	Dry	0.6	0.6	0.1%	0.0	0.0	Dry	4.1	3.8	5.4%	0.2	0.2	0.9%
WL_51	1.7	1.7	0.0%	Dry	0.1	Dry	2.3	2.3	0.0%	0.1	0.1	0.3%	6.8	6.7	1.5%	0.7	0.7	1.5%
WL_52	1.2	1.2	0.2%	Dry	0.0	Dry	1.2	1.2	0.5%	0.0	0.0	Dry	7.2	8.7	21.3%	0.2	0.2	10.2%
WL_53	0.4	0.4	0.0%	Dry	0.0	Dry	6.4	7.8	23.1%	0.0	0.0	Dry	18.4	20.0	8.8%	0.3	0.3	7.9%
WL_54 - Crescent Lagoon	0.1	0.2	11.3%	Dry	0.0	Dry	20.9	32.4	55.0%	0.1	0.1	0.5%	100.5	115.4	14.9%	3.2	3.3	2.8%
WL_55 - Nelson Lagoon (West)	1.4	1.3	3.5%	Dry	0.0	Dry	6.5	8.7	33.4%	0.1	0.1	8.7%	52.4	51.1	2.4%	1.0	1.0	5.3%
WL_56 - Nelson Lagoon (East)	0.3	0.3	0.3%	Dry	0.0	Dry	2.3	1.8	20.4%	0.0	0.0	Dry	82.9	86.6	4.5%	0.1	0.1	7.8%
WL_57	16.1	15.9	1.0%	0.0	0.4	4.0%	45.1	47.1	4.6%	1.3	1.2	1.9%	134.8	135.7	0.6%	21.3	21.9	2.8%
WL_58 - Yeppen Lagoon	27.9	28.0	0.6%	0.0	0.8	12.0%	87.0	88.7	2.0%	2.7	2.8	0.7%	250.2	252.6	0.9%	36.8	37.5	2.0%

C.3 Wetland Connectivity Velocity and Level

Percentage velocity changes greater than 10% where the absolute velocity is greater than 0.1m/s, i.e. where there is significant increase in erosive potential, are highlighted in red.

Percentage velocity changes less than 10% where the absolute velocity is greater than 0.1m/s, i.e. where there is significant decrease in erosive potential, are highlighted in green.

Differences in End of Flood levels greater than or equal to 50mm are highlighted in red and match the afflux mapping of Appendix B.

Appendix Table C-3: Wetland Connectivity Velocity and Level

Reporting Point	86.5% AEP Local Event						50% AEP Local Event						10% AEP Local Event					
	Peak Flood Velocity (m/s)			End of Flood Level (m AHD)			Peak Flood Velocity (m/s)			End of Flood Level (m AHD)			Peak Flood Velocity (m/s)			End of Flood Level (m AHD)		
	Base Case	Design	Diff	Base Case	Design	Diff (m)	Base Case	Design	Diff	Base Case	Design	Diff (m)	Base Case	Design	Diff	Base Case	Design	Diff (m)
WL_01	0.08	0.07	11.9%	7.69	7.69	0.00	0.14	0.13	6.1%	7.79	7.79	0.00	0.27	0.27	1.8%	8.72	8.72	0.00
WL_02	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.41	0.57	37.0%	8.50	8.51	0.00
WL_03 - Lotus Lagoon at BR06 (East)	0.03	0.03	0.0%	6.12	6.12	0.00	0.08	0.08	0.4%	7.79	7.79	0.00	0.27	0.24	10.8%	8.72	8.72	0.00
WL_04 - Lotus Lagoon at BR06 (West)	0.04	0.04	0.0%	6.12	6.12	0.00	0.14	0.14	0.1%	7.79	7.79	0.00	0.33	0.29	11.5%	8.72	8.72	0.00
WL_05 - Pink Lily Lagoon (East)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.01	0.01	2.9%	8.32	8.37	0.05
WL_06	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.02	0.02	0.0%	7.45	7.45	0.00
WL_07	0.09	0.09	0.0%	7.95	7.96	0.00	0.10	0.10	0.4%	7.97	7.97	0.00	0.12	0.12	0.0%	8.71	8.71	0.00
WL_08 - Pink Lily Lagoon (West)	0.00	0.00	0.0%	6.60	6.60	0.00	0.00	0.00	0.0%	6.84	6.84	0.00	0.04	0.05	20.4%	8.32	8.37	0.05
WL_09	0.27	0.27	0.0%	Dry	Dry	Dry	0.38	0.38	0.0%	Dry	Dry	Dry	0.54	0.54	0.0%	8.72	8.72	0.00
WL_10	0.11	0.11	0.5%	5.69	5.69	0.00	0.97	0.97	0.5%	6.53	6.53	0.00	1.09	1.09	0.2%	8.53	8.53	0.00
WL_11	0.01	0.01	0.0%	5.73	5.73	0.00	0.01	0.01	0.0%	6.35	6.36	0.01	0.03	0.03	0.0%	7.13	7.14	0.01
WL_12	0.03	0.03	15.9%	5.57	5.65	0.09	0.05	0.04	27.1%	6.35	6.36	0.01	0.07	0.10	51.2%	7.13	7.14	0.01
WL_13	0.04	0.04	6.9%	5.92	5.92	0.00	0.23	0.29	27.8%	5.99	5.99	0.00	0.52	0.60	15.0%	6.28	6.28	0.00
WL_14	0.55	0.49	10.6%	5.75	5.74	0.00	0.59	0.48	19.1%	5.84	5.83	0.00	0.67	0.62	7.6%	6.17	6.21	0.05
WL_15	Not modelled																	
WL_16	0.01	0.01	26.8%	6.60	6.60	0.00	0.02	0.02	0.0%	6.67	6.67	0.00	0.11	0.11	0.1%	6.77	6.77	0.00
WL_17	0.40	0.40	0.9%	5.37	5.37	0.00	0.40	0.40	2.4%	5.50	5.50	0.00	0.52	0.47	8.7%	6.05	6.06	0.01
WL_18	0.01	0.01	3.1%	6.12	6.12	0.00	0.02	0.01	42.7%	6.13	6.13	0.00	0.12	0.13	8.0%	6.16	6.16	0.00
WL_19 - Dunganweate Lagoon (West)	0.01	0.01	32.6%	6.60	6.60	0.00	0.02	0.02	0.4%	6.67	6.67	0.00	0.04	0.04	0.3%	6.77	6.77	0.00
WL_20 - Dunganweate Lagoon (East)	0.00	0.00	0.0%	6.60	6.60	0.00	0.05	0.05	1.7%	6.67	6.67	0.00	0.50	0.52	4.1%	6.77	6.77	0.00
WL_21	Dry	Dry	Dry	Dry	Dry	Dry	0.01	0.01	6.3%	7.84	7.86	0.02	0.18	0.17	3.4%	8.49	8.49	0.00
WL_22 - Lotus Lagoon at BR05 (West)	0.18	0.18	0.0%	7.27	7.27	0.00	0.40	0.40	0.0%	7.69	7.69	0.00	0.56	0.56	0.1%	8.70	8.70	0.00
WL_23	0.26	0.26	0.0%	5.72	5.72	0.00	0.89	0.89	0.4%	6.67	6.67	0.00	1.03	1.02	0.2%	8.59	8.59	0.00
WL_24	Dry	Dry	Dry	Dry	Dry	Dry	0.22	0.22	0.2%	Dry	Dry	Dry	0.44	0.44	0.9%	8.49	8.49	0.00
WL_25 - Lotus Lagoon at BR18 (East)	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.07	0.08	9.5%	8.72	8.72	0.00
WL_26 - Lotus Lagoon at BR19 (West)	Dry	Dry	Dry	Dry	Dry	Dry	0.04	0.03	17.5%	7.87	7.87	0.00	0.16	0.13	22.3%	8.72	8.72	0.00
WL_27- Nelson Lagoon (East)	0.26	0.27	3.7%	5.92	5.92	0.00	0.56	0.72	27.0%	5.99	5.99	0.00	0.93	1.17	25.1%	6.27	6.27	0.00
WL_28 - Lotus Lagoon at BR05 (East)	0.02	0.02	0.6%	7.27	7.27	0.00	0.14	0.14	0.1%	7.69	7.69	0.00	0.26	0.26	0.3%	8.70	8.70	0.00

Reporting Point	86.5% AEP Local Event						50% AEP Local Event						10% AEP Local Event					
	Peak Flood Velocity (m/s)			End of Flood Level (m AHD)			Peak Flood Velocity (m/s)			End of Flood Level (m AHD)			Peak Flood Velocity (m/s)			End of Flood Level (m AHD)		
	Base Case	Design	Diff	Base Case	Design	Diff (m)	Base Case	Design	Diff	Base Case	Design	Diff (m)	Base Case	Design	Diff	Base Case	Design	Diff (m)
WL_29 - North Cap Hwy Lagoon	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	0.10	0.07	23.9%	6.42	6.43	0.01
WL_30 - Lotus Lagoon at BR18 (West)	Dry	Dry	Dry	Dry	Dry	Dry	0.01	0.02	8.8%	7.08	7.08	0.01	0.52	0.53	0.3%	8.72	8.72	0.00
WL_32 - Lotus Lagoon at BR20 (East)	0.00	0.00	7.1%	7.02	7.02	0.00	0.09	0.09	2.2%	7.88	7.87	0.01	0.16	0.13	20.4%	8.72	8.73	0.01
WL_33 - Nelson Lagoon (West)	0.30	0.30	0.0%	5.92	5.92	0.00	0.30	0.30	0.1%	5.99	5.99	0.00	0.53	0.53	0.0%	6.28	6.28	0.00
WL_34	Dry	Dry	Dry	Dry	Dry	Dry	0.10	0.10	0.1%	7.87	7.87	0.00	0.35	0.24	31.1%	8.73	8.72	0.00
WL_35 - Lotus Lagoon at BR19 (East)	Dry	Dry	Dry	Dry	Dry	Dry	0.12	0.10	16.5%	7.87	7.87	0.00	0.17	0.17	4.5%	8.73	8.72	0.01
WL_36 - Lotus Lagoon at BR20 (West)	0.00	0.00	0.0%	7.02	7.02	0.00	0.15	0.10	31.4%	7.87	7.87	0.00	0.35	0.21	40.4%	8.72	8.72	0.00
WL_37 - South Cap Hwy Lagoon	0.05	0.05	1.2%	6.05	6.05	0.00	0.05	0.05	2.2%	6.07	6.07	0.00	0.07	0.07	0.7%	6.14	6.14	0.00
WL_38	0.12	0.12	0.0%	5.02	5.02	0.00	0.88	0.88	0.1%	6.11	6.11	0.00	1.00	1.00	0.0%	8.34	8.33	0.00
WL_39	0.06	0.06	0.0%	5.23	5.23	0.00	0.08	0.08	0.0%	5.24	5.24	0.00	0.15	0.14	5.2%	5.32	5.32	0.00
WL_40	0.20	0.20	0.0%	5.46	5.46	0.00	0.22	0.22	0.0%	5.46	5.46	0.00	0.24	0.25	4.0%	5.49	5.49	0.00
WL_41	0.10	0.10	0.0%	Dry	Dry	Dry	0.14	0.14	0.0%	Dry	Dry	Dry	0.20	0.19	3.4%	5.31	5.31	0.00
WL_42	0.05	0.05	0.0%	5.39	5.39	0.00	0.08	0.08	0.1%	5.41	5.41	0.00	0.18	0.17	4.8%	5.50	5.50	0.00
WL_43	0.05	0.05	0.0%	5.39	5.39	0.00	0.10	0.10	0.0%	5.41	5.41	0.00	0.19	0.19	3.6%	5.50	5.50	0.00
WL_44	0.00	0.00	0.0%	6.60	6.60	0.00	0.00	0.00	0.0%	6.84	6.84	0.00	0.01	0.01	1.9%	8.32	8.37	0.05
WL_45	0.01	0.01	0.0%	6.26	6.26	0.00	0.20	0.20	0.1%	7.79	7.79	0.00	0.58	0.58	0.0%	8.72	8.72	0.00
WL_46	0.24	0.24	0.0%	7.88	7.88	0.00	0.46	0.46	0.0%	7.97	7.97	0.00	0.64	0.64	0.0%	8.10	8.10	0.00
WL_47	0.11	0.11	0.0%	7.88	7.88	0.00	0.24	0.24	0.0%	7.97	7.97	0.00	0.54	0.54	0.0%	8.10	8.10	0.00
WL_48 - Deadmans Lagoon	0.12	0.12	0.0%	6.55	6.55	0.00	0.29	0.29	0.0%	6.64	6.64	0.00	0.61	0.61	0.1%	7.06	7.06	0.00
WL_49	0.36	0.36	0.0%	6.55	6.55	0.00	0.78	0.78	0.0%	6.64	6.64	0.00	1.37	1.37	0.5%	7.06	7.06	0.00
WL_50	0.01	0.01	0.0%	5.39	5.39	0.00	0.02	0.02	0.0%	5.40	5.40	0.00	0.12	0.11	7.7%	5.47	5.47	0.00
WL_51	0.09	0.09	0.5%	5.39	5.39	0.00	0.10	0.10	0.0%	5.40	5.40	0.00	0.17	0.17	1.2%	5.47	5.48	0.00
WL_52	0.01	0.01	0.0%	6.05	6.05	0.00	0.01	0.01	0.0%	6.07	6.07	0.00	0.04	0.05	17.2%	6.14	6.14	0.00
WL_53	0.00	0.00	3.1%	3.71	3.75	0.04	0.02	0.02	0.0%	5.98	5.98	0.00	0.04	0.04	4.8%	6.25	6.26	0.00
WL_54 - Crescent Lagoon	0.00	0.00	0.0%	3.71	3.75	0.04	0.04	0.06	56.6%	5.98	5.98	0.00	0.16	0.19	20.7%	6.25	6.26	0.00
WL_55 - Nelson Lagoon (West)	0.06	0.07	13.5%	4.50	4.48	0.01	0.07	0.08	11.4%	5.96	5.96	0.00	0.10	0.11	10.6%	6.20	6.20	0.00
WL_56 - Nelson Lagoon (East)	0.03	0.03	8.9%	4.50	4.48	0.01	0.04	0.04	1.3%	5.96	5.96	0.00	0.09	0.10	4.1%	6.20	6.20	0.00
WL_57	0.03	0.03	4.5%	5.37	5.37	0.00	0.09	0.09	2.6%	5.49	5.50	0.00	0.30	0.28	4.4%	6.04	6.04	0.01
WL_58 - Yeppen Lagoon	0.16	0.12	21.6%	5.37	5.37	0.00	0.20	0.20	1.4%	5.49	5.50	0.00	0.39	0.39	0.5%	6.03	6.04	0.01