



Abbot Point Growth Gateway Project – Technical Report for Wetland Flooding Component

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Abbot Point Growth Gateway Project – Technical Report for Wetland Flooding Component

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1 Introduction

1.1 Background

This report relates to the Abbot Point Growth Gateway Project ('the Project') and the associated Referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) dated 17 Apr 2015 (Reference Number: 2015/7467). On 14 May 2015, the Project was determined to be a controlled action, requiring assessment by Environmental Impact Assessment (EIA).

BMT WBM was engaged by Advisian to undertake specialist technical studies as part of the EIA. This report specifically investigates the potential flood impacts to the Caley (Kaili) Valley Wetlands, which supports a separate main report (BMT WBM, 2015) which assesses:

- Surface water hydrology and hydrodynamics;
- Wetland surface water quality; and
- Wetland ecology (excluding birds).

This report should be read in conjunction with the main report, which should be referred to for full descriptions of the Project and terminology.

1.2 Project Summary

The following provides a short description of the project as provided in the Referral (2015/7467).

The proposed project is located at the Port of Abbot Point, approximately 25 km north of Bowen on the North Queensland Coast (Figure 1-1). The proposed action involves:

- Construction of onshore dredged material containment ponds (DMCPs) within the area previously allocated for the development of Terminal 2 (T2) and adjoining industrial land;
- Capital dredging of approximately 1.1 million m³ *in situ* (Mm³) of previously undisturbed seabed for new berth pockets and ship apron areas required to support the development of Terminal 0 (T0);
- Relocation of the dredged material to the DMCPs and offshore discharge of return water; and
- Ongoing management of the dredged material including its removal, treatment and beneficial reuse within the port area and the State Development Area, where appropriate.

1.2.1 Onshore DMCPs

Dredged material will be pumped via temporary pipelines to the onshore DMCPs. There will be no dredged material placement in the Great Barrier Reef Marine Park (GBRMP) or in the GBRWHA.

The onshore area has been made available by NQBP for the development of common user DMCP infrastructure, and is located on the T2 site plus adjoining industrial land between the existing rail loop and the Caley Valley wetlands to the south (Figure 1-2). The area is adjacent to operating coal export terminal T1 and GVK Hancock's approved terminal site T3. The site has been previously cleared and used as agricultural land.

The DMCP area has been sited:

Introduction

- In proximity to the existing port noting its ultimate use will be to provide suitable land and fill for port expansion once the dredged material has dried and settled
- In proximity of proposed dredging activities
- Outside of the Caley Valley Wetlands
- The final footprint of the DMCPs has been located and designed to meet requirements for T0 dredging only.

It is noted that the DMCPs area partly overlaps and/or is adjacent to existing and approved infrastructure.

Existing and approved infrastructure has been taken into account during the impact assessment process and will be considered in the detailed design. The intention is that existing infrastructure will be avoided.

In the circumstance that the proposed siting of the DMCPs overlaps with approved infrastructure, final siting will be subject to agreement with the relevant stakeholders.

1.3 Objective

The purpose of this report is to investigate possible flood impacts of the Project to the Caley (Kaili) Valley Wetlands.



Specific objectives of this investigation were to:

- Define flood conditions for the 100 year ARI and the Probable Maximum Flood (PMF) design catchment flooding events under present-day climate conditions;
- Define flood conditions for the 100 year ARI design catchment flooding events under projected climate conditions by 2100; and
- Investigate impacts on the flood conditions for the above design events due to the proposed Project.

Note that the development may also be affected by coastal inundation. Assessment of coastal inundation is not included in the scope of works of this study.



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-  Caley Valley Wetland Boundary as Defined through DIWA Listing
-  Cadastral Boundary

Title:
Locality Plan – Abbot Point and Caley Valley Wetlands

Figure:
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Proposed Dredged Material Containment Ponds (DMCP)

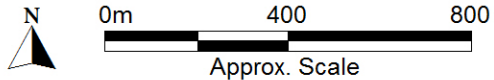
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Title:
Proposed DMCP footprint and existing infrastructure

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2 Caley Valley Wetland Flood Impact Assessment

The following sections provide a description of the model history, model components and the results of the current flood impact assessment.

2.1 Previous Studies

2.1.1 Bowen Abbot Point Flood Modelling Study (APFS) - Maunsell (2008)

Previous modelling of the Caley Valley wetlands was undertaken by Maunsell (2008) to identify areas suitable for industrial development and subsequently investigate the potential impact of a range of possible developments for the 10, 20, 50, 100 and 500 year ARI design flood events.

The modelling undertaken included the development of an XP-RAFTS hydrologic model, and a MIKE FLOOD hydraulic model for existing (baseline) and post-development conditions.

The XP-RAFTS hydrologic model was utilised to determine rainfall runoff flows entering the wetland from adjacent catchments, including from Euri Creek, Splitters Creek and numerous smaller local catchments. The hydraulic model incorporated breakout flows from the Don River, and included around 200 existing bridges and culverts.

2.1.2 North Queensland Bulk Ports Corporation Proposed Abbot Point Multi Cargo Facility – Surface Water Management for Transport Corridors - GHD (2009)

The Multi Cargo Facility (MCF) model by GHD was undertaken to investigate the impact of the proposed MCF haul and access roads. The investigation built on the modelling undertaken by Maunsell (now AECOM) as part of the Bowen Abbot Point Flood Modelling Study (APFS), described in the above section.

The MCF investigation adopted the existing conditions hydrologic and hydraulic model configurations from the APFS with the exception of the inflows into Six Mile Creek.

GHD altered the inflows into Six Mile Creek in order to rectify misrepresentations of the inflows in this area.

In addition, the MCF investigations included an assessment of the flood conditions under baseline conditions during a Probable Maximum Design Flood (PMF) event.

Modelling of the developed conditions was undertaken by GHD, based on the existing conditions model, to determine potential flood afflux caused by the inclusion of the proposed MCF haul and access roads. The MCF developed conditions model has not been utilised in the current Project investigations.

2.2 Model Description

The baseline hydrologic and hydraulic models, initially developed by Maunsell and later modified and used by GHD for the MCF study have been adopted in the present study to assess baseline flood conditions in the study area.

The following sections provide a summary of the adopted hydrologic and hydraulic baseline models. For a more detailed description, reference should be made to the previous study reports (Maunsell, 2008 and GHD, 2009).

2.2.1 Hydrologic Model

The MCF XP-RAFTS models of the Splitters, Euri/Sandy Creek and other local catchments have been adopted unchanged to provide design inflows at key locations to the hydraulic model. The local catchments include Breakfast, Goodbye, Maria, Battery, Six Mile and Spring creeks. Detailed descriptions of the modelled catchments are provided in the APFS (Maunsell, 2008).

Maunsell previously verified the performance of the XP-RAFTS models by comparing model predictions against recorded flows at the Euri Creek stream gauge, as part of the APFS. The XP-RAFTS hydrologic model was found to adequately reproduce flood hydrographs at this location.

2.2.1.1 Model settings

This section provides a summary of the inputs to the adopted XP-RAFTS hydrologic model, as described in the APFS (Maunsell, 2008):

- Sub-catchment delineation and slopes, along with channel geometry, length and slope, were determined based on the Department of Natural Resources and Water 1:100 000 and 1:25 000 topographic maps;
- Impervious area = 1% applied to all sub-catchments;
- Initial rainfall loss = 20mm;
- Continuing rainfall loss = 4mm; and
- Site specific design rainfall intensities were determined as per Australian Rainfall and Runoff (AR&R, 1987).

The XP-RAFTS layout showing sub-catchment delineation for the Euri/Sandy Creeks, Splitter Creek and local catchment models is presented in Appendix A.

2.2.1.2 100 Year ARI Design Flood Discharges.

Design events were simulated with the hydrologic model for a range of storm durations to assess the critical duration for each catchment.

For the 100 year ARI event, the 24 hour duration was found to generally produce the largest peak flood flows. Accordingly, the hydrographs for the 100 year ARI 24 hour duration storm event have been applied as inflows in the MIKE FLOOD hydraulic model.

Table 2-1 provides the peak 100 Year ARI design flows for a number of locations in the study area (refer to Appendix A for XP-RAFTS subcatchment locations).

Caley Valley Wetland Flood Impact Assessment

Table 2-1 Modelled 100 year ARI Peak Flow Discharges at Key Locations

Location	XP-RAFTS Sub-Catchment	100 Year ARI Flow Rate (m ³ /s)*
Caley (Kaili) Valley wetlands	Lake2	1,658
Euri Creek Outlet	Ocean	2,828
Goodbye Creek at Bruce Highway	GC1.20L	137
Maria Creek West at Bruce Highway	6MC1.10T	62
Maria Creek East at Bruce Highway	6MC2.10T	21
Splitters Creek Outlet	SC1.50L	1,050
Mount Steward Creek at Bruce Highway	MSC1.10T	43

*Extracted from the adopted XP-RAFTS model.

2.2.1.3 Probable Maximum Precipitation Estimation

A Probable Maximum Precipitation (PMP) assessment was undertaken by GHD (2009).

This PMP assessment estimated design rainfalls for storm durations less than six hours using the Generalised Short Duration Method (GSDM) and for storm durations greater than or equal to 24 hours using the Generalised Tropical Storm Method (GTSMR). The design rainfalls for storms of an intermediate duration were interpolated from the enveloping curve. The adopted PMP design rainfall depths are provided in Table 2-2.

Table 2-3 provides a summary of the resulting Probable Maximum Flood (PMF) design discharges for a number of representative locations (refer to Appendix A for XP-RAFTS subcatchment locations). Appendix A of the MCF study provides the peak PMF design discharges for all XP-RAFTS sub-catchments.

Table 2-2 PMP Estimates for Caley Valley Wetlands (Source: GHD, 2009)

Storm duration (hours)	Rainfall Depth (mm)
0.25	110
0.5	160
0.75	200
1	240
1.5	320
2.1	380
2.5	430
3	460
4	530
5	560
6	590
9	700
12	800
18	1020
24	1230
36	1460
48	1680
72	2060
96	2330
120	2450

Table 2-3 PMF Design Discharges for Representative Locations (Source: GHD, 2009)

Location	XP-RAFTS Sub-Catchment	PMP-DF Flow Rate (m3/s)
Caley (Kaili) Valley wetlands	Lake2	4767
Euri Creek Outlet	Ocean	10821
Goodbye Creek at Bruce Highway	GC1.20L	445
Maria Creek West at Bruce Highway	6MC1.10T	159
Maria Creek East at Bruce Highway	6MC2.10T	51
Splitters Creek Outlet	SC1.50L	4010
Mount Steward Creek at Bruce Highway	MSC1.10T	107

2.2.2 Hydraulic Model

2.2.2.1 Overview

The baseline conditions MIKE FLOOD model, as adopted in the MCF study, has been adopted to assess the flood conditions for the 100 year ARI and PMF design flood events in this study. With the exception of a correction to the orientation of a culvert at the Battery Creek crossing of the Bruce Highway, the MCF MIKE FLOOD model was adopted unchanged.

The model covers the entire wetland area from Splitters Creek to Euri Creek, as shown in Figure 2-2.

The design discharges determined with the hydrologic model were applied to the hydraulic model, which utilised a 25 m gridded Digital Elevation Model (DEM) to represent the topography of the wetlands and surrounds. The DEM was developed from Aerial Laser Scanner (ALS) ground topography survey, as described in the APFS (2008), and has a vertical accuracy of +/- 0.25m. To ensure channel profiles were adequately represented, additional ground survey was undertaken for a number of watercourses and included in the hydraulic model. Tidal tailwater conditions and the hydraulic roughness due to vegetation were also accounted for.

As part of the APFS, calibration to recorded flood levels at the Euri Creek stream gauge was undertaken by Maunsell for the January 2005 event, with a good match achieved in peak level and timing, as shown in Figure 2-1.

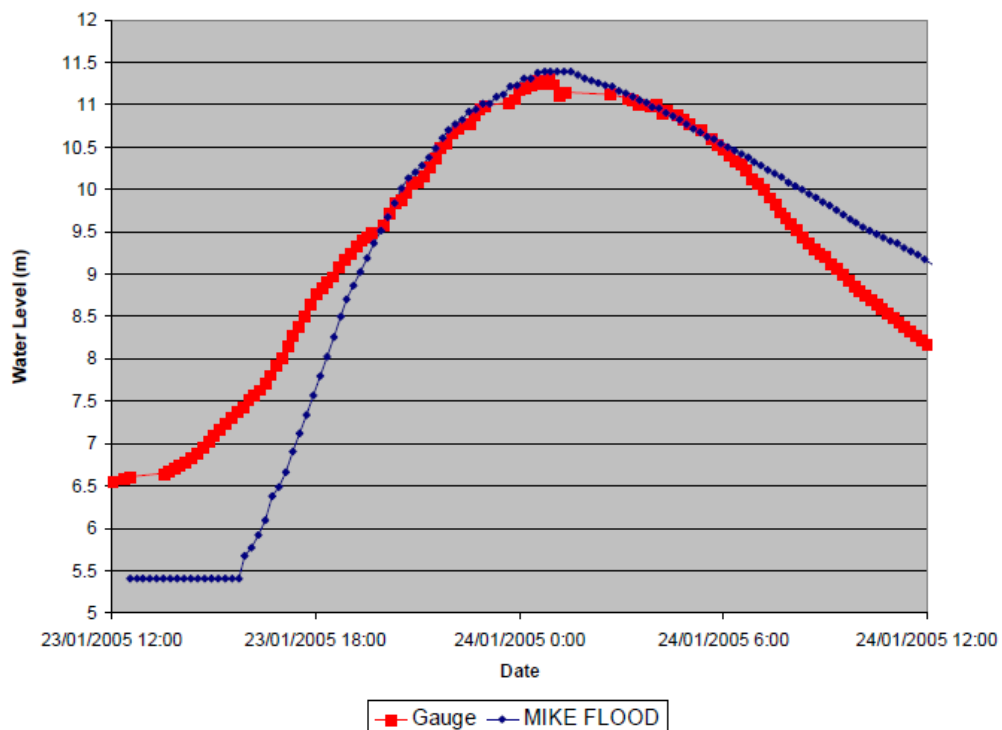


Figure 2-1 Calibration of MIKE FLOOD model to Koondandah Gauge on Euri Creek Flood Levels – January 2005 Event (Source: Maunsell, 2008)

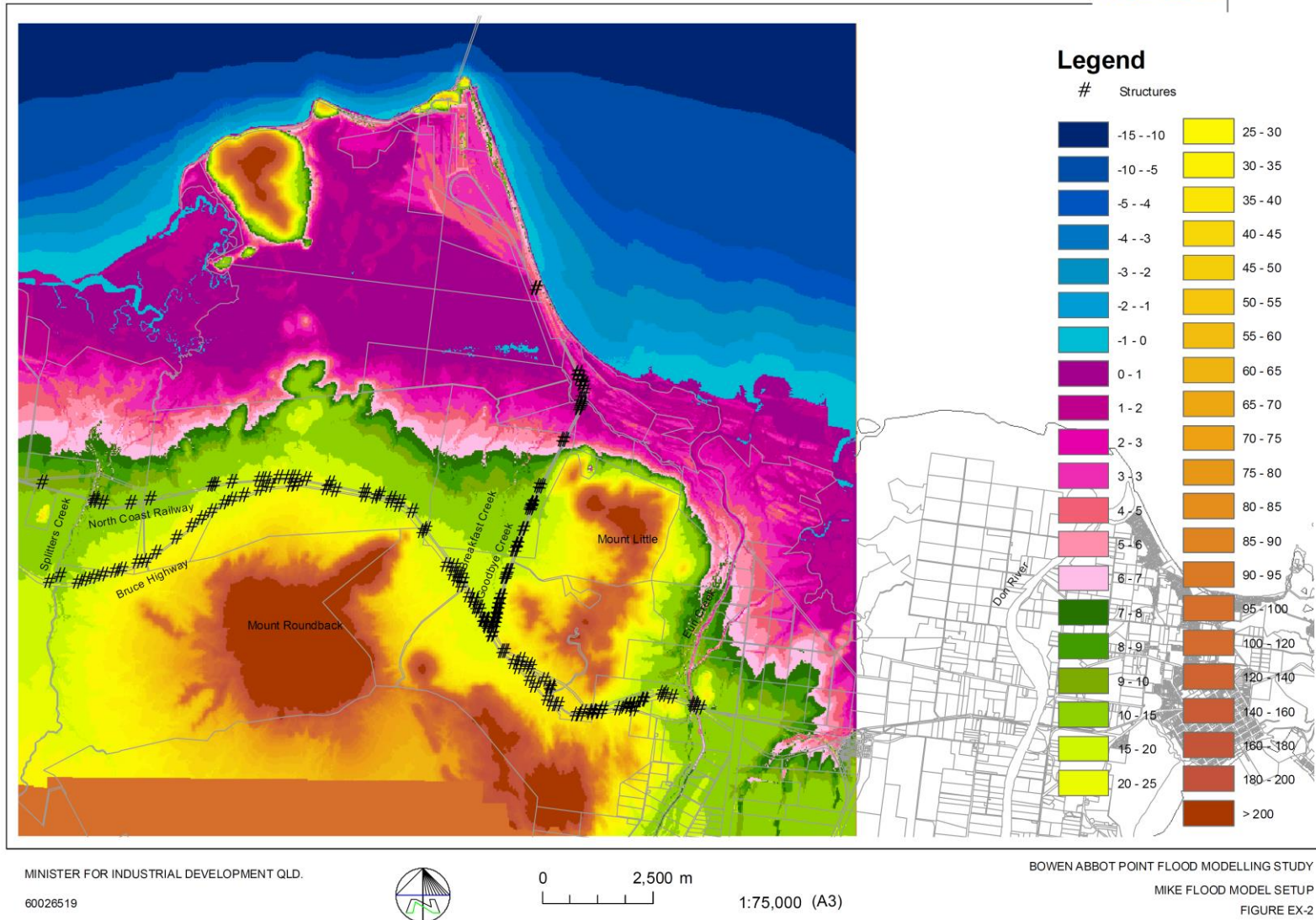


Figure 2-2 MikeFlood Model Extent and Structure Locations (Source: Maunsell, 2008)

2.2.2.2 Adopted Model Roughness

A number of different categories were adopted for defining the roughness within the hydraulic model extent, as shown in Table 2-4. The APFS (Maunsell, 2008) provides a figure indicating the regions where different Manning’s ‘n’ roughness values were adopted.

Table 2-4 Adopted Manning’s ‘n’ Values (Source: Maunsell, 2008)

Land cover type	Adopted Manning’s ‘n’ values
Dense vegetation	0.08
Medium dense vegetation	0.06
Long grasses / cultivated crops	0.05
Tidal flats	0.04
Smooth waterways / roads	0.025

2.2.2.3 Structures

Around 200 existing structures are incorporated into the hydraulic model, represented as 1-D elements. These structures are mostly culverts associated with creek crossings of the Bruce Highway, North Coast Railway and Abbot Point road and rail access. The locations of these structures are shown in Figure 2-2.

2.2.2.4 Model boundaries

Once design discharges were determined in XP-RAFTS, the hydrographs were applied to the hydraulic model. The inflows to the hydraulic model included three total catchment flow hydrographs at open boundaries, and numerous source point flow hydrographs applied at locations corresponding to the sub-catchment outlets.

Inflows to Sandy Creek for the 100 year ARI design event from the Don River were included in the hydraulic model by adopting the 20 year ARI flows from the Euri Creek Catchment Flood Study and Don River Sand Depth Study (Connel Wagner, 2005). For the PMP flood event, a constant flow rate of 4,047 m³/s was applied at the eastern model boundary to represent the Don River PMP flood event contribution.

The downstream boundary was set as a fixed tailwater level, adopted as the Mean High Water Springs (MHWS) level of 1.064m for the design events.

2.2.3 2100 Climate Change Scenario

To assess the potential effects of climate change on the flood behaviour of the site, a climate change scenario was modelled.

The adopted baseline conditions for the hydrologic and hydraulic models, described in Sections 2.2.1 and 2.2.2 were modified to provide an indication of the effects of climate change by the year 2100 on the 100 year ARI design flood event. Modifications to the baseline models included:

Caley Valley Wetland Flood Impact Assessment

- Increasing design rainfalls intensities in XP-RAFTS by 20% (DERM, 2010). Table 2-5 provides the peak 100 Year ARI + climate change design flows for a number of locations in the study area (refer to Appendix A for XP-RAFTS subcatchment locations);
- Increasing the downstream boundary water level by 0.8m (DEHP, 2015), to a peak water level of 1.86 mAHD. This level was also adopted as the initial water level in the wetlands at the start of the hydraulic model simulation; and
- Minor modifications to terrain elevation around structures on Splitters Creek and Battery Creek at Bruce Highway crossings, to ensure model stability.

Table 2-5 Modelled 100 year ARI + Climate Change Peak Flow Discharges at Key Locations

Location	XP-RAFTS Sub-Catchment	100 Year ARI + Climate Change Flow Rate (m3/s)
Caley (Kaili) Valley wetlands	Lake2	2,058
Euri Creek Outlet	Ocean	3,685
Goodbye Creek at Bruce Highway	GC1.20L	172
Maria Creek West at Bruce Highway	6MC1.10T	78
Maria Creek East at Bruce Highway	6MC2.10T	26
Splitters Creek Outlet	SC1.50L	1,372
Mount Steward Creek at Bruce Highway	MSC1.10T	53

*Extracted from the updated XP-RAFTS model.

2.3 Model Results

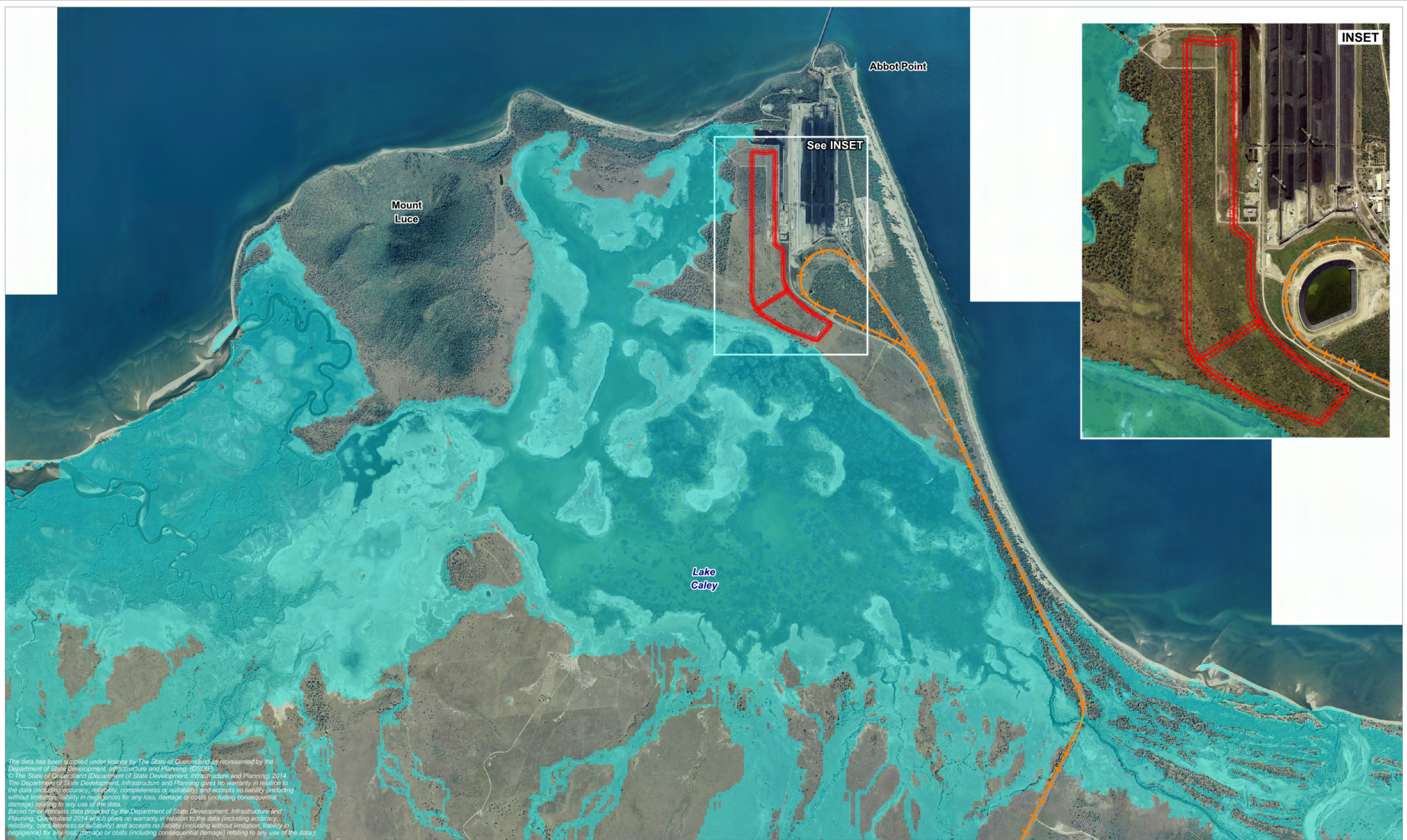
The peak flood extents for the baseline conditions 100 year ARI and PMF design flood events, and the (100 year ARI) 2100 climate change scenario are provided in Figure 2-3, Figure 2-4 and Figure 2-5. The flood maps show the results for a subset of the model extent to provide greater detail around the proposed DMCP. A summary of the results is provided below:

- The DMCP footprint is located entirely outside of the extent of flooding for the 100 year ARI design flood event;
 - The peak flood levels in the Caley Valley wetland adjacent to the DMCP for the 100 year ARI design flood event are approximately 2.4 mAHD;
- The DMCP footprint is almost entirely outside of the extent of flooding for the PMF event;
 - The peak flood levels in the Caley Valley wetland adjacent to the DMCP for the PMF design flood event are approximately 3.1 mAHD;
 - The small area where the proposed DMCP footprint overlaps the PMF flood extent at the northern end of the development footprint is even during the PMF event characterised by low to moderate inundation depths and small overland flow velocities.
- The DMCP footprint is entirely outside of the extent of flooding for the 100 year ARI + 2100 climate change design flood event;

Caley Valley Wetland Flood Impact Assessment

- The peak flood levels in the Caley Valley wetland adjacent to the DMCP for the 100 year ARI + climate change design flood event are approximately 2.6 mAHD.

A simulation of the PMF design flood event was undertaken for a developed scenario, where the DMCP footprint was blocked out. The results of this simulation confirm that the very small loss of wetland storage that the proposed DMCP footprint may cause during the PMF design flood event does not have any material impact on peak flood levels during this extreme event.



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- LEGEND**
-  Railway
 -  Proposed DMCP Footprint
 -  100 Year ARI Design Flood Extent

Title:
**100 Year ARI Design Flood Extent
 - Existing Conditions**

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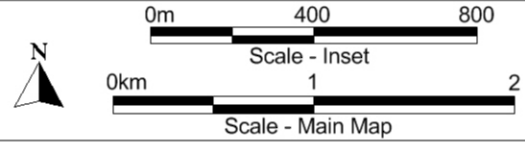
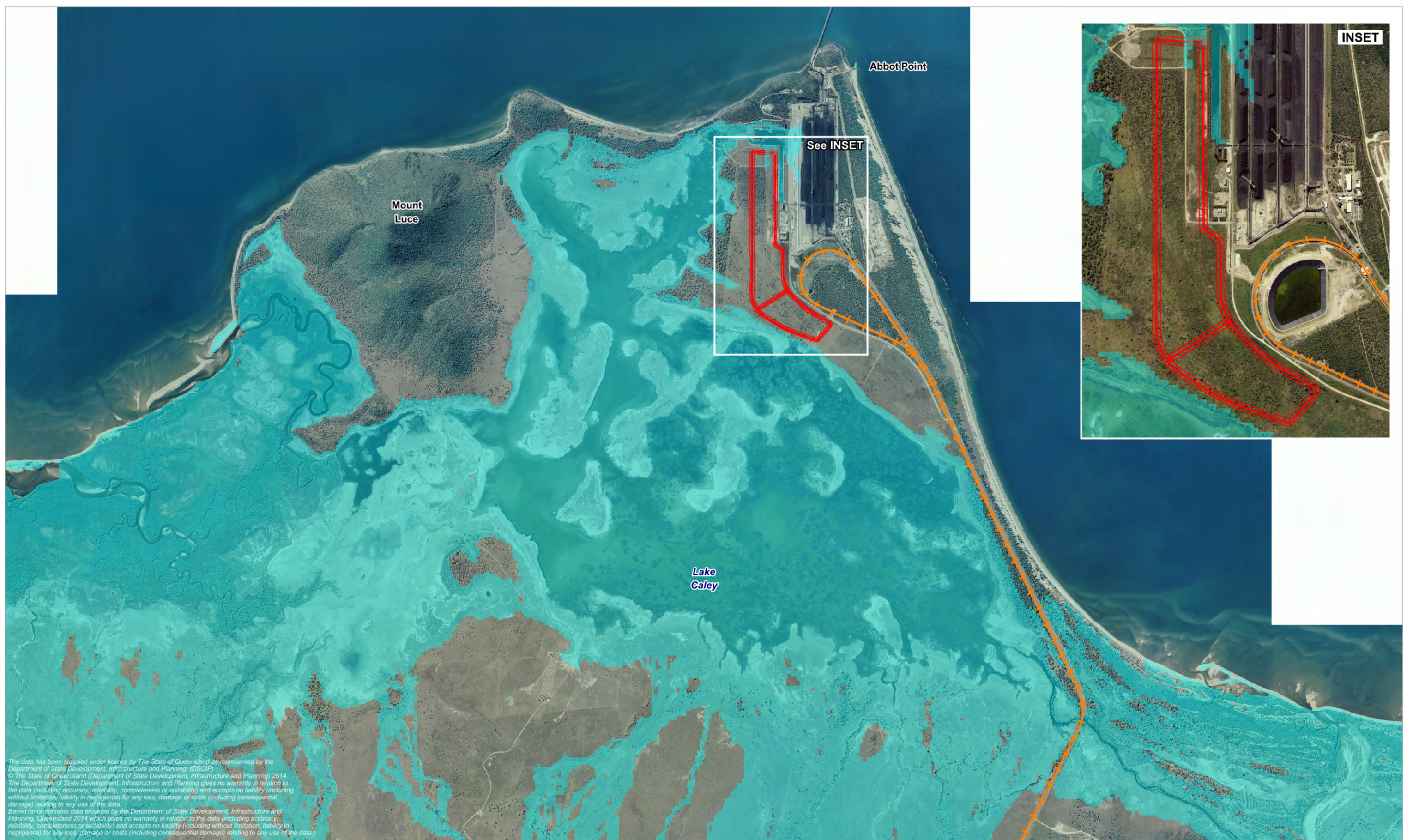


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LEGEND

-  Railway
-  Proposed DMCP Footprint
-  Probable Maximum Design Flood Extent

Title:
**Probable Maximum Design Flood Extent
 - Existing Conditions**

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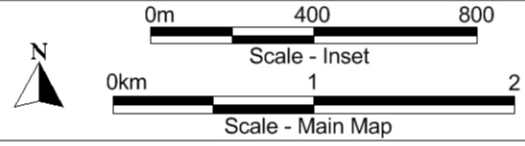
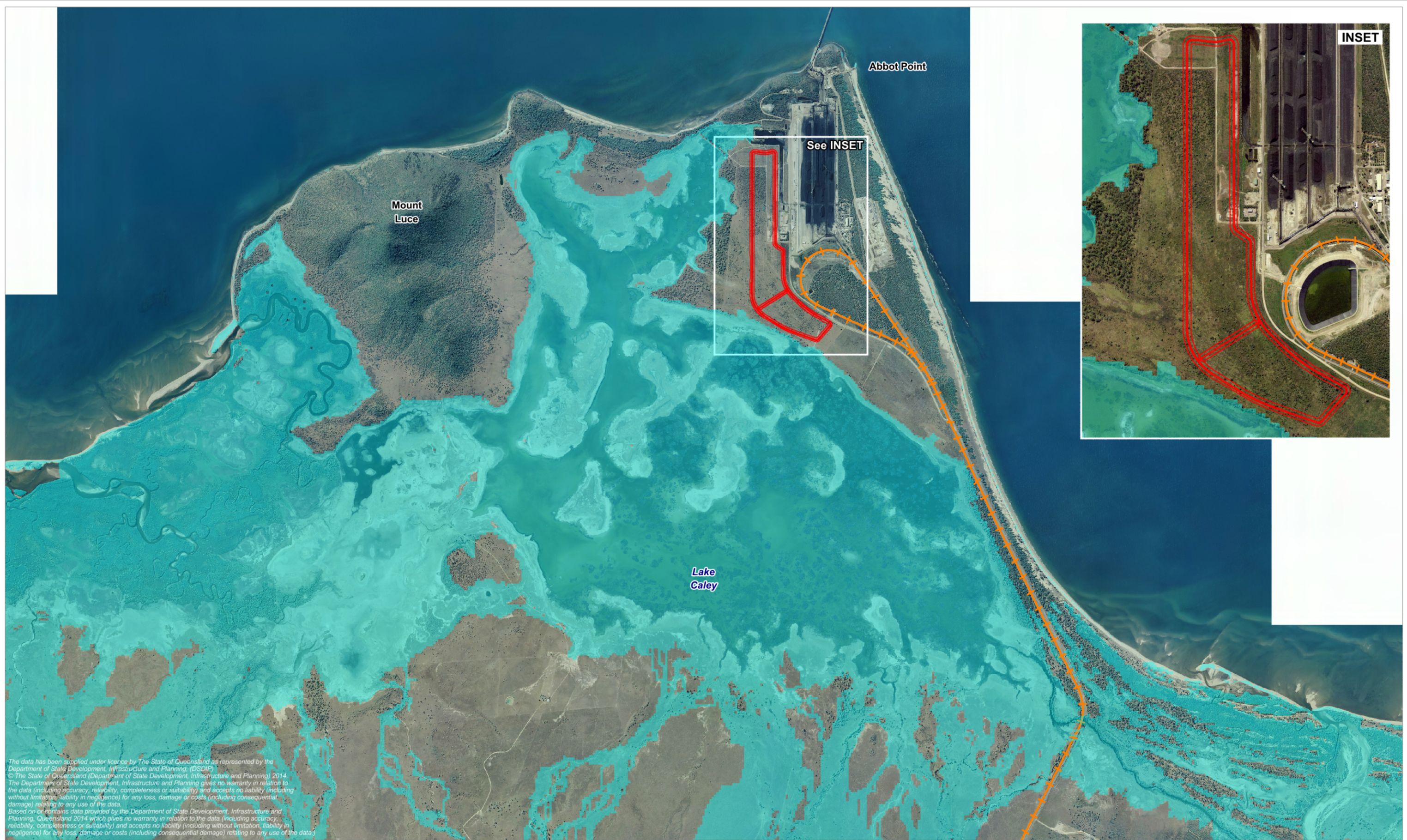


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LEGEND

-  Railway
-  Proposed DMCP Footprint
-  100 Year ARI + Climate Change Design Flood Event

Title:
**100 Year ARI + 2100 Climate Change Design Flood Extent
 - Existing Conditions**

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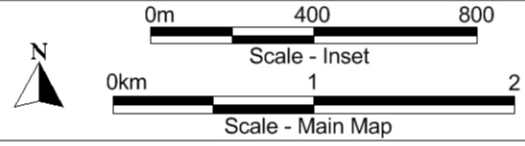


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3 Conclusion

Flood modelling of the Caley Valley wetlands was undertaken for the 100 year ARI and PMP design flood events, utilising existing XP-RAFTS hydrologic and MIKE FLOOD hydraulic models supplied by GHD. Additionally, the 100 year ARI design flood models were modified to incorporate estimated increases in rainfall intensity and sea level for the 2100 climate change scenario.

The modelling results show that the proposed DMCP footprint is entirely located outside of the flood extents for the 100 year ARI and the 100 year ARI + 2100 climate change design flood events, and is overlapped only slightly by the PMF design flood event extent for existing conditions.

The minor loss of wetland storage that the proposed DMCP footprint may cause during the PMF design flood event does not have any material impact on baseline peak flood levels.

Based on the modelling, it is concluded that the proposed DMCP will have no significant impacts on flood conditions on the wetland or existing infrastructure at Abbot Point.

4 References

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Appendix A XP-RAFTS Model Configurations



Figure A-1 XP-RAFTS Model Configuration – Euri Creek and Splitters Creek Catchments (Source: Maunsell, 2008)

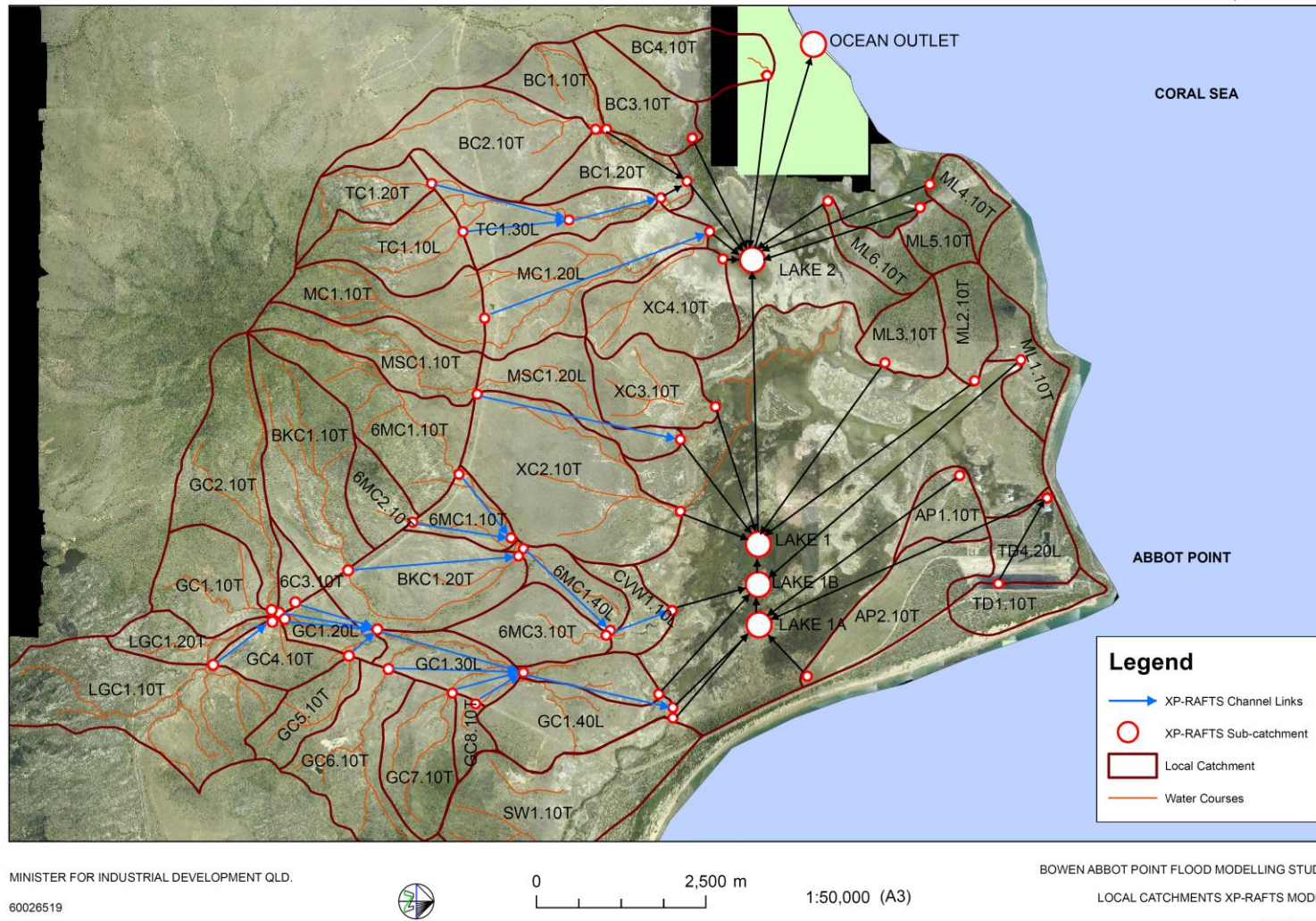


Figure A-2 XP-RAFTS Model Configuration – Local Catchments (Source: Maunsell, 2008)



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