11.4.3 Summary Outcomes of Assessment of Existing and Identified Control measures

The identified additional control measures have been assessed against the criteria outlined in the ALARP methodology **[1]** and SFAIRP framework **[20]**. The key outcomes of this evaluation are summarised below:

- Reliable and effective risk control measures and multiple lines of defence are already in place to control the hazard. As discussed in **Section 11.4.1**, the opportunities to improve controls for the identified critical hazard are determined to be **Weak**.
- Both proposed measures are engineering controls, meaning they mitigate risk through engineering means rather than administrative processes.
- Both identified controls are assessed as available, suitable, and practicable, in alignment with accepted industry best practice and dam safety engineering standards.
- Neither of the presented options is determined to be *de minimis*.
- Both potential control measures are to be progressed further through the reasonably practicable test.

11.5 Risk Reduction Achieved with Additional Control Measures

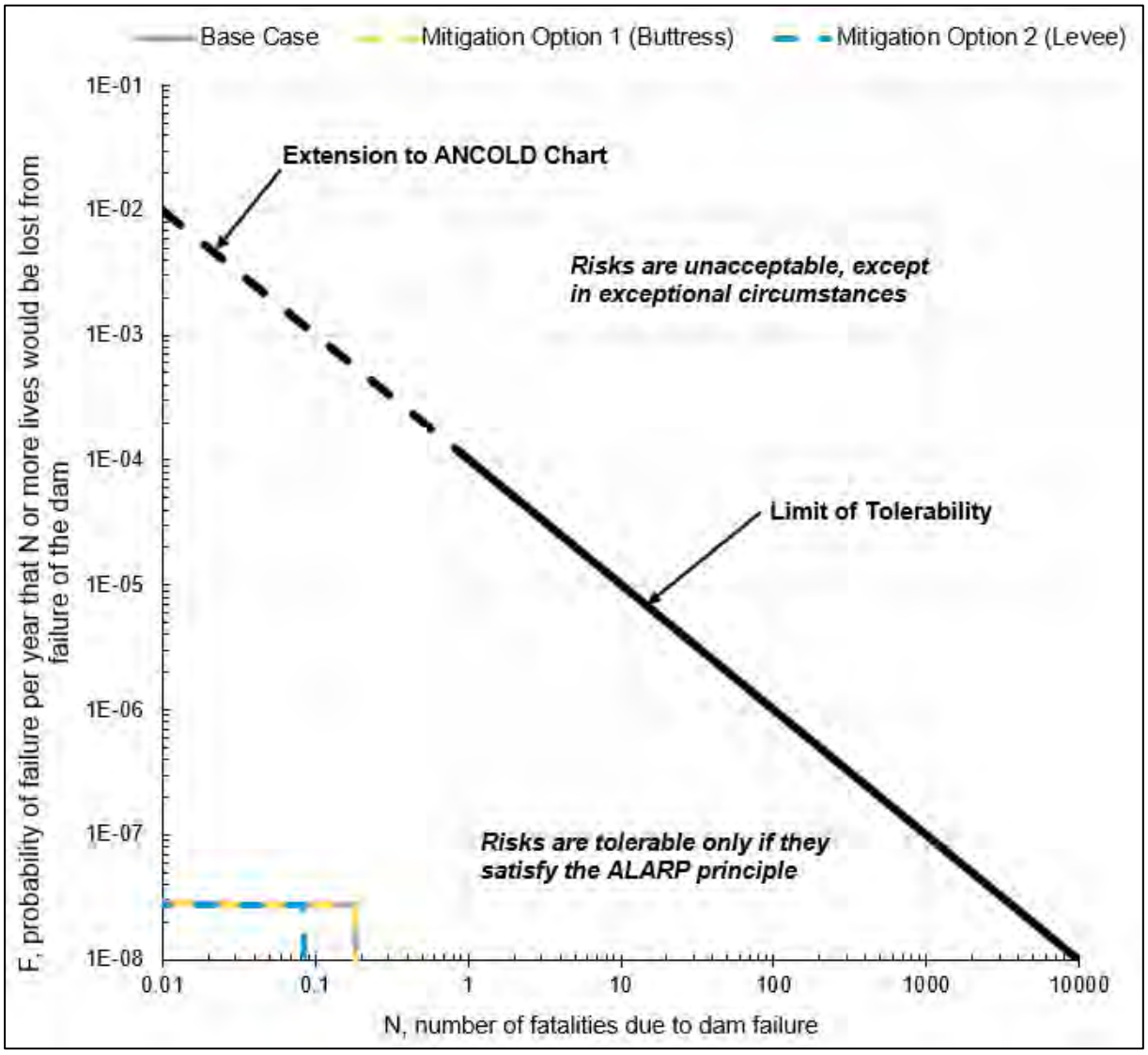
Table 21 summarises the estimated level of risk reduction that would be achieved if the additional control measures were implemented. **Graph 5** presents a comparison of the societal risk profile for each mitigation option compared to the base case.

TABLE 21 – STAGE 3 TSF ESTIMATED SOCIETAL RISK – EXISTING AND POST-IMPLEMENTATION OF THE ADDITIONAL CONTROL MEASURES

Risk Mitigation Option	Annual Probability of the Associated Critical Hazard		Total Societal Risks		Comment
	Existing	Post-Additional Control Measures	Existing	Post-Additional Control Measures	
Placement of Surplus Excavation Material along the Downstream Face	5.50E-08	5.50E-08	5.16E-09	5.15E-09	Implementation is expected to result in a negligible change to the overall risk profile. Progress to the reasonable practicable test.
Raise the Little Eva Pit Flood Protection Levee	5.50E-08	5.50E-08	5.16E-09	2.37E-09	Implementation is expected to result in a marginal change to the overall risk profile. Progress to the reasonable practicable test.

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GRAPH 5 – STAGE 3 TSF SOCIETAL RISK PLOT (RISK MITIGATION OPTIONS)



11.6 Cost to Save a Statistical Life (CSSL) and Gross Disproportion Factor

The Cost to Save a Statistical Life (CSSL) and the Gross Disproportion Factor for the proposed risk mitigation options have been estimated in accordance with the methodology outlined in ANCOLD (2022) **[1]**. Furthermore, the disproportion factor (F_D) and the justification rating for the implementation of each option have been determined with reference to Table 8.6 and 8.7 of the ANCOLD 2022 guidelines **[1]**, respectively.

The CSSL estimate has been limited to a qualitative assessment due to ATCW's limited knowledge of the capital and operational costs (and benefits) of implementing the proposed risk mitigation; as well as quantification of the economic, financial, and public safety consequences and/or benefits.

At this stage, all associated costs informing the ALARP assessment are considered order-of-magnitude estimates, derived from professional judgment and relevant historical project experience. Consequently, the estimated CSSL is also classified as an order-of-magnitude estimate. Should the outcomes of the ALARP assessment indicate the need to implement any of the proposed risk mitigation options, more detailed design work and refined cost estimates will be required to support the ALARP assessment.

The achieved risk reduction (denominator in the CSSL) for the proposed risk mitigation options is in the order of 1E-09 (i.e., the difference in societal risk between the base case and the relevant Risk Mitigation Option).

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Therefore, the CSSL is well above the threshold for a "**Poor**" Justification Rating in accordance with Table 8.7 of the ANCOLD 2022 guidelines **[1]** and as summarised in **Table 22**.

TABLE 22 – SUMMARY OF GROSS DISPROPORTION ASSESSMENT

Risk Mitigation Option	CSSL	Gross Disproportion Factor	Justification Rating
Place Surplus Material at Downstream Toe	> 7.7	1.0	**Poor**
Raise the Little Eva Pit Flood Protection Levee	> 7.7	1.0	**Poor**

11.7 Reasonably Practicable Assessment of Risk Mitigation Option

Table 23 summarises the reasonable practicability test outcomes for the proposed additional control measure.

TABLE 23 – REASONABLY PRACTICABLE TEST FOR STAGE 3 TSF ADDITIONAL CONTROL MEASURES

Risk Mitigation Option	Overall Assessment	Justification
Place Surplus Material at Downstream Toe	Not Reasonably Practicable	There is a strong degree of confidence that the dam's risk position plots below the applicable safety threshold. Therefore, the implementation of the additional control measure is deemed "Not Reasonably Practicable" based on the following key considerations: • The overall opportunities to improve controls for the critical hazard are determined to be **Weak** (**Section 11.4.1).** • The mitigation option is anticipated to have a **negligible impact** on the annual failure probability (AFP) and the overall societal risk (**Section 11.5**). • The overall justification rating for the gross disproportion assessment is assessed to be **Poor** (**Section 11.6**).
Raise the Little Eva Pit Flood Protection Levee	Not Reasonably Practicable	There is a strong degree of confidence that the dam's risk position plots below the applicable safety threshold. Therefore, the implementation of the additional control measure is deemed "Not Reasonably Practicable" based on the following key considerations: • The overall opportunities to improve controls for the critical hazard is determined to be **Weak** (**Section 11.4.1).** • The annual failure probability (AFP) is **not anticipated to improve** following the implementation of the risk mitigation option. (**Section 11.5**). • The overall improvements to the societal risk following the implementation of the risk mitigation option are estimated to be **less than one order of magnitude** (**Section 11.5**). • The overall justification rating for the gross disproportion assessment is assessed to be **Poor** (**Section 11.6**).

12 CONCLUSIONS AND RECOMMENDATIONS

The risk assessment and ALARP assessment outcomes indicate that the Stage 3 TSF societal risk profile is lower than the ANCOLD limit of tolerability for major augmentations **[1]** to an extent which ATCW consider to be "ALARP".

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ATCW consider that neither of the risk reduction mitigation measures are considered reasonable nor practicable and hence neither are recommended for implementation.

Nevertheless, it is noted that the determination on whether the ALARP principle is satisfied is a matter for judgement by MMG.

Notwithstanding, the following recommendations are made to effectively monitor and manage the risks and enhance the dam safety management system:

- Regularly update the dam safety plans, including the Operation and Maintenance Plan and the Dam Safety Emergency Plan.
- Regularly review and update the surveillance program based on the recommendations made in the ANCOLD Guidelines on Dam Safety Management System **[21]**. This ensures early detection of any potential issues or anomalies.
- Reassess the credibility of the identified potential failure modes if any modifications are made to the design or proposed operational status. Similarly, any identification of poor construction practices or deviations from specifications post-construction requires an immediate review of the failure modes to ensure the continued integrity and safety of the dam structure.
- Review the risk assessment outcomes if there are material changes to the assumed downstream conditions, such as the structure and alignment of the Little Eva Pit Flood Protection Levee and/or the number of Harmony personnel expected to be working within the Little Eva Pit.
- Ensure that the dam operations and management staff receive appropriate training and have the necessary skills to carry out the operation and maintenance tasks or to respond effectively to various scenarios in an emergency.

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REFERENCES

[1] ANCOLD (2022), "Guidelines on Risk Assessment", July 2022.

[2] ATC Williams (2025), "MMG Dugald River – Tailings Storage Facility – Stage 3 Raise Detailed Design Report", Ref. 250542-R04 (RevA), September 2025.

[3] ATC Williams (2025), "MMG Dugald River – Tailings Storage Facility Stage 3 Raise – Civil Works Technical Specification", Ref. 250542-S01 (RevA), July 2025.

[4] ATC Williams (2016), "MMG Dugald River – Tailings Storage Facility – Design Report" Ref. 108003.18-R03 (Rev1), May 2016.

[5] ATC Williams (2016), "MMG Dugald River – Tailings Storage Facility – Civil Works – Technical Specification" Ref. 108003.18-SP01 (Rev2), September 2016.

[6] ATC Williams (2017), "Civil Works Construction Report," Ref: 108003.25 R01 (RevA), July 2017.

[7] ATC Williams (2024), "Dugald River Mine – Regulated Structures – Annual Inspection Report – 2024" Ref. 108003.65-R01 (RevA), October 2024.

[8] ATC Williams (2024), "Dugald River Mine – Tailings Storage Facility – Intermediate Dam Inspection Report 2024" Ref. 108003.65-R02 (Rev0), December 2024.

[9] ATC Williams (2024), "Tailings Storage Facility Operation Plan", Ref: 108003.65 PL01 Rev2, August 2024

[10] ATC Williams (2025), "Dugald River Mine – Tailings Storage Facility – Stage 3 Concept Design" Ref. 108003.67-R01 (Rev1), March 2025.

[11] ATC Williams (2025), "MMG Dugald River – Dugald River Mine Tailings Storage Facility – Stage 3 Dam Break and Consequence Category Assessment" Ref. 250542-R03 (RevA), June 2025.

[12] ATC Williams (2025), "Dugald River – TSF Stage 3 Detailed Design – Water Balance Memorandum" Ref. 250542-M02 (RevA), June 2025.

[13] Silva, F.S., Lambe, T.W., & Marr, W.A. (2008), "Probability and Risk of Slope Failure", Journal of Geotechnical and Geoenvironmental Engineering, December 2008.

[14] U.S. Army Corps of Engineers (2025), "RMC-TotalRisk", Version 1.0, January 2025.

[15] U.S. Department of the Interior Bureau of Reclamation & U.S. Army Corps of Engineers (2019), "Best Practices in Dam and Levee Safety Risk Analysis", Version 4.1, July 2019.

[16] Maslin, K., Foster, M., & McDonald, L. (2012), "Estimating Individual Risk: A Pragmatic and Defensible Approach", 2012.

[17] Lang, S., & Foster, M. (2019), "Estimating the Individual Risk from Dam Failure", 2019.

[18] USBR (2015), "RCEM – Reclamation Consequence Estimating Methodology: Guidelines for Estimating Life Loss for Dam Safety Risk Analysis". Interim, July 2015. United States Bureau of Reclamation, Denver, Colorado.

[19] Leps, T.M. (1970), "Review of Shearing Strength of Rockfill", Journal of Soil Mechanics and Foundation Division, SM4m pp. 1159-1170.

[20] Pearse, M., Foster, M., Hill, P., Banzi, S., Liu, B., & Hameed, M. (2021), "Development of a Practical SFAIRP Framework for Dams", ANCOLD 2021 Online Event Proceedings, pp. 303-313.

[21] ANCOLD (2003), "Guidelines on Dam Safety Management", August 2003.

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APPENDICES

APPENDIX A – SYSTEM IDENTIFICATION

ID	Component	Sub-Component	Primary Function	Secondary Function	Details
SUB-SYSTEM 1		**Main Embankment**			
1.1	Dam Crest		Provides access to survey monuments , spillway, and BGM Liner anchor		Crest Level = RL 253.5 m (Stage 3 Design) Crest Width = 10 m Embankment height (Max) = 47.5 m Crest Length = 292 m
1.2	Embankment fill		Structural stability, tailings confinement		Zoned rockfill embankment with BGM liner protection along the US face Spec: Fill material shall meet the specification for each of the following material zones: • Zone 2B (BGM Support Layer) - Clayey GRAVEL (with Sand); Silty, Clayey GRAVEL (with Sand); Poorly Graded GRAVEL with clay - Atterberg Limits must plot on or above the 'A' line - Max particle size of 50 mm • Zone 2C (Granular Filter Material) - Poorly Grade GRAVEL with Clay, Silt or Sand (and Cobbbles); Clayey GRAVEL or Silty GRAVEL with Sand (and Cobbles); Poorly Grade Sandy GRAVEL (with Cobbles) - Max particle size of 150 mm • Zone 3A (Transition Rockfill) - HW-SW rock, well graded and consist of clean, hard and durable particles - max particle size of 400 mm • Zone 3B (General Rockfill) - HW-SW rock, well graded and consist of clean, hard and durable particles - max particle size of 800 mm • Zone 3C (Rockfill Drain) - SW-FR rock - max particle size of 600 mm
1.3	Upstream & Downstream Batter		Structural stability		US 1.75H : 1V with a 3m bench DS 1.5H : 1V with 5m benches
1.4	Upstream & Downstream protection		Erosion Protection		Embankment constructed with rockfill not prone to surface erosion
1.5	Foundation		Structural support		Foundation to be cleared and stripped of all surface soils and loose, fractures, weathered rock. Final preparation shall consist of the removal of loose soil or rock, or water softened material, by machine excavation.
1.6	Foundation Grouting		Seepage interception		Upstream reinforced concrete toe plinth constructed along a upstream toe of the embankment. Dowelled into rock. Foundation grouting at regular intervals along the length of the plinth to a minimum depth of 6 m and a total interception depth of the order of 10 m. Extension of toe plinth and foundation grouting is proposed for the Stage 3 raise.
1.7	Decant Pond				The decant pond forms at the western end of the facility against the Main Embankment. Due to recent heavy rainfalls, the decant pond has been extensive and has covered the majority of the tailings beach in recent years.
SUB-SYSTEM 2		**Northern Discharge Bund**			
2.1	Dam Crest		Provides access to discharge pipelines		Crest Level = RL 253.5 m (Design) Crest Width = 5 m Embankment height (Max) = 9.5 m Crest Length = 73 m

2.2	Embankment fill		Structural stability, tailings confinement		Zoned rockfill embankment with surface rip-rap protection along the upstream face Spec: Fill material shall meet the specification: • Zone 2B (BGM Support Layer) - Clayey GRAVEL (with Sand); Silty, Clayey GRAVEL (with Sand); Poorly Graded GRAVEL with clay - Atterberg Limits must plot on or above the 'A' line - Max particle size of 50 mm • Zone 3A (Transition Rockfill) - HW-SW rock, well graded and consist of clean, hard and durable particles - max particle size of 400 mm
2.3	Upstream & Downstream Batter		Structural stability		US 2H : 1V DS 2H : 1V
2.4	Upstream & Downstream protection		Erosion Protection		Embankment constructed with rockfill not prone to surface erosion
2.5	Foundation		Structural support		Foundation to be cleared and stripped of all surface soils and loose, fractures, weathered rock. Final preparation shall consist of the removal of loose soil or rock, or water softened material, by machine excavation.
2.6	Decant Pond				Decant pond typically forms away from the Northern Discharge Bund
SUB-SYSTEM 3	**Emergency Spillway**				
3	Emergency overflow structure		Safe passage of excess decant and flood water		Stage 3 Spillway designed for PMF event Invert level= RL 251.35 m Base width= 50m. Batter slopes vary due to rock quality
Other SUB-SYSTEM					
4	Decant and Return Water System		Safe passage of excess decant		The primary Return Water System (RWS) infrastructure comprises: 1. Decant Pump Station: Single end-suction centrifugal water pump with variable speed drive motor. Capable of a maximum output of 90 m3 /hr at 6.5 m of suction head. 72 m long floating suction provides feed water to the Decant Pump. Suction line comprised of 6 sections of HDPE pipeline supported by pipe floats. 2. Discharge Pipeline: Comprises a 150 m long, HDPE pipeline linking the Decant Pump Station to the Booster Pump Station 3. Booster Pump Station: Single end-suction centrifugal water pump in fixed speed configuration. Located above the TSF final filling level 4. Return Water Pipeline - Approximately 5.3 km of HDPE running from Booster Pump Station to Process Plant.
5	Drainage and Seepage Collection System		Maintaining a facility with minimal water		Stage 3: Decommission existing seepage collection pond. New seepage collection system will comprise extension of the existing rockfill seepage collection drain in the base of the foundation which discharges into a seepage monitoring sump. The sump will be a circular concrete soak well installed in a rock-filled interception trench. The downstream side of the trench will be lined with an impermeable geosynthetic.
6	Tailing Delivery System		Tailings deposition		Tailings deposition is rotated between the northern and southern discharge points, as required to maintain a centralised decant pond
7	Impoundment Area				

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APPENDIX B – HAZARD SCREENING

Failure Initiating Events	Screening Criteria	Comments
Aircraft Impact	1. The event is of equal or lesser damage potential than the events for which the dam is designed. The design significantly exceeds the requirement.	The impact of a large aircraft is conceivable but is extremely unlikely except in areas of high air traffic (for example, approach to a major airport) This structure is approximately 60km from Cloncurry airport. So a regional plane of up to 50 passengers could impact the dam. Significantly less likely event than natural events that would also cause a dam failure.
Avalanche	6. Not an initiator.	No hills or mountains around the storage and dam that are snow covered.
Barometric pressure in regard to seiche effects	6. Not an initiator.	Barometric pressure in regard to seiche effects for large reservoirs can be a hazard. This structure does not maintain a large scale lake.
Chemical Reaction	5. The event is judged to have an insignificant effect on the dam.	The chemical composition of the stored tailings and water will have an insignificant impact on the integrity of the embankment.
Earthquakes (seismic)	**POTENTIAL INITIATING EVENT**	Seismic loading-induced liquefaction, impact on the embankment (crack), and foundation liquefaction should be assessed
Fire	**POTENTIAL INITIATING EVENT**	Bush fires at the abutments may transition to the BGM Liner, resulting in a loss of water storage capabilities and potential erosion or slope instability
Floods	**POTENTIAL INITIATING EVENT**	Flood overtopping of dam crest and erosion of embankment and toe Pore pressures cause embankment instability, slope failure and loss of freeboard Embankment settlement cracking leading to internal erosion Internal erosion through defects and high permeability zones Spillway erosion could happen during the flood
Ground vibration	1. The event is of equal or lesser damage potential than the events for which the dam is designed. The design significantly exceeds the requirement.	Adjacent mine blasting may induce vibrations at the TSF, however the dam is designed for vibrations from very rare seismic events which would significantly exceed ground vibrations from blasting.
Hail	5. The event is judged to have an insignificant effect on the dam.	No critical flow control equipment involved in dam operation that could be affected by hail.
Inadequacy of maintenance (i.e., unwanted vegetation, tree roots, animal burrows, surface erosion,…)	4. The event is included in the definition of other event(s).	Inadequacy of maintenance could result in the development of defects leading to internal erosion and slope stability failure which has already been considered in other failure initiation events (Flood, Earthquake and stored water).
Intrinsic Deficiencies	4. The event is included in the definition of other event(s).	E.g. construction defects or not constructed to design standards, material deterioration, or change of material characteristics leading to internal erosion and slope stability failure which has already been considered in other failure initiation events(Flood, Earthquake and stored water).
Lightning strike	5. The event is judged to have an insignificant effect on the dam.	Lightning strike, particularly in regards to its effect on vital operating, control or monitoring equipment, is conceivable. This event will not have dam safety risk and just impose operational risk.
Meteor Strike	6. Not an initiator.	Not an initiator. Significantly less likely event than other natural events that would also cause a dam failure.
Operator Access	4. The event is included in the definition of other event(s).	The inability of operators to get to the dam during critical times. This is integrated to the event trees (developed for FM initiated from

		flood, earthquake and stored water) allowing a node for unsuccessful intervention.
Operator error	4. The event is included in the definition of other event(s).	Failure to operate the RWS appropriately could result in higher operational decant pond prior to flooding increasing the chance of flood risks. Not rotating the discharge spigots could raise the water level in an isolated section, overfilling also covered in flood and stability risks.
Pore Pressures (Dam Wall)	4. The event is included in the definition of other event(s).	Included in flood and earthquake loadings and during the normal operations in the context of the intrinsic deficiencies.
Pore Pressures (Foundations)	4. The event is included in the definition of other event(s).	Included in flood and earthquake loadings and during the normal operations in the context of the intrinsic deficiencies.
Reservoir Level Fluctuations	4. The event is included in the definition of other event(s).	Included in flood and earthquake loadings and during the normal operations in the context of the intrinsic deficiencies.
Reservoir rim landslide	1. The event is of equal or lesser damage potential than the events for which the dam is designed. The design significantly exceeds the requirement.	Reservoir rim landslide is conceivable given that the TSF is bounded by the Knapdale Valley Range, however the topography along the impoundment rim is relatively gentle and and land slide would not result in inflow volumes greater than the design designed (e.g. 1 in 10,000 flood inflows).
Security breaches	5. The event is judged to have an insignificant effect on the dam.	Not meant to be accessed by the public, and located in a remote location. However, access by unauthorised people is possible. The ability to cause dam safety issues is limited, however operational issues mainly with return water or tailings spills could be caused.
Stored Water in normal operation	**POTENTIAL INITIATING EVENT**	The stored water is itself a hazard, given that the dam is an imperfect container (hence the need to consider failure modes under normal operating conditions)
Temperature	4. The event is included in the definition of other event(s).	The high or low temperature could result in the development of defects leading to internal erosion and slope stability failure which has already been considered in other failure initiation events.
Terrorism	NOT ASSESSED	Terrorism is conceivable (but usually excluded from dam safety risk assessment studies)- ANCOLD 2022
Toxic Gas	6. Not an initiator.	Not expected to cause dam failure.
Transportation Accident	6. Not an initiator.	Not expected to cause dam failure.
Tsunami	6. Not an initiator.	Tsunami is conceivable for some low dams in coastal areas, not applicable to this site
Upstream dams	6. Not an initiator.	No dams upstream of the TSF.
Upstream natural landslide	3. The event cannot occur close enough to the dam to affect it.	No upstream landslide potential
Vandalism	1. The event is of equal or lesser damage potential than the events for which the dam is designed. The design significantly exceeds the requirement.	Vandalism is conceivable and is usually sufficiently likely to require analysis. However, it is not expected as the structure is not meant to be accessed by public, and is located in a remote location. Damage due to vandalism would not be expected to result in dam failure
Volcanic Activity	3. The event cannot occur close enough to the dam to affect it.	No hazardous volcanic activity close enough to the dam to effect it.
War	NOT ASSESSED	Act of war is conceivable (but usually excluded from dam safety risk assessment studies)
Wind	**POTENTIAL INITIATING EVENT**	Wind, particularly set-up and seiche effects, needs to be considered. This will be combined with flood effects in overtopping failure Modes

APPENDIX C – POTENTIAL FAILURE MODE CREDIBILITY ASSESSMENT

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#	FM ID	Broad FM	Failure Mode	Component	Initiating Event	Potential Mechanism & Pathway	Effect		Class of the Failure	Expected Consequence of Failure			Failure Detection	Existing Controls	Actions	Adverse Factors	Assessment (Life Safety risks are just considered)	Comments (Acceptance or Rejection Reason)
							Primary	Secondary		Life Safety	Environmental	Operation/Business						
Overtopping (OT)																		
1	DR TSF-Emb-OT-1	Overtopping	Overtopping erosion due to insufficient installed flood capacity	Main Embankment	Flood	A flood event which exceeds the spillway capacity; due to inadequate design; results in the overtopping of the embankment crest. The force of the overtopping flow erodes the embankment material, creating scour holes or channels along the embankment slope and downstream areas. Then headcut erosion initiates. Continued erosion and scouring compromise the stability and integrity of the embankment structure, reducing its load-bearing capacity and resulting in a breach formation allowing the uncontrolled release of containment. The intervention will fail due to the site flood situation.	Erosion of the crest	Loss of freeboard and overtopping	Full Dam Breach	Yes	Yes	Yes	Storm data and flood warning monitoring from Bureau of meteorology	- The storage capacity and freeboard is designed to contain extreme floods up to the PMF (Stage 3 Design Report). - The hydrology assessments consider a conservative assumption of an initial water level at the spillway invert level (Stage 3 Design Report) - The hydrology assessments account for increases to the design rainfall as a result of climate change (Stage 3 Design Report)	Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and decant pond that allows early detection of low points and mitigation of any initiated crest erosion - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Construct the embankment with free draining coarse rockfill, which adds erosion resistance to the downstream face (Engineering judgement)	- No scour assessment of the downstream rockfill face has been conducted - Intervention during a flood event would be difficult/impossible	Not Credible	Spillway capacity is designed to pass floods up to the PMF, as well as the 1:100,000 AEP + 1:10 AEP wind wave run-up, thus conforming to ANCOLD, DESI and GISTM requirements for a 'High' Consequence Category Dam. Climate change influences have also been considered in the design in accordance with guidance provided by Australian Rainfall and Runoff. Furthermore, the flood routing has conservatively considered the initial storage level at spillway invert. This PFM is therefore assessed as Not Credible for the Main Embankment
2	DR TSF-Emb-OT-2	Overtopping	Overtopping erosion due to insufficient available flood capacity due to the spillway blockage	Main Embankment	Flood	A flood event which exceeds the spillway capacity, due to full or partial blockage; results in the overtopping of the embankment crest. The force of the overtopping flow erodes the embankment material, creating scour holes or channels along the embankment slope and downstream areas. Then headcut erosion initiates. Continued erosion and scouring compromise the stability and integrity of the embankment structure, reducing its load-bearing capacity and resulting in a breach formation allowing the uncontrolled release of containment. The intervention will fail due to the site flood situation.	Erosion of the crest	Loss of freeboard and overtopping	Full Dam Breach	Yes	Yes	Yes	Routine inspection of spillway for blockages and obstructions	- The storage capacity and freeboard is designed to contain extreme floods up to the PMF (Stage 3 Design Report). - The hydrology assessments consider a conservative assumption of an initial water level at the spillway invert level (Stage 3 Design Report) - The hydrology assessments account for increases to the design rainfall as a result of climate change (Stage 3 Design Report)	Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and decant pond that allows early detection of low points and mitigation of any initiated crest erosion and/or spillway blockage - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Construct the embankment with free draining coarse rockfill, which adds erosion resistance to the downstream face (Engineering judgement)	- No scour assessment of the downstream rockfill face has been conducted - Intervention during a flood event would be difficult/impossible	Not Credible	A blockage scenario would reduce the flood capacity of the spillway, thus resulting in potential overflow during more frequent flood events than the PMF. Hydrology studies have been carried out to assess the performance of the spillway under a 50% blockage scenario. The outcomes of the assessment indicate that the Stage 3 emergency spillway is capable of passing all events up to and including the 1:100,000 AEP flood in the case of a 50% blockage. The outcomes indicate that under a PMP flood, overtopping will occur in the case of a 50% blockage. The overtopping would be limited to approximately 30 mm depth above the embankment crest at the peak of the flood. The probability of a spillway blockage occuring; combined with the probability of the decant pond starting at the spillway invert; combined with the probability of the PMP flood (nominally 1 in 10,000,000 AEP) is considered to be negligible. Therefore, this PFM has been excluded due to negligible probability.
3	DR TSF-Emb-OT-3	Overtopping	Overtopping erosion due to insufficient available flood capacity due to wind induced wave effects	Main Embankment	Flood/Wind	Reservoir level rises during extreme storm events; this raised level correlated with the wave action results in progressive erosion and overtopping of the embankment crest. The erosion extends to the downstream edge of the crest and initiates erosion of the crest, loss of freeboard and erosion of the downstream slope forming the full breach. The intervention will fail due to inability of site personnel to access the embankment due to access restrictions during a flood.	Erosion of the crest	Loss of freeboard and overtopping	Full Dam Breach	Yes	Yes	Yes	Storm and wind data and warnings monitoring from Bureau of meteorology Routine monitoring of decant pond level	- The storage capacity and freeboard is designed to contain extreme floods up to the PMF, as well as the 1:100,000 AEP flood plus the wave run-up from the 1:10 AEP wind event (Stage 3 Design Report) - The hydrology assessments consider a conservative assumption of an initial water level at the spillway invert level (Stage 3 Design Report) - The hydrology assessments account for increases to the design rainfall as a result of climate change (Stage 3 Design Report) - Wave run-up estimates based on latest available wind data from the Bureeau of Meteorology (Stage 3 Design Report)	Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and decant pond that allows early detection of low points and mitigation of any initiated crest erosion - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Construct the embankment with free draining coarse rockfill, which adds erosion resistance to the downstream face (Engineering judgement)	- No scour assessment of the downstream rockfill face has been conducted - Intervention during a flood event would be difficult/impossible	Not Credible	The wave run-up is estimated to be ~0.8m for the 1 in 10 AEP wind event. Under normal operations when the storage level is maintained at or below the MRL of RL 249.55 m, there is 1.8 m dry freeboard available to the spillway invert. This PFM is therefore assessed to be Not Credible during normal operations. The spillway is designed to pass the 1:100,000 AEP flood + 1:10 AEP wind wave run-up, assuming an initial water level at spillway invert. The probability of a flood event exceeding the 1:100,000 AEP threshold occuring concurrently with wind conditions surpassing the 1:10 AEP threshold The probability of a flood event occuring which exceeds the 1:100,000 AEP; combined with the probability of the decant pond starting at the spillway invert; combined with the probability of wind conditions surpassing the 1:10 AEP conditions is negligible. On this basis, this PFM is assessed to be Not Credible and excluded from the risk assessment due to negligible likelihood.
4	DR TSF-Spill-OT-4	Overtopping	Partial breach due to progressive headcut erosion at the spillway	Emergency Spillway	Flood	The spillway operates during flood events. The process of progressive scour initiates at the spillway sill and chute, primarily due to the erosion of the riprap and protective layers. This erosion progress towards the spillway crest leading to lowering of the spillway crest. In situations of severe flooding, any intervention attempts are likely to be unsuccessful. The erosion continues its progression, potentially resulting in a partial breach of storage capacity and a loss of containment.	Erosion of the spillway chute	Loss of freeboard and partial breach	Partial breach	Yes	Yes	Yes	Storm data from Bureau of meteorology Localised erosion of the spillway chute could be identified during the routine inspections.	- The Stage 3 spillway is designed to be constructed within a competent rock base (Stage 3 Design Report)	Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the emergency spillway that allows early detection and mitigation of any initiated spillway erosion - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Construct the spillway through competent rock in accordance with specifications and with appropriate QA/QC procedures and full-time construction supervision	- No scour/erodibility assessment of the spillway has been conducted	Not Credible	The Stage 3 spillway will be excavated to a competent rock base. This material is not considered to be prone to large scale erosion in the case of a spill. If scour occurs along the spillway rock chute, it is not expected to be significant enough to substantially lower the spillway invert. Any minor reduction in the spillway invert would result in only a partial breach with limited consequences. This PFM is assessed to be not credible and excluded from the risk assessment due to the negligible likelihood and minor consequences.
5	DR TSF-Emb-OT-5	Overtopping	Overtopping erosion due to failure of the Return Water system	Main Embankment	Normal, Flood	Return Water System functionality could be compromised due to the inadequate design or the failure of components (intake, pipe and outlet) resulting in restricted hydraulic capacity or partial/full blockage. This can happen in normal operation or flood events, resulting in elevating the ponded water against the embankment, unwanted spill, or overtopping of the embankment crest during a flood.	Elevated pond or Erosion of the crest in flood	Unwanted release or Loss of freeboard and overtopping	Full Dam Breach	Yes	Yes	Yes	Routine inspection of the Return Water System Storm data and flood warning monitoring from Bureau of meteorology	- The Stage 3 spillway has been designed to pass the PMF, assuming an initial water level at spillway invert (Stage 3 Design Report) - The hydrology assessments account for increases to the design rainfall as a result of climate change (Stage 3 Design Report) - The spillway has been designed independent from the RWS (Stage 3 Design Report)	Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the RWS that allows early detection and mitigation of the risk of RWS failure - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Maintain, exercise and review a site specific water management plan.	- Failure of the RWS may result in elevated reservoir levels	Not Credible	Under normal operations (i.e. sunny day), the failure of the decant system is expected to be detected through observation of elevated ponding against the embankments and/or throughput data to the Process Plant. Additionally, the spillway could redirect the elevated ponded water until the issue is resolved or the excess water is pumped out. The spillway has been designed assuming an initial water level at spillway invert, with no reliance on the Return Water System. The spillway has been designed for the maximum conceivable flood event (i.e., PMF) and considers potential impacts due to climate change. As such, the failure of the RWS is not expected to impact on the flood capacity of the spillway and hence not result in overtopping. Therefore, this PFM is assessed to be Not Credible
11	DR TSF-Emb-OT-11	Overtopping	Overtopping erosion due to long term deformation of embankment and loss of freeboard	Main Embankment	Normal, Flood	Loading is applied to the dam due to the impoundment of water, creating stress within the dam structure. Over time, the dam materials may undergo long-term deformation processes such as consolidation and creep. Where the deformation is more than available freeboard, embankment would be overtopped under normal operations (where the water is ponding against the embankment) or flood events compromising the overall stability of the dam. Ineffective surveillance practices or insufficient maintenance may lead to the oversight of low points on the crest, preventing successful intervention. Embankment breaches primarily caused by overtopping.	Erosion of the crest	Loss of freeboard and overtopping	Full Dam Breach	Yes	Yes	Yes	-Visible pond level and loss of freeboard. Regular surveys of the embankment crest should be analysed for trends, anomalies, or sudden changes that could indicate downstream slope instability or long term deformations. -Regular Inspections: Trained personnel visually inspect the dam crest to detect the low points.	- Embankment designed to industry standards and provides for adequate freeboard considering long term deformation of the embankment (Stage 3 Design Report) - The embankment is to be constructed on rock foundations which minimises the expected long term deformation of the structure (Engineering judgement)	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment is constructed to the design specifications - Install survey monuments on the embankment and downstream benches and implement a routine monitoring plan to track embankment deformations and for early identification of excessive movements. - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment that allows early detection and mitigation of excessive settlement or deformations - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.	- Numerical modelling of long-term embankment settlements has not been carried out	Not Credible	Nine survey monuments are proposed to be installed along the Stage 3 embankment crest and downstream bench. Under normal operations, the decant pond will not pond against the embankment crest as any elevated ponded waters will discharge via the spillway. The maximum decant pond level under normal operations corresponds to the spillway invert at approximately RL 251.35 m. This requires long-term crest settlements in excess of 2.15 m to cause any overtopping along the embankment crest. The maximum total vertical displacements to date since monitoring began in October 2018 is 75 mm. This is well within design expectations for large Rockfill embankments such as the TSF embankment. A Trigger Action Response Plan (TARP) is in place which requires activation of the Emergency Response Plan for movements in excess of 5 mm/day. The probability that the magnitude of crest settlements that is required to result in loss of freeboard (i.e. 2.15m) is allowed to continue undetected is negligible. Therefore, this PFM is assessed to be not credible under normal operations (Suny Day Failure).
12	DR TSF-Emb-OT-12	Overtopping	Overtopping erosion due to deformation of embankment and loss of freeboard post seismic events	Main Embankment	Earthquake	Significantly large seismic event occurs resulting in the embankment and foundation materials undergoing strain weakening. Embankment undergoes post-seismic deformation. Cumulative static settlement and seismic deformation exceeds crest freeboard. Water/tailings overtops the embankment crest, and flows over the downstream slope. The overtopping flow continues to erode the embankment material, creating scour holes or channels along the embankment slope and downstream areas, and headcut erosion initiates. Continued erosion and scouring compromise the stability and integrity of the embankment structure, reducing its load-bearing capacity. Intervention prove ineffective due to the abrupt and unpredictable nature of this failure mode. Embankment breaches primarily caused by overtopping.	Erosion of the crest	Loss of freeboard and overtopping	Full Dam Breach	Yes	Yes	Yes	Visual Inspection: Cracks: Look for cracks on the dam crest, slopes, and downstream toe. Significant cracking can indicate internal movement and potential instability. Deformation: Observe for any bulging, tilting, or settlement of the dam crest. Seepage: Increased seepage or leakage from the dam can indicate internal damage to water flow paths. Instrumentation Monitoring: Survey monuments: Track vertical settlements of the dam crest to assess overall stability.	- Embankment designed to industry standards and provides for adequate freeboard considering seismic deformation of the embankment (Stage 3 Design Report) - The embankment is to be constructed from rockfill and on rock foundations which are less susceptible to strain weakening (Engineering judgement) - Seismic deformation assesments have been carried out for the Stage 3 Embankment (Stage 3 Design Report)	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment is constructed to the design specifications - Install survey monuments on the embankment and downstream benches and implement a routine monitoring plan to track embankment deformations and for early identification of excessive movements. - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment that allows early detection and mitigation of excessive settlement or deformations - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.	- Seismic deformation estimates are limited to empirical estimates only	Not Credible	A detailed slope stability assessment was carried out during the design. The stability assessment considered various scenarios. The results of the stability analysis indicate that the achieved FoS exceed ANCOLD Guidelines. The minimum computed FoS along the upstream face is 2.34 at the end of filling. A post-seismic loading condition was not analysed for the following reasons: 1. Seismic loading is not expected to result in a strength loss of either the embankment or foundation (materials not judged to be susceptible to strain weakening); and 2. The rockfill embankment and rock foundation are judged to not be susceptible to liquefaction. Seismic deformation estimates were carried out using empirical database methods. The estimated settlements following seismic events are 6mm (Swaisgood, 2003) and 14 mm (Pells and Fell, 2003). The available freeboard between the spillway invert and the embankment crest is 2.15m. Therefore, this PFM is assessed to be Not Credible
22	DR TSF-Emb-OT-22	Overtopping	BGM Liner Failure resulting in excessive seepage and displacement of the embankment materials	Main Embankment	Normal, Flood, Earthquake	BGM Liner can fail due to Seam Failure, Puncture or Tear, Aging, UV exposure (if not covered), chemical degradation, or low interface shear strength between the BGM liner and the support layer, leading to slippage or wrinkling. Continued leaking through the damaged BGM liner can cause a sustained and uncontrolled loss of the stored water. The rate of seepage may increase rapidly and the velocity of the flowing water may displace the embankment materials, leading to excessive crest settlements and overtopping erosion.	Excessive seepage from embankment	Overtopping erosion of the crest	Full Dam Breach	Yes	Yes	Yes	- Observation of increased seepage out of the downstream face of the embankment or in the foundation. This may be by visual observation, or by seepage measurement, or more sophisticated methods such as thermal monitoring of the foundation or the downstream slope. - Settlements, deformation and cracking in the embankment or area downstream of the dam. -Regular Inspections: Trained personnel visually inspect the exposed BGM liner for defects, punctures, seam failure etc.	- BGM liner designed to industry standards and supplier requirements (Stage 3 Design Report) - The embankment materials (coarse rockfill) would require a sufficiently high flow velocity in order to dislodge and transport these particles, unlikely to be observed from seepage flows (Engineering judgement)	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment and BGM liner is constructed to the design specifications - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankmentand BGM liner that allows early detection and mitigation of liner failure and excessive seepage - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.	- Defects within the BGM liner will be difficult to repair - No scour/sediment transportation assessment has been conducted for the embankment materials due to seepage flows - Assessment of tensile performance of BGM liner in response to potential settlement of the supporting layer has not been conducted.	Not Credible	The presence of defects presenting within the BGM Liner is credible due to either poor construction practices; improper maintenance; manufacturing defects; and/or degradation. Once defects are present below the water surface, repairs are difficult. Seepage through the BGM liner defect may occur, and minor displacement of the rockfill embankment shell may occur. However, crest settlements in excess of 2.15 m would be required for overtopping to occur (assuming an initial water level at spillway invert). This failure mode would require a combined probability of the following: - The presence of an unidentified and unmitigated defect in the BGM liner; - Seepage flows which have sufficiently high velocities to displace coarse rockfill materials; - Embankment crest settlements in excess of 2.15 m as a result of the displaced rockfill materials; - An initial pond level at the spillway invert at the time of failure; and - Sufficiently high overtopping flows to induce headcut erosion of the coarse rockfill materials. The combined probability of these events is considered to be negligible. This PFM is therefore assessed to be Not Credible due to negligible probability.
23	DR TSF-Emb-OT-23	Overtopping	Sloughing of the embankment upstream face due to wind induced wave effects, resulting in loss of freeboard and overtopping erosion	Main Embankment	Wind	Wave action occurs which results in sloughing/erosion of the embankment upstream face. While BGM provides impermeability, it does not provide mechanical reinforcement. The erosion results in a loss of freeboard and the stored water begins overtopping the embankment crest, causing progressive erosion. The erosion continues until a full breach is formed. Intervention fails due to access restrictions to the crest during high wind events.	Erosion of the crest	Loss of freeboard and overtopping	Full Dam Breach	Yes	Yes	Yes	Wind data from Bureau of meterology Localised erosion of the upstream face could be identified during routine inspections.	- The embankment freeboard has been designed to safely accommodate the 1:100,000 AEP flood plus the wave run-up from the 1:10 AEP wind event (Stage 3 Design Report) - The design nominates a BGM liner to be installed along the embankment upstream face (Stage 3 Design Report)	- Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Establish a comprehensive dam safety management program that includes routine inspections, assessments, and emergency response plans to enable early detection of low points and mitigation of any initiated crest erosion - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and decant pond - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Install the BGM Liner to supplier specifications with appropriate QA/QC procedures and full-time construction supervision - Construct the embankment with free draining coarse rockfill, which adds erosion resistance to the downstream face (Engineering judgement)	- No scour assessment of the upstream rockfill face has been conducted	Not Credible	The embankment is to be constructed from coarse rockfill which is less susceptible to erosion. A BGM liner will also be installed along the upstream face of the embankment which effectively mitigates the potential for upstream erosion. In a scenario in which the BGM liner fails and erosion of the upstream face occurs due to wave action, crest erosion in excess of 2.15 m (depth between crest and spillway invert) would be required for overtopping to occur. The probability of this pathway occuring, in conjunction with the probability of an initial reservoir level at the spillway invert, is negligible. On this basis, this PFM is assessed to be Not Credible and excluded from the risk assessment due to negligible likelihood.
Slope Stability (SS)																		
6	DR TSF-Emb-SS-6	Slope Stability	Overtopping due to instability of the downstream slope causing slumping and loss of freeboard	Main Embankment	Normal, Flood	Reservoir level rises during flood events, or water sits against the embankment during normal operating conditions due to poor operational practices and pond mismanagement. Pore water pressure develops within the embankment. The effective stress reduces within the embankment. A deep-seated sliding occurs, causing loss of freeboard and the release of storage containment. Erosion develops into full breach formation. These instabilities may also occur due to chemical alteration of the embankment materials resulting in reduced shear strength parameters.	Downstream slide	Loss of freeboard and breach	Full Dam Breach	Yes	Yes	Yes	-Visible pond develops and is established for a period of time. Regularly collected data from instrumentation and monitoring systems should be analysed for trends, anomalies, or sudden changes that could indicate downstream slope instability. -Regular Inspections: Trained personnel visually inspect the downstream slope for signs of cracking, erosion, vegetation changes, or unusual surface features.	- A comprehensive stability assessment has been carried out for the Stage 3 embankment in accordance with industry standards (Stage 3 Design Report). - The stability assessments adopt conservative loading conditions, including elevated phreatic surface levels and pore water conditions (Stage 3 Design Report). - The embankment is designed in compliance with industry standards and provides for adequate freeboard (Stage 3 Design Report).	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment is constructed to the design specifications - Install survey monuments on the embankment and downstream benches and implement a routine monitoring plan to track embankment deformations and for early identification of excessive movements. - Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment that allows early detection and mitigation of the risk of slope instability - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Maintain, exercise and review a site specific water management plan.	- Geotechnical parameters for the rockfill are based on conservative assumptions. Laboratory testing has not been carried out - Site investigations of the Stage 3 foundation have been limited to test pitting. No rock coring/strength testing has been conducted.	Credible	A detailed slope stability assessment was carried out during the design. The stability assessment considered various scenarios. The results of the stability analysis indicate that the achieved FoS exceed ANCOLD Guidelines. The minimum computed FoS along the upstream face is 2.34 at the end of filling. It is considered that the probability of slope instability occuring is non-negligible, due to unidentified weakness, incorrect materials characterisation, unforeseen loading conditions, and/or poor construction. Therefore, this PFM is assessed to be Credible and included in the risk assessment process.
7	DR TSF-Drg S-SS-7	Slope Stability	Overtopping due to instability of the downstream slope resulting from failure of the seepage collection system	Drainage and Seepage Collection System	Normal, Flood, Earthquake	Failure of the seepage collection system occurs due to blockage from fine materials or blockage of the downstream outlet. Pore water pressure develops within the embankment. The effective stress reduces within the embankment. A deep-seated sliding occurs, causing loss of freeboard and the release of storage containment. Erosion develops into full breach formation.	Downstream slide	Loss of freeboard and breach	Full Dam Breach	Yes	Yes	Yes	- Routine inspections of the seepage collection system, noting seepage rates, colour of seepage, and clarity of seepage. - Routine review of the seepage water pump-back rates from the Seepage Collection Pond to assess for trends, anomalies, or sudden changes that could indicate blockage of the seepage collection system.	- A comprehensive stability assessment has been carried out for the Stage 3 embankment in accordance with industry standards (Stage 3 Design Report). - The stability assessments adopt conservative loading conditions, including elevated phreatic surface levels and pore water conditions (Stage 3 Design Report). - The embankment is designed in compliance with industry standards and provides for adequate freeboard (Stage 3 Design Report). - The embankment is to be constructed with free-draining rockfill, which prevents the development of an elevated phreatic surface within the embankment (Stage 3 Design Report/Technical Specifications) - Seepage collection system is designed to appropriate filter design criteria to prevent blockages/migration of fines (Stage 3 Design Report)	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment is constructed to the design specifications - Install survey monuments on the embankment and downstream benches and implement a routine monitoring plan to track embankment deformations and for early identification of excessive movements. - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment that allows early detection of increased seepage rates and mitigation of the risk of failure of the seepage collection system - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Maintain, exercise and review a site specific water management plan.	- The buried seepage collection system prevents easy access/maintenance in the case of blockage from fines	Not Credible	The embankment is constructed from free-draining rockfill. In the case of a blocked/failed seepage collection system, seepage will begin emanating at the toe of the embankment, however due to the free-draining nature a steady state phreatic surface is not expected to develop. . Additionally, the slope stability assessments indicate that even if an elevated phreatic surface were to develop within the embankment (i.e. "liner leak" case), it would have negligible impact on the critical factor of safety. The stability of the embankment is not considered to be sensitive to the performance of the seepage collection system Therefore, this PFM is assessed to be Not Credible.
8	DR TSF-Emb-SS-8	Slope Stability	Overtopping due to instability of the upstream slope causing slumping and loss of freeboard	Main Embankment	Normal, Flood, Earthquake	Reservoir level rises during flood events, or water sits against the embankment during normal operating conditions. Pore water pressure develops within the embankment material underlaying the liner due to the leak from damged liner or failure of seams. The effective stress reduces within the underlaying material. A shallow slide could occur, causing loss of freeboard and the release of storage containment.	Upstream slide	Loss of freeboard and uncontrolled release	Partial Dam Breach	Yes	Yes	Yes	-Visible pond develops and is established for a period of time. Regularly collected data from instrumentation and monitoring systems should be analysed for trends, anomalies, or sudden changes that could indicate downstream slope instability. -Regular Inspections: Trained personnel visually inspect the downstream slope for signs of cracking, erosion, vegetation changes, or unusual surface features.	- A comprehensive stability assessment has been carried out for the Stage 3 embankment in accordance with industry standards (Stage 3 Design Report). - The stability assessments adopt conservative loading conditions, including elevated phreatic surface levels and pore water conditions (Stage 3 Design Report). - The embankment is designed in compliance with industry standards and provides for adequate freeboard (Stage 3 Design Report).	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment is constructed to the design specifications - Install survey monuments on the embankment and downstream benches and implement a routine monitoring plan to track embankment deformations and for early identification of excessive movements. - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment that allows early detection and mitigation of the risk of slope instability - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Maintain, exercise and review a site specific water management plan.	- Geotechnical parameters for the rockfill are based on conservative assumptions. Laboratory testing has not been carried out - Site investigations of the Stage 3 foundation have been limited to test pitting. No rock coring/strength testing has been conducted.	Not Credible	A detailed slope stability assessment was carried out during the design. The stability assessment considered various scenarios. The results of the stability analysis indicate that the achieved FoS exceed ANCOLD Guidelines. The minimum computed FoS along the upstream face is 1.62 at the end of construction. However, the critical slip surface represents a shallow failure which will not result in a catastrophic release of containment downstream. A negligible consequence is expected. Therefore, this PFM is excluded from the risk assessments due to the negligible consequences.
9	DR TSF-Emb-BGM-9	Slope Stability	BGM Liner Failure Leading to Seepage and Instability of the Upstream Slope	Main Embankment	Normal, Flood, Earthquake	BGM Liner can fail due to Seam Failure, Puncture or Tear, Aging, UV exposure (if not covered), chemical degradation, or low interface shear strength between the BGM liner and the support layer, leading to slippage or wrinkling. Localised leakage through the damaged BGM liner allows water infiltration into the support layer and saturates the support material resulting in loss of strength and causing slumping and US slope instability. The loss of freeboard may result in the uncontrolled release of containment.	Upstream slide	Loss of freeboard and uncontrolled release	Partial Dam Breach	Yes	Yes	Yes	-Visible pond develops and is established for a period of time. Regularly collected data from instrumentation and monitoring systems should be analysed for trends, anomalies, or sudden changes that could indicate downstream slope instability. -Regular Inspections: Trained personnel visually inspect the downstream slope for signs of cracking, erosion, vegetation changes, or unusual surface features. -Regular Inspections: Trained personnel visually inspect the exposed BGM liner for defects, punctures, seam failure etc.	- A comprehensive stability assessment has been carried out for the Stage 3 embankment in accordance with industry standards (Stage 3 Design Report). - The stability assessments adopt conservative loading conditions, including elevated phreatic surface levels and pore water conditions (Stage 3 Design Report). - The embankment is designed in compliance with industry standards and provides for adequate freeboard (Stage 3 Design Report).	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment and BGM liner is constructed to the design specifications - Install survey monuments on the embankment and downstream benches and implement a routine monitoring plan to track embankment deformations and for early identification of excessive movements. - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankmentand BGM liner that allows early detection and mitigation of liner failure and slope instability - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.	- Defects of the BGM liner below the tailings/water surface are difficult to detect from visual inspections	Not Credible	A detailed slope stability assessment was carried out during the design. The stability assessment considered various scenarios. The results of the stability analysis indicate that the achieved FoS exceed ANCOLD Guidelines. The minimum computed FoS along the upstream face is 2.34 at the end of filling. The minimum computed FoS along the upstream face is 1.62 at the end of construction. However, the critical slip surface represents a shallow failure which will not result in a catastrophic release of containment downstream. A negligible consequence is expected. Therefore, this PFM is excluded from the risk assessments due to the negligible consequences.
18	DR TSF-Emb-SS-18	Slope Stability	Overtopping due to instability of the downstream slope resulting from failure of Return Water System component	Main Embankment	Flood, Normal	Return Water System functionality could be compromised due to the inadequate design or the failure of components (intake, pipe and outlet) resulting in restricted hydraulic capacity or partial/full blockage. This can happen during normal operation or flood events, resulting in elevating the ponded water against the embankment causing elevated phreatic surface levels in the embankment.	Downstream slide	Loss of freeboard and breach	Full Dam Breach	Yes	Yes	Yes	Routine inspection of the Return Water System Storm data and flood warning monitoring from Bureau of meteorology	- A comprehensive stability assessment has been carried out for the Stage 3 embankment in accordance with industry standards (Stage 3 Design Report). - The stability assessments adopt conservative loading conditions, including elevated phreatic surface levels and pore water conditions (Stage 3 Design Report)	Maintain the reservoir level below the MRL and manage the pond to prevent elevated storage levels (in accordance with Operations Manual) - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the RWS that allows early detection and mitigation of the risk of RWS failure - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Maintain, exercise and review a site specific water management plan.	- Failure of the RWS may result in elevated decant pond levels	Not Credible	Failure of the RWS system may result in the decant pond rising, thus applying additional hydrostatic pressures to the embankment. However, slope stability assessments have been carried out assuming a reservoir level coincident with the embankment crest. The slope stability assessments show that the reservoir level has negligible impact on the Factor of Safety of the downstream slope. Therefore, a failure of the RWS resulting in an elevated decant pond level is not considered to be a credible initiator/trigger for slope instability. This PFM is therefore assessed to be Not Credible.

Internal Erosion (IE)																		
15	DR TSF-Emb-IE-15	Internal Erosion	Internal erosion of the embankment	Main Embankment	Normal, Flood, Earthquake	In the upper part of the embankment, defects may be present due to the weather conditions and the rainfall cycles, causing desiccation cracking near the crest level. Cracking might also form due to the earthquake (the depth of cracking is below the FSL). Defects may also be present resulting from poorly compacted or highly permeable materials through the embankment. In the middle and lower part of the embankment, transverse cracking may be formed through the embankment due to the differential settlement or the presence of a poorly compacted or high permeability layer through the embankment. The water levels rise on the crest during the flood event and, or in normal operation, sit against the embankment long enough to seep into the tailings and embankment, establish a strong hydraulic gradient through the crack, and initiate internal erosion. The materials hold the crack. There is no filter material downstream of Zone 3A material, and the probability of continuing erosion is 1. The erosion continues, leading to the crest's collapse and freeboard loss. The intervention is not possible due to the extreme weather conditions, difficulty with access and time needed to respond. The embankment will breach due to gross enlargement of the pipe, slope instability of downstream slope, unravelling of the downstream toe or overtopping due to the formation of a sinkhole.	Excessive seepage from embankment	Full Breach of the dam	Full Dam Breach	Yes	Yes	Yes	- Observation of increased seepage out of the downstream face of the embankment or in the foundation. This may be by visual observation, or by seepage measurement, or more sophisticated methods such as thermal monitoring of the foundation or the downstream slope. - Measured higher pore pressures in the foundation and/or embankment. - Settlements, deformation and cracking in the embankment or area downstream of the dam.	- The embankment is designed to be constructed from free-draining rockfill material, with two filter zones to prevent the migration of fine particles (Stage 3 Design Report and Technical Specifications) - The filter zones have been designed in accordance with industry standards (Stage 3 Design Report) - The design includes a BGM liner along the entire upstream face of the embankment (Stage 3 Design Drawings and Technical Specifications) - The embankment materials (coarse rockfill) would require a sufficiently high flow velocity in order to dislodge and transport these particles, unlikely to be observed from seepage flows (Engineering judgement)	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment and BGM liner is constructed to the design specifications - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and BGM liner that allows early detection and mitigation of excessive seepage; defects within the embankment and BGM liner; and trends of vertical and lateral movement within the crest - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.	- No piezometers or pore pressure monitoring instrumentation within the embankment - Defects within the BGM liner will be difficult to repair - Stage 3 Seepage Collection System is to be buried beneath a capping layer - inspection of the clarity and flow rates of seepage waters is difficult	Not Credible	PFM initiation and progression requirements: In order for piping to initiate, it requires a concentrated seepage connected to a water source, with a sufficiently high hydraulic gradient to initiate internal erosion through the embankment. The flow velocities within the embankment should be high enough to dislodge and transport fine particles in the embankment. In addition, a high hydraulic gradient is required to contribute to suffusion, which removes fine particles from a soil matrix due to seepage flow in the raised embankments. The decant pond is located against the embankment, so the water source is always present. However, a BGM Liner is installed along the entire upstream face which produces a water-tight seal. In the case of any defects within the liner, filter layers prevents the migration of tailings particles. As documented in Stage 1 and 2 detailed design report, the Zone 2C material is designed to act as a filter to the Zone 2A and 2B when Zone 2C comprises a D15F not greater than 5 mm. The PSD documented in the Stage 2 construction report confirms adequate QA/QC to meet the criteria. It is expected that the construction of Stage 3 adopts the same specifications with the same level of QA/QC. Furthermore, for any defects below the tailings deposit, the probability of progression will consider the presence of tailings on the upstream side of the defects. There is a high probability that the crack-filling action will stop erosion, and the tailings will restrict the flow in the developing pipe. As a result, the potential for embankment breach and loss of containment is anticipated to be negligible for defects below the tailings deposit. Considering the existing control measures, this failure mode is assessed to be Not credible.
16	DR TSF-Emb-IE-16	Internal Erosion	Internal erosion of the embankment into the foundation or at embankment foundation contact	Main Embankment	Normal, Flood	Defects through the embankment material are in contact with the foundation defects forming a seepage path. Defects may exist in the upstream face due to differential settlement, long-term aging, UV Degradation or Thermal Expansion and Contraction. The water levels rise in the dam during the flood event and, or in normal operation, sit against the embankment long enough to seep into cracks or create seepage paths, establish a strong hydraulic gradient through the defects, and initiate internal erosion. Internal erosion initiates at the contact between the embankment and foundation due to seepage through the embankment eroding material into the foundation or seepage in the foundation at the embankment contact, eroding the embankment material. The erosion process continues if the exit is unfiltered or inadequately filtered. The process will progress if the material is able to hold a crack. The intervention may fail due to late detection or access issues where the defects are at foundation contact. The embankment will breach due to gross enlargement of the pipe, slope instability of the downstream slope, unravelling of the downstream face or overtopping due to the formation of a sinkhole.	Excessive seepage from the embankment/ foundation contact	Full Breach of the dam	Full Dam Breach	Yes	Yes	Yes	- Observation of increased seepage out of the downstream face of the embankment or in the foundation. This may be by visual observation, or by seepage measurement, or more sophisticated methods such as thermal monitoring of the foundation or the downstream slope. - Routine inspections of the seepage collection system, noting seepage rates, colour of seepage, and clarity of seepage. - Settlements, deformation and cracking in the embankment or area downstream of the dam.	- Full-time construction supervision during Stage 2 construction ensuring adequate foundation preparation (Stage 2 Construction Report) - Tailings deposition has been ongoing since 2017. It is likely that any defects present within the foundation (which aligns with a defect in the embankment/BGM Liner) will now have been filled and sealed with tailings (Engineering judgement).	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment, BGM liner, and foundation preparation is constructed to the design specifications - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and BGM liner that allows early detection and mitigation of excessive seepage; defects within the embankment and BGM liner; and trends of vertical and lateral movement within the crest - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.		Not Credible	As documented in the design and construction reports for Stage 1&2, Zone 2B can not be eroded into Zone 2A due to the much coarser material particle size. This PFM is assessing the potential erosion of Zone 2A into the rock foundation. The existing embankment is constructed on rock foundations. Type 2 Foundation preparation was conducted in areas of exposed rock foundations within the downstream of the concrete plinth. Type A2 foundation preparation consisted of the removal of all loose soil and rock by machine excavation and were moistened with water prior to material placement and compaction. During overall embankment foundation preparation it was observed that the foundation had very few open joints. No Open joints were recorded in Type 2 foundation preparation area to allow for erosion of the embankment through the foundation. Tailings have been deposited since construction began in 2017. Therefore, in the unlikely event that a defect in the embankment aligns with a joint in the foundation rock, it is expected that these joints have now been filled with tailings. Similarly, if a gap initially existed at the embankment-foundation contact, it is likely sealed by tailings deposition over time. The same condition is expected for extended foundation in abutments. Considering the existing control measures, this failure mode is assessed as not credible.
17	DR TSF-Emb-IE-17	Internal Erosion	Internal erosion through the soil/rock foundation	Main Embankment	Normal, Flood	Initiation and progression of internal erosion in embankment soil foundation may occur by concentrated leak, backward erosion or suffusion. Excessive seepage or water flow through an erodible element within the dam foundation. This could be a continuous (from upstream to downstream) crack in the plastic material forming the foundation or a loose layer in the coarse material forming the foundation. The low plasticity soil particles are detached when the seepage exits to the free unfiltered ground surface downstream. The seepage flow carries the detached particles, and the process gradually works towards the upstream side of the foundation until a continuous pipe is formed. The erosion process continues if the exit is unfiltered or inadequately filtered. The process will progress until the material is able to hold a crack. The intervention may fail due to late detection or access issues where the defects are in the foundation. The embankment will breach due to gross enlargement of the pipe, slope instability of downstream slope, unravelling of the downstream face or overtopping due to the formation of a sinkhole.	Excessive seepage from the foundation contact	Full Breach of the dam	Full Dam Breach	No	Yes	Yes	- Observation of increased seepage out of the downstream face of the embankment or in the foundation. This may be by visual observation, or by seepage measurement, or more sophisticated methods such as thermal monitoring of the foundation or the downstream slope. - Routine inspections of the seepage collection system, noting seepage rates, colour of seepage, and clarity of seepage. - Settlements, deformation and cracking in the embankment or area downstream of the dam.	- Full-time construction supervision during Stage 2 construction ensuring adequate foundation preparation (Stage 2 Construction Report) - Installation of a fully intercepting foundation grout curtain for Stage 2 (Stage 2 Construction Report) - Design for fully intercepting foundation grout curtain for Stage 3 (Stage 3 Design Report) - Stage 3 construction will require the treatment of all exposed open joints in the foundation and abutments (Stage 3 Technical Specifications)	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment, BGM liner, and foundation preparation is constructed to the design specifications - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and BGM liner that allows early detection and mitigation of excessive seepage; defects within the embankment and BGM liner; and trends of vertical and lateral movement within the crest - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.		Not Credible	The embankment is constructed on rock foundations. Foundation preparation involved the stripping and removal of all alluvial and colluvial materials until exposing weathered quartzite rock. A fully intercepting grout curtain has been installed along the upstream toe of the Stage 1 and 2 embankment at varying depths. The requirements for the foundation grouting was determined based on water testing at each grout hole prior to grouting works. The grout curtain was installed to depths up to approximately 12 m, depending on grouting requirements as determined from the water pressure testing. The Stage 3 design also nominates a fully intercepting grout curtain for the extents of the Stage 3 raise. Similiarly to the Stage 1 and 2 construction, the plinth trench is proposed to be terminated on moderately to slightly weathered rock. This structure effectively extends the cut-off at upstream. Therefore, the probability of a continuous defect existing in the foundation from the upstream to the downstream side is negligible. It is therefore considered that the probability of initiation of erosion in the rock foundation is negligible and thus this PFM is not credible.
25	DR TSF-Emb-SS-25	Internal Erosion	Internal erosion along a buried conduit	Main Embankment	Normal, Flood	Internal erosion initiates along a poorly compacted or high permeability zone around a buried conduit through the foundation. The poorly compacted or high permeability zone creates preferential paths for water to flow. Water tends to follow these paths, moving along the zone rather than permeating through the surrounding, denser soil. As water flows through the poorly compacted or high permeability zone, it exerts hydraulic forces on the soil particles. These forces can cause the initiation of erosion, where soil particles are dislodged and carried away by the flowing water. The erosion process continues if the filter diaphragm is not provided at the exit. The process will progress if the material is able to hold a crack. The intervention may fail due to late detection or access. The internal erosion weakens the overall stability of the embankment, potentially leading to embankment settlement, sinkholes, or even catastrophic failure if not addressed.	Excessive seepage at conduit exit	Full Breach of the dam	Full Dam Breach	Yes	Yes	Yes	Visual Inspection: Cracks: Look for cracks on the dam crest, slopes, and downstream toe. Significant cracking can indicate internal movement and potential instability. Deformation: Observe for any bulging, tilting, or settlement of the dam crest. Seepage: Increased seepage or leakage from the dam can indicate internal damage to water flow paths. Instrumentation Monitoring: Survey monuments: Track vertical settlements of the dam crest to assess overall stability.	- No buried conduits are present within the structure.			Not Credible	No buried conduits are present within the structure. Therefore this PFM is assessed as Not Credible.
Liquefaction (LIQ)																		
13	DR TSF-Emb-LIQ-13	Liquefaction	Embankment Breach due to flow liquefaction or foundation liquefaction	Main Embankment	Earthquake	The embankment material may be susceptible to liquefaction or may be founded on saturated granular soil which is susceptible to liquefaction in seismic events. Liquefaction is triggered in the embankment material or saturated granular soil foundation in seismic events or in static loading reducing the effective stress of the soil. The loss of strength in the foundation soil can result in embankment deformation causing slumping and loss of freeboard. The deformation surpasses the available freeboard resulting in loss of containment. Intervention prove ineffective due to the abrupt and unpredictable nature of this failure mode. Embankment breaches primarily caused by overtopping.	Embankment breach or Loss of FB	Embankment breach or overtopped	Full Dam Breach	Yes	Yes	Yes	- Field observations- detecting surface disturbances, signs of ground movements like lateral spreading, fissures, or depressions near the dam toe or downstream areas, changes in seepage pattern, turbidity, and discoloured seepage. Pre and post-earthquake survey to detect changes in dam geometry, indicating potential settlements or deformations due to liquefaction. - Post earthquake geotechnical site investigations - Post-earthquake inspection and review the monitoring data	- Technical specifications require adequate foundation preparation including stripping of all alluvial and colluvial materials until exposing weathered quartzite rock. - The embankment rockfill and rock foundations have been judged to not be susceptible to liquefaction (Stage 3 Design Report) - The Stage 3 embankment is designed to be constructed using downstream construction methods; thus the stability of the embankment is not sensitive to the state of the tailings (i.e. liquefied or not) (Stage 3 Design Report)	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment is constructed to the design specifications - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for routine and post-earthquake inspections, surveillance and maintenance of the embankment - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.		Not Credible	The embankment materials comprise competent rockfill which are not considered susceptible to liquefaction. Foundation preparation involved the stripping and removal of all alluvial and colluvial materials until exposing weathered quartzite rock. The rock foundation is not considered susceptible to liquefaction. Therefore, this PFM is assessed to be Not Credible.
14	DR TSF-Emb-OT-14	Liquefaction	Embankment Breach due to overtopping by liquefied tailings	Main Embankment	Earthquake/ Normal	The tailing material may be susceptible to liquefaction. Liquefaction is triggered in the embankment material seismic events or in static loading reducing the effective stress of the tailings causing slumping, loss of freeboard and embankment overtopping. Intervention prove ineffective due to the abrupt and unpredictable nature of this failure mode. Embankment breaches primarily caused by overtopping.	Embankment breach or Loss of FB	Embankment breach or overtopped	Full Dam Breach	Yes	Yes	Yes	Post-earthquake inspection and survey to detect changes in tailings deposited indicating deformations due to liquefaction.	- The Stage 3 ultimate tailings beach is designed to have no deposited tailings above the spillway invert (Stage 3 Design Drawings).	- Conduct quarterly LiDAR surveys to confirm the tailings beach development is within design expectations - Routinely review the production forecast estimates to identify whether the forecasts exceed the design tailings storage volume - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the tailings beach - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.		Not Credible	The final Stage 3 design tailings beach does not involve any proportion of tailings deposited above the Stage 3 spillway invert. If liquefaction were to occur, it would be expected that the tailings would remobilise to a flat (or near flat) beach slope. Given the negligible volume of tailings above the spillway invert prior to liquefaction, it would be expect that the entire tailings beach would flatten and remain below the spillway invert post-liquefaction. Therefore, no release of tailings into the downstream environment would be expected. Therefore, this PFM is assessed to be Not Credible.
Other Failure Modes																		
10	DR TSF-Emb-BGM-10	Uncontrolled Release	BGM Liner Failure Leading to Excessive Seepage and Loss of Water Containment	Main Embankment	Normal, Flood, Earthquake	BGM Liner can fail due to Seam Failure, Puncture or Tear, Aging, UV exposure (if not covered), chemical degradation, or low interface shear strength between the BGM liner and the support layer, leading to slippage or wrinkling. Continued leaking through the damaged BGM liner can cause a sustained and uncontrolled loss of the stored water. Structural failure of the embankment may not eventuate however a complete loss of stored water is possible.	Uncontrolled release	Erosion of downstream slope	Environmental Spill	No	Yes	Yes	- Construction control during installation of BGM liner with appropriate QA/QC - Regular Inspections: Trained personnel visually inspect the exposed BGM liner for defects - Regular Inspections: Trained personnel visually inspect the downstream slope for signs of excessive seepage -Regular Inspections: Trained personnel visually inspect the exposed BGM liner for defects, punctures, seam failure etc.	- BGM liner designed to industry standards and supplier requirements (Stage 3 Design Report) - No permanent populations located within the potential seepage path	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment and BGM liner is constructed to the design specifications - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankmentand BGM liner that allows early detection and mitigation of liner failure and excessive seepage - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.	- Defects of the BGM liner below the tailings/water surface are difficult to detect from visual inspections	Not Credible	The presence of defects presenting within the BGM Liner is credible due to either poor construction practices; improper maintenance; manufacturing defects; and/or degradation. Once defects are present below the water surface, repairs are difficult. However, life safety consequences are considered to be negligible owing to the fact that there are no permanent populations within the seepage path and that the rate of seepage is expected to be slow. Therefore, this PFM is assessed to be Credible but excluded from the Risk Assessment process in consideration of the negligible life safety consequences.
19	DR TSF-Emb-IE-19	Fire Damage	Fire damage to BGM Liner	Main Embankment	Normal	Vegetation establishes along the abutments which catch on fire due to extreme heat or vandalism. The fire transitions to the BGM liner, causing damage to the liner and loss of function of the BGM liner as a water containing component. Water flows through the embankment, initiating erosion of the rockfill. The erosion continues, leading to the crest's collapse and freeboard loss. The intervention is not possible due to fire risk, extreme weather conditions, and difficulty with access and time needed to respond. The embankment will breach due to gross enlargement of the pipe, slope instability of downstream slope, unravelling of the downstream toe or overtopping due to the formation of a sinkhole.	Excessive seepage from embankment	Full Breach of the dam	Full Dam Breach	Yes	Yes	Yes	- Observation of vegetation establishment along abutments and adjacent to the concrete canvas. -Regular Inspections: Trained personnel visually inspect the exposed BGM liner for defects, punctures, seam failure etc.	- The design prescribes the installation of Concrete Canvas at the abutments to protect against bushfire damage	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the Concrete Canvas and BGM liner is constructed to the design specifications - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance to detect for the establishment of vegetation along the abutments and ensuring a "fire break" remains in place, adjacent to the Concrete Canvas, along the abuments. - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.	- BGM Liner is susceptible to fire damage	Not Credible	A Concrete Canvas has been installed at the abutments to provide bushfire protection to the underlying BGM Liner for Stage 2. Concrete Canvas is also proposed for the Stage 3 Raise. The embankment and abutments are routinely monitored for the establishment of vegetation along the abutments and adjacent to the Concrete Canvas. Operations Plan requires that all shrubs and trees with a trunk base diameter of greater than 50 mm are cut at the base and removed. The probability of vegetation establishing along the abutment edges to a size in which they produce a risk of fire to the BGM Liner is negligible. This PFM is therefore assessed to be Not Credible.
20	DR TSF-Emb-SE-20	Surface Erosion	Overtopping due to slope instability caused by the formation of erosion gullies from surface water runoff	Main Embankment	Flood	The failure pathway begins with the occurrence of intense surface water runoff, often due to heavy rainfall. The runoff concentrates in specific areas on the embankment dam, leading to the formation of erosion gullies. These gullies typically develop along the slope of the dam. Over time, the concentrated flow of water erodes the downstream face, creating gullies that cut into the embankment slope. The gullies increase in size and depth as erosion continues. The erosion gullies undermine the stability of the embankment by removing material and creating voids beneath the surface. This undermines the structural integrity of the dam. As erosion progresses the embankment slope becomes steeper leading to slope failures along the embankment. Intervention is ineffective due to the poor maintenance practice. Embankment breaches primarily caused by slope instability leading to overtopping.	Downstream slide	Loss of freeboard and breach	Full Dam Breach	Yes	Yes	Yes	Erosion gullies, changes in slope characteristics, and signs of instability can be detected during the routine and annual inspections	- The Stage 3 embankment is designed to be constructed with rockfill materials which are less susceptible to surface erosion (Engineering judgement) - The Stage 3 emergency spillway outlet is located away from the embankment toe. Any spillway discharge is channeled via the existing natural drainage channels. No embankments nor engineered structures are within the flowpath.	- Implement a quality assurance plan which includes full-time construction supervision by a suitably qualified geotechnical engineer - Implement appropriate QA/QC procedures to ensure that the embankment is constructed to the design specifications - Perform hydrological studies to assess the volume and velocity of surface water runoff, identifying areas prone to erosion and potential gully formation. - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the embankment and decant pond that allows early detection of seepage and surface runoff erosion, the formation of erosion gullies, changes in slope characteristics, and signs of instability along the embankment downstream face - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Construct the embankment with free draining coarse rockfill, which adds erosion resistance to the downstream face (Engineering judgement)	- No scour/erodibility assessment of the embankment has been conducted	Not Credible	The embankment is to be constructed with rockfill material that is less susceptible to surface erosion. The formation of erosion gullies to the point in which slope instability occurs would require a sustained and unremediated development of erosion gullies. The formation of erosion gullies would be identified during routine inspections and remediated by replacement with new rockfill. Any embankment instability as a result of the steepening of the downstream face is likely to result in localised slip surfaces to form rather than large-scale global failure. The risk of erosion gullies developing to the point of causing global embankment failure is therefore considered negligible in consideration of the embankment width; routine inspection practices; embankment materials being less susceptible to erosion; and high global stability factors of safety. As a result, this PFM is considered not credible.
21	DR TSF-TD S-OP-21	Operational	Failure of Tailing Delivery System	Tailing Delivery System	Flood, Normal	Components of the Tailing Delivery System could fail due to inadequacy in structural design, construction technique or operation	Loss of Functionality	Operation Failure	Operation Failure	No	No	Yes	Routine inspection	- Operation Maintenance and Surveillance Plan which stipulates the routine inspection of tailings delivery system (Operations Plan) - Spill containment dams are positioned at appropriate locations along the tailings pipeline route (Operations Plan)	- Conduct a comprehensive condition assessment and hydraulic capacity assessment of the Tailings Delivery System - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress.		Not Credible	The structural failure of the Tailing Delivery System components would not be expected to cause failure of the embankment. However, it has operational risk implications.
24	DR TSF-Drg S-OP-24	Operational	Failure of Seepage Collection System Pump	Drainage and Seepage Collection System	Flood, Normal	The Seepage Collection System pumping infrastructure could fail due to inadequacy in structural design, construction technique or operation. The Seepage Collection System could back up and result in seepage via the embankment toe.	Loss of Functionality	Operation Failure	Operation Failure	No	No	Yes	Routine inspection Monitoring of pump data	- Operation Maintenance and Surveillance Plan which stipulates the routine inspection of tailings delivery system (Operations Plan) - Spill containment dams are positioned at appropriate locations along the tailings pipeline route (Operations Plan)	- Conduct a comprehensive condition assessment and hydraulic capacity assessment of the Seepage Collection System - Develop an Operation Maintenance and Surveillance Plan (OMSP) to describe the requirements for inspection, surveillance and maintenance of the Seepage Collection System and associated pumping infrastructure - Develop Emergency Plan and TARPs to document the procedures in the event that the Failure Mode is in progress. - Store backup and contingency pump infrastructure on site for prompt replacement/repair	- A systematic root cause analysis addressing potential failures in the electrical and mechanical components of the structure has not yet been undertaken, nor has a reliability assessment	Not Credible	The structural failure of the Seepage Collection System pumping infrastructure and components would not be expected to cause failure of the embankment. However, it has operational and environmental risk implications.



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APPENDIX H – CERTIFICATION STATEMENT

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6 February 2026

Form of certification (consequence assessment and design plan)

Name of Registered Professional Engineer providing certification:

Dale Murray Ross

Address of Registered Professional Engineer providing certification:

ATC Williams
222 Beach Rd, Mordialloc 3195

Statement of relevant experience

I hereby state that I am a Registered Professional Engineer of Queensland and meet the requirements of the definition of 'suitably qualified and experienced person'.

Statement of certification

All relevant material relied upon by me, including subsidiary certifications of specialist components, where required by the environmental authority, is provided in the attached report *Dugald River Mine – Tailings Storage Facility – Stage 3 Raise Detailed Design Report, Ref: 250542-R04 (Rev 0)* dated 6 February 2026.

I hereby certify that the design plan (and appended consequence assessment) entitled *Dugald River Mine – Tailings Storage Facility – Stage 3 Raise Detailed Design Report, Ref: 250542-R04 (Rev 0)* and dated 6 February 2026:

- Provides an assessment of the consequence category of the Dugald River Mine Stage 3 Tailings Storage Facility in accordance with the *Manual* published by the administering authority (ESR/2016/1993 Version 5.04);
- The design has been prepared in accordance with good engineering practice and the design/dam is also consistent with the standards required for structures of the assessed consequence category as set out in the *Manual* published by the administering authority (ESR/2016/1993 Version 5.04); and
- Provided the structure is constructed or modified (in consultation with the designer) in the manner specified and the facility is operated and maintained as recommended, the dam/structure/facility is capable of delivering the performance stated in the attached report so as to be compliant with relevant conditions of the environmental authority.

I Dale Murray Ross, declare that the information provided as part of this certification is true to the best of my knowledge. I acknowledge that it is an offence under section 480 of the *Environmental Protection Act 1994* to give the administering authority a document containing information that I know is false, misleading or incomplete in a material particular.

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Signed:



Dale Murray Ross, RPEQ No. 34596

Date: 6/2/2026

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APPENDIX Q: Tailings Storage Facility – Stage 3 Raise Design Basis Report (ATCW, 2026c)

REPORT

MMG Dugald River
ABN: 19 083 405 556

Dugald River Mine
Tailings Storage Facility - Stage 3
Raise Design Basis Report

250542-R01 REV 0
FEBRUARY 2026



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APPENDIX A DOCUMENT REGISTER

1 INTRODUCTION

This Report presents the design basis for the existing Tailings Storage Facility (TSF) at MMG Limited's (MMG) Dugald River Mine (DRM) site, approximately 65 kilometres north-west of Cloncurry and 85 kilometres north-east of Mt Isa.

This is a "live" document and shall be revised and updated as design details are confirmed or updated.

2 REVISIONS

Table 2.1 outlines the status and nature of revisions to this document.

TABLE 2.1 – DOCUMENT STATUS

Revision	Date	Comments
A	12/08/2025	Draft Issue
B	20/11/2025	Draft Issue – Addressing MMG comments
C	22/01/2026	Update
0	06/02/2026	Final Issue – Stage 3 Detailed Design

3 PURPOSE

This Design Basis Report (DBR) aims to document the design basis and the outcomes from the design process for the Dugald River Mine Tailings Storage Facility (DRM TSF), based on current and historic documentation, including and not limited to design reports, construction reports, technical specification documents and geotechnical investigations. It is expected that this document will act as a basis for any future works to be carried out on the DRM TSF, in accordance with current standards and regulations.

The DBR has been produced in accordance with the Global Industry Standard on Tailings Management (GISTM) **[1]** and includes definition of the following items:

- Existing site conditions;
- Design and construction history;
- Applicable regulatory and operating requirements, guidelines, codes, specifications and standards; and
- Design requirements, criteria, and assumptions

4 PROJECT SETTING AND CONTEXT

4.1 Site Description

The DRM is located approximately 85 km north-east of Mt Isa and 65 km north-west of Cloncurry in Queensland's north-west. The TSF is within a natural valley located within the Knapdale Range, a large formation of outcropping quartzite on the western side of the mine lease. The valley is approximately 4 km northwest of the DRM process plant.

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The natural formation of the Knapdale Range valley, which is within the DRM lease boundary, is employed to assist with the containment of the tailings and process water. The TSF Embankment completes the containment area west of the Knapdale Range valley.

4.2 Purpose and Components

The deposit at DRM is majority zinc-lead based with some copper mineralisation. The main purpose of the TSF is to provide storage of tailings, processed at the DRM process plant. The tailings comprise process water, finely ground rock particles and metals that cannot be economically extracted during mineral processing of the zinc-lead ore.

DRM utilise tailings paste backfill of underground mine stopes on an ongoing basis. Tailings are either transferred to the paste plant (when backfill is required) or are pumped to the TSF.

Another function of the TSF is to provide temporary water storage for mineral processing and various other mining activities (dust sprays, mine service water streams, etc.). The water stored within the TSF originates from decant (bleed) water emerging from the deposited tailings, as well as from rainfall runoff from the catchment area.

The existing TSF (Stage 2) consists of the following infrastructure:

- The 37 m high TSF embankment, which is a water-retaining structure comprising a zoned rockfill and granular material with an impermeable bituminous geomembrane (BGM) liner;
- An emergency spillway excavated into the rock on the northern abutment of the TSF Embankment, with a base width of 10 m;
- A seepage collection pond constructed downstream of the TSF Embankment, to monitor and collect foundation seepage before it discharges off-site;
- The tailings delivery system, comprising the pumping station, steel pipelines, HDPE pipelines, spill containment ponds and end-point discharges; and
- Return water system, comprising a skid-mounted pump, floating offtake, and a discharge pipeline to pump water from the TSF decant water pond, which forms over the deposited tailings centrally within the TSF. The skid-mounted decant pump transfers water to a booster pump station on the east side of the TSF, from where it is pumped back to the Process Plant.

4.3 Existing Studies and Design Work

ATC Williams (ATCW) have completed a series of tailings management studies for the Dugald River Project since 2008, including the examination of up to eight potential sites for the tailings storage and consideration of a number of different tailings management methodologies **[2]**. Detailed site options and feasibility studies were concluded in February 2009 with a geotechnical investigation of the Knapdale Range valley site, which by then had become known as “Site A” **[3]**.

A final feasibility study of the preferred site “Site A” was completed in August 2011, based on the Life of Mine storage of 22.8 Mt of tailings at the time **[4]**. Detailed design of the Stage 1 and 2 TSF was completed in 2013 **[5]**. During this design phase it became apparent that the required TSF capacity would be reduced due to an increased project requirement for tailings used in the underground mine as paste backfill. The 2013 detailed design was hence based on a tailings inventory of 9.5 Mt over a 21.5 year mine life **[5]**.

An updated design report was prepared in 2016 by ATCW reflecting a revised mining scenario with paste backfill demands and the addition of process plant pre-float concentrate as an additional TSF storage requirement, for a total tailings quantity of 12.6 Mt over a 27 year mine life **[6]**.

In 2024, MMG engaged ATCW to investigate raise options to the TSF. As part of the study, tailings beach modelling was undertaken for two production cases; a production scenario of 13.1 Mt of tailings over 16 years; and another of 21.0 Mt over 27 years **[7]**. Following submission of the report and discussions between ATCW and MMG, MMG advised their preference of proceeding with a concept

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design for a 9.25 m embankment raise to a level of RL 253.5 m (Stage 3) based upon the 21.0 Mt production scenario. The concept design report was prepared in September 2024 **[8]**.

The detailed design of the Stage 3 raise commenced in February 2025 and was completed in December 2025 **[9]**.

A list of all documents prepared by ATCW relevant to the DR TSF (to July 2025) is presented in **Appendix A**.

5 SITE CHARACTERISATION

5.1 Topography

The Knapdale valley is some 3 km long and is generally less than 500 m wide within the tailings and decant water storage area. The sides of the valley are generally steep, ranging from 1.5:1 (horiz:vert) at the southern end, to 3.5:1 in the north. The valley floor, by comparison, is relatively flat, with its level ranging from a low point of RL 207 m at the base of the TSF Embankment, to RL 235 m at the southern end (approximately a 1 % slope). The Knapdale Valley has a perimeter level generally in excess of RL 260 m.

The valley has a catchment area of 338 hectares. The eastern side of the catchment extends across the Knapdale plateau some 700 m, whilst the western side ridgeline rises more abruptly before dropping down to the western toe of the range.

The single drainage outlet (TSF Embankment location) is a relatively narrow valley approximately mid-way along the western side. This valley extends some 600 m before reaching the western extent of the range and discharging into the Cabbage Tree Creek catchment.

5.2 Geology

The DRM project is located within the Mary Kathleen Zone of the Eastern Foldbelt of the Mt Isa Inlier, on Proterozoic sandstone, siltstone and quartzite. Based on the BMR Quamby Sheet 6957, 1980 Regional Geology Sheet, the 14 km long, 3 km wide Knapdale Range consists of Knapdale Quartzite of the Mount Albert Group, which overlie the Corella Formation calc-silicates. Separating the quartzite from the Corella Formation is a low angle, mylonitic thrust fault **[4]**.

The quartzite is a massive formation of medium grained, pink-grey metamorphosed sandstone, striking predominantly north-south with a dip of foliation angle in the range of 60 to 80 degrees to the west. There are no known faults running through the valley.

A specific assessment of the Knapdale Valley structural geology was conducted by ATCW in 2011, as listed in **Appendix A**.

5.3 Hydrogeology

An assessment of the hydrogeology of the Dugald River site and the groundwater aspects of the proposed mine development were conducted by Rob Lait and Associates in 2011 **[10]**. The following is a summary:

- There are no significant aquifers within the Knapdale Quartzite. The mylonitic fault which separates the quartzite from the Corella Formation to the east is considered to form a low permeability groundwater disconnect.
- Minor perched zones occur in the upper 10 m of the quartzite formation where unloading fractures occur. However, due to the nature of the quartzite formation, the groundwater exists only locally in the fissures within the rock mass. Below this depth, the formation is massive and unfractured.
- From permeability tests conducted in the Knapdale Valley TSF floor, the potential for leachate infiltration into the Knapdale Quartzite is considered low. Therefore, the potential for groundwater contamination is low. These tests are summarised below:

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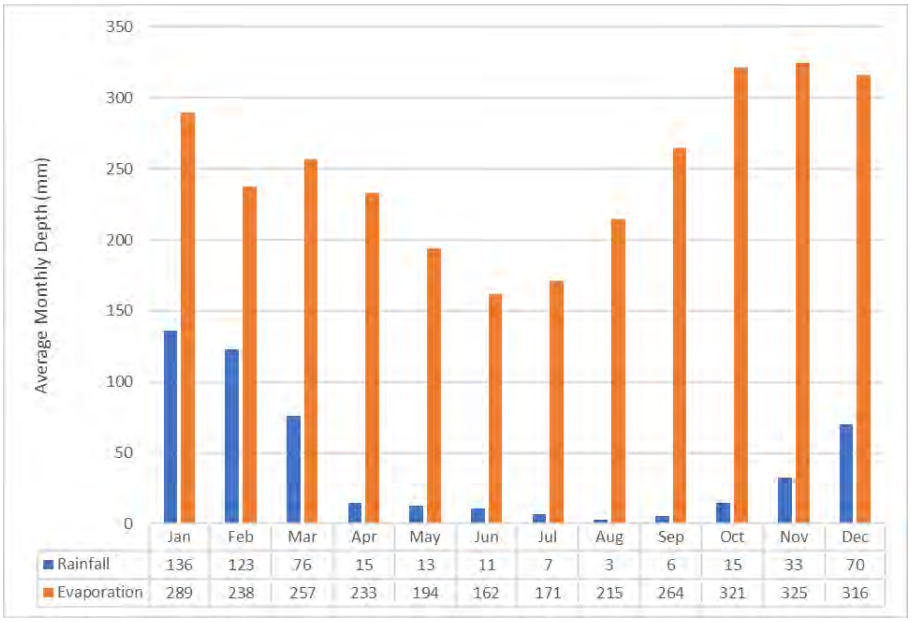
- Average permeability of shallow (6 m to 10 m) bores = 8×10^{-8} m/s
- Average permeability of deep (18 m to 30 m) bores = 5×10^{-9} m/s

- As with the Knapdale Range, the utilisation of groundwater within the Cabbage Tree Creek catchment area to the west has been very limited. However, the lack of production bores or wells in the area suggests it is a poor groundwater resource.

5.4 Climate Statistics

Highly variable rainfall occurs over the summer/wet season, which is typically hot and humid. Data obtained from the SILO Data Drill **[11]** from 01/01/1889 to 14/11/2022 indicates that the mean annual rainfall for the region is 503 mm, and the mean annual evaporation for the region is 2,991 mm. The highest monthly rainfall occurs generally over November to March, as illustrated in **Graph 5.1**. The lowest monthly rainfall occurs in the dry winter months of April to October. **Graph 5.1** indicates that monthly evaporation rates exceed rainfall year-round at the DRM site.

GRAPH 5.1 – RAINFALL AND EVAPORATION GRAPH



5.5 Design Rainfall

Estimates of the design rainfall intensities and depths for the 1 in 1 to the 1 in 2000 Annual Exceedance Probabilities (AEP) have been determined from the Bureau of Meteorology (BoM) Design Rainfall Database **[12] [13]**. The Intensity-Frequency-Duration (IFD) curves are presented in **Graph 5.2** with select AEP rainfall depths summarised in **Table 5.1**.

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GRAPH 5.2 – RAINFALL INTENSITY-FREQUENCY-DURATION CURVES

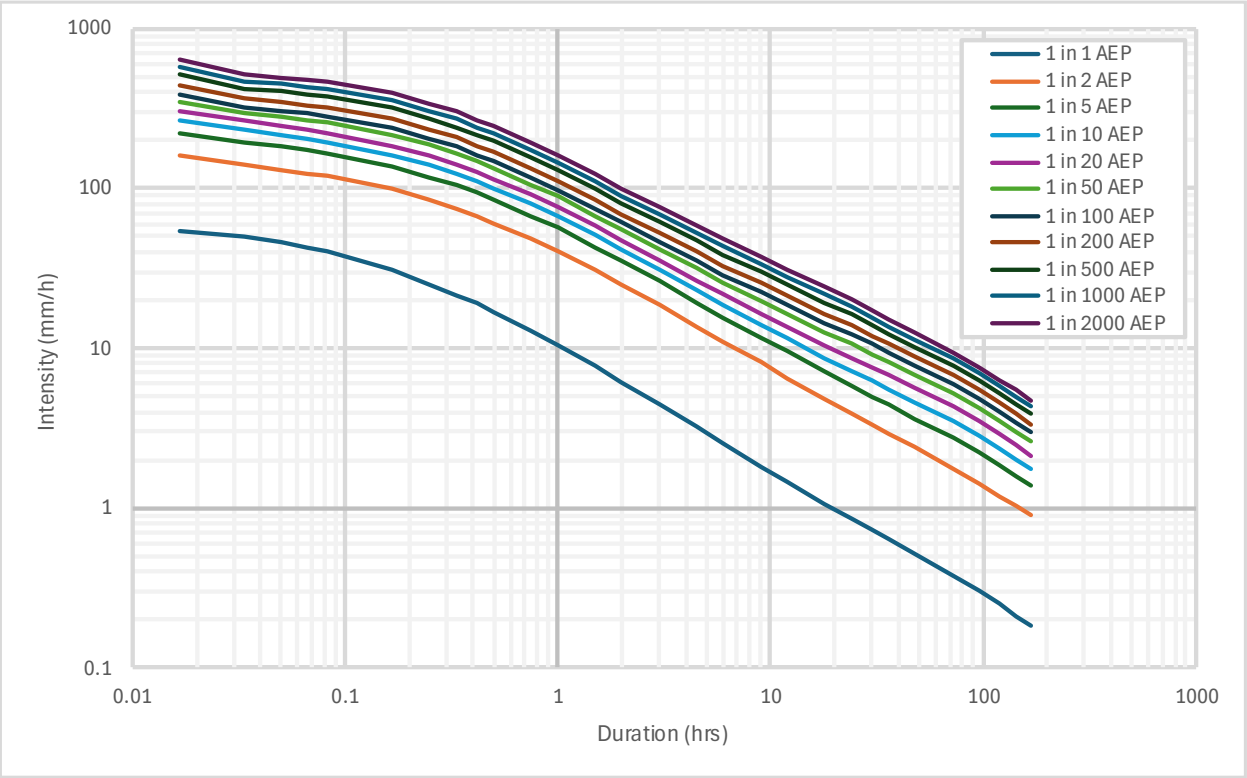


TABLE 5.1 – DESIGN RAINFALL DEPTHS

Duration (hrs)	Depth (mm)			
	1 in 10	1 in 100	1 in 1,000	1 in 2,000
0.25	35	52	77	86
0.5	50	74	110	122
0.75	60	87	129	144
1	67	97	144	160
2	83	122	181	201
3	94	138	206	229
4	101	151	226	252
5	107	163	244	272
6	113	173	260	290
9	127	200	301	335
12	138	222	334	373
l'll24	173	291	434	482
48	221	378	542	596
72	252	430	616	676
120	284	483	695	763
144	290	494	713	784
168	293	499	722	795

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5.6 Extreme Rainfall

The extreme rainfall depths for short durations (up to 6 hours) and long durations (up to 72 hours) have been estimated in accordance with the Australian Rainfall and Runoff (ARR) Guidelines **[14]** and BoM estimation methods (**[15][16]**) as part of the Consequence Category and Design Storage Allowance Review **[17]**.

The Probable Maximum Precipitation (PMP) depths for event durations between 0.25 hours and 6 hours have been estimated in accordance with the Generalised Short Duration Method (GSDM) **[15]**, whilst the PMP depths for durations up to 120 hours have been estimated in accordance with the Generalised Tropical Storm Method (GTSMR) **[16]**.

Estimates of the 1 in 10,000 AEP and 1 in 100,000 AEP events have been interpolated between the 1 in 1000 AEP, 1 in 2000 AEP, and PMP rainfall events based upon the procedure outlined in Siriwardena (1998) **[18]**. The resultant rainfall estimates are summarised in **Table 5.2**.

TABLE 5.2 – EXTREME RAINFALL DEPTHS

Duration (hrs)	Depth (mm)		
	1 in 10,000	1 in 100,000	PMP
0.25	108	142	200
0.5	153	201	290
0.75	183	246	370
1	202	272	430
2	255	355	650
3	292	410	780
4	324	459	890
5	349	497	980
6	373	530	1040
12	477	654	1080
24	606	798	1150
36	677	899	1420
48	739	987	1650
72	838	1138	2080
96	906	1239	2330
120	948	1298	2450

5.7 Climate Change Adjusted Rainfall Depths

A climate change study was carried out in April 2025 **[19]** by ATCW to adjust the design rainfall depths based on the latest ARR guidance **[14]**. The adjustments are based on a medium Shared Socioeconomic Pathway (SSP2-4.5) and are applicable for the year 2040.

The adjusted rainfall depths for select AEPs are presented in **Table 5.3**.

TABLE 5.3 – CLIMATE CHANGE ADJUSTED RAINFALL DEPTHS (YEAR 2040)

Duration (hrs)	Depth (mm)					
	1 in 10	1 in 100	1 in 1,000	1 in 10,000	1 in 100,000	PMP
0.25	43	63	94	132	173	244

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Duration (hrs)	Depth (mm)					
	1 in 10	1 in 100	1 in 1,000	1 in 10,000	1 in 100,000	PMP
0.5	61	90	134	187	245	354
0.75	73	106	157	224	300	451
1	81	118	176	247	332	525
2	99	145	215	304	422	774
3	109	161	241	342	479	913
4	118	176	263	377	534	1037
5	124	188	282	404	574	1132
6	130	199	299	429	609	1196
12	156	251	377	539	739	1220
24	194	326	486	678	893	1288
36	224	381	551	758	1006	1590
48	248	423	607	828	1106	1848
72	282	482	690	939	1274	2330
96	305	519	744	1015	1387	2610
120	318	541	778	1062	1453	2744

5.8 Wind

Wind direction and speed data over the period 2001 to 2025 was obtained from the BoM for Cloncurry Airport (weather station ID 29141) **[12]** as part of the Stage 3 Detailed Design. **Table 5.4** summarises the annual maximum recorded wind gusts in the NE-N, E, and SE-S directions.

To obtain the 1:10 AEP wind speed in each direction, lognormal probabilistic distributions were fitted to the obtained data. The estimated 1:10 AEP wind speeds are presented in **Table 5.5**. Winds blowing from the SW, W and NW directions were not considered in the assessment as it was determined that these would not induce any wave actions due to the orientation of the embankment.

TABLE 5.4 – MAXIMUM WIND SPEED SUMMARY

Year	Maximum Wind Speed (km/h)			
	All Directions	NE-N	E	SE-S
2001	61.2	29.5	37.1	61.2
2002	74.2	42.5	42.5	46.4
2003	79.6	44.3	79.6	70.2
2004	64.8	50	64.8	53.6
2005	64.8	46.4	53.6	61.2
2006	76	42.5	76	64.8
2007	70.2	53.6	53.6	63
2008	51.8	44.3	48.2	48.2
2009	63	42.5	50	63
2010	55.4	55.4	46.4	50
2011	68.4	68.4	61.2	51.8

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Year	Maximum Wind Speed (km/h)			
	All Directions	NE-N	E	SE-S
2012	64.8	46.4	57.2	64.8
2013	63	59.4	63	53.6
2014	85.3	46.4	57.2	64.8
2015	59.4	42.5	57.2	46.4
2016	57.2	42.5	55.4	57.2
2017	72.4	53.6	57.2	72.4
2018	81.4	42.5	76	81.4
2019	76	50	57.2	76
2020	72.4	50	50	48.2
2021	72.4	63	48.2	72.4
2022	76	40.7	66.6	72.4
2023	64.8	37.1	42.5	48.2
2024	68.4	50	51.8	68.4
2025	83.2	55.4	61.2	64.8
Maximum Recorded	85.3	68.4	79.6	81.4

TABLE 5.5 – 1 IN 10 AEP WIND SPEED SUMMARY

Wind Speed (km/h)	NE-N	E	SE-S
1 in 10 Wind Speed	59	71	75

5.9 Seismicity

A probabilistic seismic hazard assessment (PSHA) of the region was conducted by the Seismology Research Centre (SRC) in 2008 **[20]**.

An updated PSHA of the Dugald River TSF was conducted by ATCW in June 2024 **[21]**. The calculated site peak ground accelerations (PGA) for different return periods are presented in **Table 5.6**.

TABLE 5.6 – PGA AS A FUNCTION OF RETURN PERIOD

Return Periods	PGA (g)
475 yr	0.0029
1,000 yr	0.0063
2,000 yr	0.0123
2,475 yr	0.0146

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Return Periods	PGA (g)
5,000 yr	0.0252
10,000 yr	0.0408

6 DESIGN AND CONSTRUCTION HISTORY

6.1 Overview

The detailed design of the Stage 1 and 2 TSF Embankment was completed in 2016 by ATCW **[6]**. The TSF Embankment civil construction works occurred from June 2016 to June 2017, with only non-civil works completed thereafter. Initially, the construction of the TSF Embankment was to take place in two stages. The first stage was to be the construction of a starter embankment (crest RL 233.4 m), followed by the second stage where the embankment would be raised using downstream construction methods to RL 244.25 m.

In August 2016, MMG decided that the Stage 2 downstream raise would be constructed in conjunction with the original Stage 1 scope of works. Details of the dam construction are provided in ATCW's July 2017 Construction Report **[22]**.

Detailed design of the Stage 3 TSF Embankment was completed in December 2025 **[9]**.

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6.2 Dam Components

6.2.1 Embankment Geometry

The TSF Embankment configurations for Stage 2 and 3 can be summarised as follows in **Table 6.1**:

TABLE 6.1 – DAM COMPONENT SUMMARY

Parameter	Stage 2 (Constructed)	Stage 3 (Design)
Main Embankment		
Crest Level	RL 244.25 m	RL 253.5 m
Maximum Embankment Height	38.25 m	47.5 m
Crest Width	10 m	10 m
Crest Length	225 m	292 m
Upstream Slope (H:V)	1.75:1	1.75:1 with a 3 m bench
Downstream Slope (H:V)	1.5:1 with two 5 m benches	1.5:1 with three 5 m benches
Waterproofing Element	Bituminous Geomembrane Liner	Bituminous Geomembrane Liner
Seepage Collection System	Rockfill foundation drain with open-air seepage collection pond	Rockfill foundation drain with buried concrete soakwell
Foundation Grouting	Foundation grout curtain through upstream concrete toe plinth	Foundation grout curtain through upstream concrete toe plinth
Northern Discharge Bund		
Crest Level RL	-	RL 253.5 m
Maximum Embankment Height	-	9.5 m
Crest Width	-	5 m
Crest Length	-	73 m
Upstream Slope (H:V)	-	2:1
Downstream Slope (H:V)	-	2:1
Emergency Spillway		
Spillway Invert	RL 242.1 m	RL 251.35 m
Spillway Base Width	10 m	50 m [1]
Spillway Depth	2.15 m	2.15 m
Spillway Side Slopes (H:V)	1:1 to 1:4 dependant on site conditions	1:1 to 1:4 dependant on site conditions
Location	North abutment	Approximately 250 m north of main embankment

Note 1: The increase in spillway base width for Stage 3 is due to an increase in design requirements from the Stage 2 design (refer **Section 9**).

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6.2.2 Decant and Return Water System

Tailings bleed water and catchment runoff reports to the Decant Pond. The Return Water System (RWS) reclaims water from the Decant Pond and transfers it back to the Process Plant for reuse. The primary RWS infrastructure includes the following:

- Decant Pump Station;
- Discharge Pipeline;
- Booster Pump Station;
- Return Water Pipeline.

Details of each RWS component are provided in the TSF Operation Plan **[23]**.

It is proposed that the existing RWS configuration is maintained for the Stage 3 raise.

6.2.3 Tailings Delivery System

The Tailings Delivery System comprises the following infrastructure:

- Tailings Delivery Pumping System;
- Main Tailings Delivery Pipeline;
- Tailings Discharge Points.

Details of each Tailings Delivery System component are provided in the TSF Operation Plan **[23]**.

6.3 Design Changes

6.3.1 Introduction

Several minor design changes were made during the Stage 2 construction works primarily to address changing site conditions; contractor scheduling; and procurement and constructability issues. The following sections summarise the design changes made. Further details are provided in the Stage 2 Construction Report **[22]**.

6.3.2 TSF Embankment

- Zone 3A material footprint was extended by 20 m for the initial 2 m of fill height.
- Zone 3A ‘Exempt’ material was used in larger quantities between RL 210 m and RL 218 m.
- Additional concrete volume was required for the construction of the upstream toe plinth, which required the introduction of longitudinal waterstops and additional steel reinforcement.
- High-slump concrete was incorporated in the design for the “plinth base” pours.
- PVC waterstops were used in place of specified EVA waterstops.
- Zone 2A and 2B material compliance was adjusted to allow a greater percentage of fines.
- BGM liner was installed in three stages, requiring intermediate anchor trenches.
- Concrete Canvas (CC5) was used in place of the specified gunite abutment fire protection, and at the downstream toe of the embankment to mitigate potential rockfall damage to the BGM liner.

6.3.3 Foundation Grouting

- Grout holes were installed vertically rather than perpendicular to the plinth surface.
- Additional grout holes were added to intersect with cold joints in concrete plinth base.
- The requirement to extend secondary grout holes based on permeability results was eliminated.

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- Grout mix design was modified to suit the products used and ground conditions.

6.3.4 Seepage Collection System

- Concrete Canvas (CC5) was used in place of gunite lining.
- Zone 2C capping layer over pond lining was deemed unnecessary and omitted.
- Bunds and drains around the seepage collection pond were not constructed to the specified sizes due to space constraints, and were constructed with finer materials than specified and not compacted in accordance with the specifications. Total Soil Control soil stabilisation emulsion was applied in this area by the contractor.

6.3.5 Return Water System

- Tether control station relocated due to road alignment change. Size and orientation of the concrete pad was modified accordingly.
- TSF Embankment crest tether point was moved to accommodate the tether control station relocation, and then later replaced by a mass concrete anchor block.

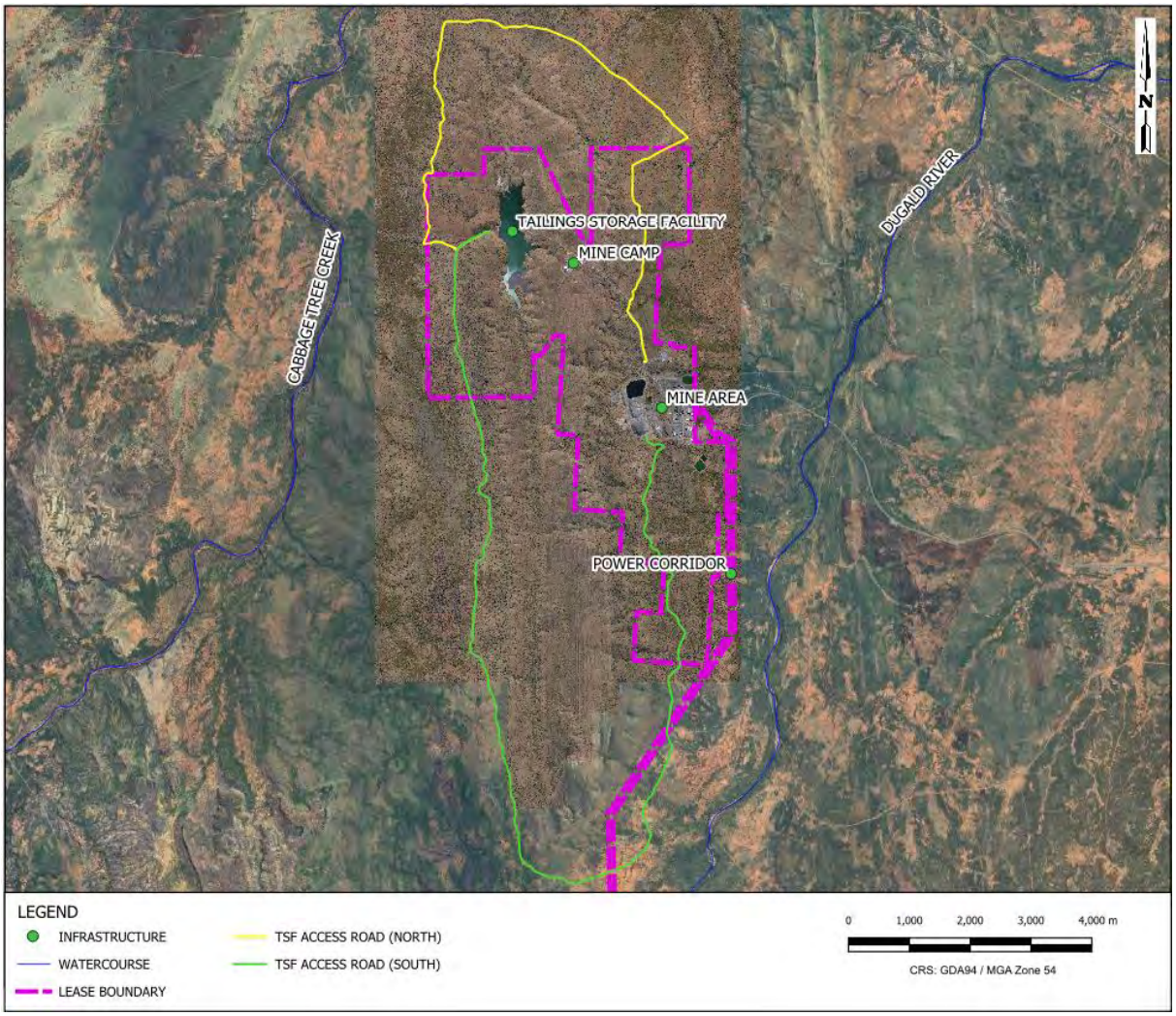
7 BATTERY LIMITS AND SURVEY

7.1 Battery Limits

The DRM site lease boundary is shown in **Map 7.1**. The lease boundary extends along the length of the power corridor until terminating east of Barkly Highway, approximately 60 km south-east of the DRM.

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MAP 7.1 – DUGALD RIVER MINE LEASE BOUNDARY (AUGUST 2024)



7.2 Survey

All designs, set-outs, as-built construction drawings, and monitoring data are produced in GDA94 / MGA Zone 54 and Australian Height Datum (AHD).

Survey data received from DRM is occasionally reported in DRM Local Mine Grid coordinates. The transformation points between the DRM Local Mine Grid and GDA94 are presented in **Table 7.1**.

TABLE 7.1 – TRANSFORMATION POINTS BETWEEN DRM LOCAL MINE GRID AND GDA94

Point	DRM Local Mine Grid			GDA94 / MGA Zone 54		
	East	North	RL	East	North	RL
82196	9984.164	13695.566	10268.967	411000.216	7759789.701	268.855
82197	10008.816	15655.134	10253.571	410695.615	7761724.908	253.459
DR01	10856.587	14353.692	10220.820	411749.4915	7760584.683	220.708

Notes: Transformation points provided by MMG via email on 25 March 2025.

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8 GUIDELINES AND STANDARDS

The design of the Dugald River TSF is to be undertaken in accordance with the following regulatory requirements, national guidelines, and global standards:

Regulatory Requirements

- DESI (2024) Manual for Assessing Consequence Categories and Hydraulic Performance of Structures, ESR/2016/1933, Version 5.03 **[24]**

National Guidelines

- ANCOLD (2019) Guideline on Tailings Dams – Planning, Design, Construction, Operation and Closure **[25]**
- ANCOLD (2019) Guidelines for Design of Dams and Appurtenant Structures for Earthquake **[26]**
- ANCOLD (2012) Guidelines on the Consequence Categories for Dams **[27]**

Global Standards

- ICMM (2020) Global Industry Standard on Tailings Management **[1]**

9 DESIGN OBJECTIVES

9.1 Overview

The key objectives of the DR TSF are summarised as follows:

- Safe and stable containment of tailings and process water;
- Safe management of decant and rainfall runoff;
- Collection and temporary storage of runoff during the wet season for use in the process plant;
- Operating the TSF on a zero-discharge basis for surface waters; and
- Closure and rehabilitation to achieve a stable, safe and non-polluting landform.

9.2 Design Criteria Summary

The TSF Consequence Category and Design Requirements as defined by DETSI **[24]**, ANCOLD **[25]** and GISTM **[1]** are summarised in **Table 9.1** for the ongoing Stage 3 raise design**.**

TABLE 9.1 – CONSEQUENCE CATEGORY AND DESIGN REQUIREMENTS (STAGE 3)

Item	Criteria Description	Criteria Requirement		
1	Consequence Category (Refer **Section 12**)	**DETSI**	Failure to Contain - Seepage	**Low**
			Failure to Contain – Overtopping	**Significant**
			Dam Break	**High**
		ANCOLD	Dam Failure	**High C**
			Environmental Spill	**Low**
		GISTM	Consequence Classification	**High**

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<table>
<tr><th>Item</th><th>Criteria Description</th><th colspan="3">Criteria Requirement</th></tr>
<tr><td rowspan="5">2</td><td rowspan="5">Embankment Stability

Minimum Factor of Safety (FoS)</td><td>Loading Condition</td><td>Criteria</td><td>Material Strength Parameters</td></tr>
<tr><td>Static Long Term</td><td>FoS ≥ 1.5</td><td>Drained (Effective) Strength</td></tr>
<tr><td>Static Short Term (loss of containment)</td><td>FoS ≥ 1.5</td><td>Undrained Strength</td></tr>
<tr><td>Static Short Term (no loss of containment)</td><td>FoS ≥ 1.3</td><td>Undrained Strength</td></tr>
<tr><td>Post-seismic /Liquefaction</td><td>FoS ≥ 1.0</td><td>Post-liquefied strength / residual strength for materials that are potentially liquefiable and 20% reduction in peak shear strength for the materials that are not liquefiable</td></tr>
<tr><td>3</td><td>Seismic Criteria</td><td colspan="3">Operating Basis Earthquake (OBE) – 1:475 AEP to 1 in 1,000 AEP (ANCOLD)
Safety Evaluation Earthquake (SEE) – 1:2,000 AEP (ANCOLD)

Operations and Closure (Active Care) – 1:2,475 AEP (GISTM)[1]</td></tr>
<tr><td>4</td><td>Wet Season Storage Allowance</td><td colspan="3">Design Storage Allowance (DSA) – 1:20 AEP wet season runoff (DETSI)

Design Storage Allowance (DSA) – 1:5 AEP wet season runoff (ANCOLD)</td></tr>
<tr><td>5</td><td>Extreme Storm Storage Allowance</td><td colspan="3">Extreme Storm Storage (ESS) – 1:10 AEP, 72-hr (DETSI)

Extreme Storm Storage (ESS) – Determine by risk assessment (ANCOLD) (refer Section 14)</td></tr>
<tr><td>6</td><td>Contingency Freeboard</td><td colspan="3">Wave run-up from 1:10 AEP wind (DETSI)

Nil wave run-up and nil additional freeboard (ANCOLD)</td></tr>
<tr><td>7</td><td>Spillway Criteria</td><td colspan="3">1:1,000 AEP to 1:100,000 AEP plus wave run-up for 1:10 AEP wind (DETSI)

1:100,000 AEP plus wave run-up for 1:10 AEP wind (ANCOLD); and PMF

1:2,475 AEP (GISTM)[1]</td></tr>
<tr><td>8</td><td>Closure</td><td colspan="3"><u>Seismic Criteria</u>

Passive Closure (Passive Care) – 1:10,000 AEP (GISTM)

Closure (ANCOLD) – Greater of:
a) Ground motion from the Maximum Credible Earthquake (MCE) on known active faults; or
b) Probabilistic ground motion from a 1:10,000 AEP event, taking into account expected long term properties of the tailings.</td></tr>
</table>

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Item	Criteria Description	Criteria Requirement
		Flood Criteria Passive Closure (Passive Care) – 1:10,000 AEP (GISTM) Closure Spillway – PMF plus freeboard accounting for potential settlement due to consolidation and earthquake induced deformation (ANCOLD)

Note 1: Under Requirement 4.2 of GISTM, it must be demonstrated that the feasibility, at a proof of concept level, to upgrade to the design for the "Extreme" classification criteria (i.e., 1 in 10,000 AEP) is maintained throughout the tailings facility lifecycle.

10 FAILURE MODE ASSESSMENT

10.1 Failure Modes

A Failure Mode and Effects Analysis (FMEA) workshop was conducted on 20th May 2025 which included participation from ATCW and MMG representatives.

The DRM Senior Independent Technical Reviewer was also present in an observational role.

The outcomes of the workshop are documented in the Stage 3 Quantitative Risk Assessment Report **[28]** and are summarised in **Table 10.1**.

TABLE 10.1 – STAGE 3 TSF CREDIBLE FAILURE MODE ASSESSMENT

No.	FM ID	Failure Mode	Initiating Event	Credibility
1	DR TSF-Emb-OT-1	Overtopping erosion due to insufficient installed flood capacity	Flood	Not Credible
2	DR TSF-Emb-OT-2	Overtopping erosion due to insufficient available flood capacity caused by the spillway blockage	Flood	Not Credible
3	DR TSF-Emb-OT-3	Overtopping erosion due to insufficient available flood capacity caused by wind-induced wave effects	Flood, Wind	Not Credible
4	DR TSF-Spill-OT-4	Partial breach due to progressive headcut erosion at the spillway	Flood	Not Credible
5	DR TSF-Emb-OT-5	Overtopping erosion due to failure of the Return Water system	Normal, Flood	Not Credible
6	DR TSF-Emb-OT-11	Overtopping erosion due to long-term deformation of the embankment and loss of freeboard	Normal, Flood	Not Credible
7	DR TSF-Emb-OT-12	Overtopping erosion due to deformation of the embankment and loss of freeboard post-seismic events	Earthquake	Not Credible
8	DR TSF-Emb-OT-22	BGM Liner Failure resulting in excessive seepage and displacement of the embankment materials	Normal, Flood, Earthquake	Not Credible

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No.	FM ID	Failure Mode	Initiating Event	Credibility
9	DR TSF-Emb-OT-23	Sloughing of the embankment upstream face due to wind-induced wave effects, resulting in loss of freeboard and overtopping erosion	Wind	Not Credible
10	DR TSF-Emb-SS-6	Overtopping due to instability of the downstream slope, causing slumping and loss of freeboard	Normal, Flood, Earthquake	Credible
11	DR TSF-Drg S-SS-7	Overtopping due to instability of the downstream slope resulting from failure of the seepage collection system	Normal, Flood, Earthquake	Not Credible
12	DR TSF-Emb-SS-8	Overtopping due to the instability of the upstream slope, causing slumping and loss of freeboard	Normal, Flood, Earthquake	Excluded due to negligible consequences, as a global failure of the embankment is not anticipated
13	DR TSF-Emb-BGM-9	BGM Liner Failure Leading to Seepage and Instability of the Upstream Slope	Normal, Flood, Earthquake	Excluded due to negligible consequences, as a global failure of the embankment is not anticipated
14	DR TSF-Emb-SS-18	Overtopping due to instability of the downstream slope resulting from failure of the Return Water System component	Flood, Normal	Not Credible
15	DR TSF-Emb-IE-15	Internal erosion of the embankment	Normal, Flood, Earthquake	Not Credible
16	DR TSF-Emb-IE-16	Internal erosion of the embankment into the foundation or at the embankment foundation contact	Normal, Flood	Not Credible
17	DR TSF-Emb-IE-17	Internal erosion through the soil/rock foundation	Normal, Flood	Not Credible
18	DR TSF-Emb-SS-25	Internal erosion along a buried conduit	Normal, Flood	Not Credible
19	DR TSF-Emb-LIQ-13	Embankment Breach due to flow liquefaction or foundation liquefaction	Earthquake	Not Credible
20	DR TSF-Emb-OT-14	Embankment Breach due to overtopping by liquefied tailings	Earthquake, Normal	Not Credible
21	DR TSF-Emb-BGM-10	BGM Liner Failure Leading to Excessive Seepage and Loss of Water Containment	Normal, Flood, Earthquake	Excluded due to negligible consequences, as a global failure of

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No.	FM ID	Failure Mode	Initiating Event	Credibility
				the embankment is not anticipated
22	DR TSF-Emb-IE-19	Fire damage to BGM Liner	Normal	Not Credible
23	DR TSF-Emb-SE-20	Overtopping due to slope instability caused by the formation of erosion gullies from surface water runoff	Flood	Not Credible
24	DR TSF-TD S-OP-21	Failure of Tailing Delivery System	Flood, Normal	Excluded due to negligible life safety consequences
25	DR TSF-Drg S-OP-24	Failure of the Seepage Collection System Pump	Flood, Normal	Excluded due to negligible life safety consequences

10.2 Critical Controls

A critical control, as defined by ICMM **[1]**, is "*a control that is critical to preventing a potential undesirable event or mitigating the consequences of such an event. The absence or failure of a critical control would disproportionally increase the risk despite the existence of other controls.*"

A summary of the critical controls for each potential failure mode of the DRM Stage 3 is summarised in **Table 10.2**.

A detailed list of controls is documented in the Risk Assessment report **[28]**.

TABLE 10.2 – STAGE 3 TSF CRITICAL CONTROLS

No.	FM ID	Failure Mode	Critical Controls
1	DR TSF-Emb-OT-1	Overtopping erosion due to insufficient installed flood capacity	Emergency spillway designed with adequate flow capacity and freeboard in accordance with best practices and with conservative assumptions
2	DR TSF-Emb-OT-2	Overtopping erosion due to insufficient available flood capacity caused by the spillway blockage	
3	DR TSF-Emb-OT-3	Overtopping erosion due to insufficient available flood capacity caused by wind-induced wave effects	
4	DR TSF-Spill-OT-4	Partial breach due to progressive headcut erosion at the spillway	Emergency spillway is designed to be constructed within competent rock base
5	DR TSF-Emb-OT-5	Overtopping erosion due to failure of the Return Water system	Emergency spillway designed using conservative assumptions and assuming an initial storage level at the spillway invert (worst-case initial conditions). The performance of the emergency spillway is independent from the performance of the Return Water System.

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No.	FM ID	Failure Mode	Critical Controls
6	DR TSF-Emb-OT-11	Overtopping erosion due to long-term deformation of the embankment and loss of freeboard	Embankment designed to be constructed from coarse rock fill and on competent rock foundations, less susceptible to long-term settlement. Routine deformation monitoring to track long-term embankment deformations and early identification of excessive movements.
7	DR TSF-Emb-OT-12	Overtopping erosion due to deformation of the embankment and loss of freeboard post-seismic events	Embankment designed to be constructed from materials less susceptible to deformation and strain-weakening following a seismic event. Estimated seismic deformations of less than 15 mm. Embankment designed with significant dry freeboard during normal operations (>2.15 m).
8	DR TSF-Emb-OT-22	BGM Liner Failure resulting in excessive seepage and displacement of the embankment materials	BGM liner designed to industry standards and supplier requirements Routine inspection of BGM liner that allows early detection and mitigation of liner failure
9	DR TSF-Emb-OT-23	Sloughing of the embankment upstream face due to wind-induced wave effects, resulting in loss of freeboard and overtopping erosion	BGM liner to be installed along upstream face mitigates the potential for upstream erosion
10	DR TSF-Emb-SS-6	Overtopping due to instability of the downstream slope, causing slumping and loss of freeboard	Embankment geometry desinged to provide sufficient stability against design loading. Comprehensive embankment stability assessment in accordance with industry standards and adopting conservative loading conditions and material parameters
11	DR TSF-Drg S-SS-7	Overtopping due to instability of the downstream slope resulting from failure of the seepage collection system	
12	DR TSF-Emb-SS-8	Overtopping due to the instability of the upstream slope, causing slumping and loss of freeboard	
13	DR TSF-Emb-BGM-9	BGM Liner Failure Leading to Seepage and Instability of the Upstream Slope	
14	DR TSF-Emb-SS-18	Overtopping due to instability of the downstream slope resulting from failure of the Return Water System component	
15	DR TSF-Emb-IE-15	Internal erosion of the embankment	BGM liner to be installed along the upstream face provides an impermeable barrier

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No.	FM ID	Failure Mode	Critical Controls
			Filter zones are incorporated within embankment geometry to prevent the migration of fine particles
16	DR TSF-Emb-IE-16	Internal erosion of the embankment into the foundation or at the embankment foundation contact	BGM liner to be installed along the upstream face provides an impermeable barrier Embankment to be constructed on rock foundations with minimal observed open joints. Any open joints expected to be filled and sealed with deposited tailings, preventing erosion of embankment through the foundation.
17	DR TSF-Emb-IE-17	Internal erosion through the soil/rock foundation	Fully intercepting grout curtain installed along the toe of Stage 1 and Stage 2 embankments, and is to be extended for the Stage 3 embankment.
18	DR TSF-Emb-SS-25	Internal erosion along a buried conduit	No buried conduits present within the structure
19	DR TSF-Emb-LIQ-13	Embankment Breach due to flow liquefaction or foundation liquefaction	All alluvial and colluvial materials within the foundation are to be stripped prior to construction to expose weathered quartzite rock Embankment rockfill and rock foundations are judged not to be susceptible to liquefaction
20	DR TSF-Emb-OT-14	Embankment Breach due to overtopping by liquefied tailings	Design does not include any tailings deposited above the Stage 3 spillway invert. Tailings are expected to flatten and remain below the spillway invert post-liquefaction.
21	DR TSF-Emb-BGM-10	BGM Liner Failure Leading to Excessive Seepage and Loss of Water Containment	BGM liner designed to industry standards and supplier requirements Routine inspection of BGM liner that allows early detection and mitigation of liner failure
22	DR TSF-Emb-IE-19	Fire damage to BGM Liner	Concrete Canvas geosynthetic to be installed at the abutments to provide bushfire protection to underlying BGM Liner
23	DR TSF-Emb-SE-20	Overtopping due to slope instability caused by the formation of erosion gullies from surface water runoff	Embankment to be constructed from rockfill material less susceptible to surface erosion Routine inspection of embankment face that allows

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No.	FM ID	Failure Mode	Critical Controls
			early detection and mitigation of further erosion
24	DR TSF-TD S-OP-21	Failure of Tailing Delivery System	Structural integrity of embankment is independent to the performance of the Tailings Delivery System
25	DR TSF-Drg S-OP-24	Failure of the Seepage Collection System Pump	Structural integrity of embankment is independent to the performance of the Seepage Collection System

11 DAM BREAK ASSESSMENT

11.1 Overview

A dam break assessment was carried out for the Stage 2 TSF configuration in 2015 **[29]**. The outcomes from the Stage 2 dam break assessment were relied upon to assign the consequence category for the Stage 2 TSF.

An updated dam break assessment was completed for the Stage 3 TSF configuration as part of the Stage 3 detailed design **[30]**. The following sections detail the key assumptions and considerations made to support the Stage 3 dam break assessment.

11.2 Modelled Scenarios

The selection of the dam break scenarios to be modelled have been based upon the credible failure modes identified in the FMEA process (**Section 10.1**).

Dam break modelling was carried out for a hypothetical Sunny Day Failure (SDF) mechanism. Under this scenario, it was assumed that global instability failure occurs causing significant deformation of the embankment and a loss of freeboard. Water begins overtopping the embankment, resulting in gradual erosion of the embankment crest. The loss of confining stress also causes static liquefaction of the tailings, which begin overtopping the embankment once the crest erodes to the level of the tailings. The release of water and liquefied tailings is into a dry downstream environment.

11.3 Breach Characteristics

The embankment breach was assumed to occur at the location coincident with the greatest embankment height in order to maximise the potential release volumes. This corresponds to the centre of the Stage 3 TSF.

The breach depth was limited to approximately two-thirds of the embankment height for the following reasons:

1. The identified credible failure mode relates to overtopping and progressive erosion of the crest, rather than a global failure of the entire structure, such as an instability failure through the foundation;
2. The embankment will be constructed predominantly from quarried quartzite rockfill and lined with a Bituminous Geomembrane Liner, and therefore will be less susceptible to erosion;
3. A portion of the liquefied tailings is assumed to mobilise and continue the breach propagation, however it is expected that a point of equilibrium will be reached with increased depth as higher strength, more consolidated tailings are exposed;
4. The embankment will be approximately 130 m wide at the base of the breach; and
5. A portion of the mobilised tailings and embankment materials will likely be deposited against the downstream toe of the embankment, providing additional resistance against continued breach propagation to the full height.

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A sensitivity assessment was also carried out assuming a full-height breach to understand the potential increase in the failure impact.

The adopted breach parameters are summarised in **Table 11.1** based on the estimated release volumes detailed in **Section 11.6**.

TABLE 11.1 – EMBANKMENT BREACH PARAMETERS

Parameter	SDF
Breach Base Level	RL 221.5 m
Breach Height	32.0 m
Average Breach Width	82.6 m
Breach Side Slopes	1H:1V
Breach Development Time	0.56 hrs (34 mins)

11.4 Tailings Parameters

The tailings parameters adopted for the dam break assessments are summarised in **Table 11.2**.

TABLE 11.2 – ADOPTED TAILINGS PARAMETERS FOR DAM BREAK ASSESSMENTS

Parameter	Description	Value	Source
G_S	Solids specific gravity	2.97	**Section 13.2**
ρ_d	In-situ dry density	1.35 t/m^3	**Section 13.3**
S_u	Undrained, post-liquefaction shear strength ratio	0.07	**Section 13.5**
C_w	Initial solids concentration (by weight)	71.2%	Calculated from G_S and ρ_d

11.5 Tailings Rheology

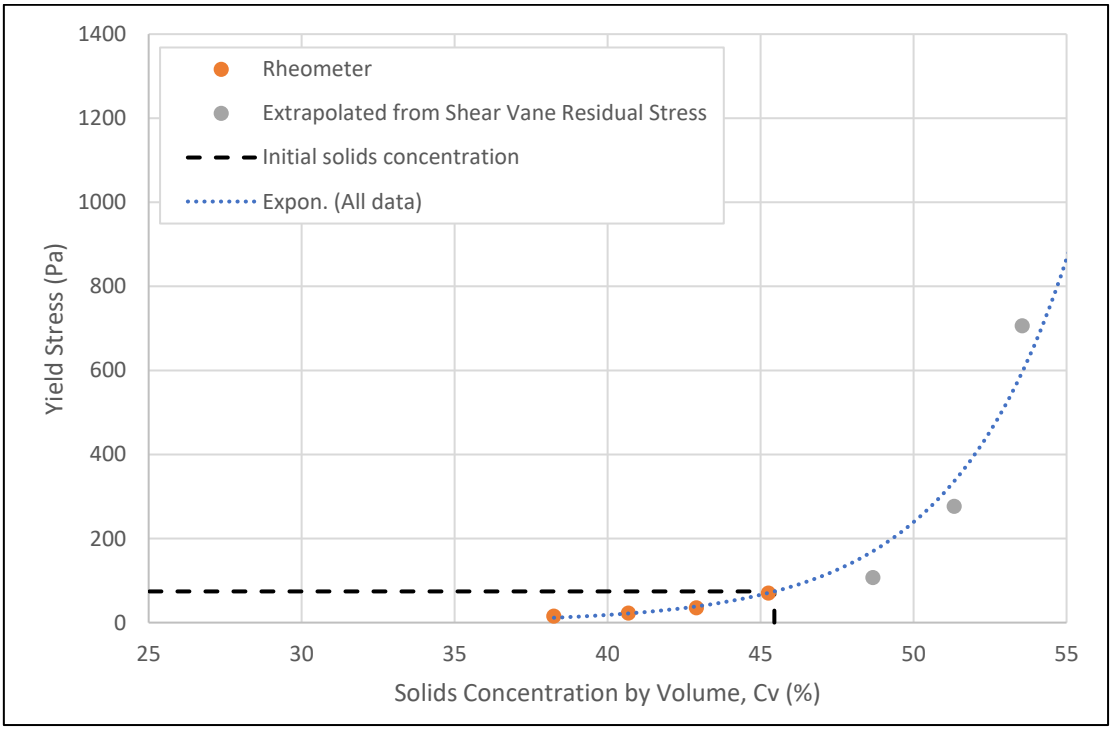
The tailings rheological parameters define the non-Newtonian flow characteristics of the liquefied tailings, and have been obtained from the following laboratory testing which have been completed in ATCW's Melbourne laboratory:

- Bob and Cup Rheology Test
- Shear Vane with Shrinkage Limit Density Testing

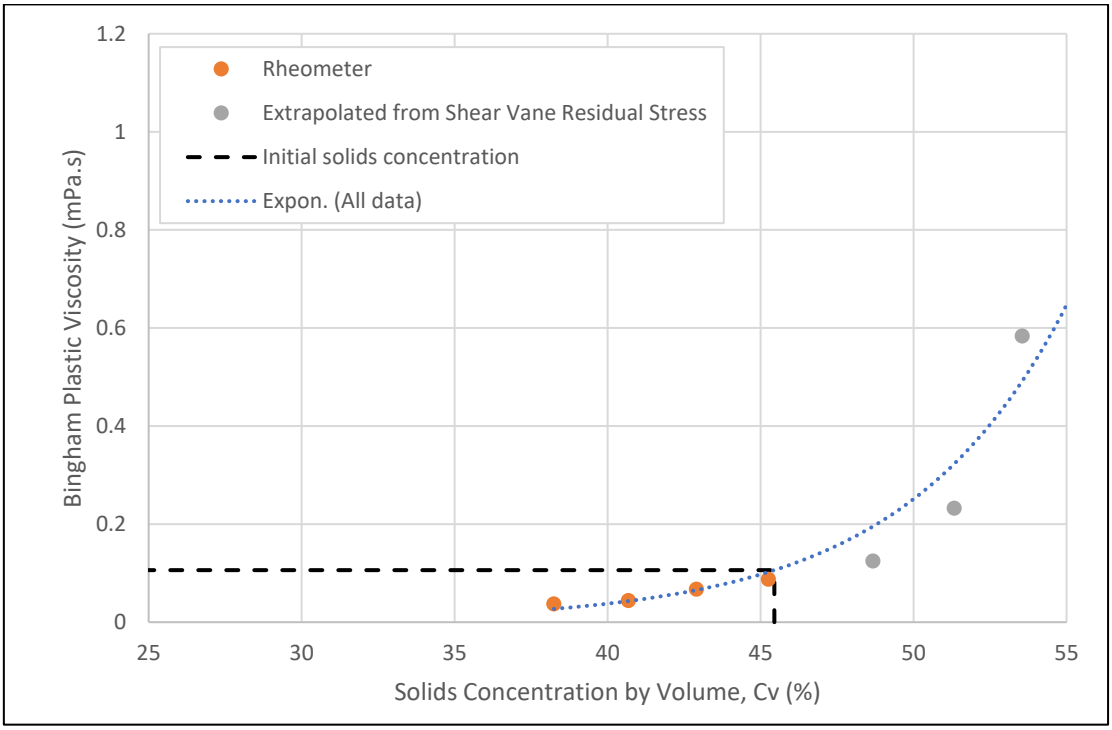
The exponential relationships between the Bingham Plastic yield stress and the Bingham Plastic viscosity versus solids concentration is presented in **Graph 11.1** and **Graph 11.2**.

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GRAPH 11.1 – BINGHAM PLASTIC YIELD STRESS



GRAPH 11.2 – BINGHAM PLASTIC VISCOSITY



11.6 Dam Break Release Volumes

The estimated water release volume was determined as the volume of stored water above the assumed breach base. The reservoir volume prior to the dam break was conservatively assumed to be at the spillway invert level to represent that maximum potential impact.

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The tailings release volume was estimated by predicting a residual post-failure slope of the tailings backscarp based on Infinite Slope Theory **[31]** . This is estimated to be 3.3% based upon the tailings parameters listed in **Table 11.2**. The tailings material located above the tailings backscarp is assessed as the mobilised failure volume.

The assumed release volumes are summarised in **Table 11.3**.

TABLE 11.3 – ASSUMED DAM BREAK RELEASE VOLUMES

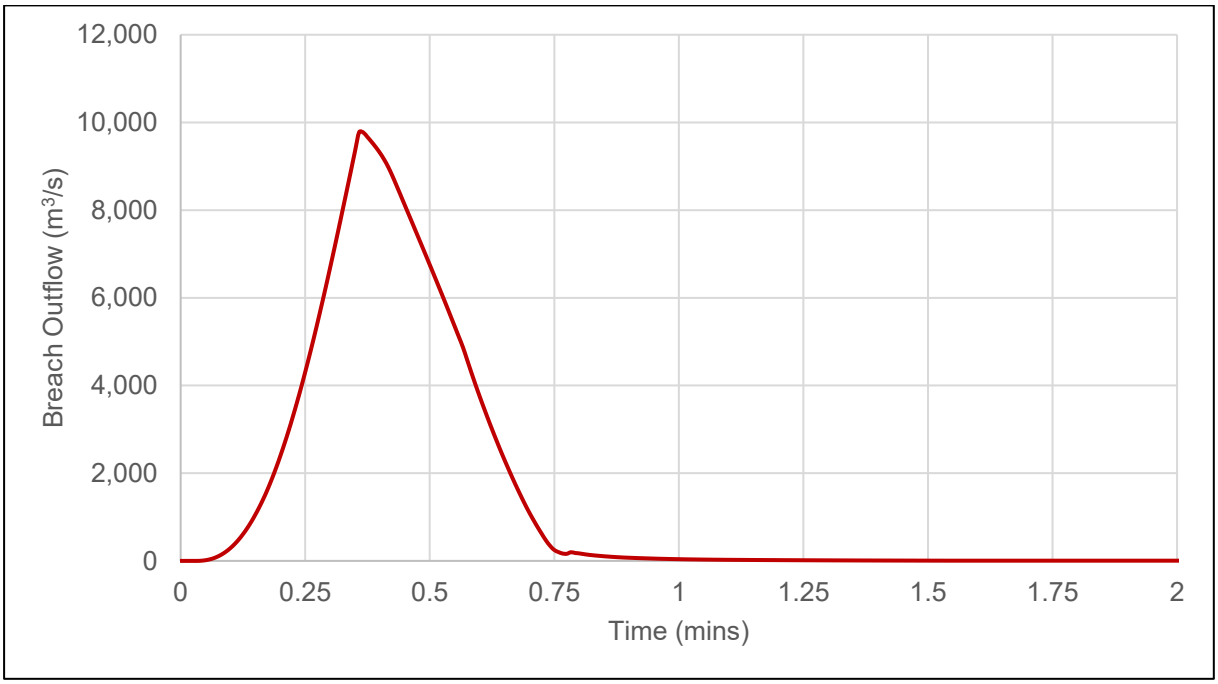
Parameter	SDF
Tailings Release Volume	3,859,700 m3
Water Release Volume	7,248,500 m3

11.7 Breach Hydrograph

The breach hydrograph has been developed in hydraulic modelling software HEC-RAS. This method idealises the tailings breach hydrograph as water flow. ATCW considers this to be conservative and appropriate, particularly given that the majority of the dam break flows are expected to comprise water.

A plot of the assumed breach hydrograph is presented in **Graph 11.3**.

GRAPH 11.3 – DAM BREAK HYDROGRAPH



11.8 Modelling Outcomes

The results of the Stage 3 dam break assessment indicate that the dam break flows will initially propagate westward through the unnamed tributary of Cabbage Tree Creek until intersecting the Cabbage Tree Creek drainage path. It is noted that the dam break flows may inundate multiple drainage paths before turning into Cabbage Tree Creek and flowing northwards towards the Little Eva Pit.

The results indicate that the proposed diversion drain and flood protection levee around Little Eva Pit are capable of diverting the majority of the mobilised flood volumes away from the Little Eva Pit. The

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results indicate that some minor overtopping of the proposed flood protection levee is anticipated at the northern extents where the crest of the proposed flood protection levee is at its lowest.

After being diverted away from the Little Eva Pit, the dam break flows continue northwards along the Cabbage Tree Creek before joining the Leichardt River at the Cabbage Tree Creek-Leichardt River confluence.

11.9 Sensitivity Analysis

As part of the Stage 3 dam break assessments, a sensitivity analysis was carried out by assuming a full-height embankment breach. This assumption results in the release of approximately 11.4 Mm^3 of liquefied tailings (comprising approximately 83% of the Stage 3 storage volume).

The results of the sensitivity assessment indicate that the dam break flows follow a similar flow path to the Base Case assessment, but with a wider footprint along both the unnamed Tributary of Cabbage Tree Creek and Cabbage Tree Creek itself.

The results indicate that the addition of the liquefied tailings results in significant overtopping of the proposed Little Eva Pit flood protection levee. It is therefore evident that the performance of the Little Eva Pit flood protection levee is sensitive to the mobilised tailings volume (and by extension the assumed breach depth).

As such, the dam break outcomes should be reviewed once as-built data for the Little Eva Pit flood protection levee becomes available.

12 CONSEQUENCE CATEGORY

12.1 Guidelines and Considerations

As part of the Stage 3 dam break assessment **[30]**, consequence category assessments have been carried out in accordance with the following methodologies:

- DETSI **[24]** - three separate scenarios for which different design criteria apply
  - Failure to Contain (seepage) – sets the required containment and detection measures;
  - Failure to Contain (overtopping) – sets the required flood management criteria (i.e., Design Storage Allowance and Mandatory Reporting Level); and
  - Dam Break – sets the required spillway capacity.
- ANCOLD **[25]** – two separate scenarios for which different design criteria apply
  - Dam Failure – sets the required spillway capacity and seismic design ground motions; and
  - Environmental Spill – sets the required flood management criteria (i.e., Design Storage Allowance, Extreme Storm Storage Allowance and Contingency Freeboard).
- GISTM **[1]**
  - Dam Failure – sets the required earthquake and flood management criteria, differentiating between active care and passive care.

12.2 Population at Risk (PAR)

Based on the ANCOLD guidelines **[27]**, the PAR is considered to be “all those persons who would be directly exposed to floodwaters within the dam break affected zone if they took no action to evacuate”

The ANCOLD and GISTM assessments consider both internal (i.e. MMG personnel) and external populations; whilst the DESI assessments only consider third-party (external) populations.

The assessment of PAR has been based on information provided by MMG and considers the proportion of time the individual or group can be expected to be exposed to the dam break inundation area. Separate PAR estimates have been carried out for Day and Night periods.

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MMG have advised that the potential PAR will comprise those listed in **Table 12.1**. The time-weighted estimate of the PAR is summarised in **Table 12.2**.

TABLE 12.1 – POTENTIAL POPULATIONS AT RISK

Task	No. People	Frequency (day time)	Frequency (night time)
Daily Inspections	1 person	1 hrs per inspection, once per day	Day shift only
Weekly Inspections	2 people	2 hrs per inspection, once per week	Day shift only
Monthly Inspections	1 person	2 hrs per inspection, once per month	Day shift only
Annual Surveillance Inspections	5 people	10 hrs per inspection, once per year	Day shift only
SCP Pump Maintenance	2 people	2 hrs a week	Day shift only
Environmental Sampling	2 people	2 hrs, once per month 3 hrs, once per quarter	Day shift only
Land Owner Inspections	1 person	6 hrs, twice per year	Day shift only
Drilling	2 people	12 hrs, once per year	Day shift only
Ad hoc Inspections	2 people	2 hrs, once per month	Day shift only
Little Eva Pit[1]	10 people	12 hrs shift	Day shift and night shift

Note 1: Conservative assumptions due to limited available information.

TABLE 12.2 – ESTIMATED POPULATION AT RISK

Task	Frequency	People Hours/Week	
		Day Time	Night Time
Daily Inspections	1 person x 1 hrs per inspection x once per day	7.000	-
Weekly Inspections	2 people x 2 hrs per inspection x once per week	4.000	-
Monthly Inspections	1 person x 2 hrs per inspection x once per month	0.462	-
Annual Surveillance Inspections	5 people x 10 hrs per inspection x once per year	0.962	-
SCP Pump Maintenance	2 people x 2 hrs a week	4.000	-

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Task	Frequency	People Hours/Week	
		Day Time	Night Time
Environmental Sampling	(2 people x 2 hrs x once per month) + (2 people x 3 hrs x once per quarter)	1.385	-
Land Owner Inspections	1 person x 6 hrs x twice per year	0.231	-
Drilling	2 people x 12 hrs x once per year	0.462	-
Ad hoc Inspections	2 people x 2 hrs x once per month	0.923	-
Little Eva Pit	10 people x 12 hrs	840.000	840.000
	Total People Hours/Week	859.424	840.000
	Total Hours per Week	84	84
	Equivalent PAR (Time-Weighted)	**10.231**	**10.000**

12.3 Potential Loss of Life (PLL)

Estimates of the PLL have been carried out in accordance with ANCOLD **[32]**. As recommended by ANCOLD, the RCEM approach **[33]** has been used to estimate the PLL.

The fatality rates and Weighted PLL for each population is summarised in **Table 12.3**. The low fatality rate assigned to the Little Eva Pit personnel has been assigned with reference to the low severity of flooding within this area as estimated from the dam break modelling **[30]**.

TABLE 12.3 – ESTIMATED POTENTIAL LOSS OF LIFE

Task	People Hours/Week	Weighted PAR		Fatality Rate	Weighted PLL	
		Day	Night		Day	Night
Daily Inspections	7.000	0.083	-	0.8	0.067	-
Weekly Inspections	4.000	0.048	-	0.8	0.038	-
Monthly Inspections	0.462	0.005	-	0.8	0.004	-
Annual Surveillance Inspections	0.962	0.011	-	0.8	0.009	-
SCP Pump Maintenance	4.000	0.048	-	0.8	0.038	-
Environmental Sampling	1.385	0.016	-	0.8	0.013	-
Land Owner Inspections	0.231	0.003	-	0.8	0.002	-
Drilling	0.462	0.005	-	0.8	0.004	-
Ad hoc Inspections	0.924	0.011	-	0.8	0.009	-

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Task	People Hours/Week	Weighted PAR		Fatality Rate	Weighted PLL	
		Day	Night		Day	Night
Little Eva Pit	840.000	10.000	10.000	0.01	0.100	0.100
	Total PAR	10.231	10.000	**Total PLL**	0.285	0.100

12.4 Consequence Category Summary

A summary of the assigned Consequence Categories is provided in **Table 12.4**.

TABLE 12.4 – CONSEQUENCE CATEGORY SUMMARY

Methodology	Scenario	Base Case
DESI	Failure to Contain - Seepage	**Low**
	Failure to Contain – Overtopping	**Significant**
	Dam Break	**High**
ANCOLD	Dam Failure	**High C**
	Environmental Spill	**Low**
GISTM	Consequence Classification	**High**

13 TAILINGS

13.1 Production Forecast

The latest production forecast provided to ATCW by MMG is dated February 2026, and has been reproduced in **Table 13.1**.

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TABLE 13.1 – TAILINGS PRODUCTION FORECAST (FEBRUARY 2026)

Source	Year	Tailings to TSF (Mt)	
		Annual	Cumulative
Actuals	**2017**	0.231	0.231
	2018	1.243	1.474
	2019	1.066	2.540
	2020	0.807	3.347
	2021	0.819	4.166
	2022	0.827	4.993
	2023	0.835	5.828
	2024	0.854	6.681
Forecast	**2025**	0.928	7.609
	2026	0.858	8.467
	2027	0.861	9.329
	2028	0.784	10.113
	2029	0.893	11.006
	2030	1.002	12.008
	2031	0.786	12.794
	2032	0.806	13.600
	2033	0.791	14.391
	2034	0.773	15.165
	2035	0.781	15.946
	2036	0.775	16.721
	2037	0.772	17.493
	2038	0.779	18.272
	2039	0.824	19.096
	2040	0.827	19.923
	2041	0.891	20.814
	2042	0.820	21.634
	2043	0.709	22.343

13.2 Tailings Characterisation

ATCW has completed numerous tailings characterisation testing on the Dugald River tailings. The laboratory testing included basic characterisation tests (particle density, plasticity) and specialised tailings testing (initial and shrinkage limit density, rheology, Rowe Cell consolidation).

A summary of the outcomes from the characterisation testing is presented in **Table 13.2**.

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TABLE 13.2 – TAILINGS CLASSIFICATION SUMMARY

Parameter	2008 [34] Flocculated Pb/Zn Bulk Float Tailings Sample	2015 [35] Flocculated Zn Tailings	2025 [36] Flocculated Tailings
Specific Gravity	2.96	2.97	2.96
Liquid Limit	21	19	28
Plastic Limit	15	19	16
Plasticity Index	6	0	12
Unified Soil Classification	Low plasticity silt	Low plasticity silt	Low plasticity clay
Segregation Threshold	46% solids	47% solids	40% solids
Initial Settled Density	1.08 – 1.2 t/m^3	1.22 t/m^3	1.15 t/m^3
Shrinkage Limit Density	1.63 t/m^3	1.67 t/m^3	1.80 t/m^3

13.3 Design Density

The adopted Overall In-situ Density (OID) is 1.35 t/m^3 for the Stage 3 design.

A summary of the achieved OID to date is presented in **Table 13.3**.

TABLE 13.3 – TAILINGS DEPOSTION DATA

Date of Survey	Tonnage (t)	Volume (m^3)	OID (t/m^3)
15 October 2024	6,452,600	4,672,300	1.38

As presented in **Table 13.3**, the OID of the tailings is 1.38 t/m^3 as of 15 October 2024 **[37]**, which is above the adopted design basis OID of 1.35 t/m^3.

13.4 Liquefaction Potential

Based upon the tailings particle size distribution and Tailings Characteristics reported in **Section 13.2**, the tailings are a fine grained silt/clay of low plasticity.

The criteria published by Boulanger **[38]** show that a fine-grained silt tailings with Plasticity Index less than 5 will be potentially liquefiable when saturated. Therefore, the DRM tailings are conservatively assessed to be potentially liquefiable on the basis of the results of the laboratory testing (**Table 13.2**).

13.5 Shear Strength

To date, no in-situ shear strength testing has been conducted on the deposited tailings. However, the Stage 2 northern tailings beach has reached an accessible level for the first time since deposition first commenced.

A scope of works is currently being considered to undertake field testing to assess the in-situ strength of the deposited tailings. The proposed program is designed to:

- Establish a reliable baseline of tailings shear strength through onsite testing.
- Validate the geotechnical characteristics and in-situ density design basis by undisturbed sampling and subsequent laboratory analysis.
- Monitor strength gain trends over time to confirm consolidation and desiccation (via evaporative drying) behaviour.

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- Reduce uncertainty in closure staging, capping design and capping trials by establishing basis of design parameters.
- Align with best practice expectations under the Global Industry Standard on Tailings Management (GISTM), which emphasises the use of site-specific data, laboratory testing, and monitoring to inform safe and stable closure design.

The outcomes from the ongoing tailings strength testing will be documented within the DBR when available.

13.6 Brittle Behaviour

The tailings are not located within the structural zone of the TSF embankment. Therefore, although the DRM tailings are considered to be potentially liquefiable, the stability of the embankments do not rely on the strength or presence of the tailings. Hence, no brittle failure mechanisms are expected.

13.7 Beach Slope and Rheology

To date, deposition has occurred predominantly sub-aqueously (i.e., into the decant pond). For sub-aqueous deposition conditions, beach slopes are generally steeper. A summary of the achieved beach slopes based on the October 2024 survey is presented below **[37]**:

- Subaerial Beach Slopes - Northern 0.5%, Southern 0.6%
- Subaqueous Beach Slopes - Northern 1.0% - 4.8%, Southern 1.4% - 5.9%

The Stage 3 design has assumed continued sub-aqueous deposition at the design solids concentration (52 – 55 % w/w) and adopts the following beach slope profiles:

- Sub-aerial: Northern 0.3%, Southern 0.5%
- Sub-aqueous (upper slope): Northern 5.5%, Southern 2.2%
- Sub-aqueous (lower slope): Northern 1.3%, Southern 4.5%

The design beach slopes will be reviewed once dewatering of the decant pond is carried out and sub-aerial deposition commences.

14 WATER MANAGEMENT

14.1 Operating Pond

A water balance study was completed in June 2025 **[39]** to understand potential TSF decant volumes to inform the Stage 3 design process. The water balance modelling was carried out for the following three scenarios:

1. Scenario 1: Baseline climate data
2. Scenario 2: Climate change adjusted climate data
3. Scenario 3: Climate change adjusted climate data plus operational evaporator fans

14.1.1 Decant Pond Volume

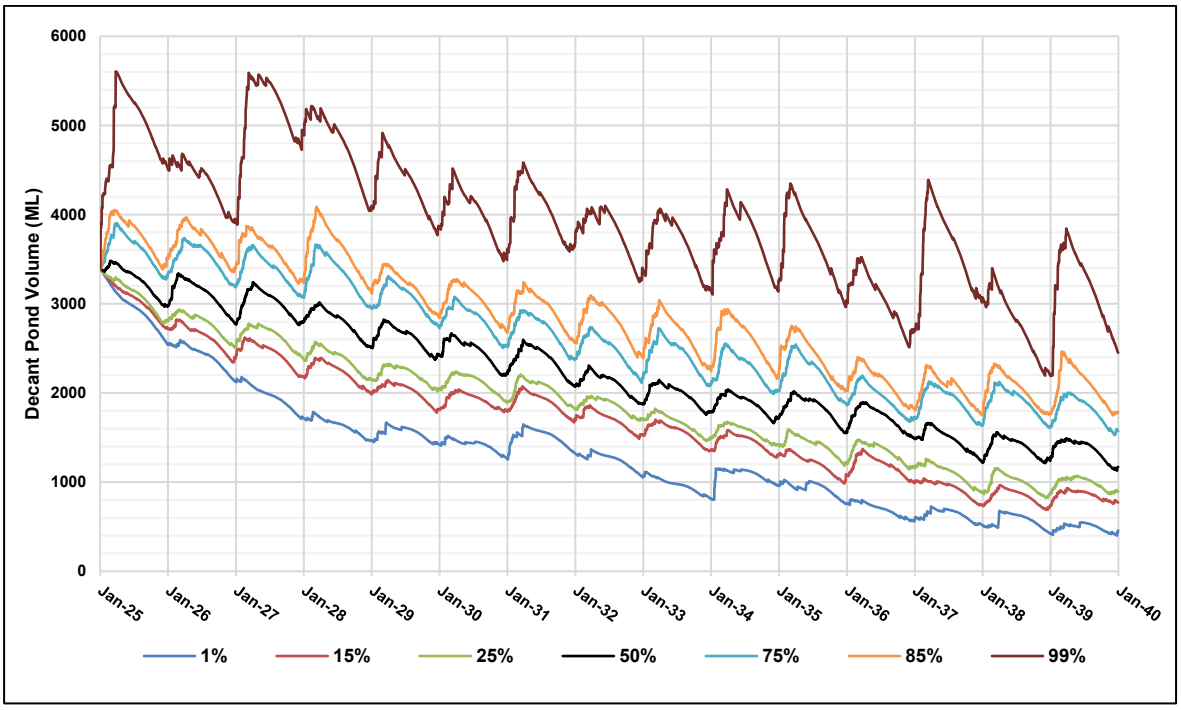
The outcomes from the water balance study are shown in **Graph 14.1** to **Graph 14.3**, depicting the modelled water volume stored in the TSF for each of the above scenarios.

The results indicate that the TSF decant pond generally reduces over time as a result of climatic effects (i.e., evaporation rates exceeding precipitation).

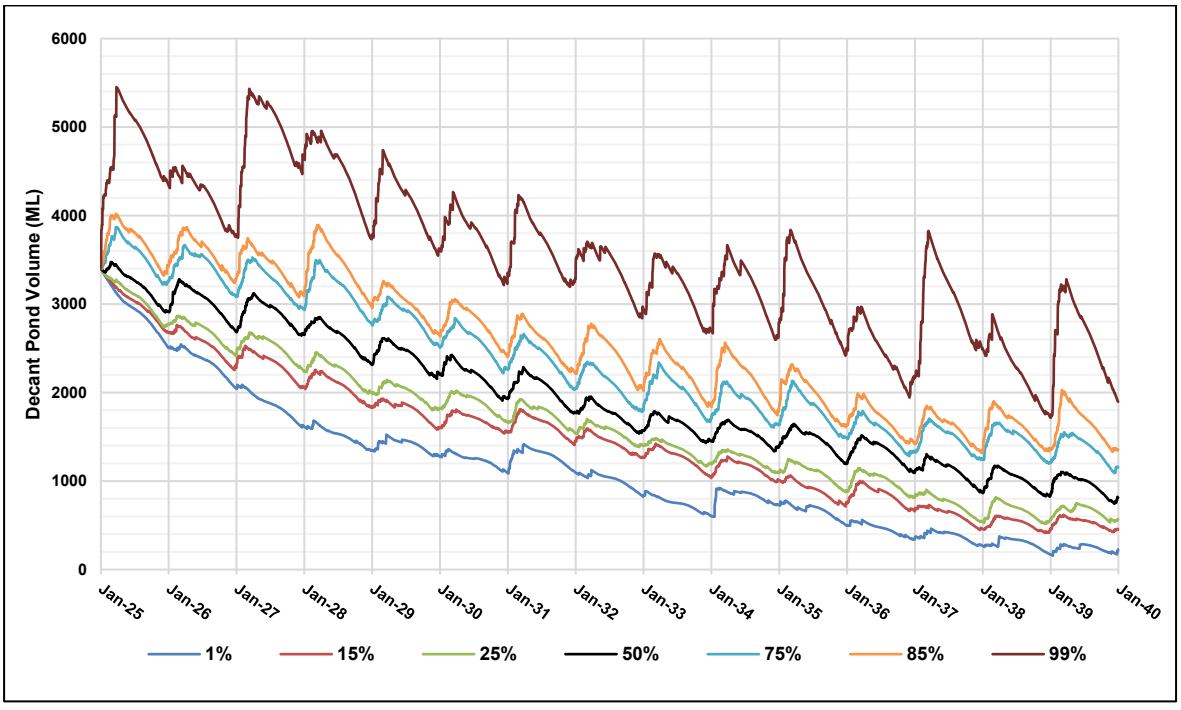
A comparison between Scenario 2 and Scenario 1 indicates that the influences of climate change (i.e., increasing evaporation rates over time and moderate decline in precipitation rates over time) impose a negative effect on decant pond volumes.

The results from Scenario 3 indicate that the role of the evaporator fans in drawing down the decant pond volumes is significant.

GRAPH 14.1 – SCENARIO 1 (BASELINE) DECANT POND VOLUME

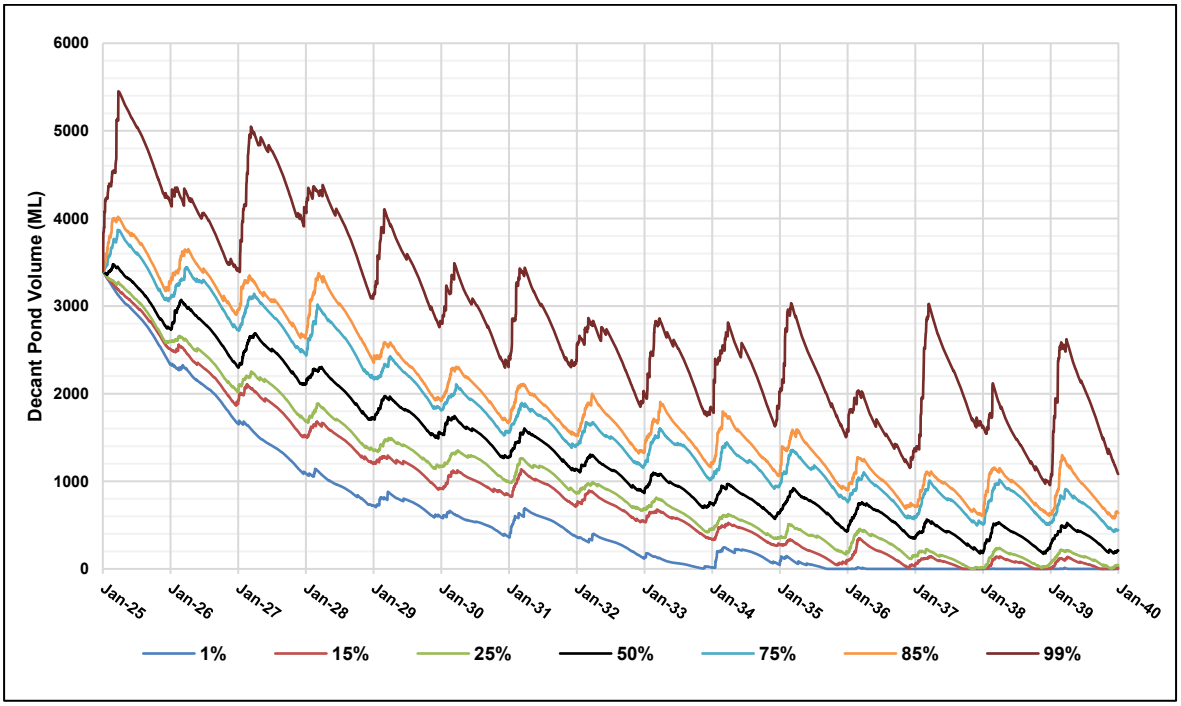


GRAPH 14.2 – SCENARIO 2 (CLIMATE CHANGE) DECANT POND VOLUME



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GRAPH 14.3 – SCENARIO 3 (CLIMATE CHANGE & EVAPORATORS) DECANT POND VOLUME



14.1.2 Decant Pond Level

The outcomes from the water balance study are shown in **Graph 14.4** to **Graph 14.6**, depicting the modelled decant pond level in the TSF for each of the three scenarios.

The results indicate that for Scenario 1 and 2, there is a 15% probability that the Stage 2 DSA Reporting Level is exceeded by March 2028.

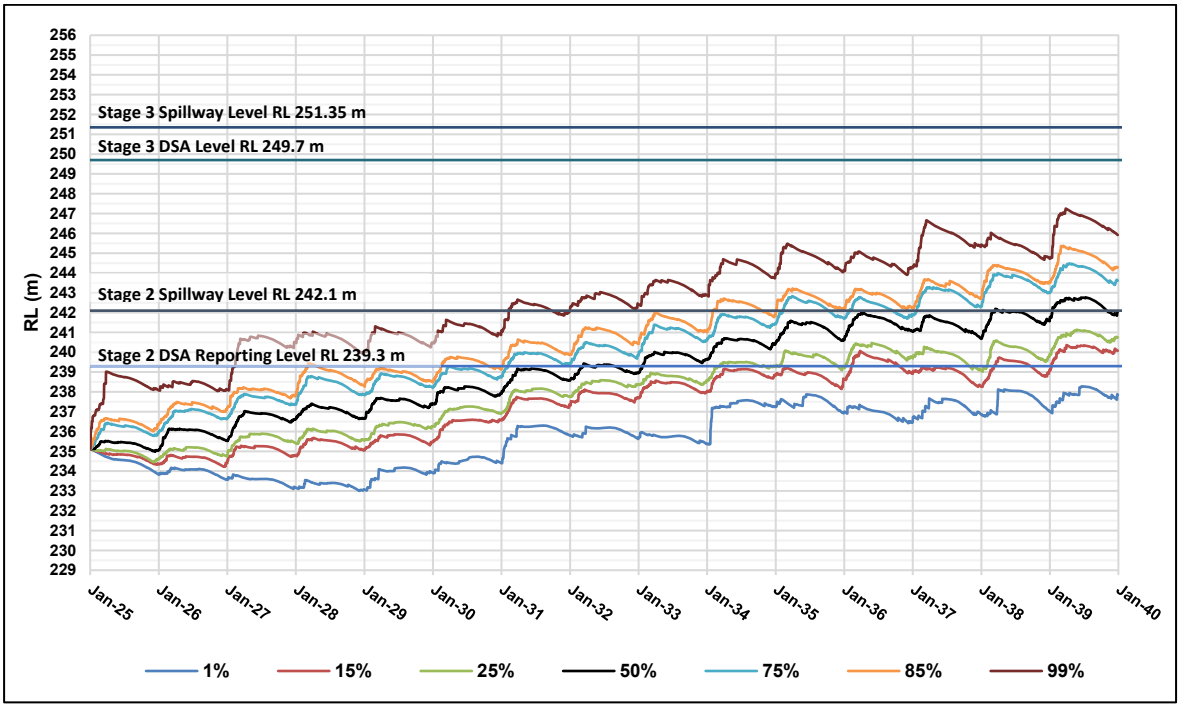
The results from Scenario 3 indicate that the evaporators play a significant role in reducing the decant pond level. Hence, the 15% probability of the Stage 2 DSA Reporting Level being exceeded is extended to February 2031 under Scenario 3.

The Stage 3 TSF is currently planned to be constructed by the end of 2027. Hence, there is a less than 1% chance that the Stage 2 DSA Reporting Level is exceeded prior to the construction of the Stage 3 TSF based on the water balance outcomes.

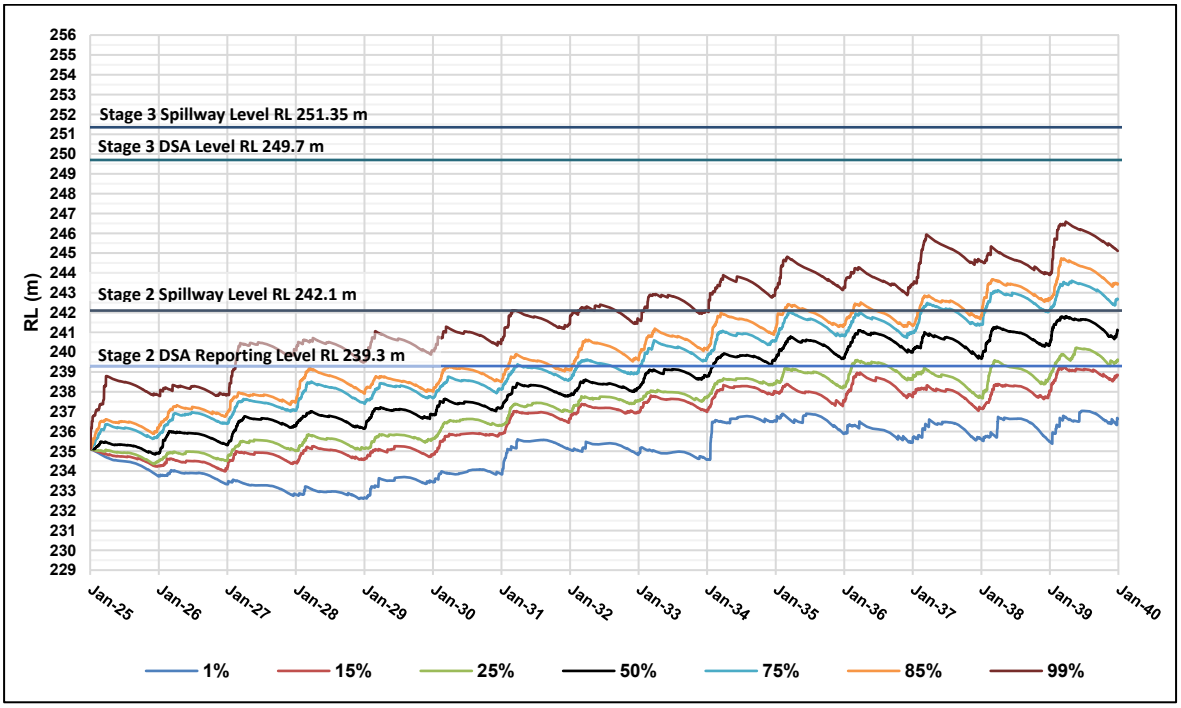
The results from all Scenarios indicate that the Stage 3 DSA Reporting Level is not exceeded for any of the water balance realisations (maximum probability plots not shown for clarity). It is thus unlikely that the Stage 3 DSA Reporting Level will be exceeded during the operational life of the facility.

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GRAPH 14.4 – SCENARIO 1 (BASELINE) DECANT POND LEVEL

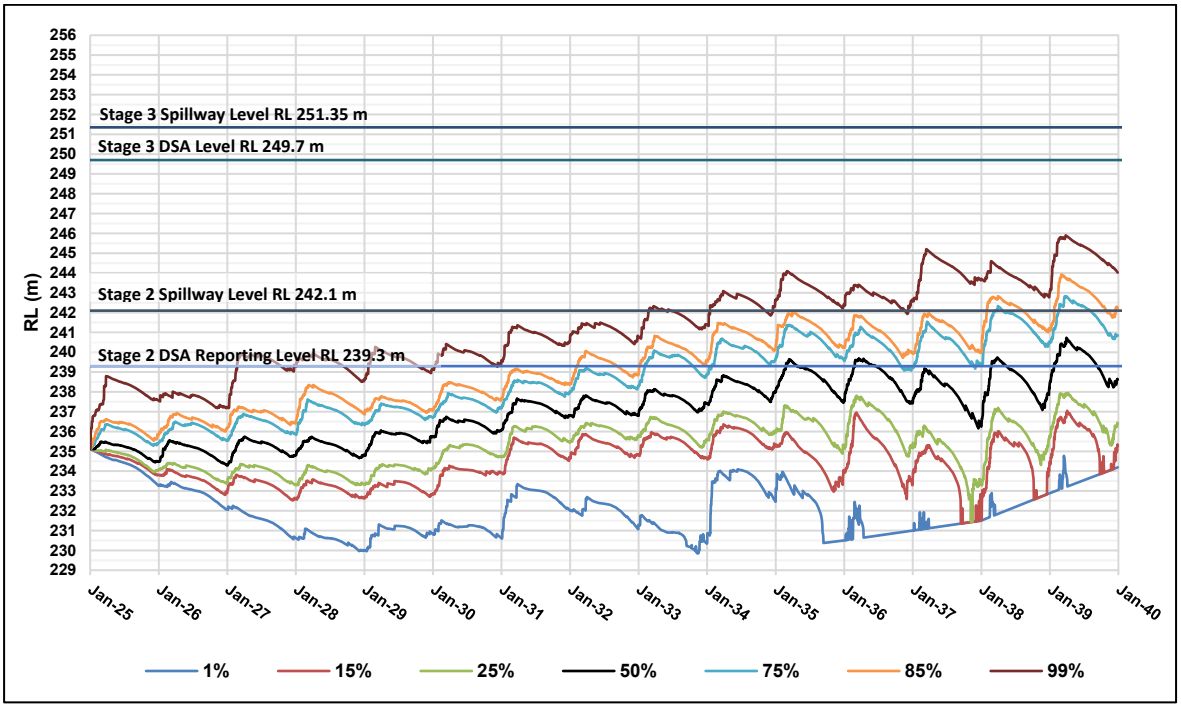


GRAPH 14.5 – SCENARIO 2 (CLIMATE CHANGE) DECANT POND LEVEL



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GRAPH 14.6 – SCENARIO 3 (CLIMATE CHANGE & EVAPORATORS) DECANT POND LEVEL



14.2 Design Storage Allowance

The DSA and ESS criteria were reviewed in December 2022 **[17]** for the Stage 2 Geometry as part of a study to reclassify the DESI "failure to contain – overtopping" consequence category from 'High' to 'Significant'. The reduction in consequence category was approved by DES in the April 2023 amendment to the Environmental Authority (EA) **[40]**. The required DSA under a 'Significant' classification was determined to be **2,060 ML**.

The DSA was reviewed in June 2025 for the proposed Stage 3 Geometry as documented in the Stage 3 water balance study **[39]**. The required DSA under the 'Significant' classification was determined to be **1,500 ML**, corresponding to a DSA Reporting level of RL 249.8 m.

14.3 Spillway Capacity

The Stage 2 spillway was designed to pass the 1:10,000 AEP flood plus the 1:10 AEP wind induced wave run-up in accordance with DETSI requirements at the time of design **[6]**. The performance of the spillway was reviewed as part of the 2022 consequence category review **[17]** which found it to be satisfactory.

The Stage 3 emergency spillway is designed for the greater of the 1:100,000 AEP plus 1:10 AEP wind induced wave run-up; and/or the Probable Maximum Flood (PMF). This satisfies the requirements of a "High C" dam failure consequence category dam in accordance with ANCOLD guidelines **[25]**.

A summary of the Stage 3 spillway design outcomes and conformance to the design criteria is provided in **Table 14.1**.

TABLE 14.1 – STAGE 3 SPILLWAY DESIGN SUMMARY

Design Criteria	Spillway Invert	Peak Flood Depth	Wave Runup + Setup	Remaining Freeboard	Assessment
1:100,000 AEP plus wave run-up for 1:10 AEP wind	RL 251.35 m	0.78 m	0.80 m	0.57 m	Pass
PMP	RL 251.35 m	1.54 m	N/A	0.61 m	Pass

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14.4 Water Accounting

A site Water Account is carried out on an annual basis. The most recent report covered the period of January to December 2024 **[41]** and is summarised in **Table 14.2**.

Total inputs were 3,476 ML, total outputs were 3,457 ML, and the recorded change in storage inventory was 33 ML. This resulted in a discrepancy in the water balance of -14 ML, or 0.4% of total inputs, which is considered a very good result.

TABLE 14.2 – 2024 ANNUAL WATER ACCOUNT STATEMENT (JANUARY TO DECEMBER 2024)

Category	Input / Output	Parameter	Volume (ML)		Total (ML)
			High quality	Low quality	
Operational	Withdrawal	Entrainment (ore water content)	0	27	3,164
		Ground (groundwater inflow)	105	0	
		Surface (rainfall & runoff)	45	1,388	
		Third Party (external water supply)	1,599	0	
	Consumption	Entrainment (tailings & concentrate)	0	772	3142
		Evaporation (incl. dust suppression)	86	1,434	
		Other	5	0	
	Discharge	Ground (seepage)	92	713	
		Surface (discharge to watercourse)	36	3	
		Third party (supply to cattle tanks)	1	0	
Other Managed Water	Withdrawal	Surface (rainfall & runoff)	185	127	312
	Discharge	Surface	106	0	315
		Other (evaporation & seepage)	54	155	
Initial Storage Volume					**3,477**
Final Storage Volume					**3,510**
Change in Storage Volume					**33**
Total Inputs					**3,476**
Total Outputs					**3,457**
Imbalance					**-14**
Difference (as a % of total inputs)					**0.4%**

Ongoing review of the model's ability to accurately predict overflow from site storages continues to be required, as part of the Water Accounting Framework process and to support ongoing operational modelling.

14.5 Seepage and Drainage

Seepage continues to flow from the toe of the downstream batter of the Stage 2 TSF Embankment and is directed into the Seepage Collection Pond through the rockfill drain.

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The pond has been fitted with an electric pump to maintain the level within the Seepage Collection Pond by returning water into the TSF impoundment. Level sensors positioned in the pond control the pump operation locally.

The Stage 3 Seepage Collection System will comprise extension of the rockfill drain into a buried concrete soakwell. The existing Seepage Collection Pond will be filled as part of the Stage 3 civil works.

14.6 Surface Water Management

The TSF operates on a zero-discharge basis for surface waters. Thus, all surface water runoff report to the Decant Pond along with tailings bleed water. This water is available for re-use within the Process Plant and various other mine activities. Details of the operating levels of the decant pond are provided in the TSF Operation Plan **[23]**.

15 GEOTECHNICAL ANALYSIS

15.1 Geotechnical Investigations

Geotechnical investigations of the Knapdale Valley and TSF Embankment footprint areas were carried out in two campaigns as follows:

1. Preliminary investigation (Dec 2008) **[42]** – Investigation of TSF Embankment area only; and
2. Main investigation (Oct 2012) **[43]** – Additional investigation of TSF Embankment area, potential borrow sources within the Knapdale Valley floor and foothills, and potential quarry locations.

A summary of the major findings is presented as follows:

- The TSF Embankment area subsurface strata consist of moderate strength, highly fractured, highly to moderately weathered quartzite for the upper 5 m. The rock becomes less fractured and defect spacing decreases at depths between 5 m and 10 m;
- Rock mass permeability of the TSF Embankment foundation rock and TSF impoundment floor is considered to be low (in range of 10^{-7} to 10^{-9} m/sec).
- Groundwater within the Knapdale Valley is confined to within the joints and defects of the rock mass and fluctuates seasonally within a depth of 10 m below surface level;
- Quartzite rock within the Knapdale Valley was found to be generally suitable for quarrying rockfill for embankment construction;
- Granular and low permeability residual, colluvial and alluvial materials existing within the Knapdale Valley were found to be generally suitable for embankment construction. Such materials were typically found on the floor and foothills of the valley, particularly on the south-western side and within the southern end.

15.2 Material Parameters

The material parameters adopted for the stability analysis of the Stage 3 embankment are summarised in **Table 15.1**. Further detail on the selection of these parameters is provided in the Stage 3 detailed design report **[9].**

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TABLE 15.1 – MATERIALS PARAMETERS FOR STAGE 3 STABILITY ANALYSES

Material	Strength Envelope		Unit Weight (kN/m^3)
	Effective Strength	Post-Seismic Strength	
Zone 2B	c' = 0 kPa, ϕ' = 35°	c' = 0 kPa, ϕ' = 29°	20
Zone 2C	Leps' Lower-Average (Capped at 40°)	Leps' Lower Bound (Capped at 36°)	22.5
Zone 3A	Leps' Average (Capped at 40°)	Leps' Lower Bound (Capped at 36°)	22.5
Zone 3B			
Foundation – Quartzite Rock	Bedrock (Impenetrable)		22.5
Tailings	No strength		20

15.3 Slope Stability

The results of the stability analyses for the Stage 3 configuration are summarised in **Table 15.2** and are presented in the Stage 3 Detailed Design report **[9]**.

TABLE 15.2 – STABILITY ANALYSES RESULTS

Structure	Scenario	Description	Failure Direction	FoS Required	FoS Modelled
TSF Embankment	Long-Term	Tailings at RL 236 m Pond at RL 248 m	Downstream	1.5	1.60
			Upstream		2.30
	Liner Leak	Tailings at RL 236 m Pond at RL 248 m	Downstream	1.5	1.59
	Dam Crest Flood	Tailings at RL 236 m Pond at RL 253.5	Downstream	1.3	1.60
	End of Construction	Tailings at RL 222 m Pond at RL 236 m	Upstream	1.3	1.56
	Post-Seismic	Tailings at RL 236 m Pond at RL 248 m	Downstream	1.0	1.38
Northern Discharge Bund	Long-Term	Tailings at RL 236 m Pond at RL 248 m	Downstream	1.5	1.92
	Dam Crest Flood	Tailings at RL 236 m Pond at RL 253.5	Downstream	1.3	1.92
	Post-Seismic	Tailings at RL 236 m Pond at RL 248 m	Downstream	1.0	1.66

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15.4

15.4 Deformation Assessment

The Stage 3 embankment raise has been assessed for seismic-induced deformation using empirical methods, as detailed in the Stage 3 detailed design report **[9]**. The results of the assessment indicate maximum crest settlements of less than 15 mm.

16 ENVIRONMENTAL

16.1 Tailings Geochemistry

A review of the available geochemical monitoring data was carried out in 2024 **[44]**.

Summary statistics for the complete dataset collected between October 2018 and April 2024 is shown in **Table 16.1**. The small variation between the median and mean values indicate that the properties of the tailings are generally stable.

TABLE 16.1 – TAILINGS GEOCHEMISTRY SUMMARY STATISTICS

Test	NAPP (kg H2SO4/t)	ANC (kg H2SO4 equiv./t)	MPA (kg H2SO4 equiv./t)	Total Zinc (mg/kg)	Total Lead (mg/kg)	Total Sulphur (%)
Count	201	201	204	199	199	204
Median	231	51	285	13,800	3,610	9
Mean	231	52	285	14,197	3,725	9
Standard Deviation	37	18	32	5,059	951	1

16.2 License Conditions

License conditions are set out in the current Dugald River Environmental Authority (EA) EPML0073121 **[45]**.

16.3 Sensitive Receptors

An assessment of the potential environmental harm resulting from an overtopping event from the TSF was carried out as part of the 2022 consequence category review **[17]**. The outcomes from the assessment are summarised below:

- There are no World Heritage Properties, National Heritage Places, Wetlands of International Importance, Great Barrier Reef Marine Park, Commonwealth Marine Areas, or Listed Threatened Ecological Communities listed for the downstream receiving environment;
- There are 17 Listed Threatened Species within the potential receiving environment;
- There are several areas of Matters of State Environmental Significance (MSES) pertaining to regulated vegetation (intersecting a watercourse) and regulated vegetation (essential habitat) within the potential receiving environment;
- There are no High Ecological Value (HEV) wetlands or waterways identified within the potential receiving environment;
- Cabbage Tree Creek and its unnamed tributary are identified as areas of ‘Medium’ riverine subcatchment significance; and
- The registered bores to the west of the TSF, within the potential inundation footprint are all for groundwater monitoring purposes and are not used for human consumption.

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16.4 Source Path Receptor and Contaminant Soil Models

A Groundwater Impact Assessment was undertaken for the Dugald River TSF by CDM Smith in 2025 **[46]**. The hydrogeological model developd by CDM Smith is summarised as follows:

- Rainfall provides direct recharge to the local groundwater system when rainfall exceeds evaporation. Infrequent rainfall patterns result in episodic flow and short periods of potential recharge to the groundwater system during surface water flow events.
- Unconsolidated alluvial sediments are present along the extent of Cabbage Tree Creek and Dugald River. As the creeks and drainage features within the vicinity of the TSF are ephemeral, the presence of groundwater within the alluvium is sporadic and related to rainfall events where the creeks and drainage features flow.
- The Knapdale Quartzite, which underlies the TSF, is considered to be an aquitard (i.e., a unit that contains groundwater but has very low yields).
- The direction of groundwater flow reflects topography. A groundwater divide is associated with the elevated Knapdale Range.
- Groundwater flow is in a westerly direction within the Lady Clayre Formation, Coocerina Formation and Mount Roseby Schist located to the west of the Knapdale Quartzite. Groundwater flow is in an easterly direction within the Mount Roseby Schist located to the east of the Knapdale Quartzite.
- Groundwater flow generally occurs within a thin fracture zone at surface.
- Shallow and deep groundwater comprise a single continuous groundwater flow system, with no separate shallow groundwater system (CDM Smith, 2021). This is supported by the geology, with basement rocks extending to the surface or near the surface.
- Groundwater levels measured near the TSF do not indicate any rise in groundwater elevation since tailings deposition commenced in 2017, indicating minimal to no seepage from the TSF has occurred.

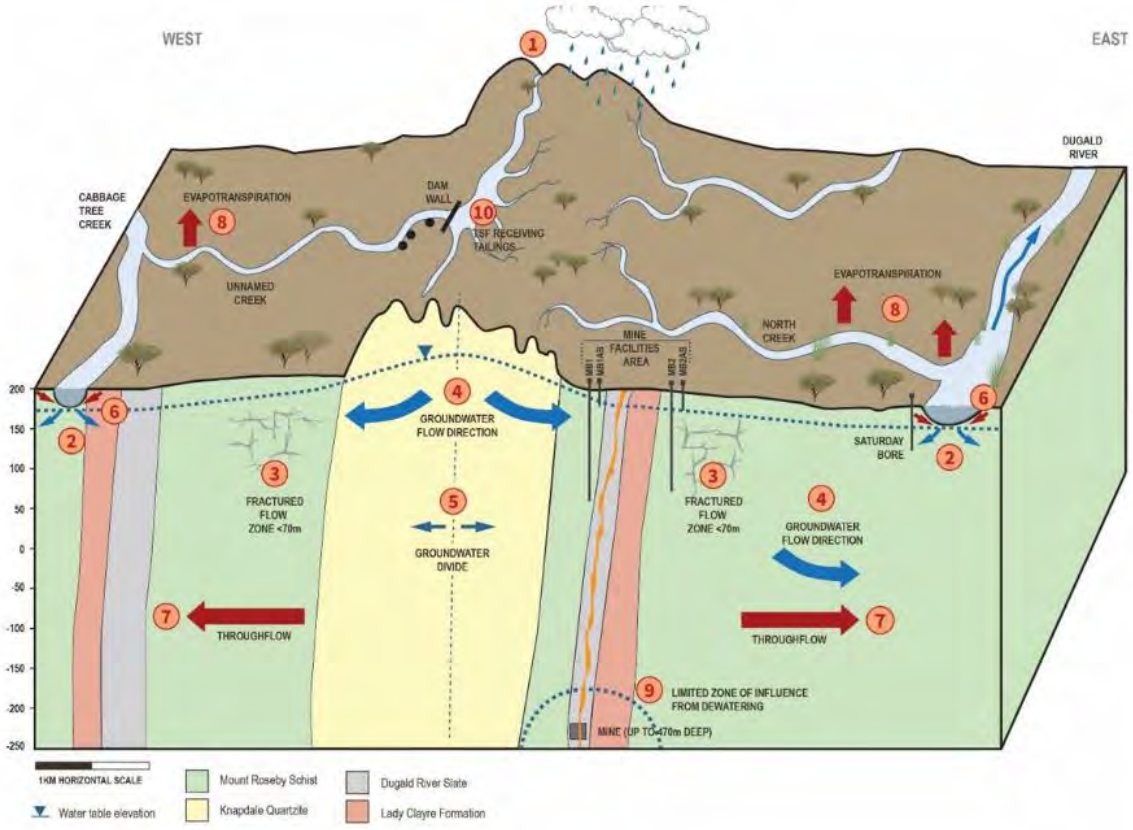
A conceptual groundwater model is presented in **Diagram 16-1.**

CDM Smith provide the following commentary regarding impacts on groundwater quality **[46]**:

- The project will utilise existing infrastructure for storing tailings associated with mineral processing. Therefore, there is no potential for contamination from new surface infrastructure areas.
- The Stage 3 TSF raise has the potential to affect local groundwater quality due to limited seepage of potential acid mine drainage contaminated water migrating from the TSF into the underlying groundwater regime. However, due to the very low permeability of the Knapdale Quartzite underlying the TSF, and the absence of any evidence of seepage from the TSF since tailings deposition commenced in 2017, impacts on groundwater quality associated with local contamination from TSF seepage are considered highly unlikely.

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DIAGRAM 16-1: CONCEPTUAL HYDROGEOLOGICAL MODEL [46]



16.5 Groundwater Quality

CDM Smith **[46]** have provided the following commentary on groundwater quality at the Dugald River TSF:

- Groundwater quality within the vicinity of the TSF is classified as slightly acidic to slightly alkaline, with pH ranging from 5.1 to 8.2. Groundwater is typically fresh to brackish, with measured electrical conductivity (EC) values ranging from 3 to 1,790 µS/cm.
- A Piper plot categorises water type based on the normalised, relative proportion of each major anion and cation. The Piper plot indicates that the major ion chemistry of the groundwater in the area is varied, ranging from magnesium bicarbonate type to calcium chloride type. This reflects rainfall recharge into the groundwater system with a short residence time (magnesium bicarbonate type) mixing with deeper, older groundwater with an extended resident type (calcium chloride type).
- There is generally little variation in groundwater chemistry over time for each groundwater monitoring bore, with the exception of MB6, which has seen a decrease in sulfate concentration over time.
- Metal and metalloid concentrations in groundwater within the vicinity of the TSF are typically below laboratory detection limits. Elevated levels of arsenic, copper, manganese and zinc are seen in groundwater monitoring bores within the vicinity of the TSF, however, the concentrations do not exceed the livestock drinking water guideline values (ANZECC, 2000).

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17 MONITORING AND INSTRUMENTATION

17.1 Operations Plan

The Operation Plan **[23]** outlines the requirements and methodologies for the operation, inspection, monitoring and reporting for the TSF.

The Plan presents the procedures to be implemented so that the Dugald River TSF is operated in accordance with the design objectives and associated regulatory approvals.

The requirements for monitoring of the TSF is summarised in **Table 17.1**.

TABLE 17.1 – SUMMARY OF TSF MONITORING REQUIREMENTS

Item	Frequency	Responsible Personnel	Purpose	Records / Reports
Plant Tailings Production Records	Daily	Inspections Coordinator	Tailings filling reconciliation and density checks.	Compile monthly & forward to EOR for density assessment. Retain data for use during annual inspection report.
Estimate of Decant Water Level	Daily	Inspections Coordinator	Generation of a comprehensive inflow database and to maintain pond within regulatory operating levels.	Routine Checklist & TARP. Retain data for use during annual inspection report, and potential water balance calibrations.
Return Water Decant Pond Clarity	Daily	Inspections Coordinator	Check that tailings are not flowing through the RWS Pump intake.	Routine Checklist & TARP. Retain data for use during annual inspection report.
Tailings Beach Aerial & Bathymetric Survey	Quarterly	Inspections Coordinator Senior Surveyor	Decant pond volume, tailings beach slope correlation and density checks.	Forward to EOR for assessment. Retain data for use in annual inspection report.
Survey of TSF Embankment Movement Monitoring Points	Daily	Inspections Coordinator Senior Surveyor	Monitor settlement and vector movements of the embankment crest and downstream slope.	Compile monthly & forward to EOR for assessment. Retain data for use during annual inspection report.
Seepage Collection Pond Monitoring	Dailly	Inspections Coordinator	Monitor the rate of seepage from the TSF Embankment and/or foundations.	Compile monthly & forward to EOR for density assessment. Retain data for use during annual inspection report.
Rainfall & Evaporation	Daily	SSHE Department	Development of a database of daily climate data, used to confirm / update design estimations.	Retain data for use during annual inspection report.
Fauna Mortality	Weekly / Monthly	SSHE Department	Monitor mortality rates for further assessment (refer to Items D41 & D42 of the Dugald River EA).	Report to DEHP within 48 hours of discovery of any mortalities.
Tailings Net Acid Producing Potential (NAPP) & metal concentrations	8 tests per 100,000 t of tailings	SSHE Department	Develop a database of acid generating potential of tailings (refer to Item H1 of the Dugald River EA).	Retain data for use during annual inspection report.

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17.2 Operational Performance Objectives

The following summarises the key operational performance objectives of the TSF:

- Discharge of tailings at or above the target solids concentration to encourage sub-aerial deposition;
- Discharge of tailings on a rotational basis such that the tailings beach and low point is maintained in the centre of the valley, where the decant pond is located;
- Collect and store runoff and tailings bleed water in the decant pond for recovery and reuse;
- Maintain the decant pond to a minimum operating depth of 1.0 m and provide adequate storage to contain the wet season flows on the 1st of November;
- Maintain the decant pond below the Maximum Reporting Level;
- Manage impoundment seepage and prevent discharge off-site.

18 CLOSURE AND REHABILITATION

18.1 Closure Objectives

Decommissioning and rehabilitation requirements for the TSF are addressed by Schedule Item D28 of the Dugald River EA **[45]**, which states that the TSF site must be rehabilitated to achieve a stable, safe and non-polluting landform.

The following general objectives relate to the rehabilitation of the Dugald River TSF:

- Return the majority of disturbed land to a condition similar to the pre-existing condition of native habitat;
- Upon rehabilitation, make disturbed areas stable to ensure that the proposed subsequent land use is not compromised by surface instability or erosion;
- Ensure that constructed landforms are geochemically stable to the extent that they do not impact on surface water or groundwater quality. In particular for the TSF, this will mean controlling and minimising the transport mechanism either upwards or downwards for oxidation products within the tailings; and
- Revegetation initiatives to boost the re-establishment of the native ecosystem using direct seeding species mixes.

18.2 Closure Concept

The general approach to closure will incorporate a low water flux cover system that includes a capillary break, sealing layer, waste rock layer and revegetated topsoil. Four cover options have been proposed to be modelled to assess their relative performance regarding net percolation and to determine which option(s) would meet the closure objectives. These options are presented in the Conceptual Closure Design Report **[47]**.

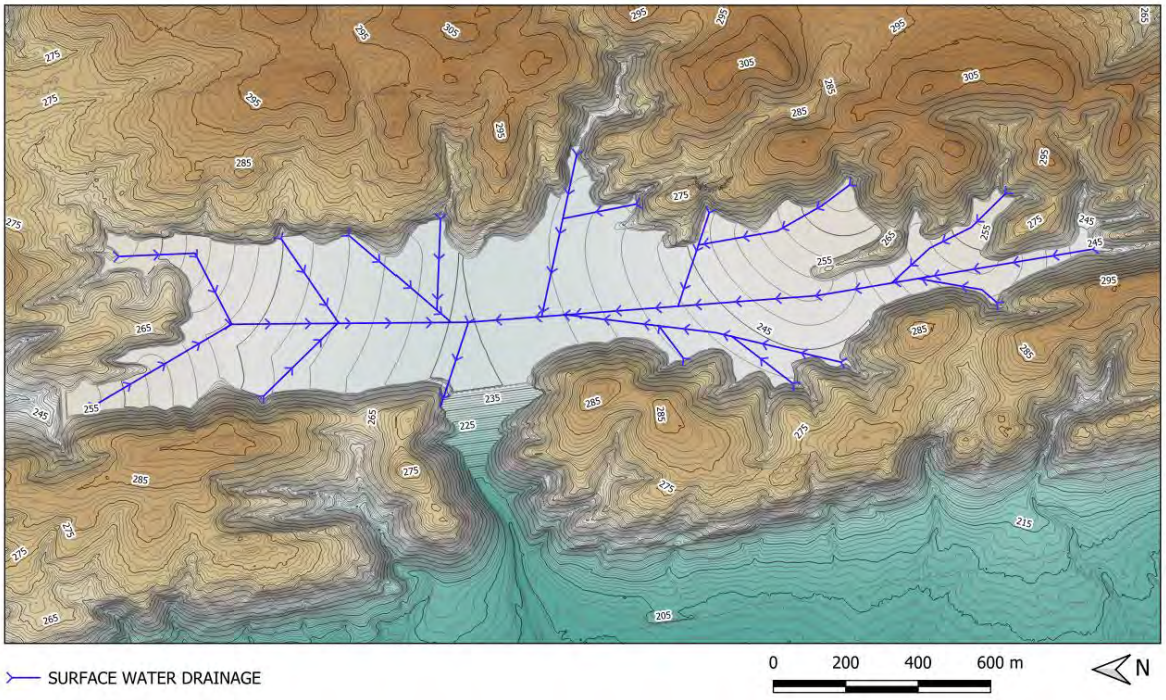
Rehabilitation of the embankment will comprise flattening the batter from 1.5H:1V to 6.5H:1V, undertaken by pushing excess fill material from the crest of the embankment to fill the downstream toe of the embankment. To allow for a self-shedding closure landform whilst also minimising erosion, the final tailings beach slopes are proposed as follows:

- 1.5% for first 500 m (top 1/3 of beach);
- 1% for second 500 m (middle 1/3 of beach); and
- 0.67% for remaining slopes (bottom 1/3 of beach).

The proposed conceptual general arrangement for the final drainage of the rehabilitated TSF is shown in **Diagram 18-1**. The conceptual drainage channels shown are intended to allow for the capture of runoff from upstream external catchment sources, rather than incidental rainfall on the TSF itself. Further detail is provided in the Conceptual Closure Design Report **[47]**.

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DIAGRAM 18-1 – CONCEPTUAL SURFACE WATER DRAINAGE



19 INDEPENDENT REVIEWS

19.1 Independent Technical Review Board

Dr Peter Chapman of WSP has acted as the Senior Independent Technical Reviewer (SITR), effectively providing the Independent Tailings Review Board (ITBR) function, for the DR TSF since mid-2022.

The latest review workshop was held in June 2025. A summary of the recommendations arising from the 2025 review workshop **[48]** is provided in **Table 19.1**.

TABLE 19.1 – SUMMARY OF 2025 RECOMMENDATIONS

Aspect/Gap	Recommendation(s)	Priority and Reference
The rate of seepage through the embankment is steadily increasing. While not an immediate issue, it may require consideration of intervention measures	Review the seepage data in the context of pond elevation and consider if mitigation/capture measures are required as part of the planned wall raise.	P3 2025-M-01
Desktop emergency drills have taken place but without input from the EoR. The drills revealed some gaps that need to be addressed.	The EoR and RTFE should be involved in future desktop emergency drills and should review the current emergency preparedness and response plan. MMG should also consider running a field-based emergency evacuation drill and note any gaps in current procedures.	P3 2025-M-02
Access to the beach raises the opportunity to gather performance data for the TSF, particularly strength and consolidation data. This will be useful for future expansions and closure planning.	Consider undertaking sample collection and testing of the tailings to update the knowledge base for operations and closure planning.	P4 2025-I-01

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Aspect/Gap	Recommendation(s)	Priority and Reference
The survey monuments indicate ongoing movement, 8 years after construction. The movement also appears to have increased in rate in recent years. While the movement is well within typical values for rockfill dams, the ongoing movement appears to be atypical.	Consider the rate of movement against predicted values and continue to monitor the embankment.	P4 2025-I-02

19.2 Dam Safety Review

An independent Dam Safety Review (DSR) was carried out in August 2025 by Brett Stephens of Archadia Consulting **[49]**. A summary of the recommendations arising from the DSR is provided in **Table 19.2**.

The next DSR is to be scheduled for commencement in 2030.

TABLE 19.2 – SUMMARY OF DSR RECOMMENDATIONS

Item	MMG Priority Ranking	Recommendation	Recommended Timeframe
D1-Medium	P2	A FMEA completed for the TSF for Stage 3 should be adapted for the current TSF configuration. The results of this work should be used to review the engineering design and TARPs for the TSF as appropriate.	<6 months
D2-Medium	P4	A Design Basis Report should be developed for the TSF	< 12 months
G1-Medium	P4	Ensure all governance documents have a unique identifier and version number to support Change Management	6 – 12 months
DS1-Medium	P3	The large rocks which have fallen in the spillway should be removed	6 – 12 months
E1-Medium	P4	Future tailings deposition points should be piped down to the life of facility tailings levels at each location to limit regret remediation costs. Dumping of vacuum trucks should be at points where future rehabilitation works are not needed. Noting that the current deposition above the final TSF level will need remedial works.	As part of Stage 3 raise.
G2-Medium	P3	Regular checks on the MRL and Pond Marker levels should occur and be documented.	< 6 months
D3-Medium	P3	Update the consequence categories in the Operational Plan to include ANCOLD and GISTM criteria to align with corporate standards.	6 – 12 months
D4-Medium	P3	Confirm that the levy around Little Eva Pit will be constructed as assumed in the TSF dam break.	1 – 3 years (subject to 3rd party)
G3-Medium	P3	Management of change needs to be documented to capture the processes followed to facilitate and trigger changes to the TSF. These changes may be captured as part of updates to the Design Basis Report or other document as a preferred by MMG .	6 – 12 months
D1-Medium	P3	Include the effects of climate change in future engineering for the TSF.	6 – 12 months
G3-Medium	P4	A single factual data report should be developed for the TSF.	6 – 12 months
D5-Medium	P3	The effects of piping and internal erosion should be included in the FMEA for the TSF if not already done so.	<6 months

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20 CLOSING

Your attention is drawn to the “Conditions of Report” which appear at the end of this report.

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REFERENCES

[1] ICMM (2020), “Global Industry Standard on Tailings Management”, International Council on Mining & Metals, August 2020.

[2] ATC Williams (2008), “Dugald River Feasibility Study Site Options Assessment,” 108003.1 R01, March 2008.

[3] Australian Tailings Consultants (2009), “Dugald River Feasibility Study Preliminary Geotechnical Investigation,” Ref: 108003.1-R06, February 2009.

[4] ATC Williams (2011), “Dugald River Project Feasibility Study Tailings Storage Facility Final Report - Site A1,” Ref: 108003.4 R10, August 2011.

[5] ATC WIlliams (2013), “Tailings Storage Facility & Process Water Dam Design Report,” Ref: 108003.7 R16, September 2013.

[6] ATC Williams (2016), “MMG Dugald River Tailings Storage Facility Design Report,” Ref: 108003.18 R03 (Rev1), May 2016.

[7] ATC Williams (2024), “TSF Embankment Raise Options Assessment,” Ref: 108003.62-L02, March 2024.

[8] ATC Williams (2024), “Tailings Storage Facility - Stage 3 Concept Design Report,” Ref: 108003.67-R01, September 2024.

[9] ATC Williams (2025), “Dugald River Mine – Tailings Storage Facility – Stage 3 Detailed Design Report”, Ref: 250542-R04 (December 2025).

[10] Rob Lait and Associates (2011), “Dugald River Project – Tailings Storage Dam Groundwater Aspects and Conceptual Groundwater Model,” Ref: Project No. 116, June 2011.

[11] The Long Paddock (2021), “SILO Data Drill for Cell -20.25, 140.15,” Queensland Government, [Online]. Available: https://www.longpaddock.qld.gov.au/silo/gridded-data/. [Accessed 2022].

[12] Australian Government Bureau of Meteorology BoM Climate Website (2013), [Online]. Available: http://www.bom.gov.au/climate/data/index.shtml. [Accessed 2025].

[13] Australian Government Bureau of Meteorology Design Rainfall Data System (2016), [Online]. Available: http://www.bom.gov.au/water/designRainfalls/revised-ifd/. [Accessed 2025].

[14] Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), Version 4.2, 2019.

[15] Bureau of Meteorology. (2003). The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method. Melbourne, Australia: Bureau of Meteorology.

[16] Walland, D. J., Meighen, J., Xuereb, K. C., Beesley, C. A., & Hoang, T. M. (2003). Revision of the Generalised Tropical Storm Method for Estimating Probable Maximum Precipitation. Melbourne, Australia: HRS Report No. 8, Hydrology Report Series, Bureau of Meteorology.

[17] ATC Williams (2022), “Tailings Storage Facility – Consequence Category and Design Storage Allowance Review,” Ref: 108003.60.R01 (Rev0), December 2022.

[18] Siriwardena, L. and Weinmann, P.E. (1998), A technique to interpolate frequency curves between frequent events and probable maximum events. CRCCH Research Report 98/9, Cooperative Research Centre for Catchment Hydrology, December 1998.

[19] ATC Williams (2025), “Dugald River Mine – Design Rainfall & Climate Change Data Generation”, Ref: 240473 R01 (RevA) (to be published).

[20] Seismology Research Centre, “Dugald River Embankment Dam - Seismic Hazed Assessment and Time History Analysis,” April 2008.

[21] ATC Williams (2024), “MMG Dugald River, Probabilistic Seismic Hazard Analysis,” Ref: 108003.66-R01 (RevA), June 2024

[22] ATC Williams (2017), “Civil Works Construction Report,” Ref: 108003.25 R01 RevA, July 2019.

[23] ATC Williams (2024), “Tailings Storage Facility Operation Plan”, Ref: 108003.65 PL01, August 2024

[24] Queensland Government Department of Environment, Tourism, Science and Innovation (DETSI), “Manual for Assessing Consequence Categories and Hydraulic Performance of Dams,” ESR/2016/1933 Version 5.03, February 2024.

[25] ANCOLD (2019), “Guideline on Tailings Dams – Planning, Design, Construction, Operation and Closure,” July 2019.

[26] ANCOLD (2019), “Guidelines for Design of Dams and Appurtenant Structures for Earthquake,” 2019.

[27] ANCOLD (2012), “Guidelines on Consequence Categories for Dams”, Australian National Committee on Large Dams, October 2012.

[28] ATC Williams (2025), “MMG Dugald River – Tailings Storage Facility – Stage 3 Quantitative Risk Assessment (QRA) Report”, Ref 250542-R02 (RevA), August 2025.

[29] ATC Williams (2015), “Tailings Storage Facility Dam Break Study”, Ref: 108003.18 R01, December 2015

[30] ATC Williams (2026), “Dugald River Mine – Tailings Storage Facility – Stage 3 Dam Break and Consequence Category Assessment”, Ref: 250542-R03 Rev0, Jan 2026.

[31] Lu, Z., Tan, Y., & Pirouz, B. (2022) Non-Newtonian Tailings Dam Break Analysis and Released Volume Estimation Using Site-Specific Parameters. Tailings 2022.

[32] ANCOLD (2022), “Guidelines on Risk Assessment”, July 2022.

[33] USBR (2015) RCEM – Reclamation Consequence Estimating Methodology: Guidelines for Estimating Life Loss for Dam Safety Risk Analysis. Interim, July 2015. United States Bureau of Reclamation, Denver, Colorado.

[34] ATC Williams (2008), “Feasibility Study Laboratory Testing of Tailings,” Ref: 108003.01 R05, 2008.

[35] ATC Williams (2015), “TSF Laboratory Testing Report,” Ref: 108003.21 R01, October 2015.

[36] ATC Williams (2025), “TSF Laboratory Testing Report”, Ref: L250542-R01-RevA, May 2025.

[37] ATC Williams (2024), “Dugald River Mine Tailings Storage Facility Intermediate Dam Inspection Report 2024,” Ref: 108003.65 (Rev0), December 2024.

[38] Boulanger, R.W. and Idriss, I.M. (2006), “Liquefaction Susceptibility for Silts and Clays,” in Journal of Geotechnical and Environmental Engineering, ASCE, 2006, pp. 1413-1426, Volume 132, No.11.

[39] ATC Williams (2025), “Dugald River – TSF Stage 3 Detailed Design – Water Balance Memorandum”, Ref: 250542-M02 RevA, June 2025.

[40] Queensland Department of Environment and Science (DES), “MMG Australia Limited - Dugald River - Environmental Authority,” EPML00731213, version 2.06, April 2023.

[41] ATC Williams (2025), “2024 Annual Water Account,” Ref: 240475 R01 Rev0, 2025.

[42] ATC Williams (2009), “Preliminary Geotechnical Investigation,” Ref: 108003R06, 2009.

[43] ATC Williams (2013), “Process Water Dam & Tailings Storage Facility - Geotechnical Investigation Factual Report,” Ref: 108003.11-R02, 2013.

[44] ATC Williams (2024), “Updated Geochemical Review of Tailings,” Ref: 108003.68 L01 Rev0, 2024.

[45] Queensland Department of the Environment, Tourism, Science and Innovation (DETSI), “MMG Australia Limited - Dugald River - Environmental Authority,” EPML00731213, version 3.02, April 2025.

[46] CDM Smith (2025), “Groundwater Impact Assessment for the Dugald River Mine TSF”, Rev 1, April 2025.

[47] ATC Williams (2025), “Tailings Storage Facility Conceptual Closure Design Report,” Ref: 240189 R01 Rev0, 2025.

[48] MMG (2025), “2025 Senior Independent Technical Reviewer Summary Report – RevA DRAFT”, June 2025.

[49] Archadia Consulting Pty Ltd (2025), “Dugald River Mine Tailings Storage Facility – Dam Safety Review”, Ref: 20251219R_Dugald_TSF_DSR_Rev1”, 2025.

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APPENDICES

APPENDIX A – DOCUMENT REGISTER

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DELIVERABLES REGISTER

ATCW deliverables provided to MMG Dugald River to July 2025.

Job#	Area	Date	ATC Doc. No.	MMG Doc. No.	Type	Revision #	Status	Deliverable Title
250542	TSF	24/06/2025	250542-R03	N/A	Report	A	Draft	Dugald River Mine - Tailings Storage Facility - Stage 3 Dam Break and Consequence Category Assessment
250542	TSF	10/06/2025	250542-M02	N/A	Memorandum	A	-	Dugald River - TSF Stage 3 Detailed Design
250542	TSF	12/05/2025	250542-L01	N/A	Letter	A	-	Dugald River TSF Stage 3 Raise - Seepage Collection System Investigation
240189	TSF	12/05/2025	240189.M03	N/A	Memorandum	2		TSF Cover Soils Geotechnical Investigation - FINAL
240189	TSF	17/04/2025	240189-R01-rev1	N/A	Report	1	Final Issue	Conceptual Closure Design Report
240288	General	1/04/2025	2420288-M02 Task 4 and 5	N/A	Memorandum	0	-	PCRP supporting studies - Concept stormwater closure plan and site-wide closure landform
108003.67	TSF	31/03/2025	108003.67-R01	N/A	Report	1	Final Issue	Tailings Storage Facility - Stage 3 Concept Design Report
240189	TSF	19/03/2025	240189.M04	N/A	Memorandum	1	-	Lanform Conceptual Design - Erosion Modelling
240189	TSF	19/03/2025	240189.M05	N/A	Memorandum	1	-	Landform Conceptual Design - Conceptual Cover System Options
240189	TSF	19/03/2025	240189.M06	N/A	Memorandum	1	-	Landform Conceptual Design - Conceptual Cover System Modelling Results
240475	General	21/02/2025	240475.R01	N/A	Report	0	Final Issue	2024 Annual Water Account
240189	TSF	20/02/2025	240189.M02	N/A	Memorandum	-	-	Preliminary TSF Closure Landform Design (Surface)
240288	TSF	7/02/2025	240288.R01	N/A	Report	A	Draft	Progressive Closure and Closure Planning - TSF and Process Area Hydraulic Impact Assessment
240288	General	21/01/2025	2420288-M01 Task 2	N/A	Memorandum	-	-	Additional PRCP Studies - Closure dewatering strategy
108003.65	TSF	20/12/2024	108003.65-R02	N/A	Report	0	Final Issue	Intermediate Dam Inspection Report 2024
108003.68	TSF	3/12/2024	108003.68-L01	N/A	Letter	0	-	Updated Geochemical Review of Tailings
240146	General	21/11/2024	240146.M01	N/A	Memorandum	-	-	Wet Season Forecast Model Instructions for use
240146	General	13/11/2024	240146.R01	N/A	Report	0	Final Issue	2024 Mid-Year Water Account
108003.65	General	29/10/2024	108003.65-R01	N/A	Report	A	Draft	Dugald River Regulated Structures - Annual Inspection Report 2024
108003.65	TSF	20/09/2024	108003.65-L01	N/A	Letter	A	-	TSF Regulated Structures Wet Season Performance to 1st July
108003.65	TSF	30/08/2024	108003.65-PL01	0016-PLN-2160-PM-0001	Plan	2 (Draft)	Fully revised to address changed responsibilities, operational & regulatory requirements	TSF Operation Plan
108003.67	TSF	19/07/2024	108003.67-L01	N/A	Letter	A	-	TSF Stage 3 Raise - Zone 2 Borrow Investigation
108003.66	General	12/06/2024	108003.66-R01	N/A	Report	A	-	Probabilistic Seismic Hazard Analysis Report
108003.53	General	24/04/2024	108003.53-R05	N/A	Report	0	Final Issue	Dugald River Mine 2023 End of Year Water Account
108003.62	TSF	14/03/2024	108003.62-L02	N/A	Letter	1	-	TSF Embankment Raise Options Assessment
108003.62	TSF	13/03/2024	108003.62-R02	N/A	Report	0	Final Issue	Intermediate Dam Inspection Report 2023
108003.65	TSF	4/03/2024	108003.65-M01	N/A	Memorandum	0	-	Water Balance Model - TSF Decant Volume Estimation
108003.62	General	10/01/2024	108003.62-R01	N/A	Report	0	Final Issue	Dugald River Regulated Structures - Annual Inspection Report 2023
108003.62	TSF	6/09/2023	108003.62-L01	N/A	Letter	0	-	TSF Regulated Structures Wet Season Performance to 1st July
108003.31	TSF	13/02/2023	108003.31-L01	N/A	Letter	1	-	Tailings Pipeline HDPE Section Containment Ponds
108003.58	TSF	9/02/2023	108003.58-R02	N/A	Report	0	Final Issue	Intermediate Dam Inspection Report 2022
108003.53	General	2/02/2023	108003.53-R04	N/A	Report	0	Final Issue	Dugald River Mine 2022 End of Year Water Account
108003.60	TSF	13/12/2022	108003.60-R01	N/A	Report	0	Final Issue	Tailings Storage Facility - Consequence Category and Design Storage Allowance Review
108003.58	General	14/11/2022	108003.58-R01	N/A	Report	0	Final	Dugald River Regulated Structures - Annual Inspection Report 2022
108003.53	General	24/08/2022	108003.53-R03	N/A	Report	0	Final Issue	Dugald River Mine 2022 Mid-Year Water Account
108003.61	TSF	22/08/2022	108003.61-L01	N/A	Letter	A	-	Project Everest Update
108003.58	TSF	19/08/2022	108003.58-M01	N/A	Memorandum	A	-	Update time to fill estimate for Knapdale Valley TSF
108003.59	TSF	22/07/2022	108003.59-L01	N/A	Letter	A	-	TSF Maximum Life of Asset Concept Design
108003.58	TSF	8/07/2022	108003.58-L01	N/A	Letter	1	-	TSF Regulated Structures Wet Season Performance to 1st July
108003.31	TSF	29/06/2022	108003.31-R01	N/A	Report	0	Revised Issue, Final	Review of Steel Pipeline Corridor Spill Containment System
108003.52	TSF	7/04/2022	108003.52-R02	N/A	Report	0	Final Issue	Intermediate Dam Inspection Report 2021
108003.53	General	14/02/2022	108003.53-R02	N/A	Report	1	Revised Final Issue	Dugald River Mine 2021 End of Year Water Account
108003.52	General	17/12/2021	108003.52-R01	N/A	Report	0	Final	Dugald River Regulated Structures - Annual Inspection Report 2021
108003.55	TSF	13/09/2021	108003.55-R01	N/A	Report	B	Draft Issue	Tailings and Groundwater Review
108003.55	General	12/09/2021	108003.55-M02	N/A	Memorandum	A	-	Desktop Review of the Eva Copper Project (Eva) - Water Supply Shortfall Analysis
108003.51	General	6/09/2021	108003.51-R01	N/A	Report	1	Revised Issue, Final	Stormwater Management Options Assessment
108003.55	General	5/09/2021	108003.55-M01	N/A	Memorandum	A	-	Desktop Review of the Eva Copper Project (Eva) - Independent Review Eva Copper Project Borefield Assessment
108003.53	General	13/08/2021	108003.53-R01	N/A	Report	1	Revised Final Issue	Dugald River Mine 2021 Mid-Year Water Account
108003.54	TSF	29/07/2021	108003.54-PL02	N/A	Plan	1	Issued for MMG Review	Stage 2 PAF Pad Runoff Dam Emergency Action Plan
108003.52	TSF	28/07/2021	108003.52-L01	N/A	Letter	-	-	TSF Regulated Structures Wet Season Performance to 1st July
108003.54	TSF	27/07/2021	108003.54-PL01	N/A	Plan	1	Issued for MMG Review	TSF Emergency Action Plan
108003.56	TSF	21/07/2021	108003.56-P001	N/A	Contractual	-	-	TSF Dam Review Committee - 2021 Attendance and Participation Scope and Budget Proposal
108003.49	TSF	31/05/2021	108003.49-R01	N/A	Report	1	Final Issue, Updated	TSF and Process Area Hydraulic Impact Assessment
108003.48	TSF	13/04/2021	108003.48-R01	N/A	Report	0	Final Issue	Life of Asset Concept Study
108003.48	TSF	15/03/2021	108003.48-P01	N/A	Presentation	0	-	Life of Asset Concept Study
108003.46	General	1/03/2021	108003.46-R02	N/A	Report	1	Revised Issue, Final	2020 Annual Water Account
108003.44	TSF	24/02/2021	108003.44-R02	N/A	Report	A	Issued for MMG Review	Intermediate Dam Inspection Report 2020
108003.44	General	21/12/2020	108003.44-R01	N/A	Report	0	Final Issue	Regulated Structures Annual Inspection Report 2020
108003.46	General	1/12/2020	108003.46-M02	N/A	Memorandum	-	-	Flow meter review
108003.46	General	21/10/2020	108003.46-M01	N/A	Memorandum	-	-	2020 Mid-Year Water Account
108003.42	TSF	7/10/2020	108003.42-L01	N/A	Letter	-	-	Geochemical Review of Tailings
108003.37	TSF	27/02/2020	108003.37-R02	N/A	Report	A	Issued for MMG Review	Comprehensive Dam Inspection Report (2019)
108003.37	General	31/10/2019	108003.37-R01	N/A	Report	0	Final Issue	Regulated Structures Annual Inspection Report 2019
108003.36	TSF	26/12/2018	108003.36-R01	N/A	Report	A	Draft	Intermediate Dam Inspection Report No. 1 (2018)
108003.38	TSF	11/01/2018	108003.38-SP01	N/A	Specification	A	Issued for MMG Review	Secondary Seepage Collection System Civil Works Technical Specification
108003.25	TSF	28/07/2017	108003.25R01	N/A	Report	0	Final Issue	Tailings Storage Facility - Stage 1 & 2 Civil Works Construction Report
108003.18	TSF	20/10/2016	108003.18-SP01 Annex A	0016-SPE-2160-C-0001 Annex A	Specification	4	Sections 2, 3, 5, 6, 7, 9 & 12	Tailings Storage Facility - Civil Works Technical Specification, Annexure A - Grouting of PWD Embankment Upstream Plinth
108003.18	TSF	13/09/2016	108003.18-SP01	0016-SPE-2160-C-0001	Specification	2	Modified for Stage 2 works inclusion	Tailings Storage Facility - Civil Works Technical Specification
108003.25	TSF	13/08/2016	108003.25-PL01	N/A	Plan	1	Final Issue	Tailings Storage Facility - Civil Works Construction Quality Assurance Plan
108003.18	TSF	24/05/2016	108003.18-R03	N/A	Report	1	Final Issue	TSF Design Report
108003.18	TSF	11/03/2016	108003.18-SP02	0016-SPE-2160-M-0001	Specification	0	Issue for Construction	Tailings Storage Facility - Return Water System Technical Specification & Data Sheets
108003.18	TSF	9/03/2016	108003.18-R02	N/A	Report	1	Revised due to modified return water pumping rate	Rainfall Analysis and Water Balance Report
108003.18	TSF	22/12/2015	108003.18-R01	N/A	Report	0	Final Issue	TSF Dam Break Study
108003.21	TSF	8/10/2015	108003.21-R01	N/A	Report	0	Final Issue	Laboratory Testing Report

108003.18	TSF	25/09/2015	108003.18-L991		Letter			Basis of Design X:\2008\108003 Dugald River\18 Revised TSF Design\Correspondence\Out\108003.18-L001.pdf
108003.20	TSF	29/07/2015	108003.20-R01	N/A	Report	0	Final Issue	TSF Revised Concept Design
108003.16	TSF	11/12/2014	108003.16-R01	N/A	Report	0	Final Issue	Review of TSF Site and Design Options
108003.7	General	6/09/2013	108003.7-R16	N/A	Report	0	Final Issue	TSF & PWD Design Report
108003.11	General	29/05/2013	108003.11-R02	N/A	Report	0	Final Issue	Geotechnical Investigation Factual Report
108003.11	General	25/09/2012	108003.11-R01	N/A	Report	B	Final Issue	TSF & PWD Geotechnical Investigation
108003.4	TSF	28/08/2011	108003.4-R10	N/A	Report	2	Final Issue	Feasibility Study Site A1
108003.4	TSF	26/08/2011	108003.4-R11	N/A	Report	1	Final Issue	Feasibility Study Site A1 (EIS Version)
108003.3	TSF	7/04/2011	108003.3-R09	N/A	Report	0	Issued for MMG Review	Feasibility Study Site H - 2011
108003.2	TSF	20/10/2010	108003.2-R08	N/A	Report	0	Final Issue	Feasibility Study 2010 Revision
108003.2	TSF	27/08/2010	108003.2-R07	N/A	Report	0	Final Issue	Feasibility Study 2010 EIS Revision
108003.1	TSF	20/02/2009	108003.1-R06	N/A	Report	-	-	Feasibility Study Preliminary Geotechnical Investigation
108003.1	TSF	14/11/2008	108003.1-R04	N/A	Report	1	-	Feasibility Study Final Report
108003.1	TSF	2/09/2008	108003.1-R05	N/A	Report	-	-	Feasibility Study Laboratory Testing of Tailings
108003.1	TSF	25/08/2008	108003.1-R03	N/A	Report	-	-	Feasibility Study Site H2 Geotechnical Investigation
108003.1	TSF	29/03/2008	108003.1-R02	N/A	Report	-	-	Feasibility Study Conceptual Design Report
108003.1	TSF	28/03/2008	108003.1-R01	N/A	Report	-	-	Feasibility Study Site Options Assessment



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APPENDIX R: PAF Dam 2 (Stage 4 PAF Pad Expansion) Consequence Category Assessment (ATCW, 2026b)

REPORT

MMG DUGALD RIVER
ABN: 19 083 405 556

Dugald River Mine

PAF Dam 2 (Stage 4 PAF Pad Expansion)
Consequence Category Assessment

250893.01.R01_Rev 0
December 2025



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Document Control

Project Name:	Dugald River Mine
Document Title:	PAF Dam 2 (Stage 4 PAF Pad Expansion) - Consequence Category Assessment
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Document Number:	250893.01.R01-Rev 0

Revision History

Revision	Issue	Issue Date	Prepared by	Reviewed by
A	Client Review	19/11/25	MAB	CN
0	Final Issue	19/12/25	MAB	CN

Issue Register

Distribution List	Date
MMG Dugald River (Jack Hollingsworth/ Dirk McNicoll)	19/12/2025

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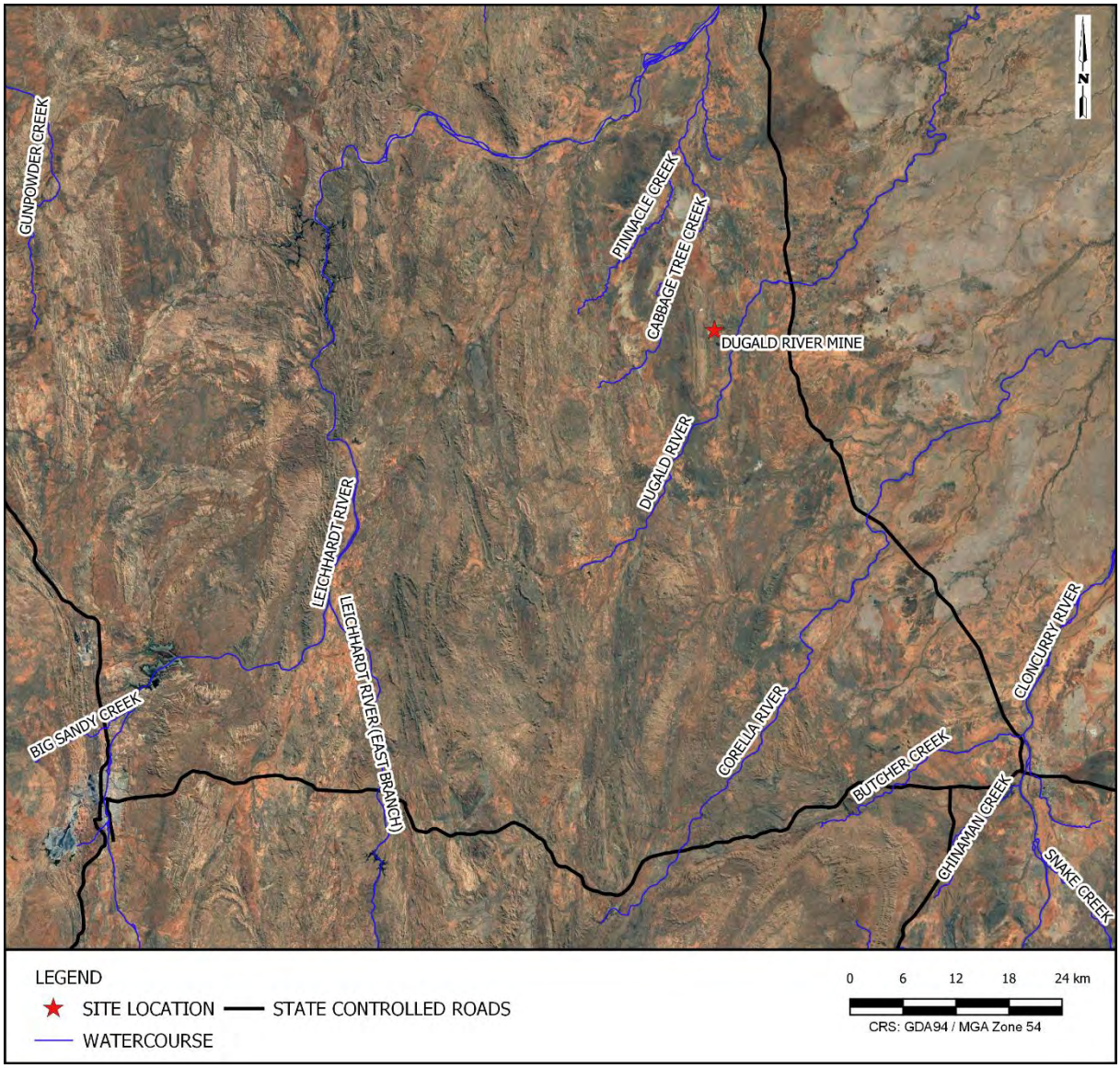
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1 INTRODUCTION

1.1 Location

MMG Australia Pty Ltd (MMG) owns and operates the Dugald River Mine (DRM) in northwest Queensland. The DRM is located approximately 65 km northwest of Cloncurry and is accessed from the Burke Developmental Road. The location of DRM is shown on **DIAGRAM 1**.

DIAGRAM 1: SITE LOCATION



1.2 Setting and PAF Dam 2 Background

Waste rock from the underground workings is stockpiled on dedicated pads, separated into non-acid forming (NAF) and potentially acid-forming (PAF) areas. Runoff from the PAF Pad is directed to, and contained within, the HDPE-lined PAF Dam 2. PAF Dam 1 is scheduled for removal as part of the planned Stage 4 PAF Pad expansion and has previously been declassified as a regulated structure **[1]**.

The Stage 4 expansion will substantially increase the catchment draining to PAF Dam 2, prompting a reassessment of its Consequence Category. PAF Dam 2 (also known as Stage 2 PAF Pad Runoff

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Dam) continues to be treated as a regulated structure in accordance with Dugald River Mine Environmental Authority (EA) EPML00731213 (updated 28 April 2025 **[1]**.

Following planned PAF Pad Expansion and removal of PAF Runoff Dam 1, the mine water storage infrastructure at the Dugald River Mine processing area comprises the following:

- PAF Dam 2 (also known as Stage 2 PAF Pad Runoff Dam)
- Sediment Dam G (SDG)
- ROM Area Runoff Dam (RARD)
- Raw Water Dam (RWD)
- Processing Plant Containment Dam (PPCD)
- Processing Plant Runoff Dam (PPRD)
- Sediment Dams A, C, D and F (SDA, SDC, SDD, SDF)
- Mine Workshop Runoff Dam (MWRD)
- STP Dam 1 and 2 (STPD1 & 2)
- Underground Mine Water Collection Dam (UGMWCD)

The processing area layout including the above infrastructure and mining leases are shown on **DIAGRAM 2**. The PAF Dam 2 is located on ML2499, ML2469 and ML2470.

DIAGRAM 2: SITE LAYOUT



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1.3 Scope of Work

The Dugald River Mine process area water dams are regulated under Conditions D1 to D3 of the EA **[1]**, reproduced as follows:

D1 'The consequence category of any structure must be assessed by a suitably qualified and experienced person in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/1993)* at the following times:

(a) prior to the design and construction of the structure, if it is not an existing structure; or

(b) prior to any change in its purpose or the nature of its stored contents.

D2 A consequence assessment report and certification must be prepared for each structure assessed and the report may include a consequence assessment for more than one structure.

D3 Certification must be provided by the suitably qualified and experienced person who undertook the assessment, in the form set out in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (ESR/2016/1933).

The most recent Consequence Category Assessment (CCA) was undertaken by ATC Williams (ATCW) in July 2023 **[3]**. This CCA **[3]** assessed the PAF Dam 2 (Stage 2) as '**Significant**' consequence on the basis of the 'Failure to Contain – Dam Break' scenario. This was a result of the water quality of the PAF runoff and seepage collecting in the PAF Dam 2 being assessed as hazardous.

The purpose of this CCA is to re-assess the consequence category of the PAF Dam 2 following the planned Stage 4 PAF Pad expansion resulting in increased PAF Dam 2 catchment area, and to determine whether there will be any change to the consequence category or applicable hydraulic performance criteria in accordance with the Manual **[4]**.

1.4 Available Site Data

This CCA was undertaken using the guidelines in the Manual **[4]**. The following data were available and considered in completing the CCA:

- 'PAF Pad Expansion – Stage 4 Design Report', Ref: 240261.04.R01, dated November 2015 ATC Williams **[1].**
- Queensland Globe Map Resourced, retrieved 15 May 2023 **[5].**
- SILO Data Drill for Cell -20.23 (latitude), 140.15 (longitude) of evaporation data and patched rainfall for the period of 01/01/1889 to 13/05/2023 **[6]**.
- 'EPBC Act Protected Matters Report', 12 November 2025, Department of Agriculture. Water and the Environment and Energy **[7]**.
- 'Environmental Reports – Matters of State Environmental Significance', 12 November 2025, Department of Environment and Science **[8]**.
- 'Environmental Reports – Biodiversity and Conservation Values – Biodiversity Planning Assessments and Aquatic Conservation Assessments', 12 November 2025, Department of Environment and Science **[9]**.
- 'Environmental Reports – Regional Ecosystems – Biodiversity Status', 12 November 2025, Department of Environment and Science **[10]**.
- 'WetlandMaps', 12 November 2025, Department of Environment and Science **[11]**.
- 'Bore Reports', Business Queensland, accessed 12 November 2025, **[12].**
- Dugald River Mine Water Quality Sampling, 'Chemistry Table', 13 March 2023 **[13]**.

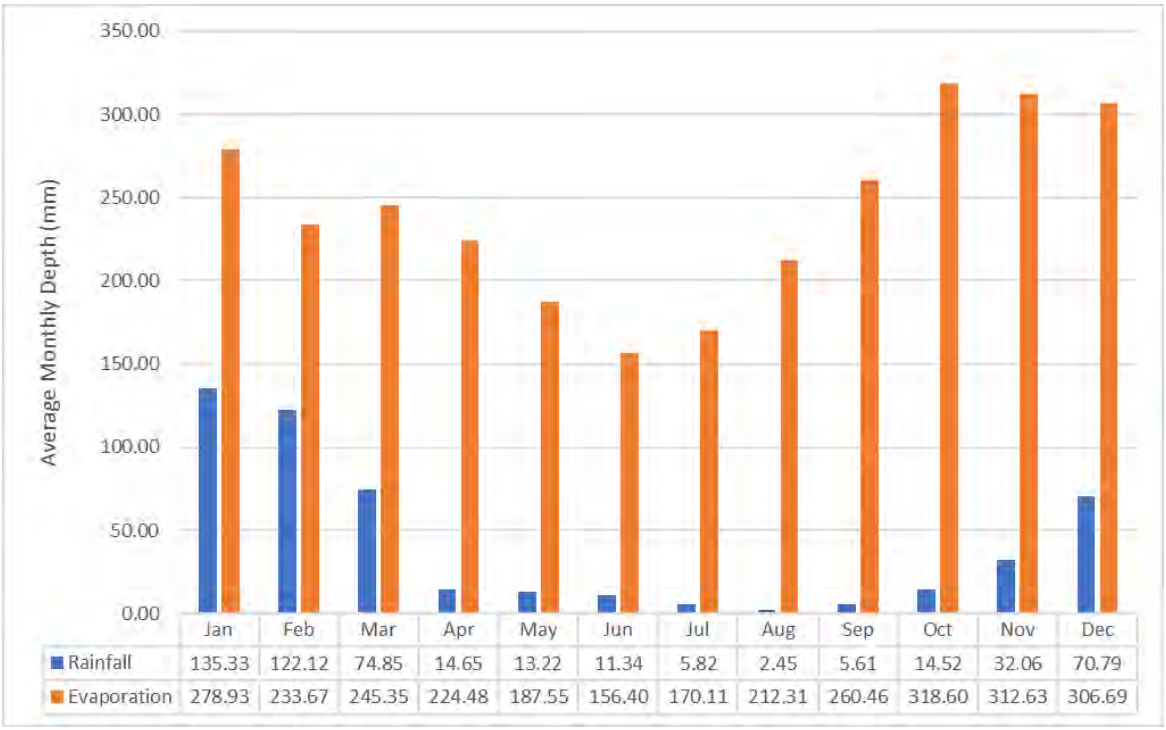
1.5 Climatic Conditions

The Köppen Climate classification of the region is a hot semi-arid climate (BSh) **[14].** Highly variable rainfall occurs in the summer/ wet season, which is typically hot and humid. The data obtained from the

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SILO Data Drill (The Long Paddock, 2023) **[6]** indicates that the mean annual rainfall for the region is 508 mm. The highest monthly rainfall occurs mostly in December through to March, as illustrated in **DIAGRAM 3.** The lowest monthly rainfall occurs in the dry winter months of April to October. **DIAGRAM 3** indicates that monthly evaporation rates exceed rainfall year-round at the Dugald River Mine site.

DIAGRAM 3: AVERAGE ANNUAL RAINFALL AND EVAPORATION FOR DUGALD RIVER MINE



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	135.33	122.12	74.85	14.65	13.22	11.34	5.82	2.45	5.61	14.52	32.06	70.79
Evaporation	278.93	233.67	245.35	224.48	187.55	156.40	170.11	212.31	260.46	318.60	312.63	306.69

1.6 Subsurface Conditions

Investigation of available surface geology data from 'Queensland Globe' determined that the Dugald River mine site is located in an area of 'The Mount Albert Group' (PLa) formation. The formation is composed of sandstone, mudstone, and conglomerate, and it was deposited during the Late Triassic and Early Jurassic periods. The sandstone formations are relatively porous and weak, while the shale formations are relatively impermeable and strong. The limestone formations are considered porous and strong.

1.7 Surface Water Quality and Sampling

Water quality sampling data was provided by MMG for the PAF Dam 2 for the period February 2014 to January 2022. The water quality results are summarised in **Table 1**. Where sampled analytes exceed the EA release limits, these values are highlighted in red.

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TABLE 1: PAF DAM 2 WATER QUALITY SAMPLING

Quality Parameter (Total)	Release Limit	Sampling Date										
		06/02/14	15/08/14	31/08/14	09/11/14	17/01/15	02/01/16	10/04/16	18/07/16	29/03/18	15/04/18	30/01/22
pH (pH units)	**5.5 – 9.0**	10.24	8.27	9.98	8.02	8.18	6.24	6.65	7.31	7.33	7.69	7.09
EC (µS/cm)	**1000**	507	2,625	2,656	8,595	723	4,280	6,256	6,993	6,705	7,200	14,512
Sulphate (mg/L)	**1000**	12	-	910	3,660	347	1,780	3,140	3,690	2,260	2,770	-
Dissolved Metals												
Aluminium (mg/L)	**5**	1.97	0.15	0.2	0.47	0.12	0.45	<0.01	0.05	0.1	0.04	-
Arsenic (mg/L)	**0.5**	0.004	0.003	0.003	0.006	<0.01	0.001	<0.001	0.001	0.001	<0.001	-
Cadmium (mg/L)	**0.01**	<0.0001	<0.0001	0.0007	0.0002	<0.005	0.162	0.175	0.191	0.0231	0.0212	-
Copper (mg/L)	**1**	0.006	0.006	0.006	0.002	<0.01	<0.001	<0.001	<0.001	0.002	0.001	-
Lead (mg/L)	**0.1**	0.014	0.003	0.002	0.004	<0.01	0.041	0.007	-	0.029	0.01	-
Manganese (mg/L)	**Containment limit based on upstream quality plus 10%**	0.145	0.02	0.014	-	0.27	6.98	0.632	0.833	1.99	1.28	-
Nickel (mg/L)	**1**	0.003	0.002	<0.001	0.008	<0.01	0.068	0.06	0.074	0.013	0.011	-
Zinc (mg/L)	**20**	0.029	0.01	0.011	0.008	1.23	97.1	65.2	79.3	14.3	10.6	-

* As provided by MMG

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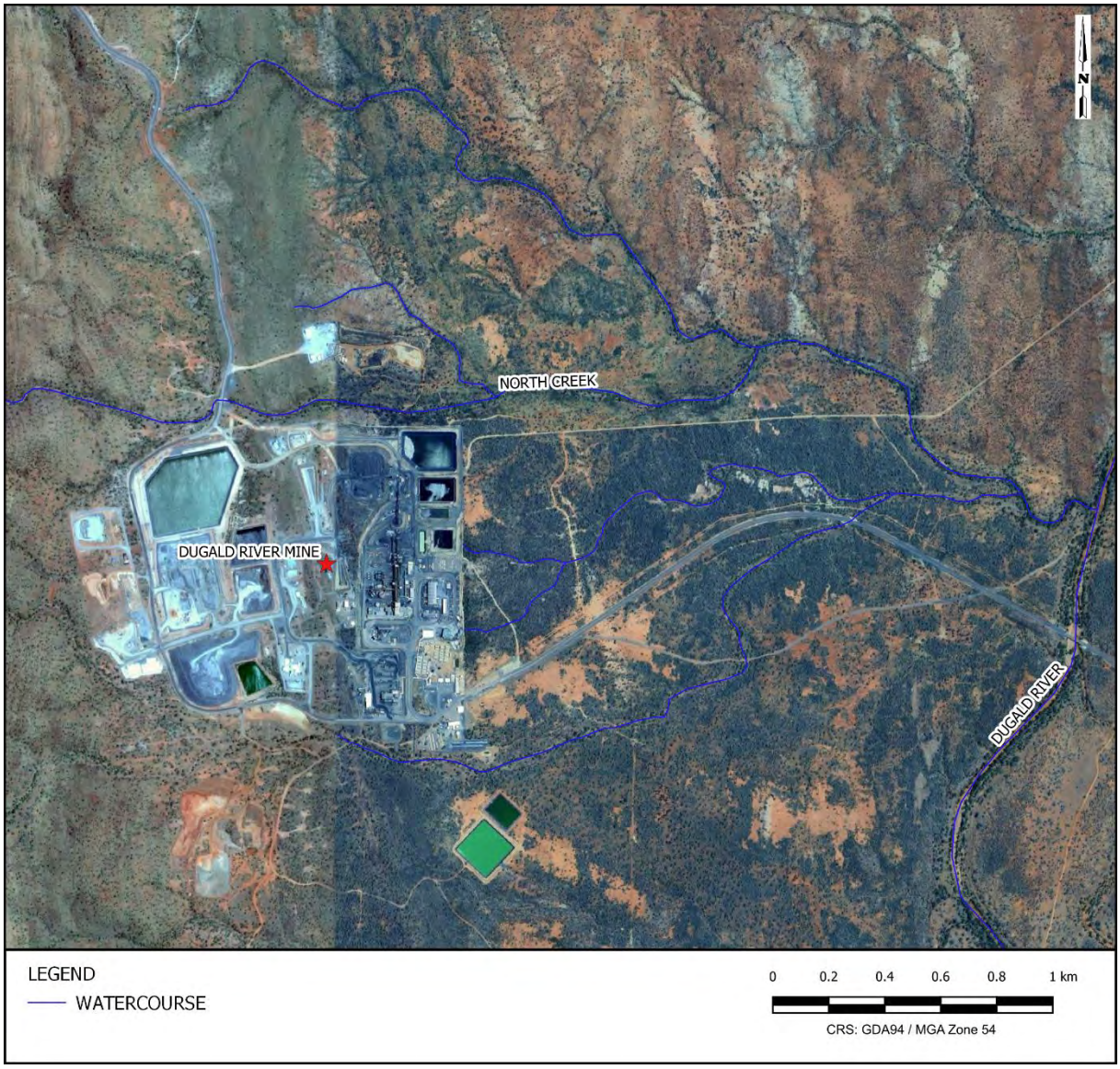
2 SITE DESCRIPTION

2.1 Site Topography and Hydrology

The DRM site is situated on gently sloping plains in central western Queensland, approximately 3 km west of the Dugald River. The Dugald River flows in a northerly direction past the site.

On the north side of the PAF Dam 2, North Creek conveys flows in an easterly direction to the Dugald River. The location of North Creek and the Dugald River relative to the site are shown on **Diagram 4**.

DIAGRAM 4: LOCAL WATERCOURSES



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2.2 Configuration and Details of PAF Dam 2

2.2.1 PAF Dam 2

The PAF Dam 2 is deemed to consist of the following components and related infrastructure items:

- PAF Waste Rock Pad constructed integrally with the Runoff Dam;
- Drains and bunds around the perimeter of the PAF Pad, which discharge 'Dirty' water into the Runoff Dam via a concrete inlet spillway;
- Runoff Dam comprising zoned, granular fill perimeter embankments;
- HDPE liner on the internal embankment slope and floor of the Runoff Dam;
- HDPE double-lined basin areas in the low-point of the Runoff Dam;
- Runoff Dam internal toe seepage collection system, comprising drainage pipework, outlet pipe and collection well;
- Runoff Dam emergency spillway; and
- 'Clean' stormwater runoff diversion drains and bunds (surrounding the PAF Stage 2 facility).

The dam itself is a fully HDPE-lined, hexagonal storage formed partially in cut, with perimeter embankments and localised impoundment flood infilling restricted to the eastern sides. The six perimeter walls are each between 100 m and 300 m in length.

The PAF Dam 2 configuration details are summarised in Table 2.

TABLE 2: PAF DAM 2 CONFIGURATION

Description	Specifications
Type	HDPE lined
Construction Material	Formed in excavation, with rockfill embankments
Dam Crest Level	210.5 m AHD
Spillway Crest (full supply) level	209.5 m AHD
Spillway Base Width	38 m
Minimum spillway Side Slope	3(H) to 1(V)
Storage Capacity to Spillway	184 ML
Storage Area	8.0 Ha

3 GENERAL ENVIRONMENTAL HARM ASSESSMENT

In assessing the consequence category for the failure of a structure in accordance with the Manual **[4]**, the assessment is undertaken against the following 'environmental harms':

- harm to humans;
- general environment harm; and
- general economic loss or property damage.

When considering general environmental harm, the receiving environment for the failure of a structure includes, but is not limited to, ephemeral waterways and rivers. The main receiving environment for a failure of the PAF Dam 2 within a 10 km flow path downstream to the south and east includes:

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- North Creek, and
- Dugald River.

The Dugald River receives flows from the Corella River approximately 111 km to the northeast of the site.

In accordance with the Manual **[4]**, the Consequence Category Assessment (General Environmental Harm) is concerned with effects to areas with 'Significant Values' and 'Moderate Values' within the receiving environment. The values are defined as follows:

- Significant Values:
  - Matters of National Environmental Significance (MNES);
  - Matters of State Environmental Significance (MSES);
  - High Ecological Value (HEV) waters as per the Queensland Environmental Protection (Water) Policy 2009 (EPP Water) **[16]**.
- Moderate Values:
  - Slightly or moderately disturbed waters as per the EPP Water **[16]**;
  - Wetland of general ecological significance (GES) as mapped on the Queensland Government referable wetland mapping;
  - Riverine areas, springs or lakes and associated flora and fauna.

The characteristics and exposure of these receiving environments, is identified in the environmental assessment reports in **Appendix A**, **Appendix B**, **Appendix C** and **Appendix D**.

3.1 Potential Surface Environment Impacts

The relevant characteristics of North Creek and the Dugald River and the Corella River in the context of environmental values, were assessed from the following sources:

- Matters of National Environmental Significance;
- Matters of State Environmental Significance;
- High Ecological Value Wetlands and Waterways;
- Aquatic Conservation Significance; and
- Registered Private Bores.

The relevant information from each of these data sources are discussed in the following sub-sections.

3.1.1 Matters of National Environmental Significance (MNES)

The Protected Matter Report (PMR) **[7]** for the project area is provided in **Appendix A**. The report lists the MNES that may occur within ML2499, ML2470 and ML2469, and within a 5 km buffer. It includes locations upstream and downstream of the project area, as well as locations in adjacent catchments.

There are no Commonwealth Lands, Commonwealth Heritage Places, World Heritage Properties, National Heritage Places, Wetlands of International Importance, Great Barrier Reef Marine Park, Commonwealth Marine Area or Listed Threatened Ecological Communities listed for the receiving environment in the PMR **[7]**.

The PMR **[7]** contains 17 Listed Threatened Species and 13 Migratory Species; as well as 18 Listed Marine Species listed for the receiving environment. The critically endangered and endangered animals listed in the PMR **[7]** is summarised in **Table 3**.

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TABLE 3: MNES LISTED CRITICALLY ENDANGERED AND ENDANGERED ANIMALS

Name	Scientific Name	Status	Presence	Location
Curlew Sandpiper	Calidris Ferruginea	Critically Endangered	Species or species habitat may occur within area (Bird)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Carpentarian Grasswren	Amytornis dorotheae	Endangered	Species or species habitat know to occur within area (Bird)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Red Goshawk	Erythrotriorchis radiatus	Endangered	Species or species habitat know to occur within area (Bird)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Gouldian Finch	Erythrura gouldiae	Endangered	Species or species habitat may occur within area (Bird)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Night Parrot	Pezoporus occidentalis	Critically Endangered	Species or species habitat likely to occur within area (Bird)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Australian Painted Snipe	Rostratula australis	Endangered	Species or species habitat may occur within area (Bird)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Gulf Snapping Turtle	Elseya lavarackorum	Endangered	Species or species habitat know to occur within area (Reptile)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Mertens' Water Monitor	Varanus mertensi	Endangered	Species or species habitat know to occur within area (Reptile)	Within ML2499, ML2470, ML2469 and with a 5 km buffer
Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish	Pristis pristis	Endangered	Species or species habitat know to occur within area (Shark)	Within ML2499, ML2470, ML2469 and with a 5 km buffer

3.1.2 Matters of State Environmental Significance (MSES)

There are several areas of MSES **[8]** within ML2499, ML2470, ML2498 and ML2601:

- Wildlife Habitat (endangered or vulnerable);
- Regulated vegetation (essential habitat) downstream of the PAF Stage 2 Dam; and
- Regulated vegetation (intersecting a watercourse) along North Creek.

This area is shown in the MSES documentation in **Appendix B – Maps 3a and Map 4**.

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3.1.3 High Ecological Value Wetlands and Waterways

Assessment of the available data MSES data **[8]** (**Appendix B – Map 2**) showed that no High Ecological Value (HEV) wetlands or waterways were identified in the receiving environment within ML2499, ML2470, ML2498 and ML2601.

3.1.4 Aquatic Conservation Significance

North Creek and Dugald River are located in the Northwest Highlands bioregion, the Mount Isa Inlier biogeographic subregion, which falls within the Flinders catchment. North Creek and the Dugald River were assessed against the characteristics for riverine areas, lakes and springs, as per the Queensland Government Maps **[11]**.

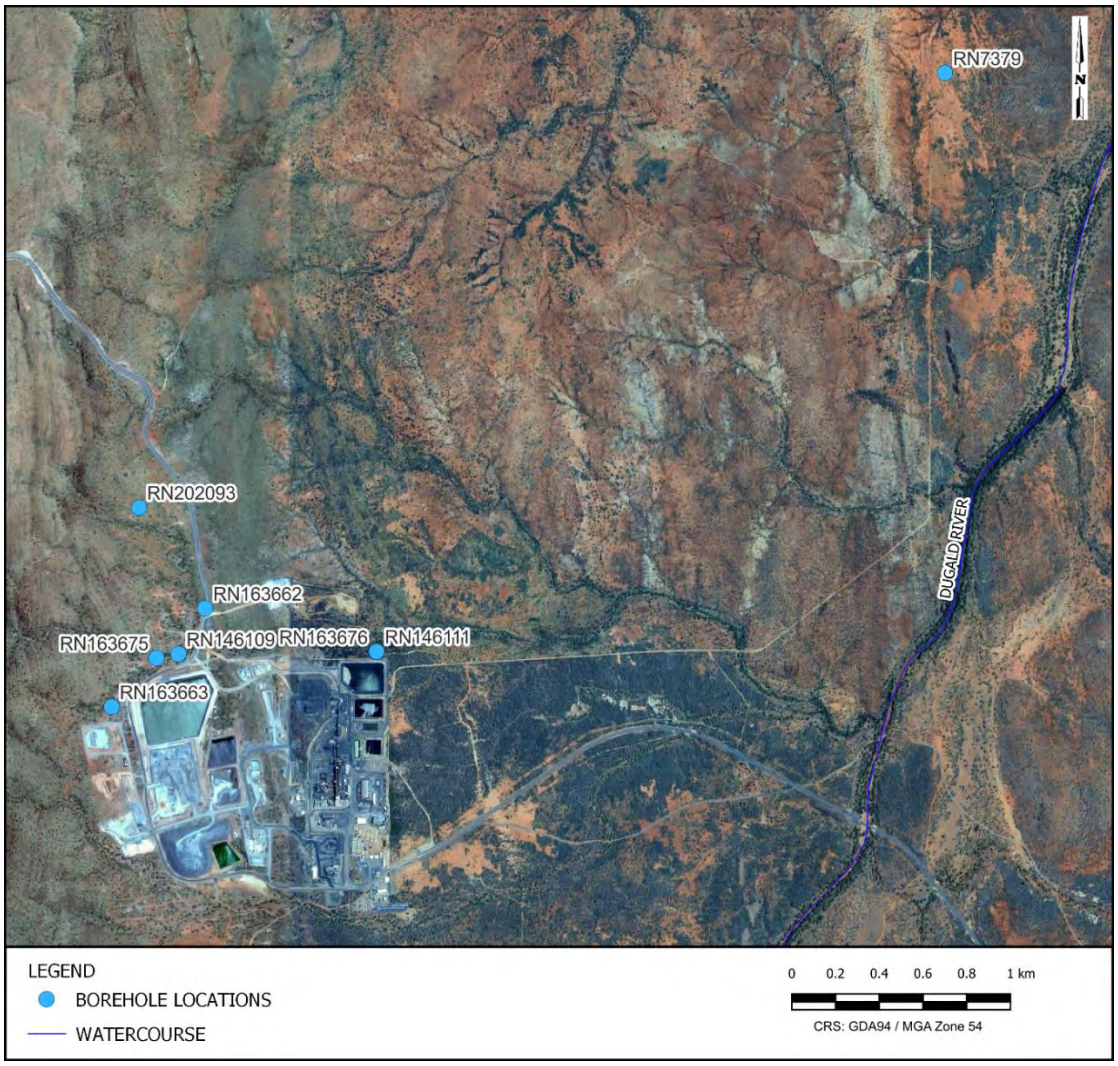
Review of the available wetland mapping, MNES **[7]**, MSES **[8]**, Biodiversity and Conservation Values **[9]** and Regional Ecosystems **[10]** did not identify any riverine waterbodies in the unnamed tributary of Dugald River or Dugald River.

North Creek or Dugald River were identified as areas of 'Medium' riverine sub catchment significance as depicted in **Appendix C – Map 5**. 'Medium' riverine values refer to riverine wetlands in deep water habitat in a natural or artificial channel.

3.1.5 Groundwater Supply

The borehole locations relative to the site and downstream of PAF Dam 2 are shown on **Diagram 5**.

DIAGRAM 5: BORES ADJACENT TO SITE LOCATION



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Table 4 provides a summary of the local registered private boreholes adjacent to ML2499, ML2470, ML2498 and ML2601 located downstream of PAF Dam 2. All of the listed boreholes are no longer in use.

TABLE 4: REGISTERED LOCAL BOREHOLES LOCATED DOWNSTREAM

Local Bore Locations and Details				
Bore*	**Coordinates (GDA94, Zone 54)**	**Location on Site**	**Date Drilled**	**Type/Role**
RN146109	411301 E 7761214 N	Approx. 140 m downstream of PAF Stage 2 Dam	21/11/2008	Sub Artesian Facility – Water Supply
RN163675	411199 E 7761205 N	Approx 170 m downstream of PAF Stage 2 Dam	01/11/2012	Sub Artesian Facility – Water Supply
RN163662	411395 E 7761383 N	Approx. 320 m downstream of PAF Stage 2 Dam	01/11/2012	Sub Artesian Facility – Water Supply
RN202093	411126 E 7761865 N	Approx. 830 m downstream of PAF Stage 2 Dam	11/12/2022	Sub Artesian Facility – Water Supply
RN163663	410983 E 7760929 N	Located 125 m west of PAF Stage 2 Dam	01/11/2012	Sub Artesian Facility – Water Supply
RN163676	412187 E 7761185 N	Approx. 800 m east of PAF Stage 2 Dam	01/11/2012	Sub Artesian Facility – Water Supply
RN146111	412191 E 7761189 N	Approx. 800 m east of PAF Stage 2 Dam	20/11/2008	Sub Artesian Facility – Water Supply
RN7379	414777 E 7763841 N	Approx 4.5 kms north-east of PAF Stage 2 Dam	1/01/1900	Sub Artesian Facility – Water Supply

*Details provided by Queensland Globe **[5]** and Business Queensland **[12]**. Accessed 12 November 2025.

3.2 Simplified Runout Estimate

3.2.1 Release Estimate

The PAF Dam 2 contains mine-impacted waters. Within the 'Guideline for failure impact assessment of water dams' **[18]**, Section 2.2.3 provides for a preliminary assessment of an indicative runout distance of up to 5 km for a storage containing 200 ML. As a conservative measure the PAF Dam 2 will be considered at a full supply level capacity of 205 ML. However, under normal operating conditions, the storage is not operated at full supply. As such, a credible failure scenario has assumed a maximum stored volume of 200 ML. Therefore, the preliminary assessment suggests that a failure of the PAF Dam 2 would have a maximum runout distance of 5 km.

3.2.2 Failure Conditions and Impact Area

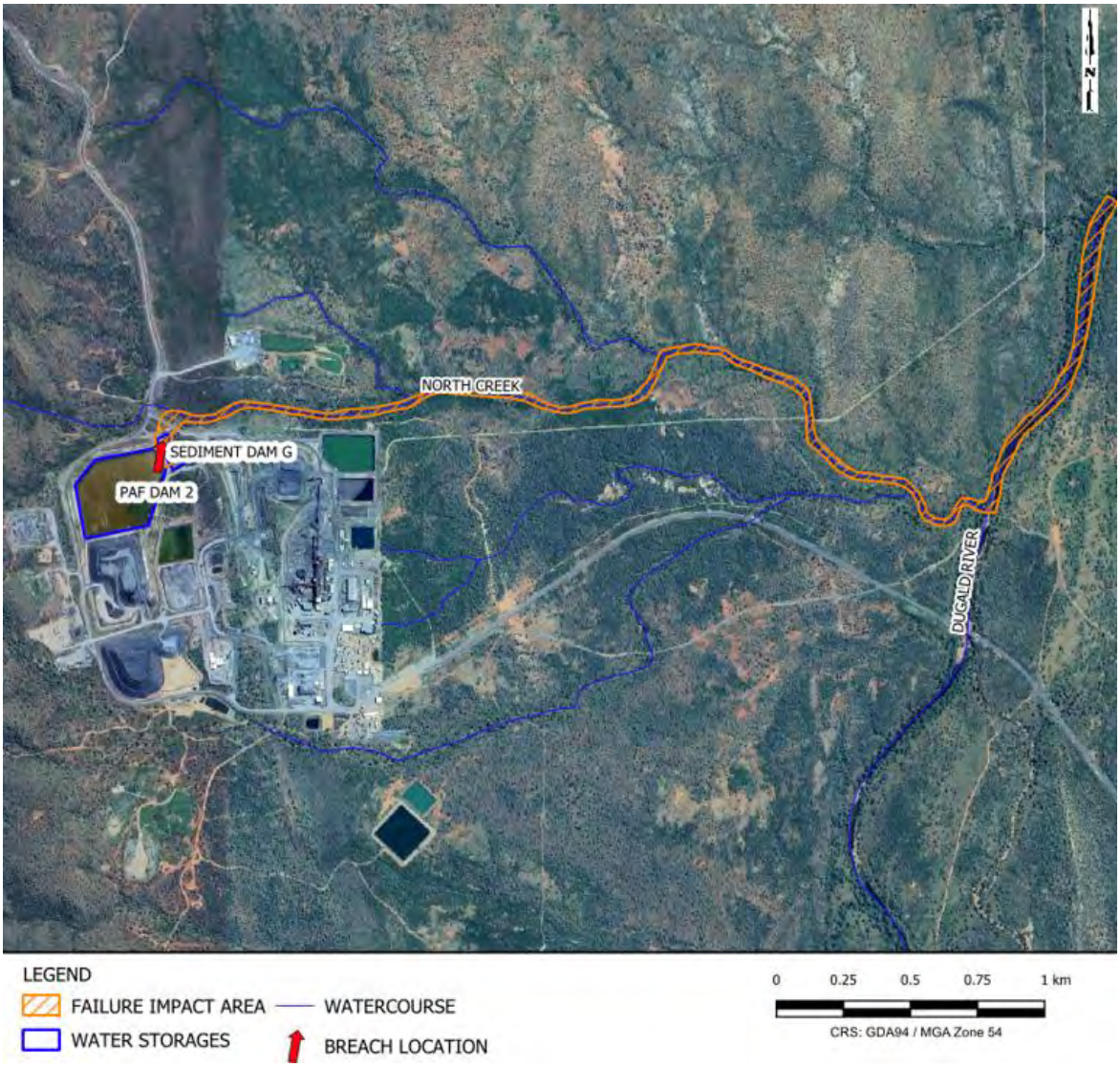
Due to the simplified nature of this runout assessment, the failure assessment assumes 'Sunny Day Failure' (SDF) conditions, namely, occurring without coincident rainfall over the site or failure impact area. A 'Flood Day Failure' (FDF) occurs in conjunction with coincident rainfall over the site and impact area. As such only the SDF failure has been included as part of this assessment.

Located immediately downstream of PAF Dam 2 is Sediment Dam G. This dam would be impacted from the dam break of PAF Dam 2. A dam break failure of the PAF Dam 2 into the sediment dam would cause either an overtopping or partial/full collapse of the sediment dam embankment. However, as the assumed breach occurs as part of a SDF, the downstream sediment dam would not contain any impounded water. As such, no additional mine-impacted waters would be released into North Creek; however, sediment release would be expected to occur.

The Dugald River Mine Access Road provides access to the site and is located approximately 400 m upstream of the confluence of North Creek with the Dugald River, as shown on **Diagram 6**.

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DIAGRAM 6 – ASSUMED BREACH LOCATION AND FAILURE PATH



The width of the North Creek was measured from detailed site survey for several locations downstream of the PAF Dam 2. Detailed survey of the Dugald River was not available, and as such, the low flow channel of the Dugald River was estimated based on aerial imagery. An average maximum flow width of 0.1 km was measured for North Creek and 0.13 km for Dugald River.

Based on a maximum runout distance of 5 km across North Creek and the Dugald River the average flow width of 0.08 km and 0.10 km, the downstream impacted area was estimated to be 0.55 km^2 based on the preliminary assessment. This was calculated using **Equation 1**.

In accordance with the Queensland Government Guideline **[18]**, the preliminary level of assessment undertaken is considered appropriate and sufficient to assign the consequence category for PAF Dam 2 following the planned Stage 4 PAF Pad expansion.

EQUATION 1: IMPACT AREA ASSESSMENT

Unnamed Tributary (3.5 km) x Width (0.1 km) + Dugald River (1.5 km) x Width (0.13 km) = 0.55 km^2

3.2.3 Population at Risk

Population at Risk (PAR) is a key indicator in characterising off property impacts. PAR is defined as people other than site personnel or people engaged in on-site work. The PAR therefore comprises the

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general public within the failure impact zone. The most likely locations of impact to non-site personnel are the general public travelling on the Burke Developmental Road.

The Burke Developmental Rd is located approximately 9.5 km downstream of the site. In the event of a dam break of the PAF Dam 2, with a preliminary runout distance estimate of 5 km, the Burke Development Road would not be impacted. However, it is possible that the actual runout distance could exceed 5 km, although at such distances, the flow depths, velocities, and associated impacts are expected to be minor.

The Mine Access Road is located approximately 400 meters upstream of the confluence of North Creek with the Dugald River. As this road only provides access to the site, it has been assumed that the general public would not be routinely present on this road.

Therefore, the PAR has been assessed to be 0.

4 CONSEQUENCE CATEGORY ASSESSMENT

4.1 Basis of the Consequence Category Assessment

The PAF Dam 2 has been assessed against the requirements of the Manual **[4]** for operational site conditions. This involved a desktop review of potential harm associated with failure-to-contain and dam break scenarios. The assessment has been undertaken in consideration of the planned Stage 4 PAF Pad expansion, which will increase the PAF Dam 2 catchment area.

4.2 Stage 4 PAF Pad Expansion Considerations

As noted above, this CCA has been undertaken to address the planned Stage 4 PAF Pad expansion, which will increase the catchment area contributing to PAF Dam 2 following the decommissioning of PAF Dam 1. The purpose of this updated assessment is to confirm whether the previously assigned consequence category remains appropriate under the revised catchment conditions.

The perimeter drains surrounding the Stage 4 PAF Pad are considered integral components of the overall containment system and will not be managed as regulated structures in their own right. These drains meet the definition under Clause 2.3.1.1 of the Manual **[4]** as levees or drains "designed to divert contaminated waters into a containment dam" (i.e. PAF Dam 2). Accordingly, their function and performance have been assessed as part of the PAF Dam 2 system rather than as separate infrastructure.

Failure of the perimeter drains would not result in containment loss, overtopping, nor dam-break scenarios for PAF Dam 2. In practice, such a failure would reduce inflows to the dam, thereby lowering the likelihood of overtopping of PAF Dam 2. Any potential impacts would be limited to minor, localised environmental effects, with negligible consequences for PAR.

The Stage 4 PAF Pad expansion is not expected to be subject to ingress from external runoff nor flooding, as the surrounding topography naturally directs surface water away from the facility. The diversion drains are not designed to exclude non–mine-affected floodwaters from operational areas or containment systems; therefore, the requirements of Sections 2.3.1.2 and 2.3.2 of the Manual are not considered applicable in this instance.

4.3 Consequence Category Assessment Regulatory Requirements

The Manual sets out the requirements of the administering authority for a consequence category assessment and certification of the design of regulated structures, constructed as part of environmentally relevant activities under the Environmental Protection Act (1994) **[16]**.

The purpose of the Manual is to:

- guide the assessment of the Consequence Category of all structures constructed as part of activities that require an EA or development approval;
- guide the determination of the structure/s that require formal documentation; and

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- provide approved methods for specifying the design performance and monitoring requirements for those structures.

Assessment criteria for CCA is based on the following failure event scenarios:

- Failure to Contain – Seepage

  Spills or release to ground/groundwater via seepage from the floor and/or sides of the structure. This is only relevant to a new structure so has not been included in this CCA review.

- Failure to Contain – Overtopping

  Spills or releases from the structure that result from loss of containment due to overtopping.

- Failure to Contain – Dam Break

  Collapse of the structure due to any possible cause.

Under these scenarios, several modes of failure are possible as described below:

- A failure to contain scenario means a release that results from loss of containment due to excessive seepage, overtopping and/or other deficiencies in water management aspects of the storage. Although typically non-flood producing, failure to contain events may involve contaminant release, which could endanger environmental values or human life/wellbeing.
- A dam break scenario involves the partial or complete collapse of a structure due to any possible cause. For the purposes of the CCA, a simplified empirical dam break assessment was undertaken for the PAF Dam 2 to the north towards North Creek and the Dugald River, assuming the following:
  - Sunny Day Failure conditions with the PAF Dam 2 full to the spillway level; and
  - Full failure of above ground embankments to natural ground level.

The basis for assessment of Consequence Category from the Manual is reproduced in **Table 5**.

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TABLE 5: CONSEQUENCE CATEGORY ASSESSMENT CRITERIA [4]

Environmental Harm	Consequence Category		
	High	**Significant**	**Low**
Harm to Humans	Location such that people are routinely present in the failure path and if present loss of life to greater than 10 people is expected[8]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.	Location such that people are routinely present in the failure path and if present loss of life to 1 person or greater but less than 10 people is expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.	Location such that people are not routinely present in the failure path and loss of life is not expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.
	Location such that contamination of waters (surface and/or groundwater[9]) used for human consumption could result in the health of 20 or more people being affected[10].	Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of 10 or more people but less than 20 people being affected[9].	Location such that contamination of waters (surface and/or groundwater[8]) used for human consumption could result in the health of less than 10 people being affected[9].
General environmental harm	Location such that: a) Contaminants may be released to areas of MNES, MSES or HEV waters that are not already authorised to be disturbed to at least the same extent under other conditions of this authority subject to any applicable offset commitment (Significant Values); and b) Adverse effects[11] on Significant Values are likely; and c) The adverse effects[10] are likely to cause at least one of the following: i) loss or damage or remedial costs greater than $50,000,000; or ii) remediation of damage is likely to take 3 years or more; or iii) permanent alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 5 km².	Location such that contaminants may be released so that adverse effects[10] (that are not already authorised to be disturbed to at least the same extent under other conditions of the authority subject to any applicable offset commitment) either: a) Would be likely to be caused to Significant Values but those adverse effects[10] would not be likely to meet the thresholds for the High Consequence Category and instead would be likely to cause at least one of the following: i) loss or damage or remedial costs greater than $10,000,000 but less than $50,000,000; or ii) remediation of damage is likely to take more than 6 months but less than 3 years; or iii) significant alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 1 km² but less than 5 km². or b) Would be likely to be caused to environmental values classed as slightly or moderately disturbed waters[12], wetland of general ecological significance[13], riverine areas, springs or lakes and associated flora and fauna (Moderate Values), and the adverse effects[10] are likely to cause at least one of the following: i) loss or damage or remedial costs greater than $20,000,000; or ii) remediation of damage is likely to take more than 1 year; or iii) significant alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 2 km².	Location such that either: a) Contaminants are unlikely to be released to areas of Significant Values or Moderate Values; or b) Contaminants are likely to be released to those areas, but would be unlikely to meet any of the minimum thresholds specified for the Significant Consequence Category for adverse effects[10]
General economic loss or property damage	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $10 million or greater in rehabilitation, compensation, repair or rectification costs[14].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $1 million and greater but less than $10 million in rehabilitation, compensation, repair or rectification costs[13].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require less than $1 million in rehabilitation, compensation, repair or rectification costs[13] .

7 To be used for all failure event scenarios.

8.'People routinely present in the failure path' could be considered to be people who occupy buildings or other places of occupation that lie within the failure impact zone. For the purposes of this Manual, this should refer to people other than site personnel engaged by the resource operation and located on the tenements and tenure associated with the resource operation; for other ERAs, it would be the 'premises referred to in the authority'. It should be noted that while this is appropriate for the assessment of consequence categories in accordance with this Manual, adherence to the requirements of this Manual does not limit, amend or change in any way, any other requirements to be complied with under relevant health and safety acts or legislation that requires the safety of site personnel to be considered.

9 When considering potential impacts on groundwater, it is not envisaged that a full hydrogeological assessment will be required in all cases. Any consideration of potential impacts on groundwater systems should consider the water quality of the potential receiving aquifer as well as the quality of fluid stored in the regulated dam. Existing groundwater drawdown in areas surrounding resource operations (e.g. drawdown as a result of mine pit or underground mine dewatering) can also be considered when assessing the consequence of dam seepage on groundwater systems.

10 'An adverse effect on human health means a physiological effect on human health and does not include an impact on the quality of downstream water that merely negatively affects taste, and which is unlikely to cause persons to become physically ill.

11 Adverse effects include chronic and acute effects where an acute effect is on living organism/s which results in severe symptoms that develop rapidly, and a chronic effect is an adverse effect on a living organism/s which develops slowly. In some instances, it may be necessary to carry out or reference existing ecological/toxicological studies to assess the impacts of contaminants on living organisms.

12 See Water EPP for definitions.

13 Wetland of general ecological significance' means a wetland shown on a map of referable wetland as a 'general ecologically significant wetland' or 'wetland of other environmental value'.

14 This does not include the holder's own mine or gas production, on-site industrial or commercial assets, the holder's workers' accommodation, agricultural facilities on the holder's land such as a farm shed or farm dam or infrastructure solely for servicing the holder.

4.4 Consequence Category Assessment

Assessments against the failure scenarios in the Manual for the PAF Dam 2 for operational site conditions were undertaken. These assessments are contained in **Table 6** respectively.

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TABLE 6: CONSEQUENCE CATEGORY ASSESSMENT – PAF DAM 2

Environmental Harm	Consequence Category	
	Failure to Contain - Overtopping	**Failure to Contain - Dam Break**
Harm to Humans	In the event of an overtopping failure, flows would pass south through the unnamed tributary of Dugald River and enter Dugald River. There are no non-site personnel that are routinely present in the failure path. There are no identified bores used for human consumption in the failure impact area. It is considered that in the event of an overtopping failure, flows would be contained to the existing site drainage infrastructure and/or the unnamed tributary of the Dugald River. Overtopping would occur in conjunction with period of prolonged, significant rainfall. **Consequence Category is assessed as Low.**	In the event of a dam break failure of the PAF Dam 2, flows would pass north-east through the unnamed tributary of Dugald River and enter Dugald River. The estimated impact area is 0.55 km^2 with no PAR due to the natural topography making it unlikely the dam break will impact the Burke Developmental Rd. The Mine Access Road crosses the Dugald River, but is located upstream of the confluence North Creek and the Dugald River. As the Mine Access Road is used for site access only, the general public are not expected to be present on it. As such, the PAR was assessed to be 0. **Consequence Category is assessed as Low.**
General environmental harm	In the event of an overtopping failure, flows would pass east through the unnamed tributary of Dugald River and enter Dugald River. The unnamed tributary of Dugald River and Dugald River contain the following: • Wildlife Habitat (endangered or vulnerable) • Regulated vegetation (essential habitat) downstream of the PAF Dam 2; and • Regulated vegetation (intersecting a watercourse) along the unnamed tributary of Dugald River. In the event of an overtopping failure, water quality parameters are expected to be diluted due to significant, prolonged rainfall in the upstream catchment. Impacts to these areas would be likely; however, would not be expected to reach the thresholds for a 'Significant' or 'High' consequence impact. **Consequence Category is assessed as Low**	In the event of a dam break failure of the PAF Dam 2, flows would pass north-east through North Creek and enter Dugald River. There are several areas of MSES which would be impacted by released mine impacted water. The released waters exceed EA criteria for released water for multiple analytes and chemical parameters. In the event of a release, these chemical parameters are expected to impact the following areas of MSES: • Wildlife Habitat (endangered or vulnerable) • Regulated vegetation (essential habitat) downstream of the PAF Dam 2; and • Regulated vegetation (intersecting a watercourse) along North Creek. The impacts to these areas of MSES are not likely to meet the threshold for a 'High' consequence category. The impacts to the areas of MSES are likely to result in the following: • remediation of damage is likely to take more than 6 months but less than 3 years; or • significant alteration to existing ecosystems. **Consequence Category is assessed as Significant.**
General economic loss or property damage	In the event of an overtopping failure of the PAF Dam 2, there is no third party assets in the failure path that would require rehabilitation, compensation, repair or rectification. An overtopping failure to the north or east would impact site infrastructure only. **Consequence Category assessed as Low.**	In the event of a dam break failure of the PAF Dam 2. There are no third party assets in the failure path that would require rehabilitation, compensation, repair or rectification. A dam break failure would only impact site infrastructure. **Consequence Category is assessed as Low.**
Overall Consequence Category	**LOW**	**SIGNIFICANT**

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5 CONSEQUENCE CATEGORY ASSESSMENT SUMMARY

While the Stage 4 PAF Pad expansion increases the contributing catchment area to PAF Dam 2, the CCA methodology is based on the nature and extent of potential impacts rather than the probability of failure. As the dam geometry and general configuration remain unchanged, the initial failure assumptions adopted for this assessment are consistent with those used in previous evaluations. Based on these considerations, the consequence category for PAF Dam 2 remains **Significant**.

Table 7 summarises the CCA outcome, which aligns with the previous assessments due to no changes to the quality of water contained within the dam and the potential for impact to the downstream receiving environment.

TABLE 7: CONSEQUENCE CATGEORY ASSESSMENT SUMMARY

Failure Scenario	PAF Dam 2
Failure to Contain – Seepage	N/A
Failure to Contain – Overtopping	Low
Failure to Contain - Dam Break	Significant
Overall	**Significant**
Regulated Structure, as defined in the Manual (Y/N)	Y

As the risk for the 'Failure to Contain – Overtopping' scenario is low there is no requirement for the dam to accommodate the Design Storage Allowance (DSA) at the start of the wet season (1 November). Nor does the dam require a Mandatory Reporting Level (MRL).

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REFERENCES

[1] ATC Williams (2025), 'Dugald River Mine – PAF PAD Expansion - Stage 4 Design Report', Ref: 240261.04-R01 Rev A, dated November 2025.

[2] Department of Environment and Science (2020), Environmental Authority EPML00731213 (Effective Date 31 August 2025), Queensland Government.

[3] ATC Williams (2023), 'Dugald River Mine – PAF Stage 2 Dam Consequence Category Assessment', Ref: 108003.63-R01 Rev 0, dated July 2023.

[4] Department of Environment and Science (2025), 'Manual for Assessing Consequence Categories and Hydraulic Performance of Structures', ESR/2016/1933, July 2025, version 5.04, Queensland Government.

[5] Queensland Government, 'Queensland Globe', accessed 18 May 2023, https://qldglobe.information.qld.gov.au/help-info/, Queensland Government.

[6] The Long Paddock (2021), SILO Data Drill for Cell -18.75, 138.60, accessed 18 May 2023 https://www.longpaddock.qld.gov.au/silo/gridded-data/, Queensland Government

[7] Department of Agriculture, Water and the Environment (2021), 'EPBC Act Protected Matter Report', accessed 12 November 2025, http://www.environment.gov.au/epbc/pmst/, Australian Government.

[8] Department of Environment and Science (2021a), 'Environmental Reports - Matters of State Environmental Significance', accessed 12 November 2025, https://apps.des.qld.gov.au/report-request/environment/, Queensland Government.

[9] Department of Environment and Science (2021b), 'Environmental Reports - Biodiversity and Conservation Values – Biodiversity Planning Assessments and Aquatic Conservation Assessments', accessed 12 November 2025 https://apps.des.qld.gov.au/report-request/environment/, Queensland Government.

[10] Department of Environment and Science (2021c), 'Environmental Reports - Regional Ecosystems – Biodiversity Status', accessed 12 November 2025 https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions, Queensland Government.

[11] Department of Environment and Science (2021d), 'WetlandMaps', accessed 12 November 2025, https://wetlandinfo.des.qld.gov.au/wetlandmaps/, Queensland Government.

[12] Business Queensland (2021), 'Bore Reports' accessed 12 November 2025, https://www.business.qld.gov.au/industries/mining-energy-water/water/bores-and-groundwater/bore-reports, Queensland Government.

[13] Dugald River Mine (2023), '20230313 Chemistry Table', 13 March 2023.

[14] Beck, H.E., N.E. Zimmermann, T.R. McVicar, N. Vergopolan, A. Berg, E.F. Wood (2018), 'Present and future Köppen-Geiger climate classification maps at 1-km resolution', *Scientific Data* 5:180214, doi:10.1038/sdata.2018.214 (2018)

[15] Department of Natural Resources, Mines and Energy (DNRME), 'Queensland Globe', accessed 18 May 2023, https://qldglobe.information.qld.gov.au/help-info/, Queensland Government.

[16] Queensland Parliament (2018), Environmental Protection Act 1994, 1 January 2018 Reprint, Queensland Government.

[17] Queensland Government (2019), 'Traffic census of the Queensland state-declared road network – 2019', Accessed 18 May 2023

[18] Department of Natural Resources, Mines and Energy (2018), ‘Guideline for failure impact assessment of water dams’, November 2018, Queensland Government.

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CONDITIONS OF REPORT

1. This report must be read in its entirety.
2. This report has been prepared by ATCW for the purposes stated herein and ATCW's experience, having regard to assumptions that can reasonably be expected to make in accordance with sound professional principles. ATCW does not accept responsibility for the consequences of extrapolation, extension or transference of the findings and recommendations of this report to different sites, cases, or conditions.
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APPENDICES

APPENDIX A – EPBC ACT PROTECTED MATTER REPORT

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 12-Nov-2025

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	13

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	5
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species			[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.			
Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Amytornis dorotheae			
Carpentarian Grasswren [558]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Chloebia gouldiae listed as Erythrura gouldiae			
Gouldian Finch [90091]	Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus			
Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos			
Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Grantiella picta			
Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Pezoporus occidentalis](#) Night Parrot [59350]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Macrotis lagotis](#) Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area	In feature area
[Sminthopsis douglasi](#) Julia Creek Dunnart [305]	Vulnerable	Species or species habitat may occur within area	In feature area
REPTILE			
[Acanthophis hawkei](#) Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Elseya lavarackorum](#) Gulf Snapping Turtle [67197]	Endangered	Species or species habitat may occur within area	In feature area
[Varanus mertensi](#) Mertens' Water Monitor [1568]	Endangered	Species or species habitat known to occur within area	In feature area
SHARK			
[Pristis pristis](#) Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Endangered	Species or species habitat may occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Marine Species			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pristis pristis			
Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Endangered	Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
Hirundo rustica			
Barn Swallow [662]		Species or species habitat may occur within area	In feature area
Motacilla cinerea			
Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius veredus			
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Glareola maldivarum			
Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Pandion haliaetus](#) Osprey [952]		Species or species habitat may occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Bubulcus ibis as Ardea ibis](#) Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chalcites osculans as Chrysococcyx osculans			
Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Charadrius veredus			
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In buffer area only
Glareola maldivarum			
Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster			
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Hirundo rustica			
Barn Swallow [662]		Species or species habitat may occur within area overfly marine area	In feature area
Merops ornatus			
Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea			
Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Pandion haliaetus			
Osprey [952]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Reptile			
Crocodylus johnstoni			
Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Dugald River Wind Farm	2024/09807		Completed	In feature area
Dugald River Wind Farm ? Optimised Design	2024/10090		Completed	In feature area
Controlled action				
CopperString Project	2010/5581	Controlled Action	Completed	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Dugald River Zinc and Lead Mine extension, Qld	2015/7573	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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APPENDIX B – ENVIRONMENTAL REPORTS – MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

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Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

ML: 2498

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and a field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@detsi.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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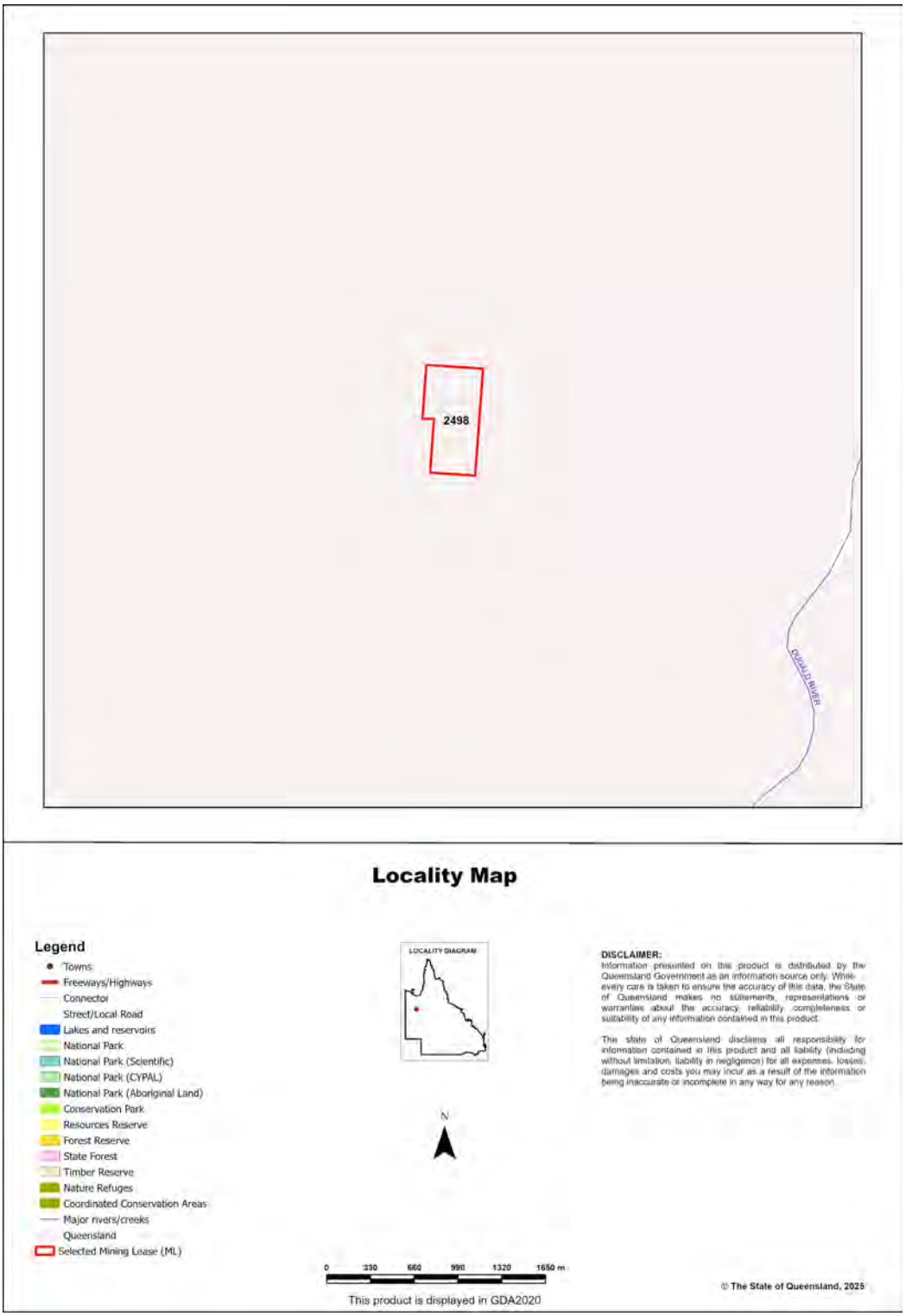
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: ML: 2498, with area 29.06 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992;*

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- *Threatened wildlife under the Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
  - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
  - Category R areas on the regulated vegetation management map;
  - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
  - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0 ha	0.0%
1b Protected Areas- nature refuges	0 ha	0.0%
1c Protected Areas- special wildlife reserves	0 ha	0.0%
2 State Marine Parks- highly protected zones	0 ha	0.0%
3 Fish habitat areas (A and B areas)	0 ha	0.0%
4 Strategic Environmental Areas (SEA)	0 ha	0.0%
5 High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values	0 ha	0.0%
6a High Ecological Value (HEV) wetlands	0 ha	
6b High Ecological Value (HEV) waterways	0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	0.88 ha	3.0%
7b Special least concern animals	0 ha	0.0%
7c i Koala habitat area - core (SEQ)	0 ha	0.0%
7c ii Koala habitat area - locally refined (SEQ)	0 ha	0.0%
7d Sea turtle nesting areas	0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0 ha	0.0%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0 ha	0.0%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0 ha	0.0%
8d Regulated Vegetation - Essential habitat	0.88 ha	3.0%
8e Regulated Vegetation - intersecting a watercourse	0.6 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0 ha	0.0%
9a Legally secured offset areas- offset register areas	0 ha	0.0%
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0 ha	0.0%

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(No results)

1b. Protected Areas - nature refuges

(No results)

1c. Protected Areas - special wildlife reserves

(No results)

2. State Marine Parks - highly protected zones

(No results)

3. Fish habitat areas (A and B areas)

(No results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(No results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii	Keys boronia	V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Euastacus bindal	Mount Elliot crayfish	CR	None
Euastacus binzayedi		CR	None
Euastacus eungella		E	None
Euastacus hystricosus		E	None
Euastacus jagara	Jagara hairy crayfish	CR	None
Euastacus maidae		CR	None
Euastacus monteithorum		E	None
Euastacus robertsi		E	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Melaleuca irbyana	swamp tea-tree	E	None
Macadamia ternifolia		V	None
Macadamia tetraphylla	bopple nut	V	None
Petrogale penicillata	brush-tailed rock-wallaby	V	None
Petrogale coenensis	Cape York rock-wallaby	E	None
Petrogale purpureicollis	purple-necked rock-wallaby	V	Core
Petrogale sharmani	Sharmans rock-wallaby	V	None
Petrogale xanthopus celeris	yellow-footed rock-wallaby (Qld subspecies)	V	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

(No results)

Special least concern animal species records

(No results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

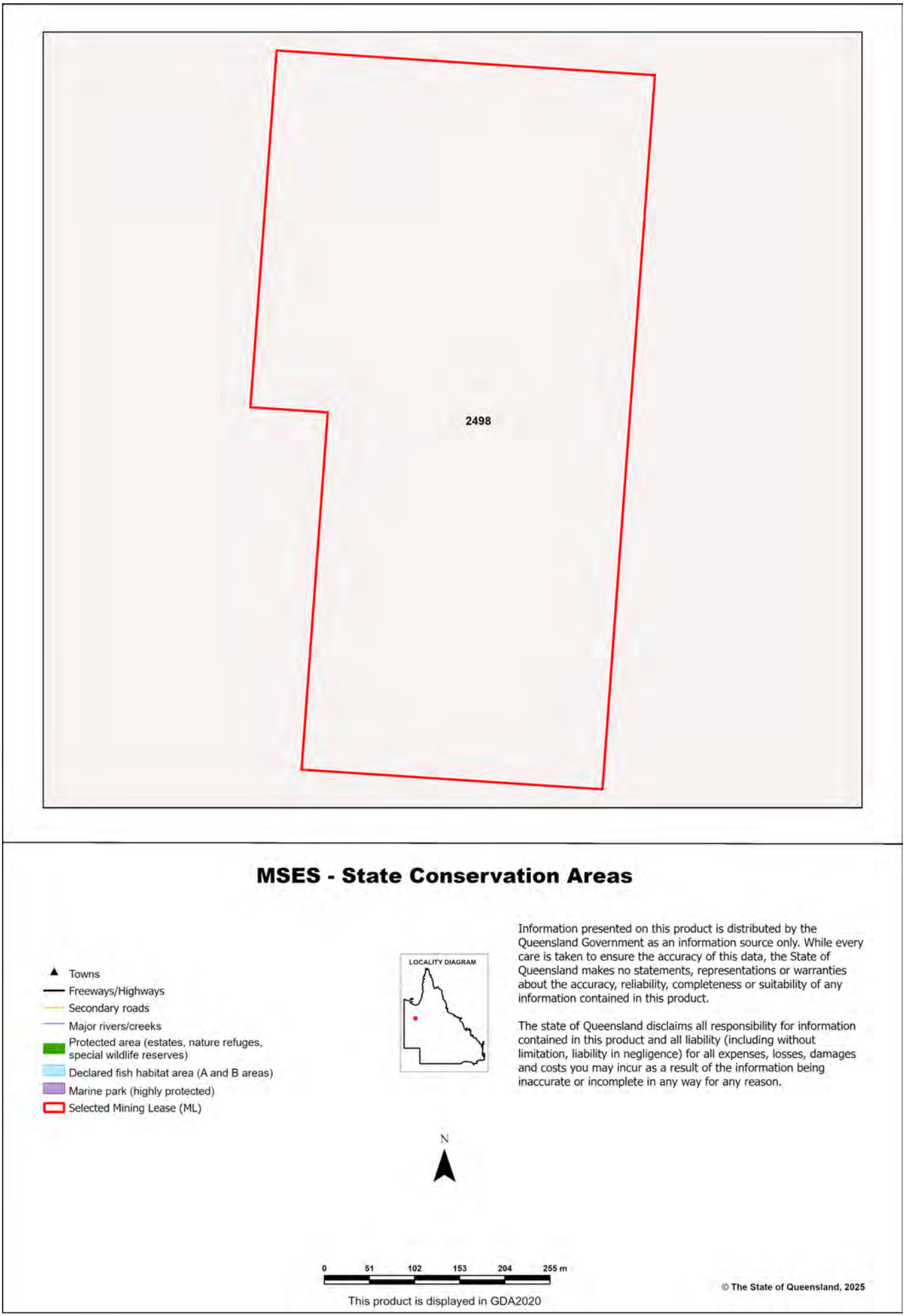
(No results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

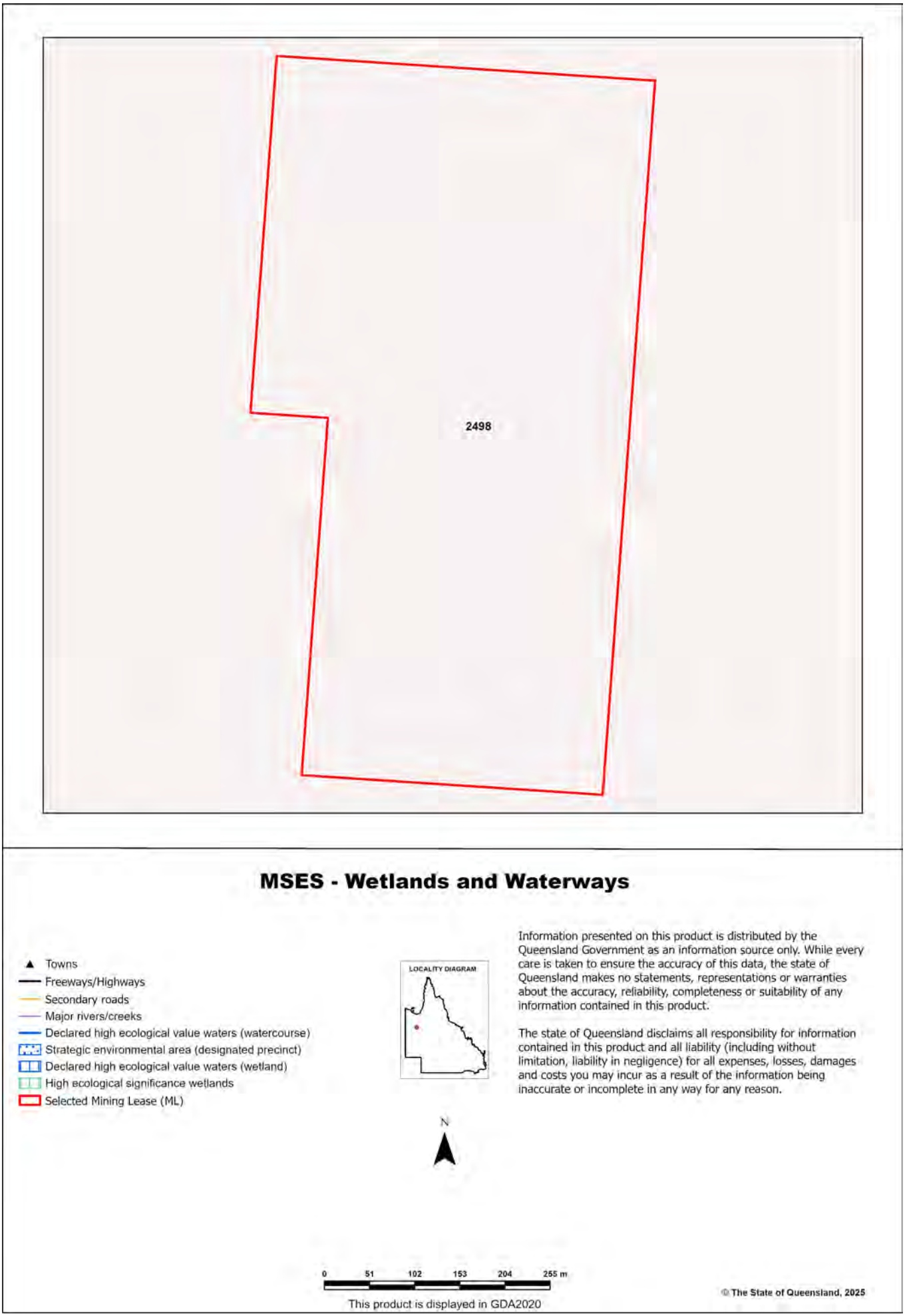
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Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

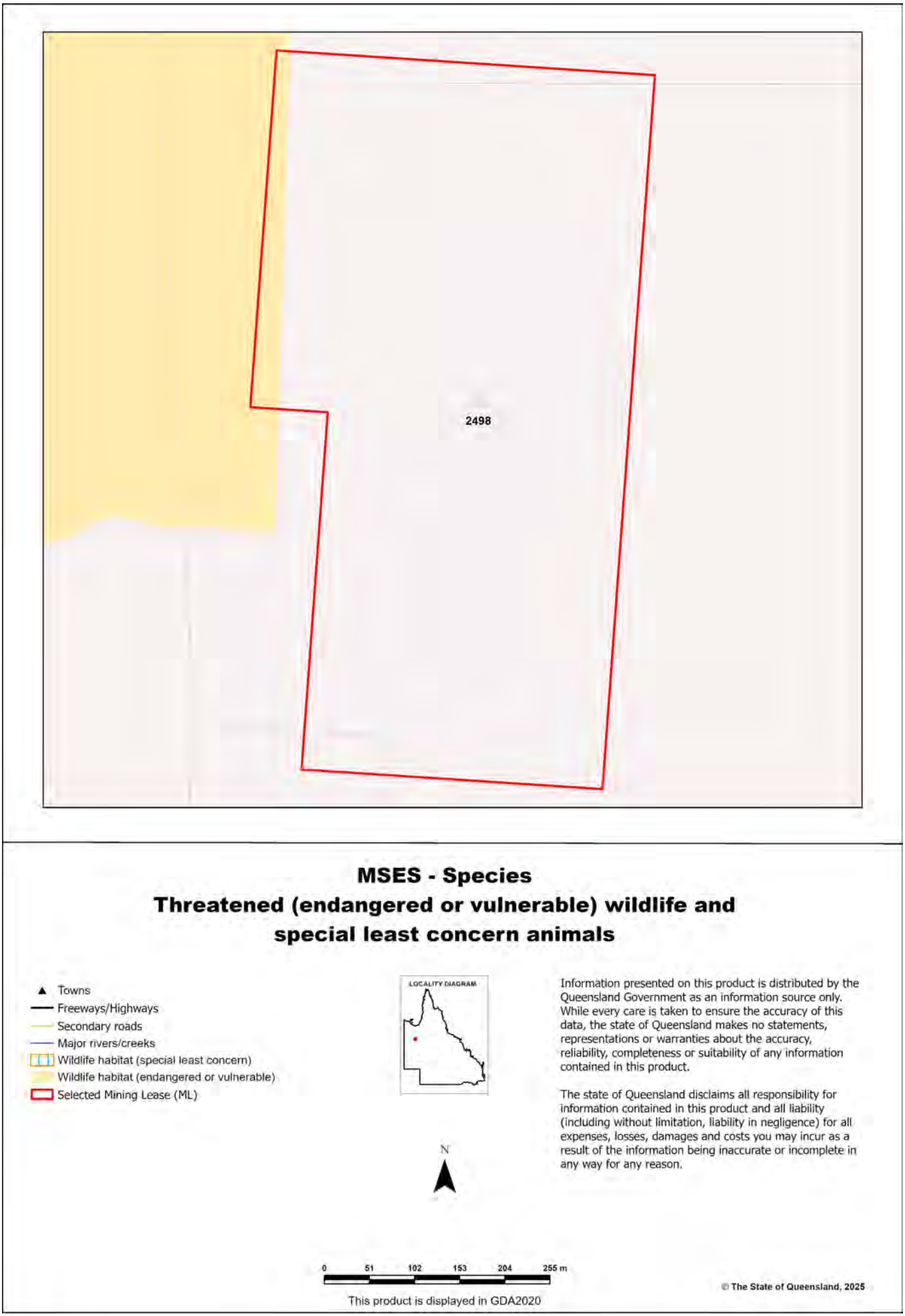
Map 1 - MSES - State Conservation Areas



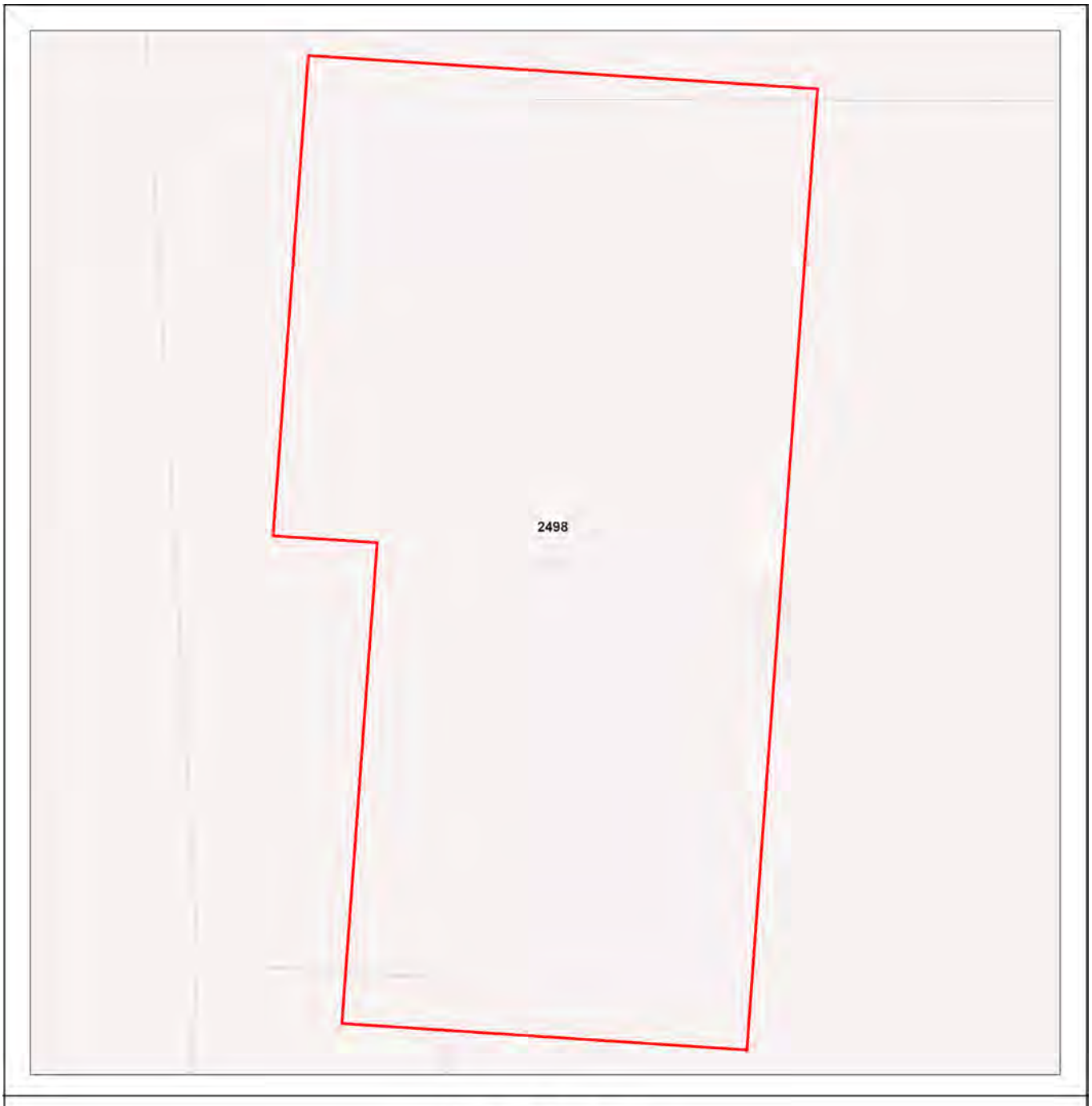
Map 2 - MSES - Wetlands and Waterways



Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



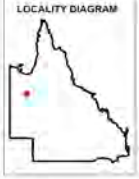
Map 3b - MSES - Species - Koala habitat area (SEQ)



MSES - Species
Koala habitat area (SEQ)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
- Koala habitat area (locally refined)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



While every care is taken to ensure the accuracy of this product, the Department of the Environment, Tourism, Science and Innovation acting on behalf of the State of Queensland makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the data being inaccurate or incomplete in any way and for any reason. Due to varying sources of data, spatial locations may not coincide when overlaid.

The represented layers for SEQ 'koala habitat area-core' and 'koala habitat area- locally refined' in MSES are sourced directly from the regulatory mapping under the Nature Conservation (Koala) Conservation Plan 2017. Whilst every effort is made to ensure the information remains current, there may be delays between updating versions. Please refer to the original mapping for the most recent version. See https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

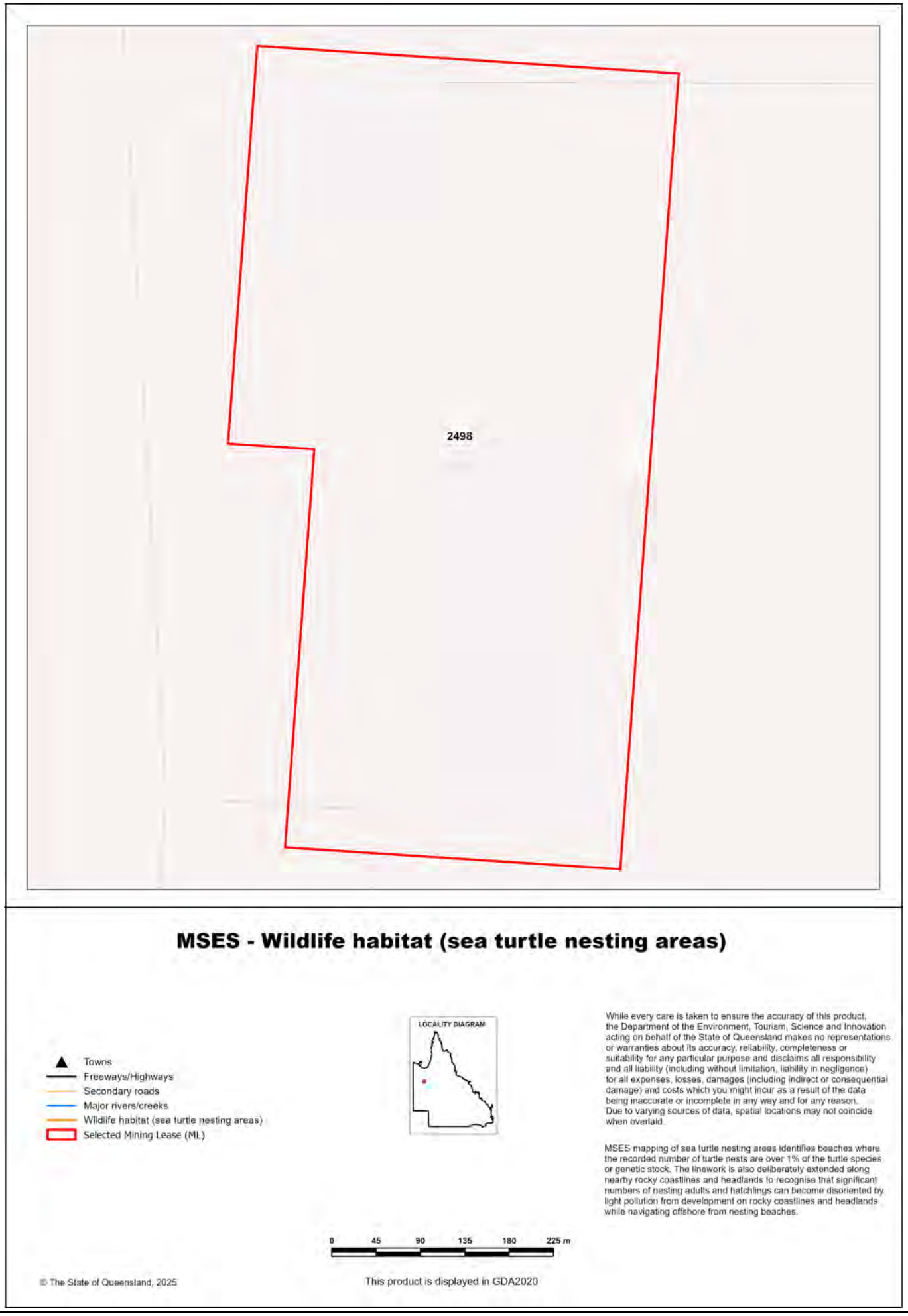
The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

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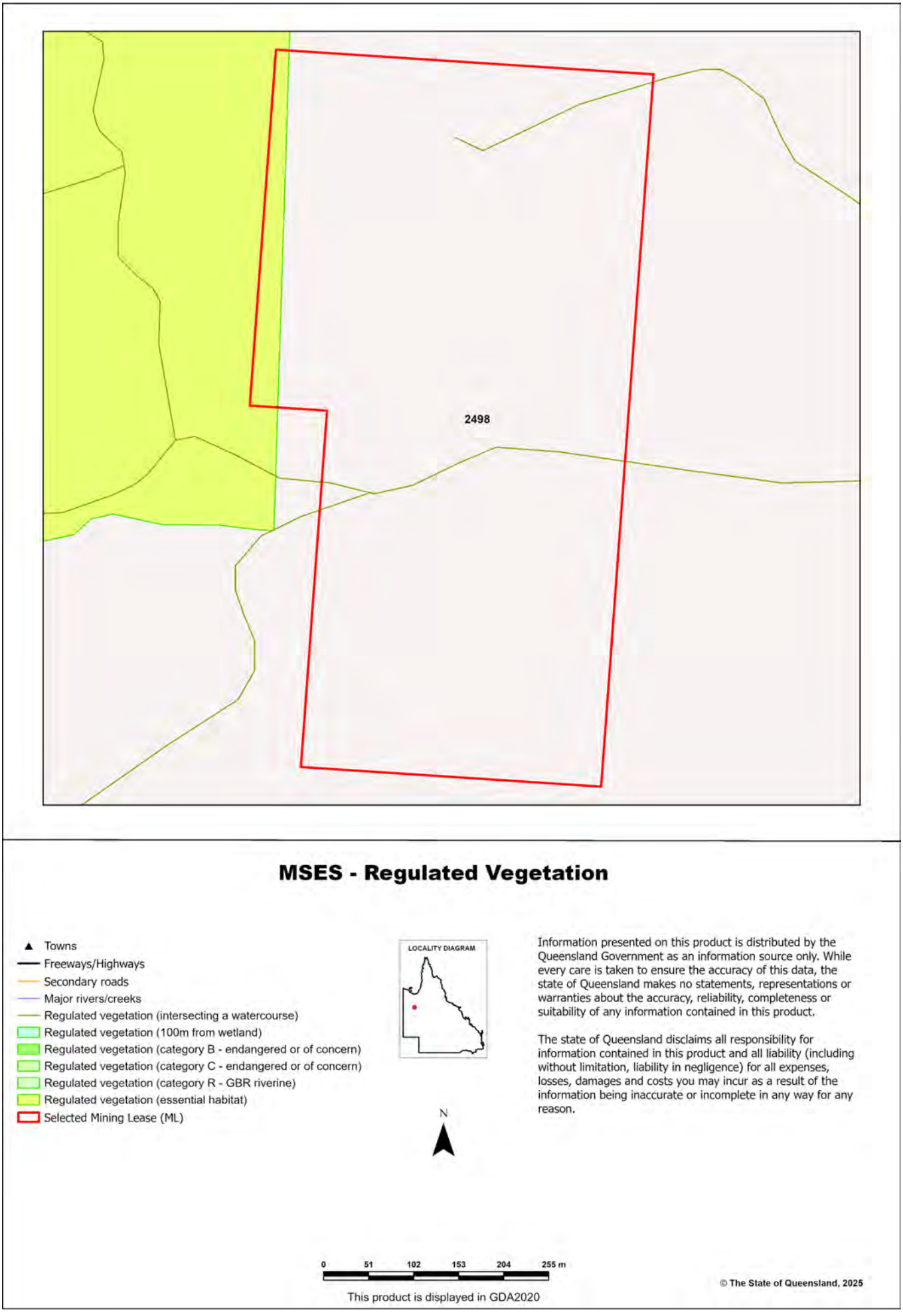
0 45 90 135 180 225 m

This product is displayed in GDA2020

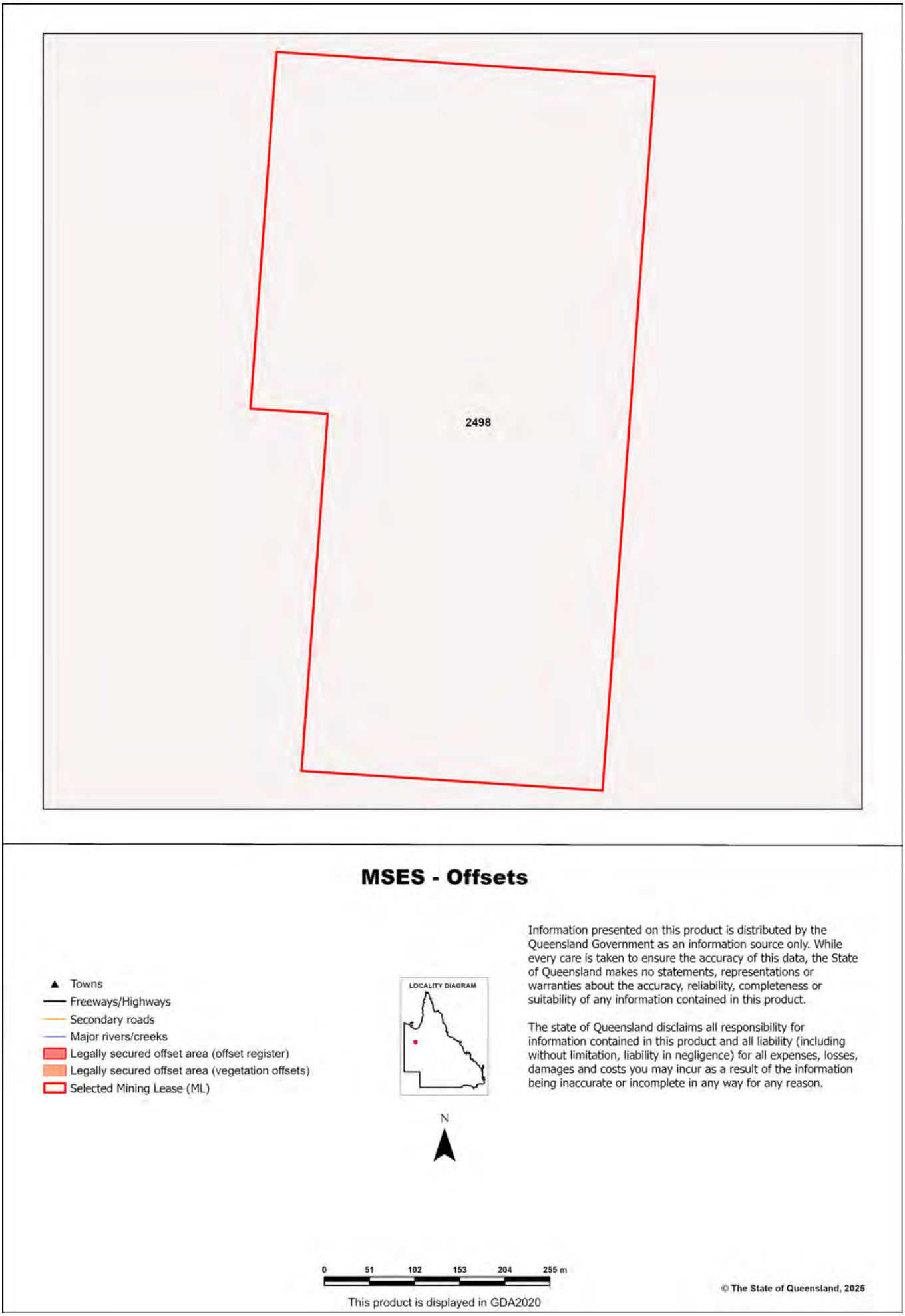
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). Its primary purpose is to support implementation of the SPP biodiversity policy.

MSES mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

MSES mapping does not determine whether state or local development assessment is required. For state assessment triggers refer to the Development Assessment Mapping System (DAMS). For local assessment triggers, refer to the relevant local planning scheme.

The Queensland Government's "Method for mapping - matters of state environmental significance can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DETSI
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DETSI	- Department of the Environment, Tourism, Science and Innovation
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA2020	- Geocentric Datum of Australia 2020
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

ML: 2499

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and a field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@detsi.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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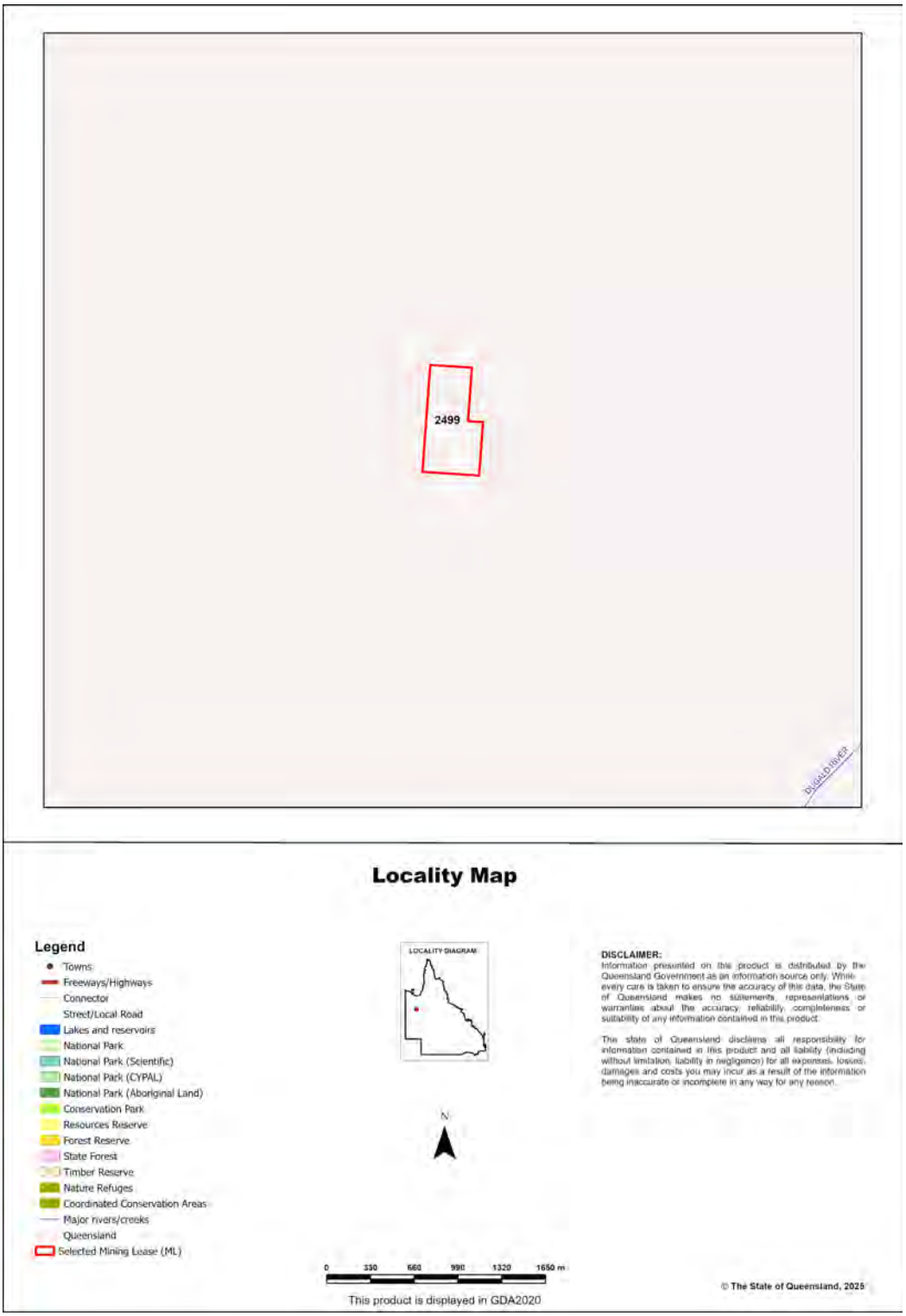
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: ML: 2499, with area 28.08 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992;*

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- *Threatened wildlife under the Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
  - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
  - Category R areas on the regulated vegetation management map;
  - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
  - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0 ha	0.0%
1b Protected Areas- nature refuges	0 ha	0.0%
1c Protected Areas- special wildlife reserves	0 ha	0.0%
2 State Marine Parks- highly protected zones	0 ha	0.0%
3 Fish habitat areas (A and B areas)	0 ha	0.0%
4 Strategic Environmental Areas (SEA)	0 ha	0.0%
5 High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values	0 ha	0.0%
6a High Ecological Value (HEV) wetlands	0 ha	
6b High Ecological Value (HEV) waterways	0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	13.19 ha	47.0%
7b Special least concern animals	0 ha	0.0%
7c i Koala habitat area - core (SEQ)	0 ha	0.0%
7c ii Koala habitat area - locally refined (SEQ)	0 ha	0.0%
7d Sea turtle nesting areas	0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0 ha	0.0%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0 ha	0.0%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0 ha	0.0%
8d Regulated Vegetation - Essential habitat	13.19 ha	47.0%
8e Regulated Vegetation - intersecting a watercourse	0.8 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0 ha	0.0%
9a Legally secured offset areas- offset register areas	0 ha	0.0%
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0 ha	0.0%

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(No results)

1b. Protected Areas - nature refuges

(No results)

1c. Protected Areas - special wildlife reserves

(No results)

2. State Marine Parks - highly protected zones

(No results)

3. Fish habitat areas (A and B areas)

(No results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(No results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii	Keys boronia	V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Euastacus bindal	Mount Elliot crayfish	CR	None
Euastacus binzayedi		CR	None
Euastacus eungella		E	None
Euastacus hystricosus		E	None
Euastacus jagara	Jagara hairy crayfish	CR	None
Euastacus maidae		CR	None
Euastacus monteithorum		E	None
Euastacus robertsi		E	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Melaleuca irbyana	swamp tea-tree	E	None
Macadamia ternifolia		V	None
Macadamia tetraphylla	bopple nut	V	None
Petrogale penicillata	brush-tailed rock-wallaby	V	None
Petrogale coenensis	Cape York rock-wallaby	E	None
Petrogale purpureicollis	purple-necked rock-wallaby	V	Core
Petrogale sharmani	Sharmans rock-wallaby	V	None
Petrogale xanthopus celeris	yellow-footed rock-wallaby (Qld subspecies)	V	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

(No results)

Special least concern animal species records

(No results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

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8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

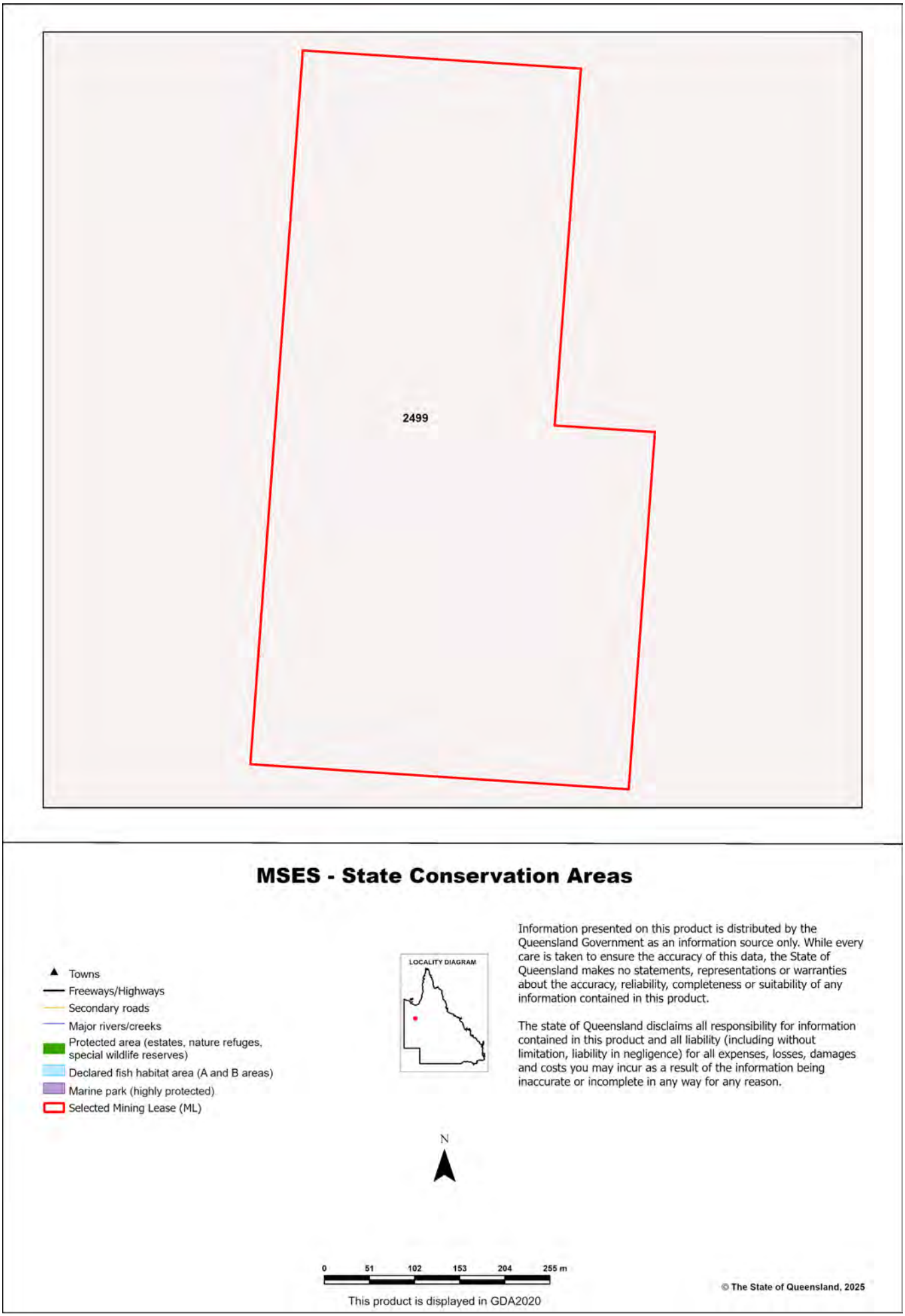
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9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

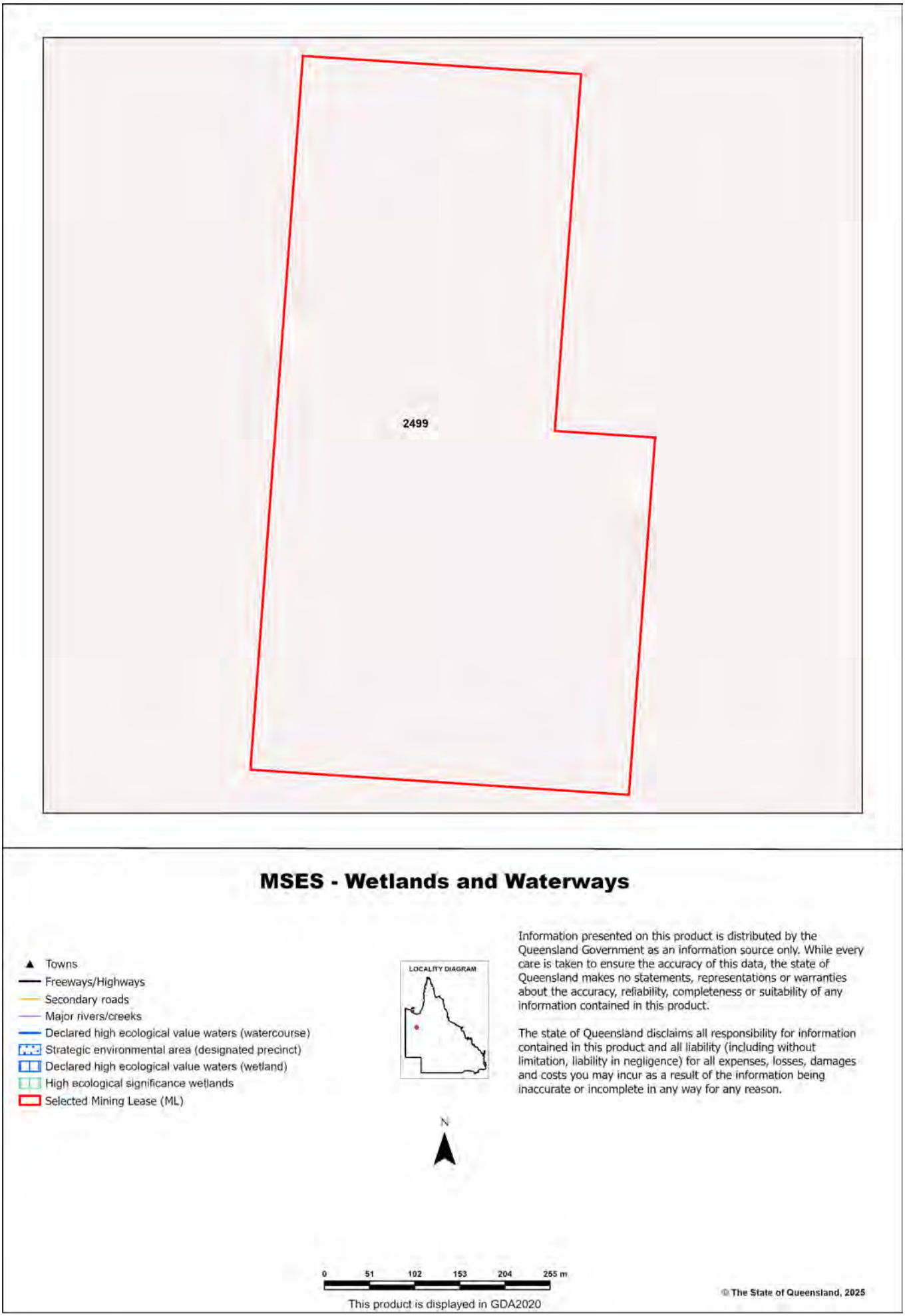
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Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

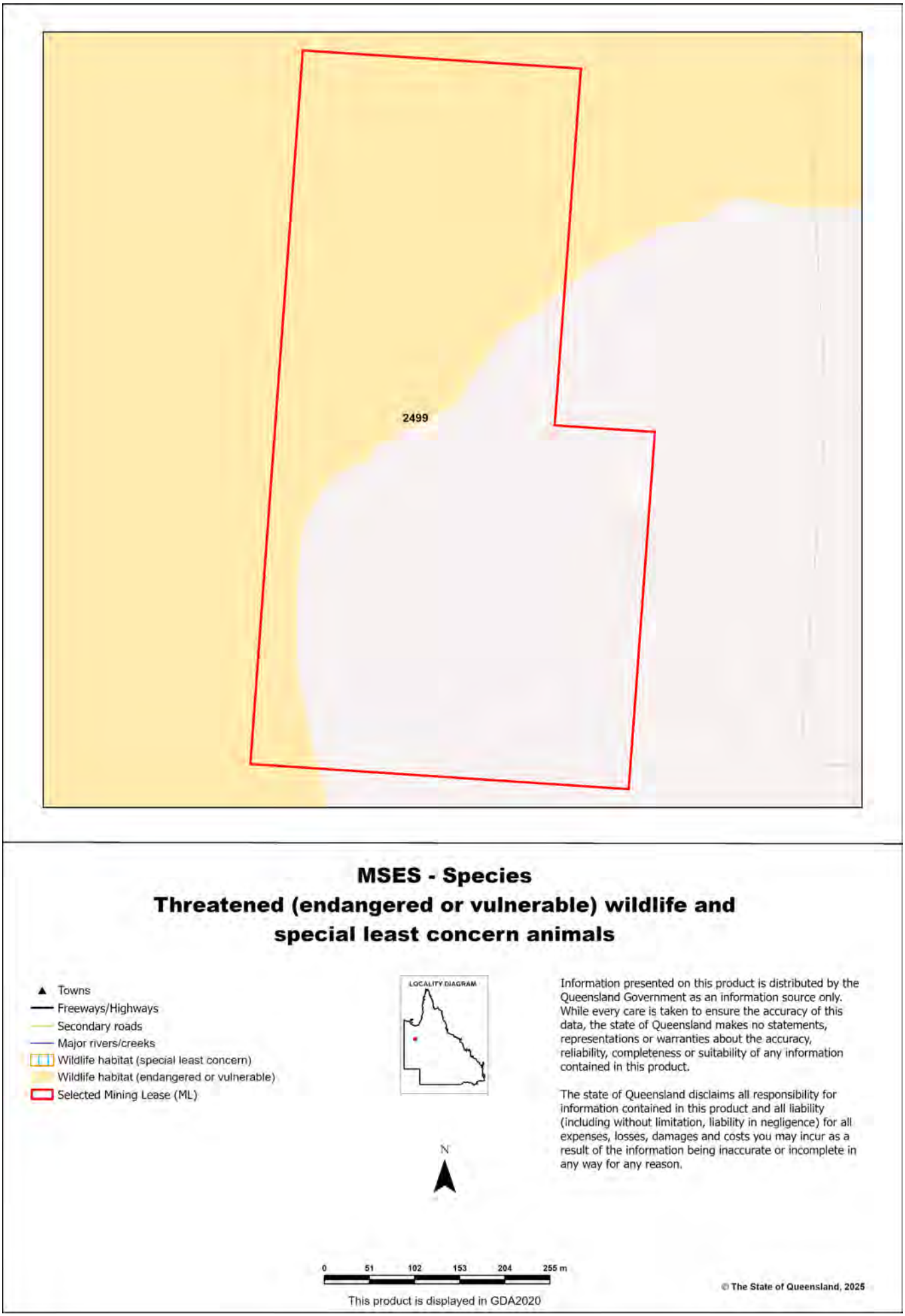
Map 1 - MSES - State Conservation Areas



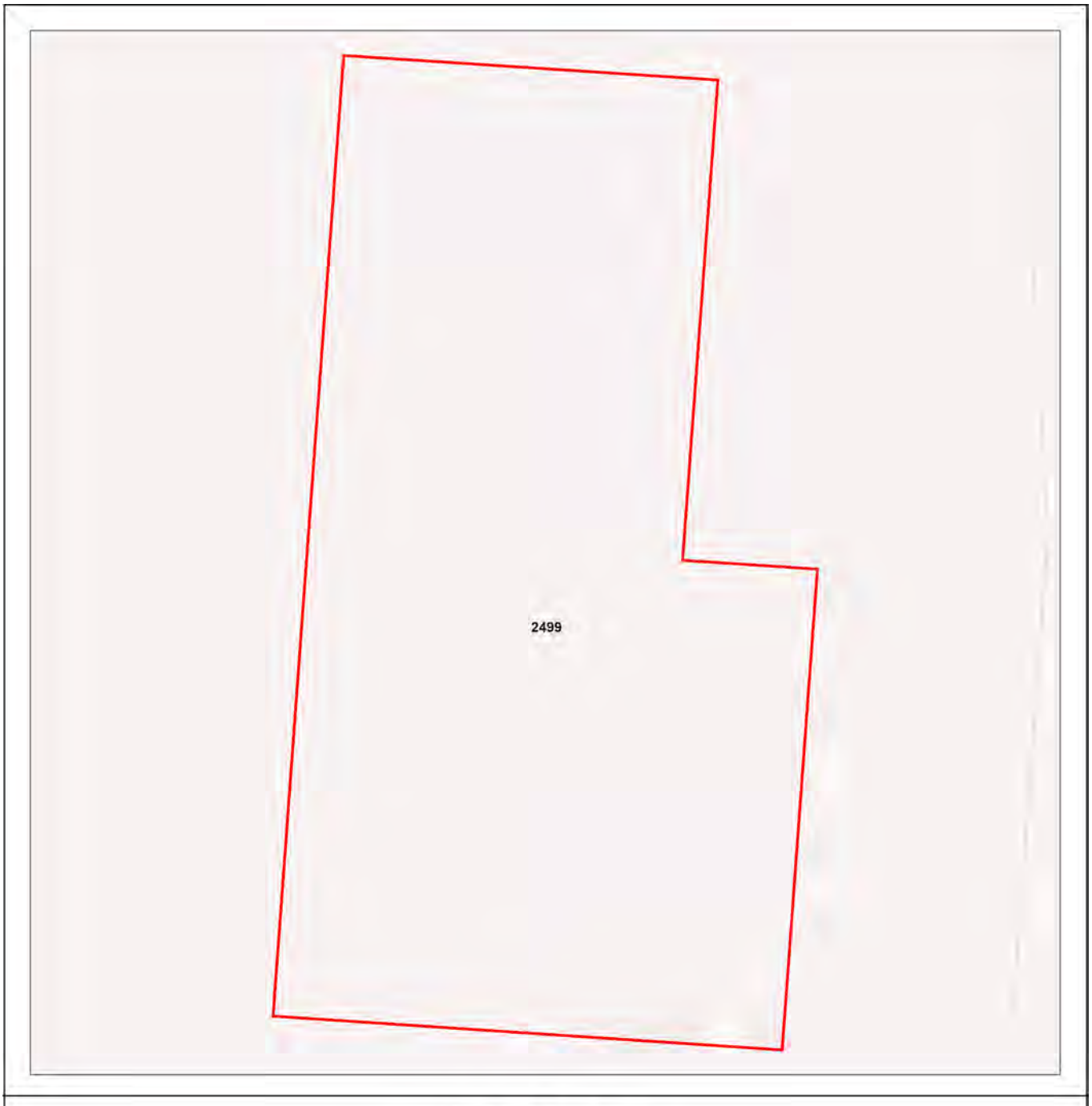
Map 2 - MSES - Wetlands and Waterways



Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



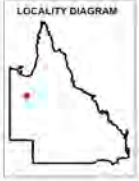
Map 3b - MSES - Species - Koala habitat area (SEQ)



MSES - Species
Koala habitat area (SEQ)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
- Koala habitat area (locally refined)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



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The represented layers for SEQ 'koala habitat area-core' and 'koala habitat area- locally refined' in MSES are sourced directly from the regulatory mapping under the Nature Conservation (Koala) Conservation Plan 2017. Whilst every effort is made to ensure the information remains current, there may be delays between updating versions. Please refer to the original mapping for the most recent version. See https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

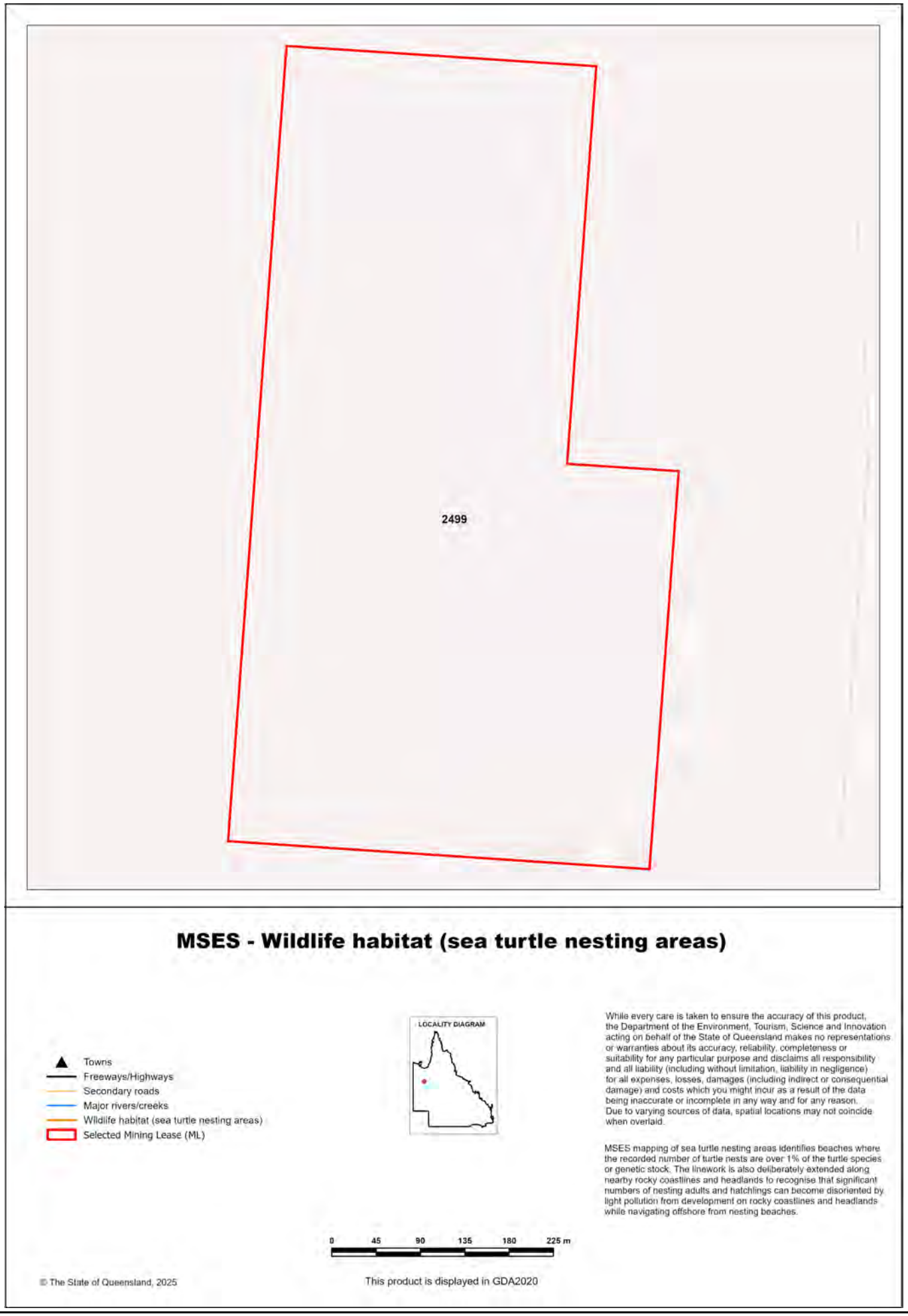
The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

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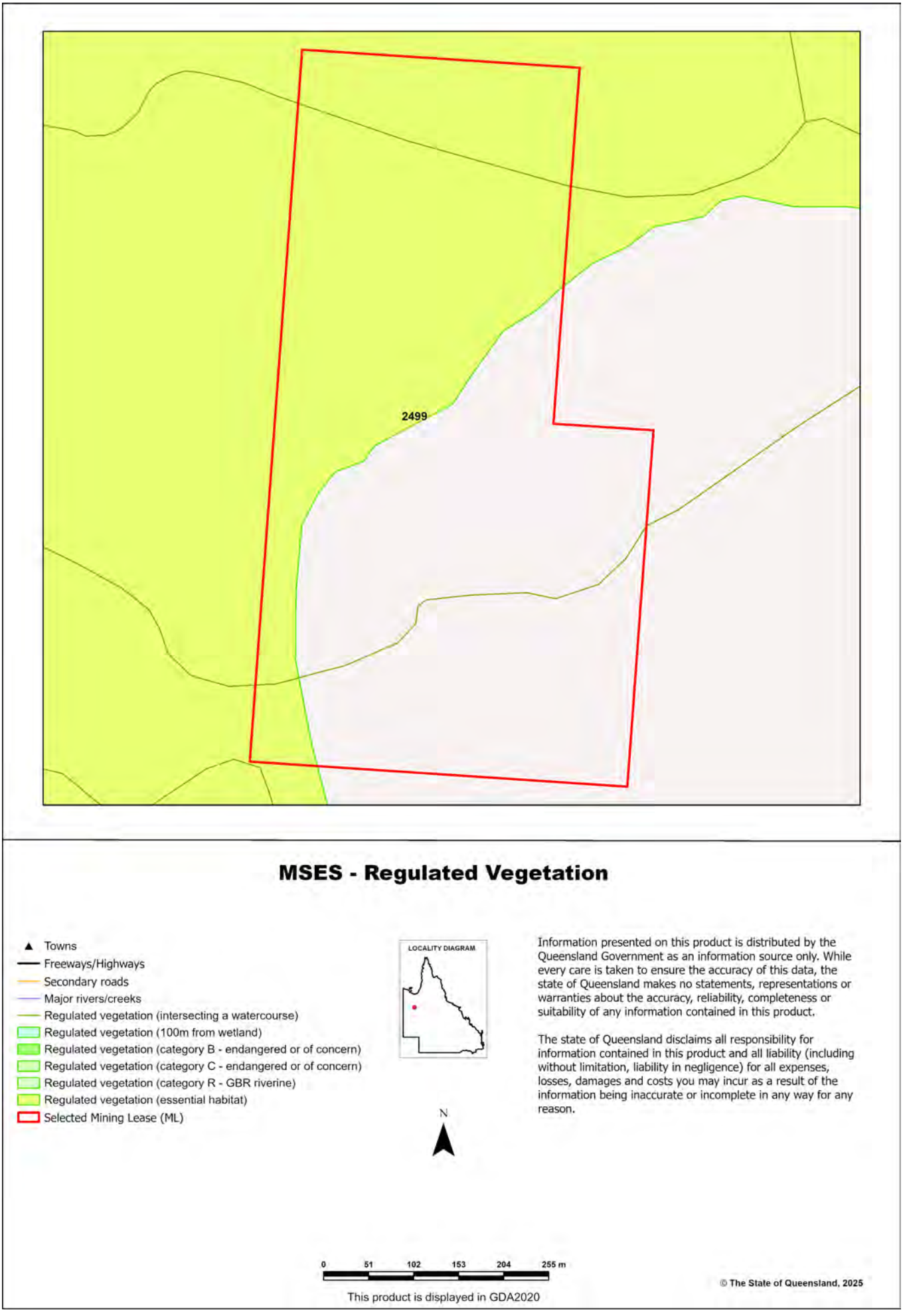
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This product is displayed in GDA2020

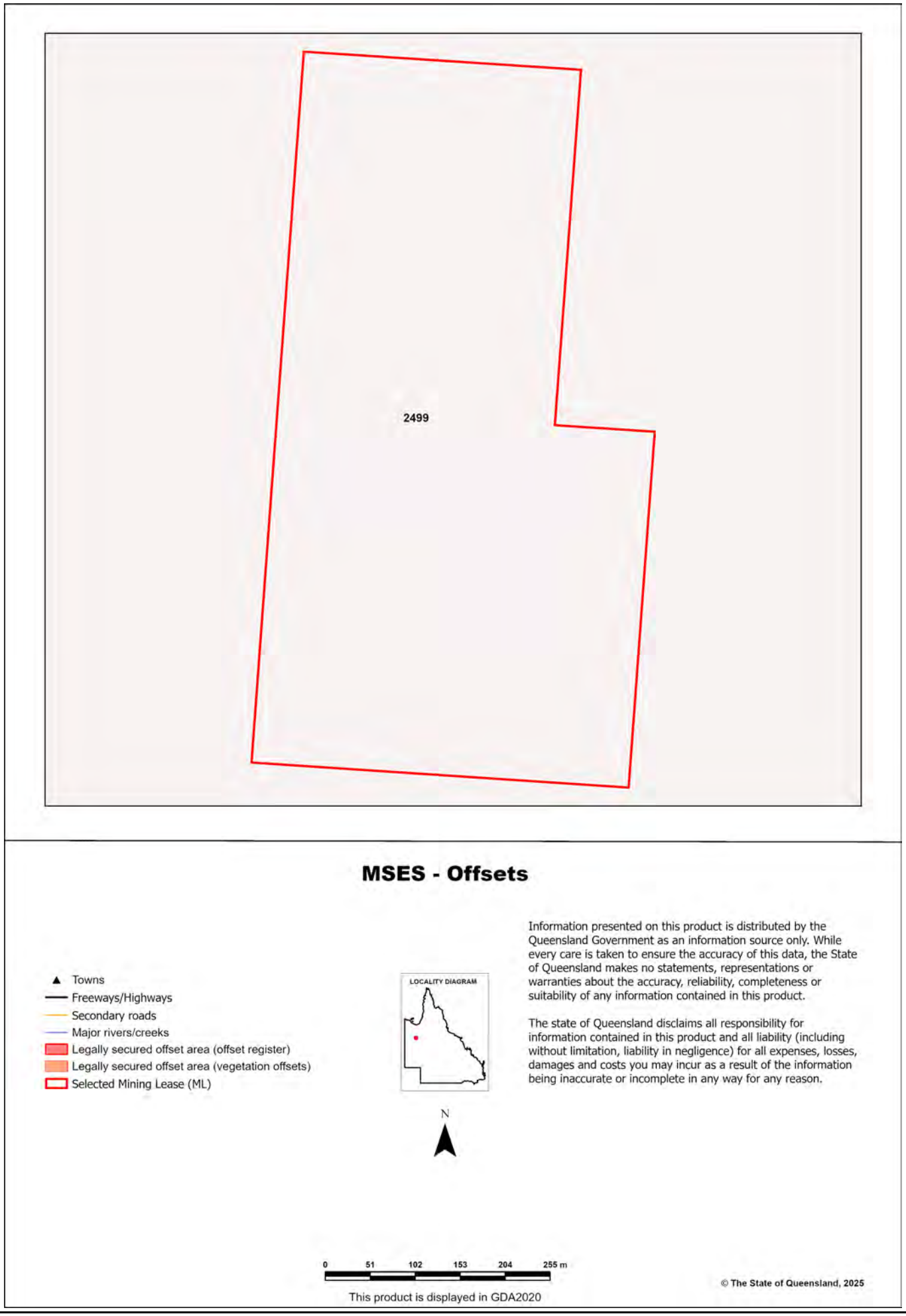
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). Its primary purpose is to support implementation of the SPP biodiversity policy.

MSES mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

MSES mapping does not determine whether state or local development assessment is required. For state assessment triggers refer to the Development Assessment Mapping System (DAMS). For local assessment triggers, refer to the relevant local planning scheme.

The Queensland Government's "Method for mapping - matters of state environmental significance can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DETSI
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DETSI	- Department of the Environment, Tourism, Science and Innovation
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA2020	- Geocentric Datum of Australia 2020
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

ML: 2470

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and a field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@detsi.qld.gov.au

Disclaimer

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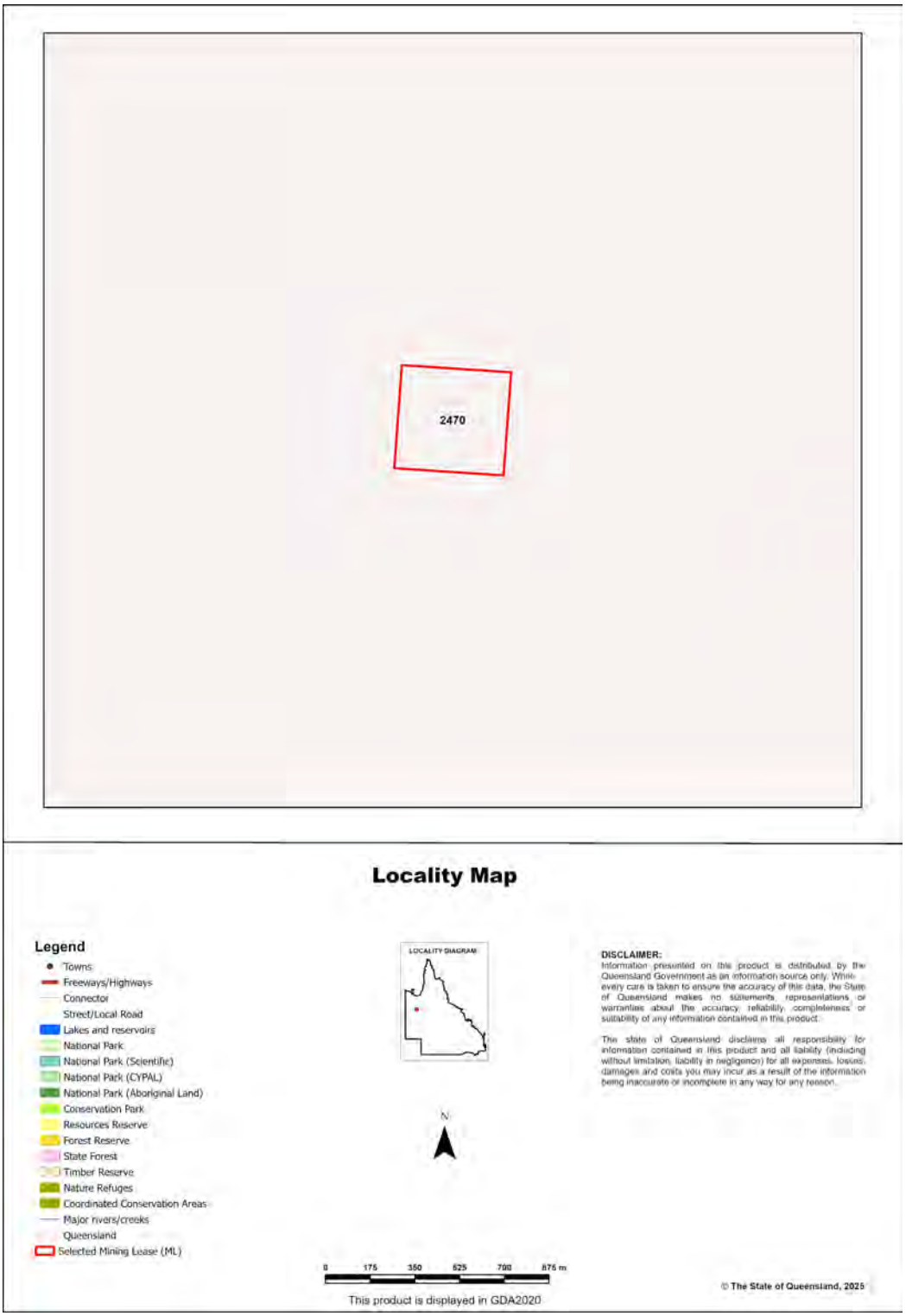
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: ML: 2470, with area 16.19 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992;*

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- *Threatened wildlife under the Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
  - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
  - Category R areas on the regulated vegetation management map;
  - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
  - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0 ha	0.0%
1b Protected Areas- nature refuges	0 ha	0.0%
1c Protected Areas- special wildlife reserves	0 ha	0.0%
2 State Marine Parks- highly protected zones	0 ha	0.0%
3 Fish habitat areas (A and B areas)	0 ha	0.0%
4 Strategic Environmental Areas (SEA)	0 ha	0.0%
5 High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values	0 ha	0.0%
6a High Ecological Value (HEV) wetlands	0 ha	
6b High Ecological Value (HEV) waterways	0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	5.67 ha	35.0%
7b Special least concern animals	0 ha	0.0%
7c i Koala habitat area - core (SEQ)	0 ha	0.0%
7c ii Koala habitat area - locally refined (SEQ)	0 ha	0.0%
7d Sea turtle nesting areas	0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0 ha	0.0%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0 ha	0.0%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0 ha	0.0%
8d Regulated Vegetation - Essential habitat	5.67 ha	35.0%
8e Regulated Vegetation - intersecting a watercourse	0.9 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0 ha	0.0%
9a Legally secured offset areas- offset register areas	0 ha	0.0%
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0 ha	0.0%

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(No results)

1b. Protected Areas - nature refuges

(No results)

1c. Protected Areas - special wildlife reserves

(No results)

2. State Marine Parks - highly protected zones

(No results)

3. Fish habitat areas (A and B areas)

(No results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(No results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii	Keys boronia	V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Euastacus bindal	Mount Elliot crayfish	CR	None
Euastacus binzayedi		CR	None
Euastacus eungella		E	None
Euastacus hystricosus		E	None
Euastacus jagara	Jagara hairy crayfish	CR	None
Euastacus maidae		CR	None
Euastacus monteithorum		E	None
Euastacus robertsi		E	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Melaleuca irbyana	swamp tea-tree	E	None
Macadamia ternifolia		V	None
Macadamia tetraphylla	bopple nut	V	None
Petrogale penicillata	brush-tailed rock-wallaby	V	None
Petrogale coenensis	Cape York rock-wallaby	E	None
Petrogale purpureicollis	purple-necked rock-wallaby	V	Core
Petrogale sharmani	Sharmans rock-wallaby	V	None
Petrogale xanthopus celeris	yellow-footed rock-wallaby (Qld subspecies)	V	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

(No results)

Special least concern animal species records

(No results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

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Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

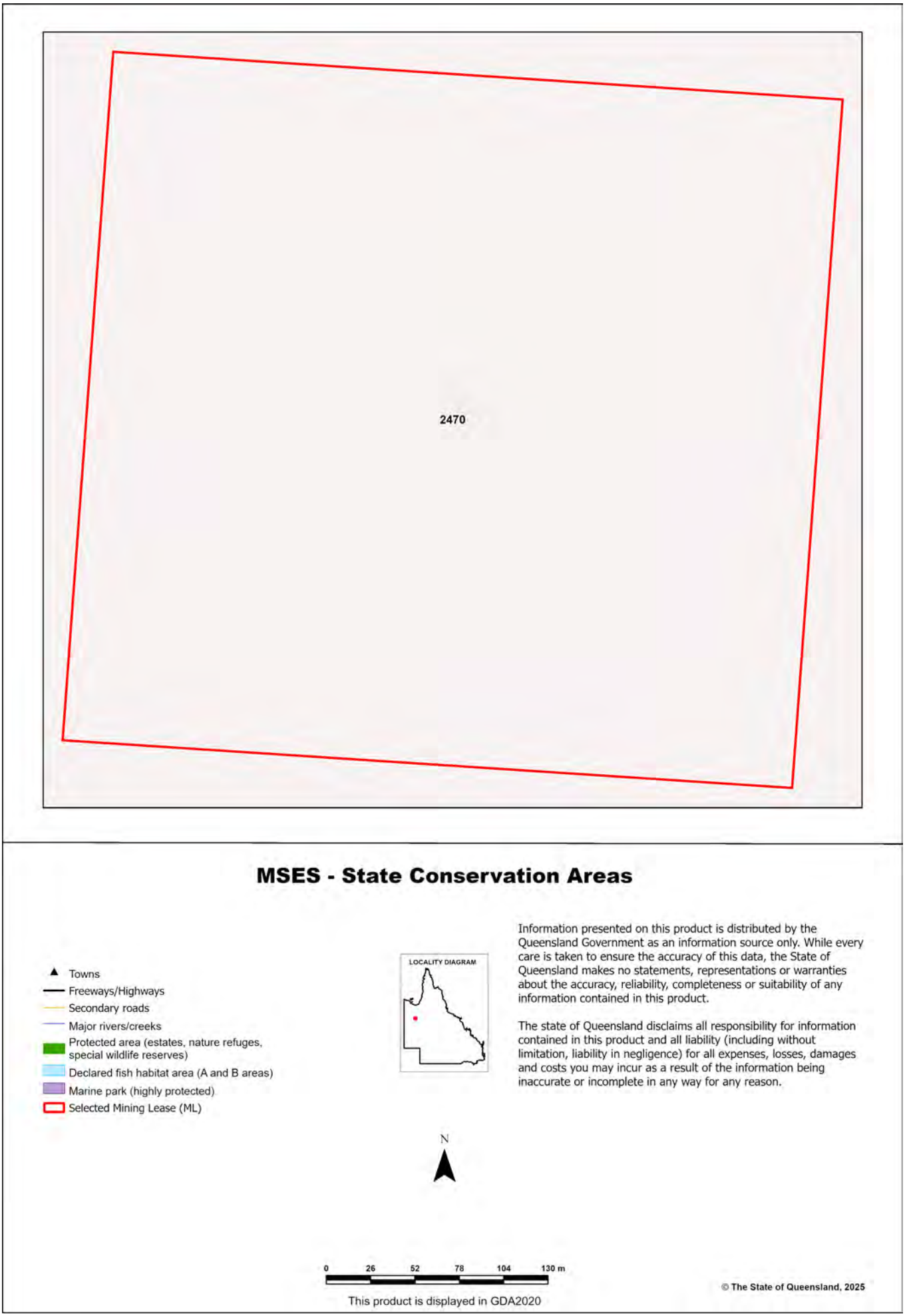
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9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

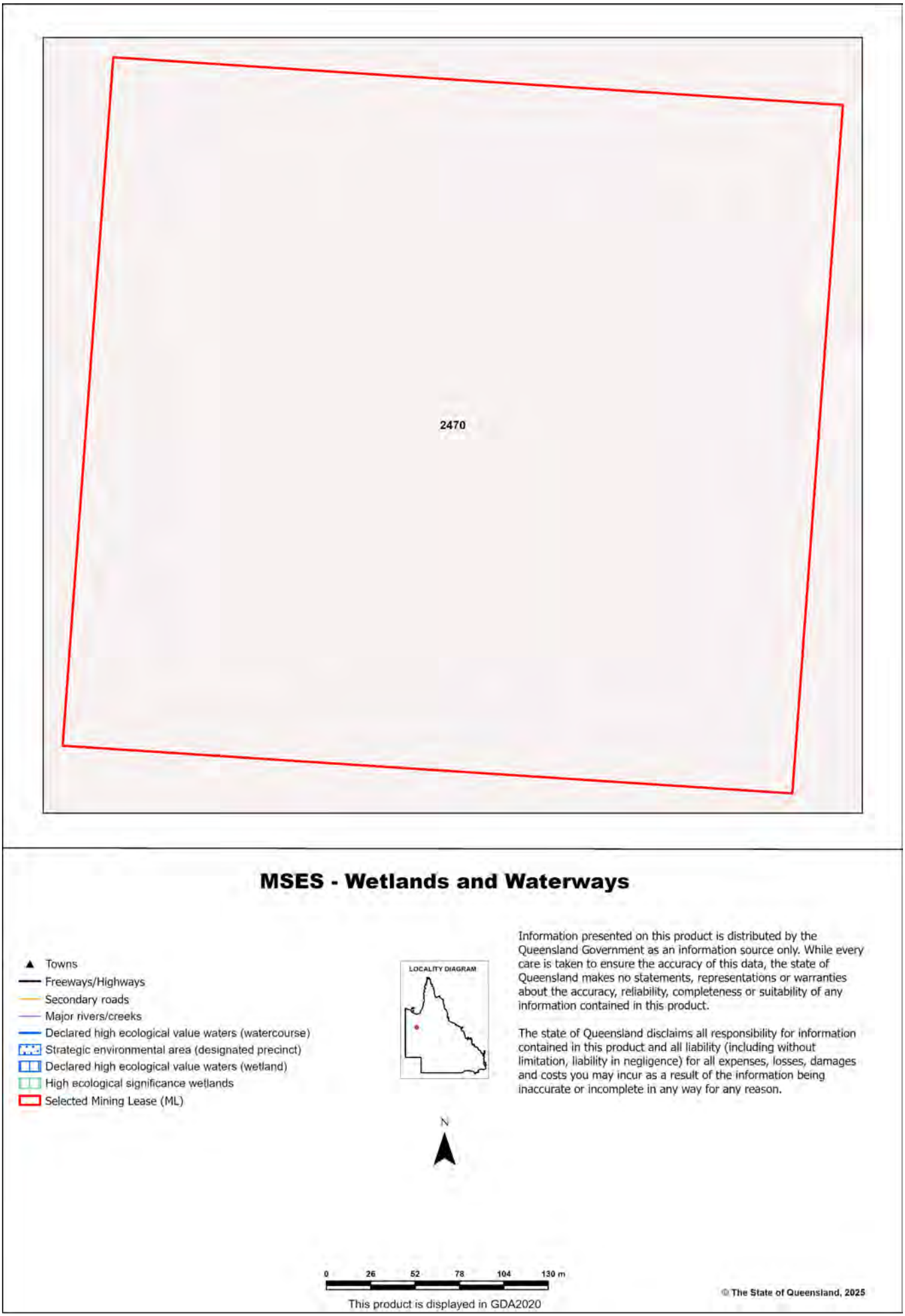
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Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

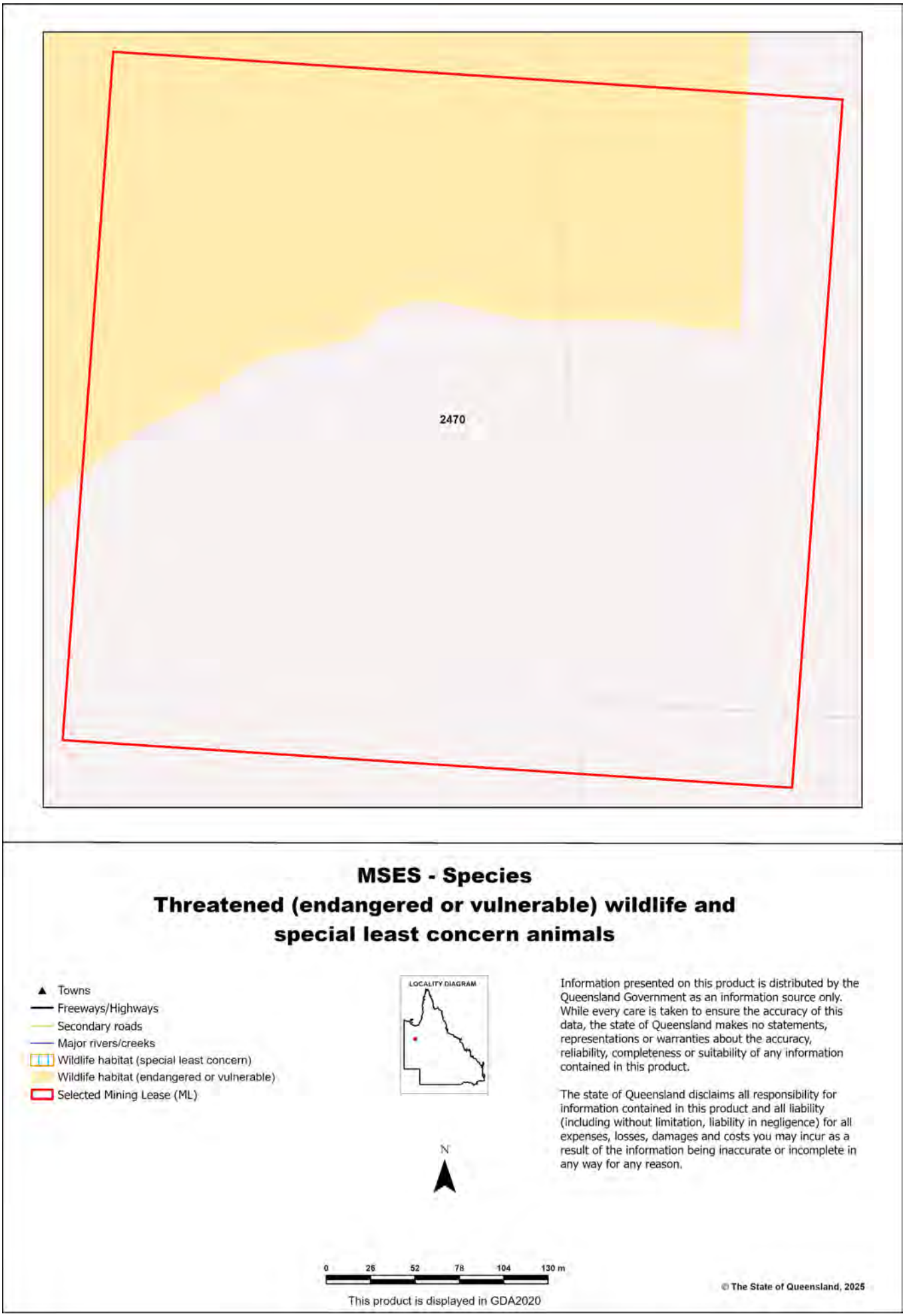
Map 1 - MSES - State Conservation Areas



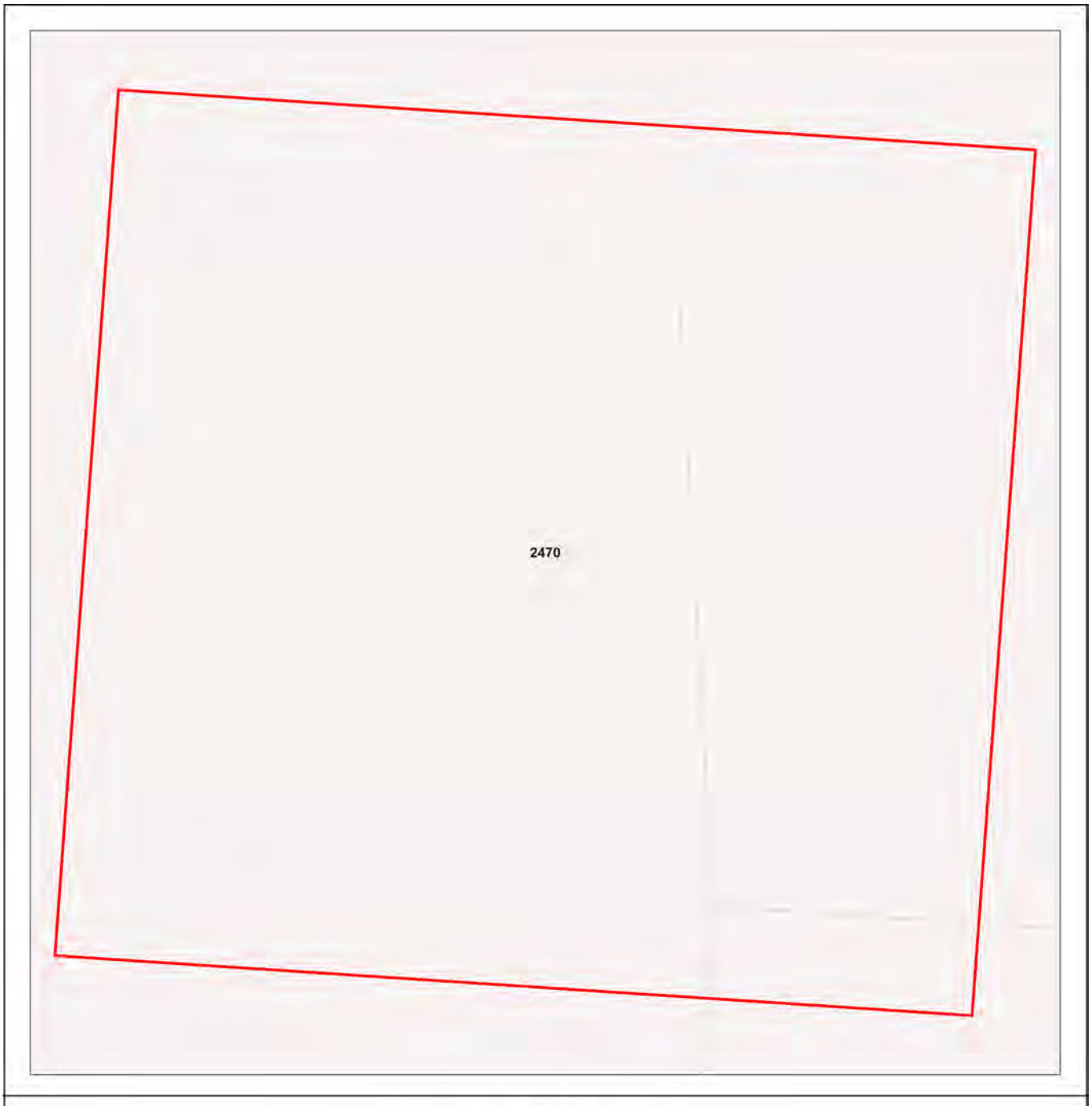
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Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



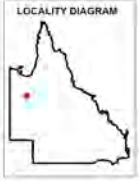
Map 3b - MSES - Species - Koala habitat area (SEQ)



MSES - Species
Koala habitat area (SEQ)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
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- Selected Mining Lease (ML)

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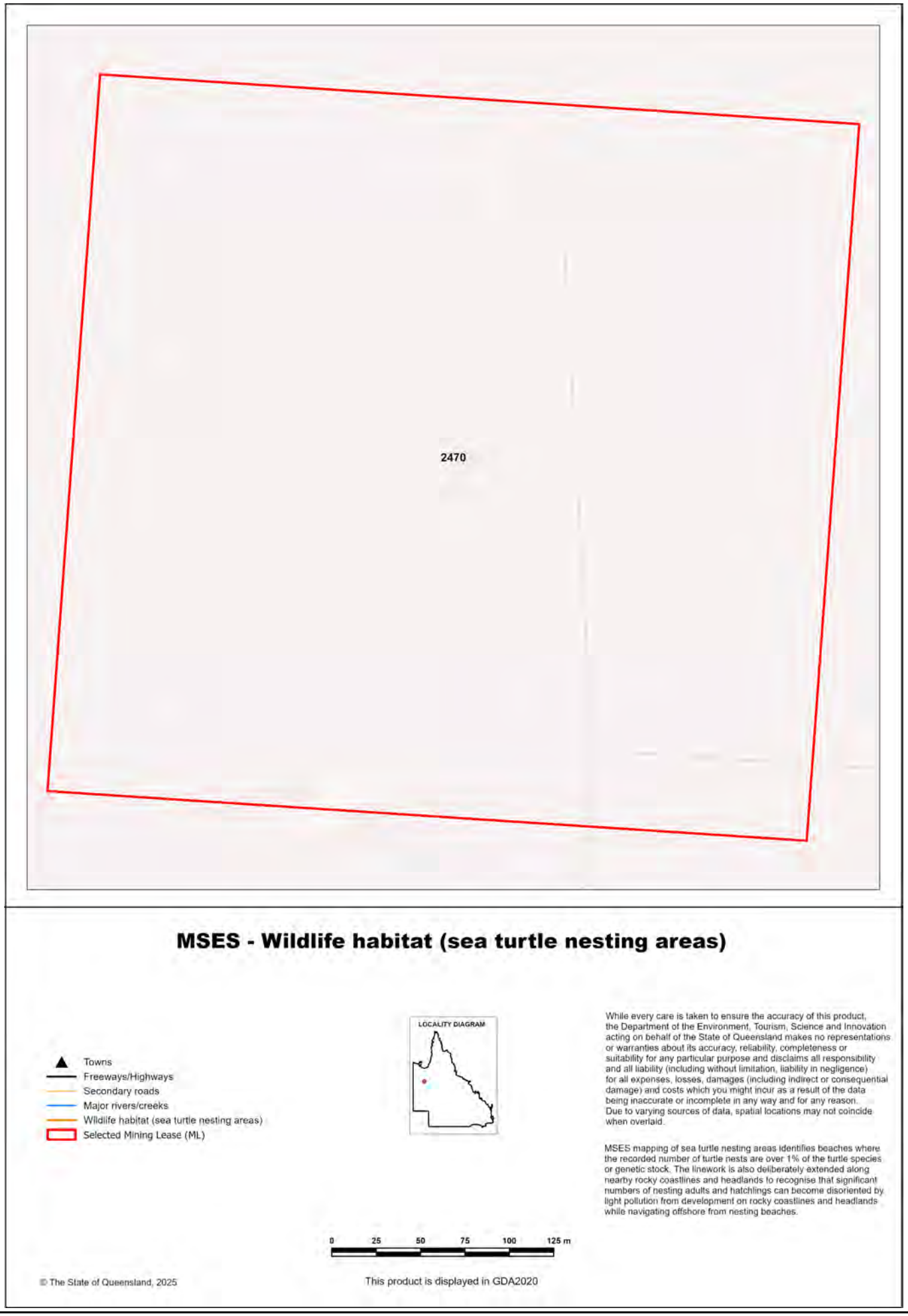
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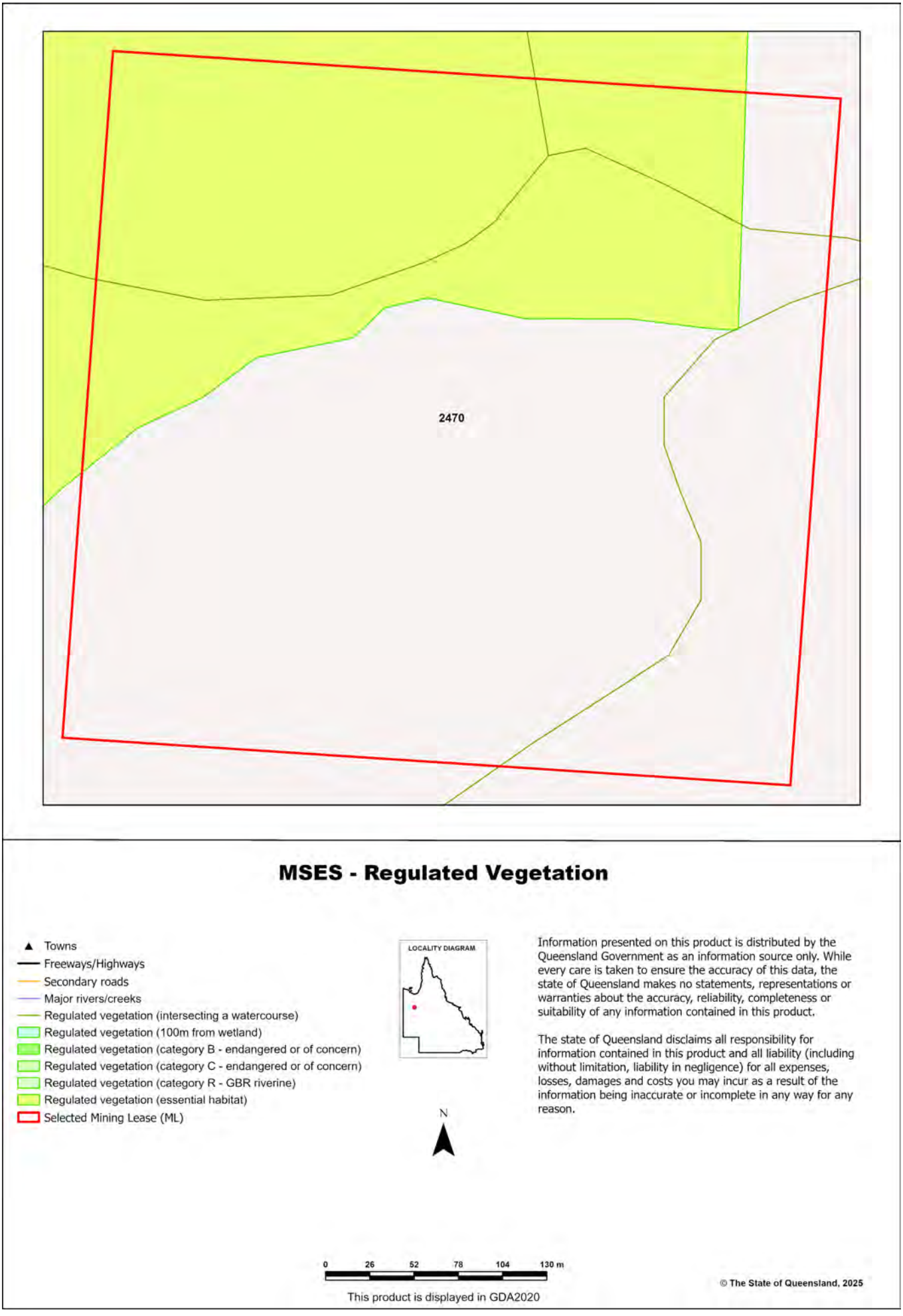
This product is displayed in GDA2020

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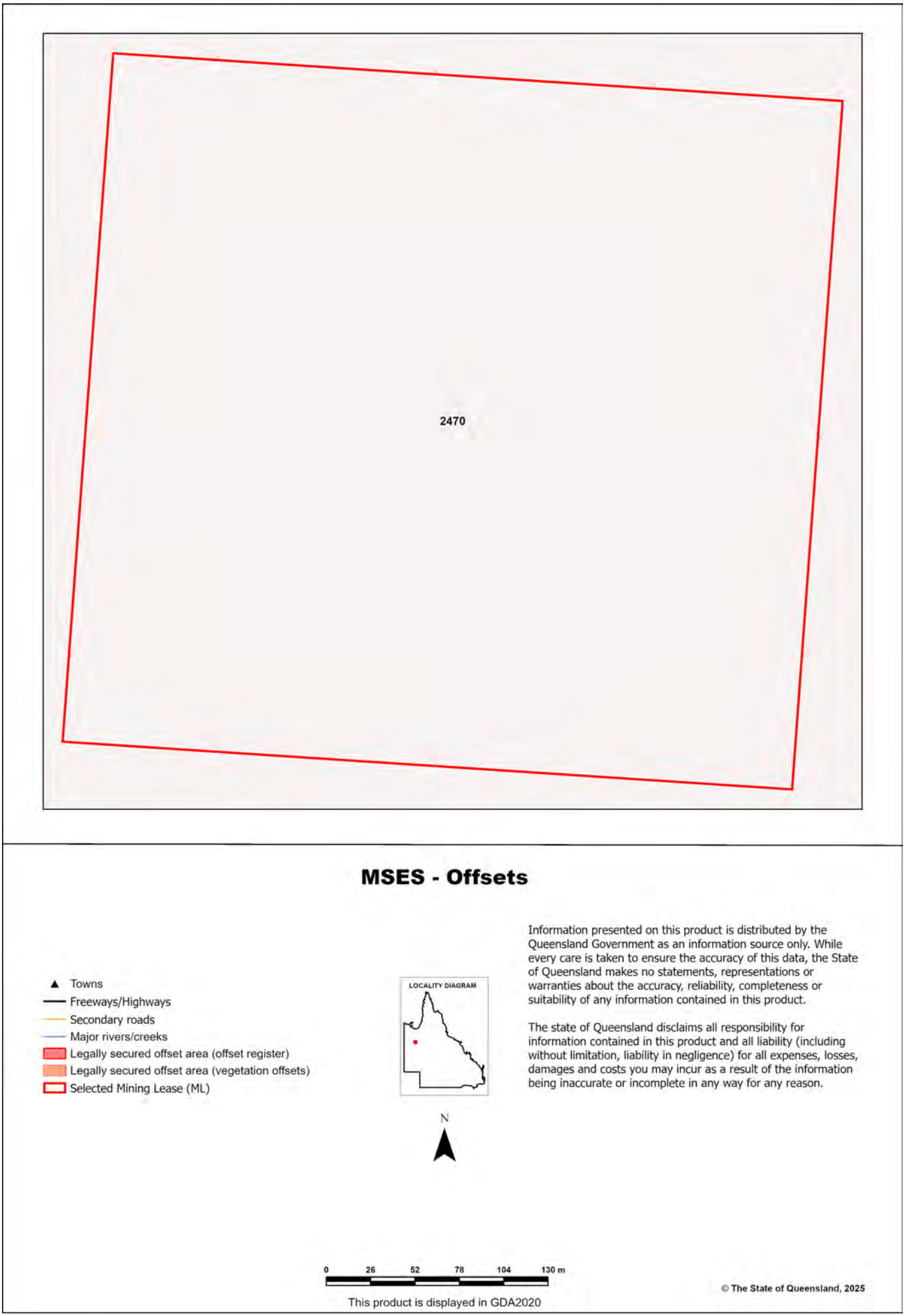
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). Its primary purpose is to support implementation of the SPP biodiversity policy.

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- Matters of State environmental significance

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Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DETSI	- Department of the Environment, Tourism, Science and Innovation
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA2020	- Geocentric Datum of Australia 2020
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

ML: 2601

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

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The information presented in this report should be considered as a guide only and a field survey may be required to validate values on the ground.

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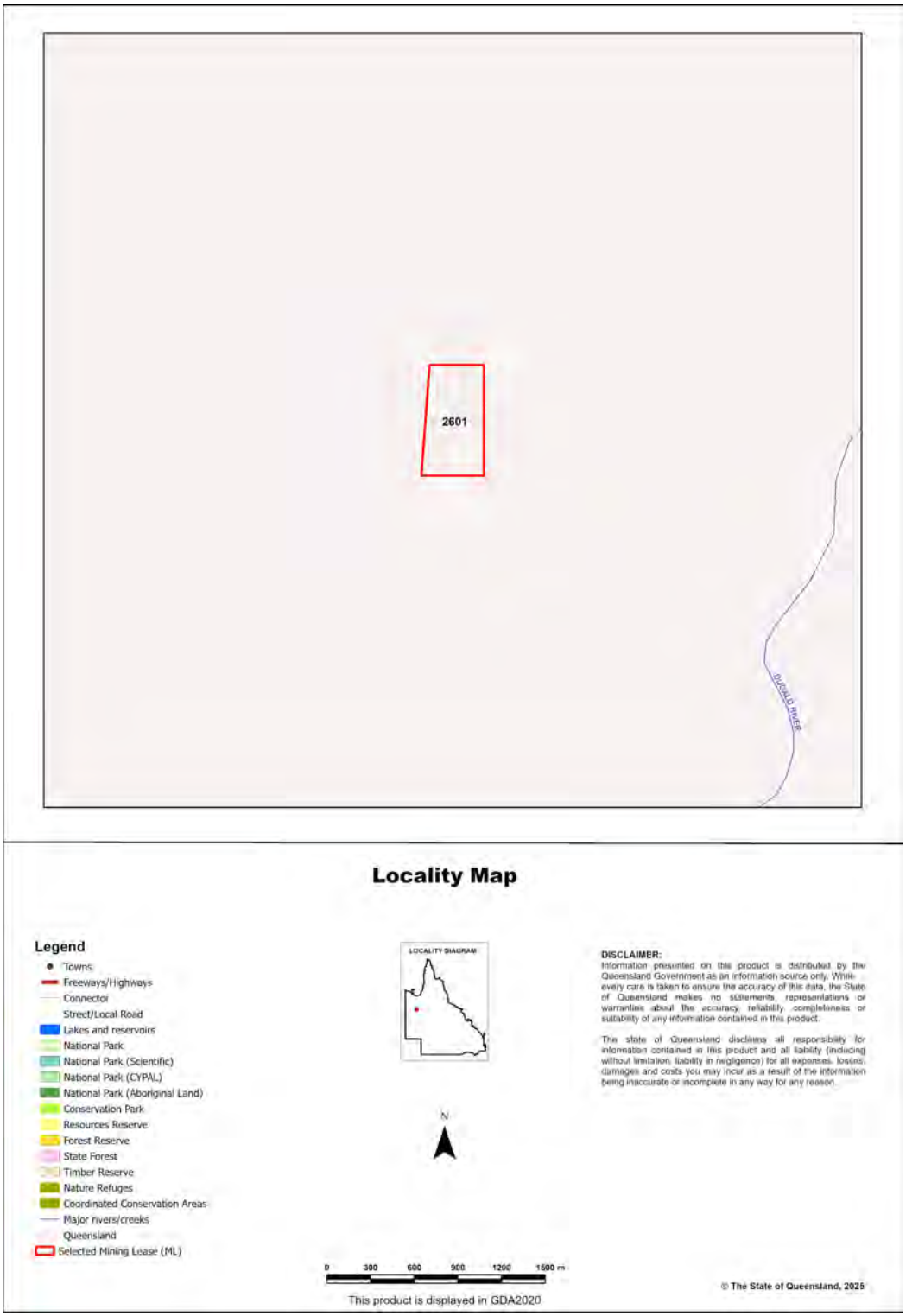
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: ML: 2601, with area 28.5 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992;*

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- *Threatened wildlife under the Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
  - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
  - Category R areas on the regulated vegetation management map;
  - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
  - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0 ha	0.0%
1b Protected Areas- nature refuges	0 ha	0.0%
1c Protected Areas- special wildlife reserves	0 ha	0.0%
2 State Marine Parks- highly protected zones	0 ha	0.0%
3 Fish habitat areas (A and B areas)	0 ha	0.0%
4 Strategic Environmental Areas (SEA)	0 ha	0.0%
5 High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values	0 ha	0.0%
6a High Ecological Value (HEV) wetlands	0 ha	
6b High Ecological Value (HEV) waterways	0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	0 ha	0.0%
7b Special least concern animals	0 ha	0.0%
7c i Koala habitat area - core (SEQ)	0 ha	0.0%
7c ii Koala habitat area - locally refined (SEQ)	0 ha	0.0%
7d Sea turtle nesting areas	0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0 ha	0.0%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0 ha	0.0%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0 ha	0.0%
8d Regulated Vegetation - Essential habitat	0 ha	0.0%
8e Regulated Vegetation - intersecting a watercourse	0.7 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0 ha	0.0%
9a Legally secured offset areas- offset register areas	0 ha	0.0%
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0 ha	0.0%

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(No results)

1b. Protected Areas - nature refuges

(No results)

1c. Protected Areas - special wildlife reserves

(No results)

2. State Marine Parks - highly protected zones

(No results)

3. Fish habitat areas (A and B areas)

(No results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(No results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Not applicable

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii	Keys boronia	V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Euastacus bindal	Mount Elliot crayfish	CR	None
Euastacus binzayedi		CR	None
Euastacus eungella		E	None
Euastacus hystricosus		E	None
Euastacus jagara	Jagara hairy crayfish	CR	None
Euastacus maidae		CR	None
Euastacus monteithorum		E	None
Euastacus robertsi		E	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Melaleuca irbyana	swamp tea-tree	E	None
Macadamia ternifolia		V	None
Macadamia tetraphylla	bopple nut	V	None
Petrogale penicillata	brush-tailed rock-wallaby	V	None
Petrogale coenensis	Cape York rock-wallaby	E	None
Petrogale purpureicollis	purple-necked rock-wallaby	V	None
Petrogale sharmani	Sharmans rock-wallaby	V	None
Petrogale xanthopus celeris	yellow-footed rock-wallaby (Qld subspecies)	V	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

(No results)

Special least concern animal species records

(No results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Not applicable

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

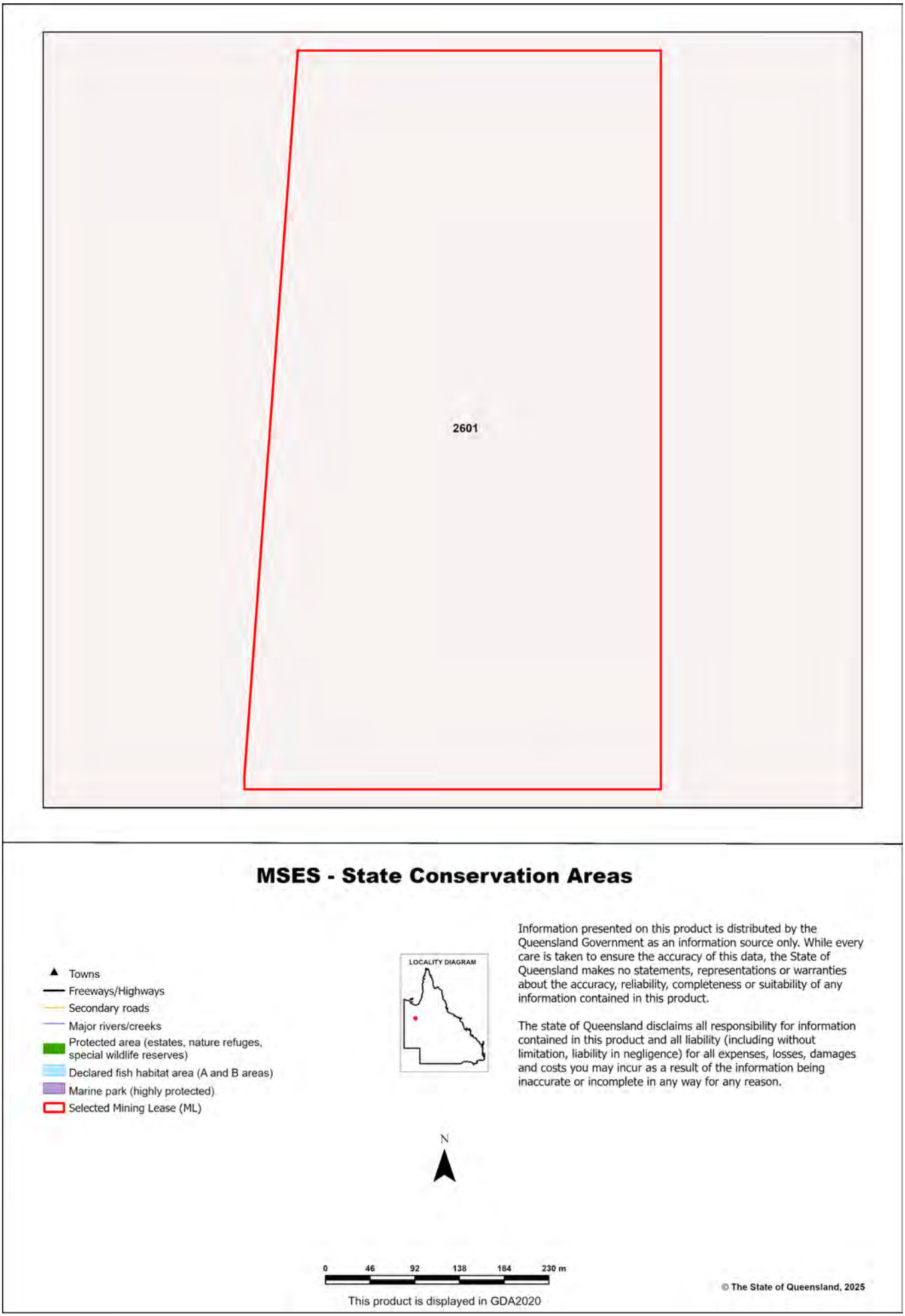
(No results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

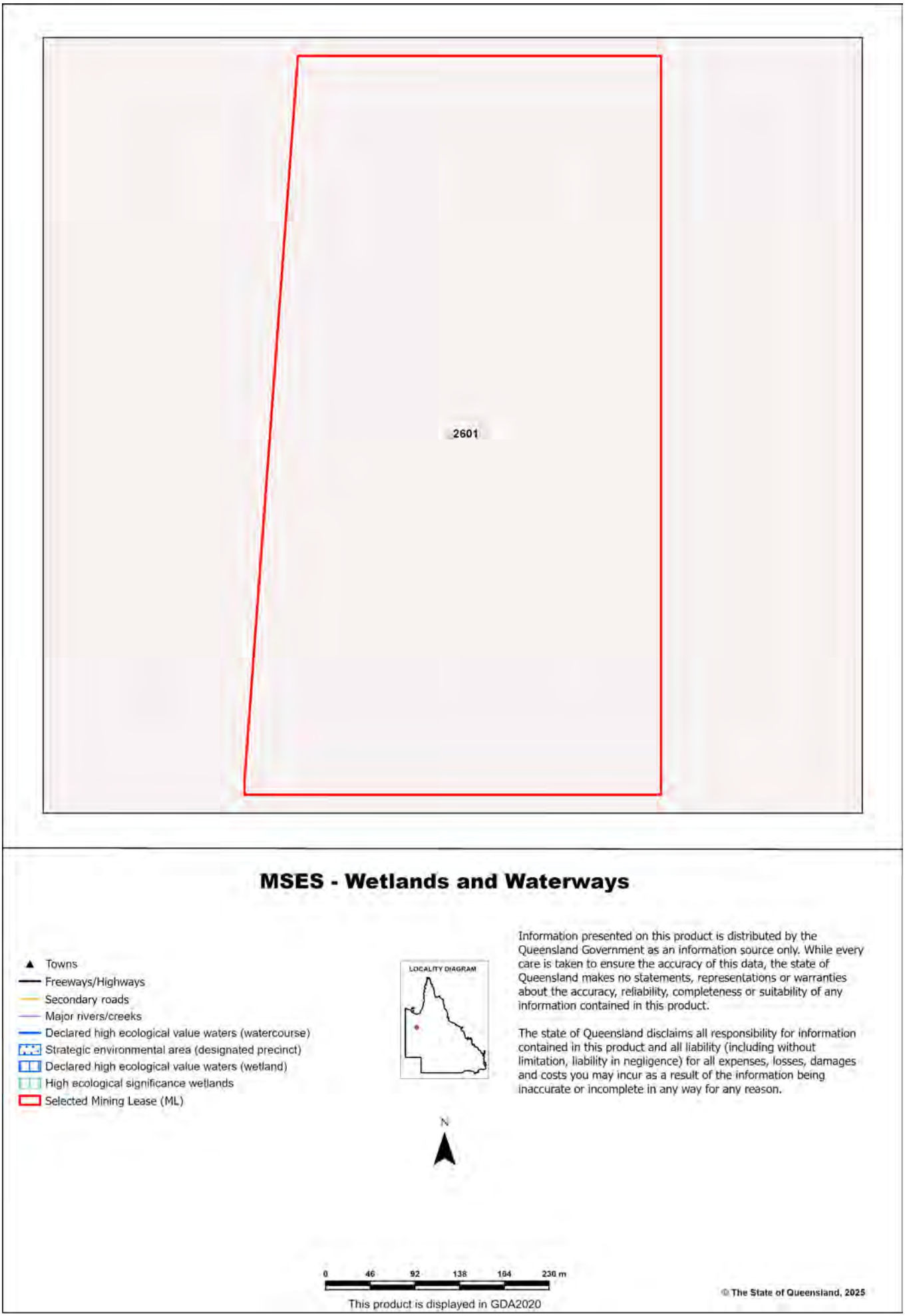
(No results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

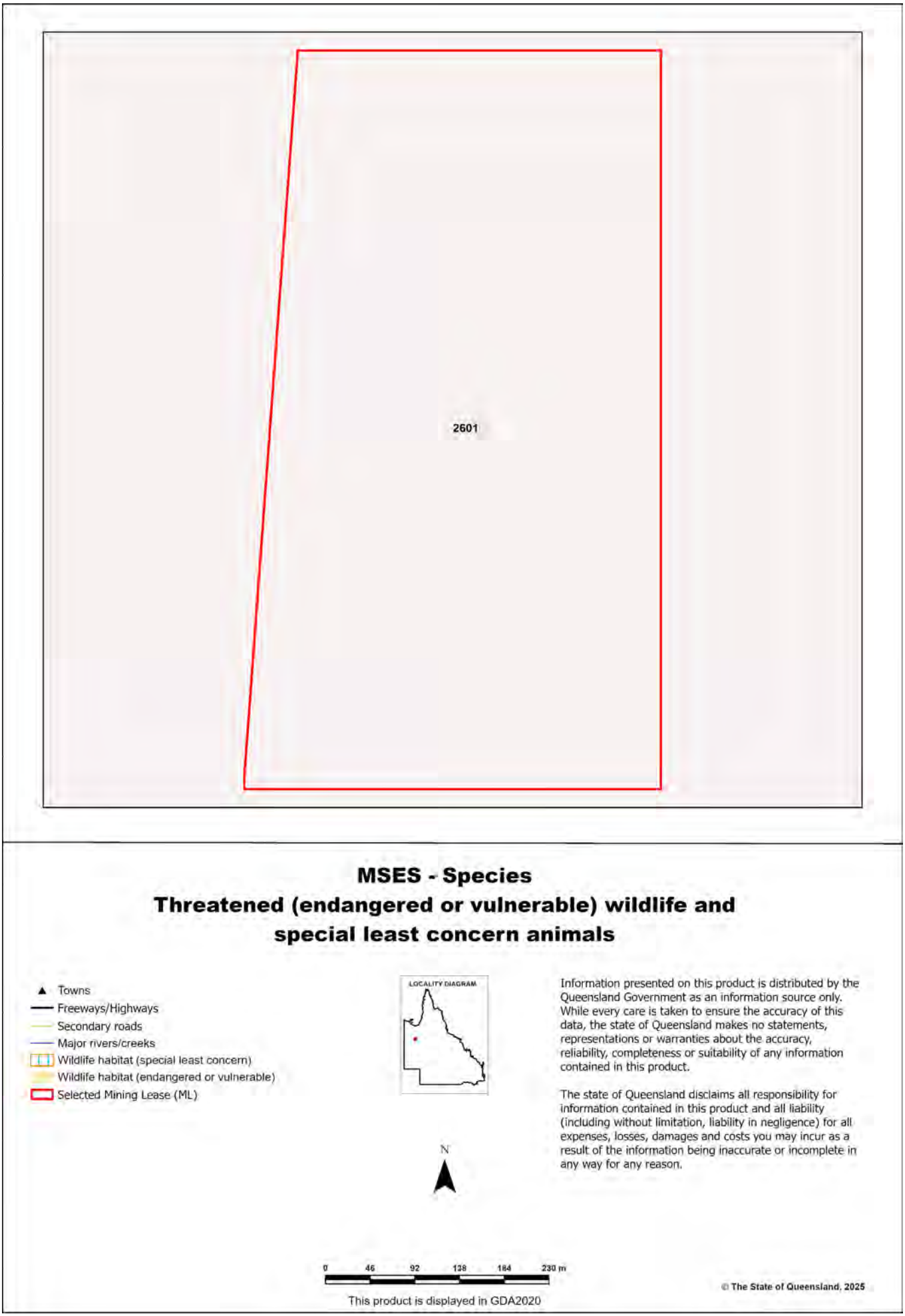
Map 1 - MSES - State Conservation Areas



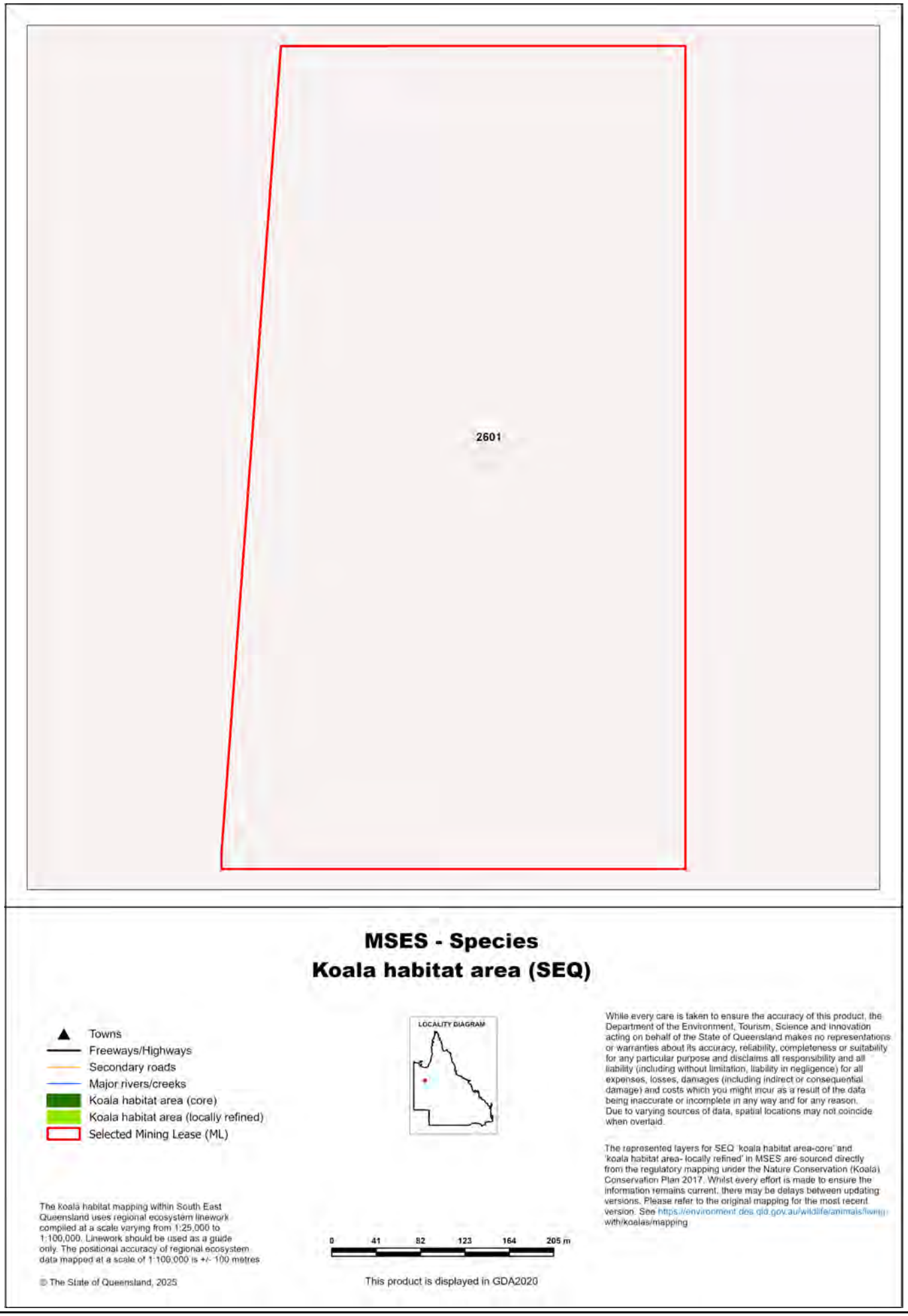
Map 2 - MSES - Wetlands and Waterways



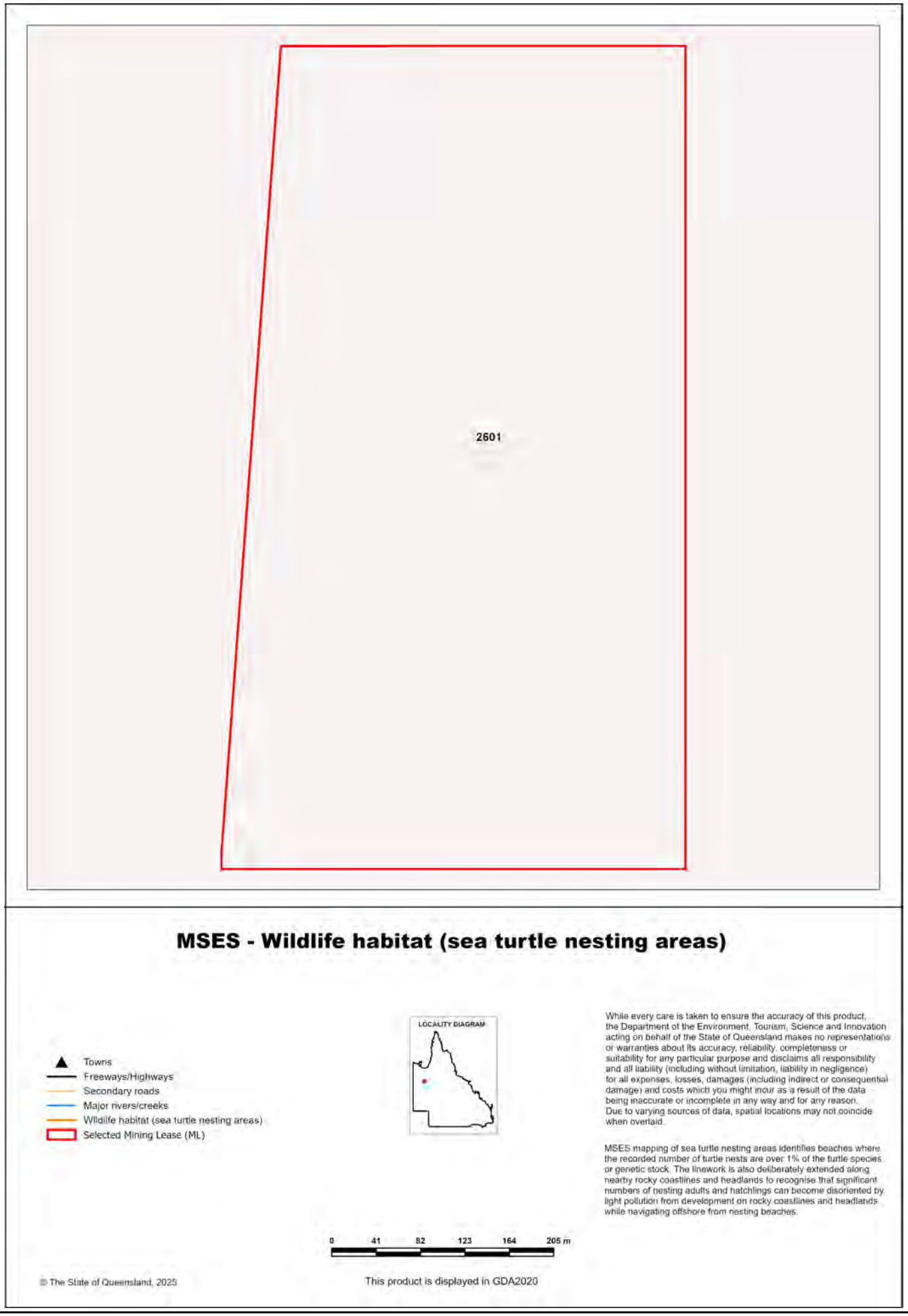
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



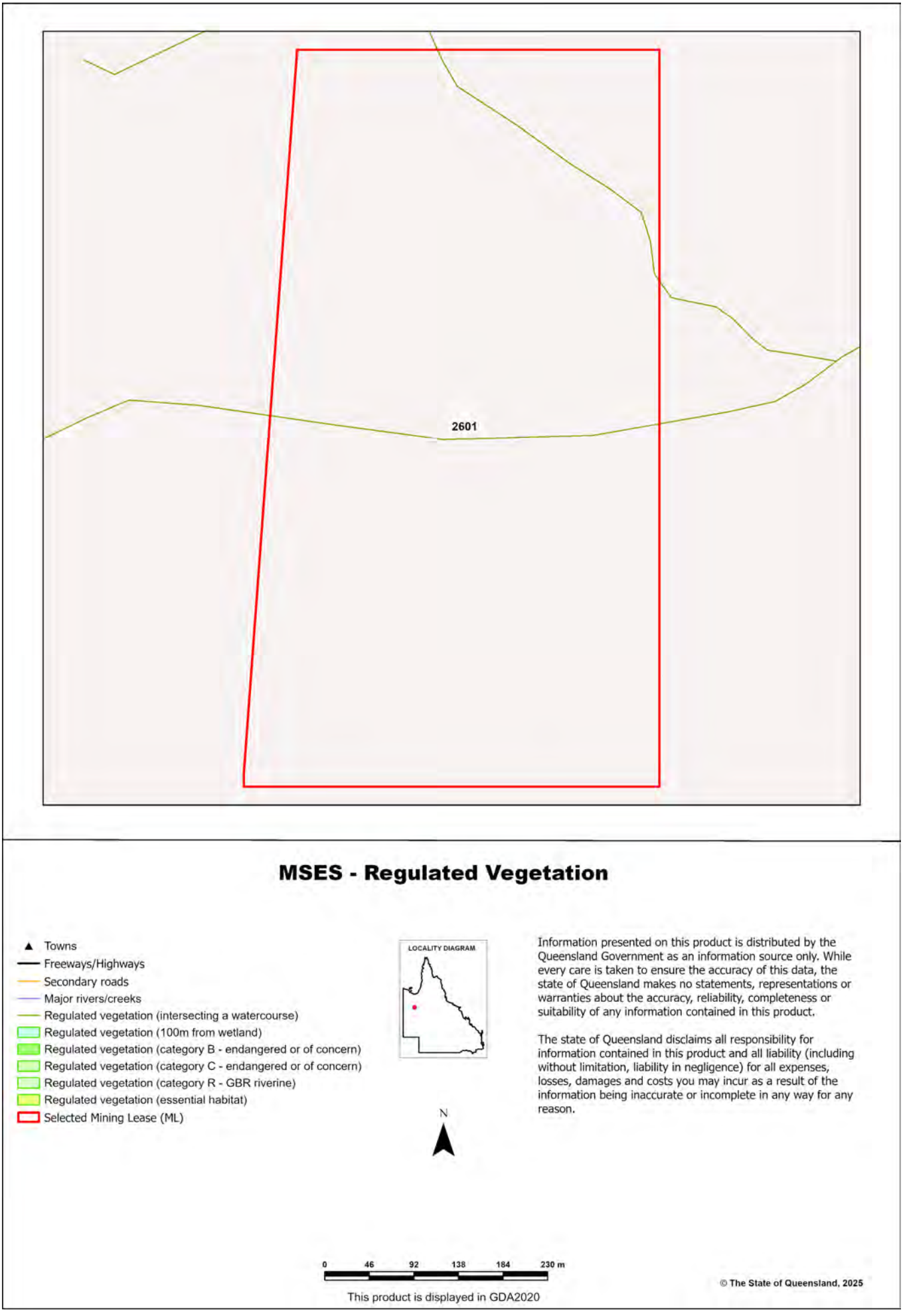
Map 3b - MSES - Species - Koala habitat area (SEQ)



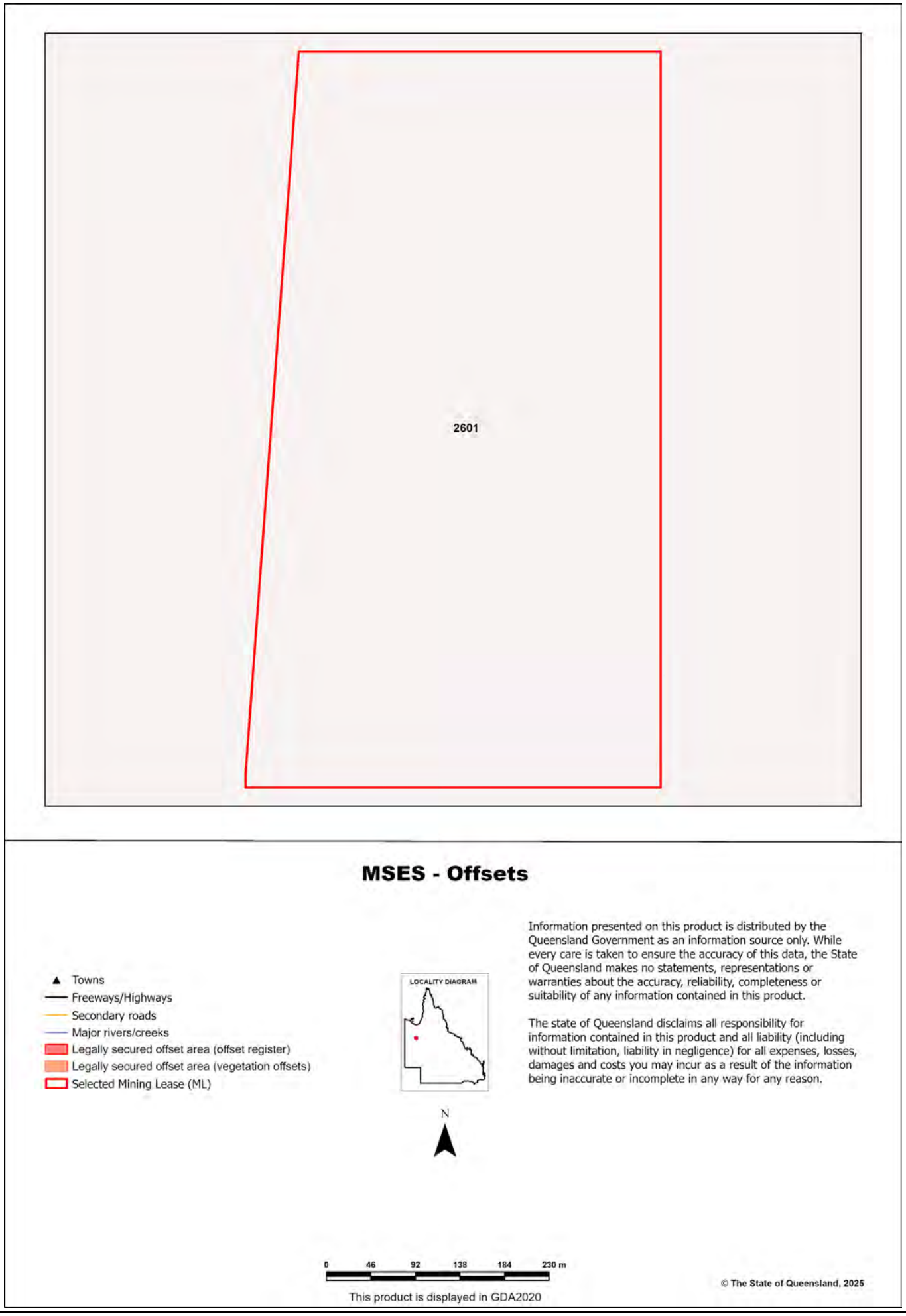
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



Map 4 - MSES - Regulated Vegetation



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RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999

APPENDIX C – ENVIRONMENTAL REPORTS – BIODIVERSITY AND CONSERVATION VALUES – BIODIVERSITY PLANNING ASSESSMENTS AND AQUATIC CONSERVATION ASSESSMENTS

TAILINGS.WATER.WASTE.

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest

ML: 2601

Environmental Reports - General Information

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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Details for area of interest: ML: 2601, with area 28.5 ha

Local Government(s)	
Cloncurry Shire	
Bioregion(s)	**Subregion(s)**
Northwest Highlands	Mount Isa Inlier
Catchment(s)	
Flinders	

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Biodiversity Planning Assessment(s)	Aquatic Conservation Assessment(s) (riverine)	Aquatic Conservation Assessment(s) (non-riverine)
Northwest Highlands v1.1	Eastern Gulf of Carpentaria v1.1	Eastern Gulf of Carpentaria v.1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.80	2.81
Of concern	0.00	0.00
No concern at present	15.23	53.43

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	16.03	56.24

Table 5: Non-riverine wetlands intersecting the AOI

(No Records)

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

(No Records)

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	28.50	100.01

Table 8: Summary table, aquatic conservation significance (non-riverine)

(No Records)

Biodiversity Planning Assessments

Introduction

The Department of the Environment, Tourism, Science and Innovation (DETSI) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DETSI. Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	16.03	56.24

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the *Environment Protection and Biodiversity Conservation Act 1999*. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar

sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has high connectivity or buffers an endangered RE or Sig. Wetland (G)	16.03	56.24

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa	0.00	0.00	16.03	56.24	0.00	0.00	0.00	0.00
B1: Ecosystem Value (Bioregion)	0.00	0.00	0.00	0.00	16.03	56.24	0.00	0.00
B2: Ecosystem Value (Subregion)	0.00	0.00	0.00	0.00	16.03	56.24	0.00	0.00
C: Tract Size	0.00	0.00	16.03	56.24	0.00	0.00	0.00	0.00
D1: Relative RE Size (Bioregion)	16.03	56.24	0.00	0.00	0.00	0.00	0.00	0.00
D2: Relative RE Size (Subregion)	16.03	56.24	0.00	0.00	0.00	0.00	0.00	0.00
F: Ecosystem Diversity	0.00	0.00	16.03	56.24	0.00	0.00	0.00	0.00

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
G: Context and Connection	16.03	56.24	0.00	0.00	0.00	0.00	0.00	0.00

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

(No Records)

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al*. 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
Ia: Centres of Endemism	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ib: Wildlife Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ic: Disjunct Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Id: Limits of Geographic Ranges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ie: High Species Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
If: Relictual Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ig: Variation in Species Composition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ih: Artificial Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ii: Hollow Bearing Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ij: Breeding or Roosting Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ik: Climate Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

  - Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;
  - Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;
  - Maintaining large scale seasonal/migratory species processes and movement of fauna;
  - Maximising connectivity between large tracts/patches of remnant vegetation;
  - Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

  - Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);
  - Follow major watershed/catchment and/or coastal boundaries;
  - Incorporate major altitudinal/geological/climatic gradients;
  - Include and maximise connectivity between large tracts/patches of remnant vegetation;
  - Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

  - Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

(No Records)

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

(No Records)

Expert panel decision descriptions:

(No Records)

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning prcesses

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland *Info*:

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	28.50	100.01

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	28.50	100.01	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	28.50	100.01	0.00	0.00
3. Diversity and richness	0.00	0.00	28.50	100.01	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	28.50	100.01	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	28.50	100.01	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

(No Records)

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Diversity and richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/ Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, Herbrecs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

Species	Common name	NCA status	EPBC status	Migratory species*	Wetland species**	Identified flora/fauna
Petrogale purpureicollis	purple-necked rock-wallaby	V				FA
Varanus mertensi	Mertens' water monitor	E	E		I	FA

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DETSI internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

**B - Convention on the Conservation of Migratory Species; C - China-Australia Migratory Bird Agreement; J - Japan-Australia Migratory Bird Agreement; E - East Asian-Australasian Flyway Partnership; R - Republic of Korea-Australia Migratory Bird Agreement.*

***I - wetland indicator species; D - wetland dependent species.*

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Identified flora/fauna
Amytornis ballarae	Kalkadoon grasswren	FA

Species	Common name	Identified flora/fauna
Artamus cinereus	black-faced woodswallow	FA
Barnardius zonarius macgillivrayi	Cloncurry parrot	FA
Ctenotus decaneurus	ten-lined ctenotus	FA
Ctenotus striaticeps	stripe-headed finesnout ctenotus	FA
Egernia hosmeri	Hosmer's skink	FA
Gehyra robusta	robust dtella	FA
Heteromunia pectoralis	pictorella mannikin	FA
Neosilurus hyrtlii	Hyrtl's catfish	FA
Varanus mertensi	Mertens' water monitor	FA

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

Species	Common name	Identified flora/fauna
Leiopotherapon unicolor	Spangled Perch	FA

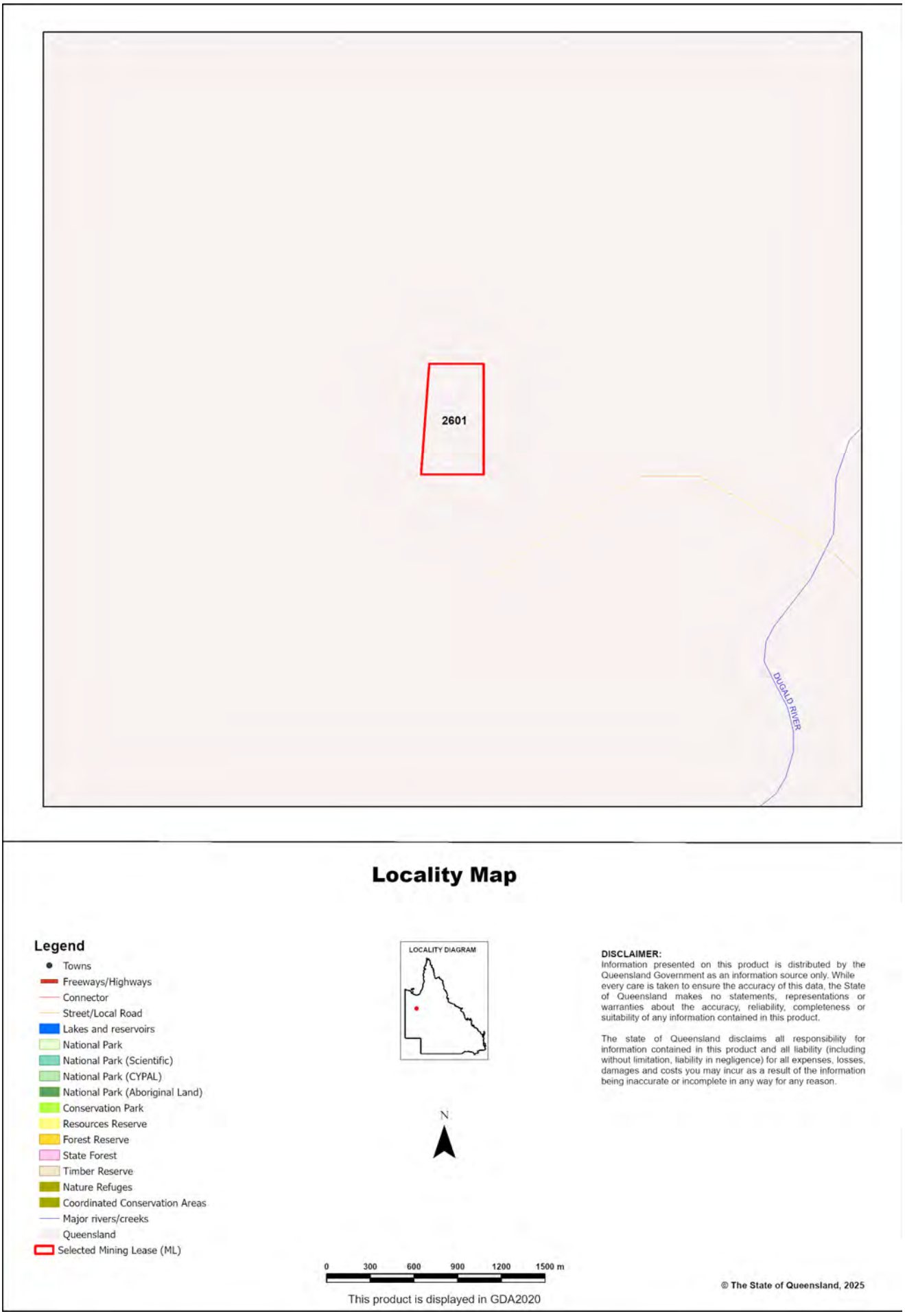
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

Species	Common name	Identified flora/fauna
Leiopotherapon unicolor	Spangled Perch	FA

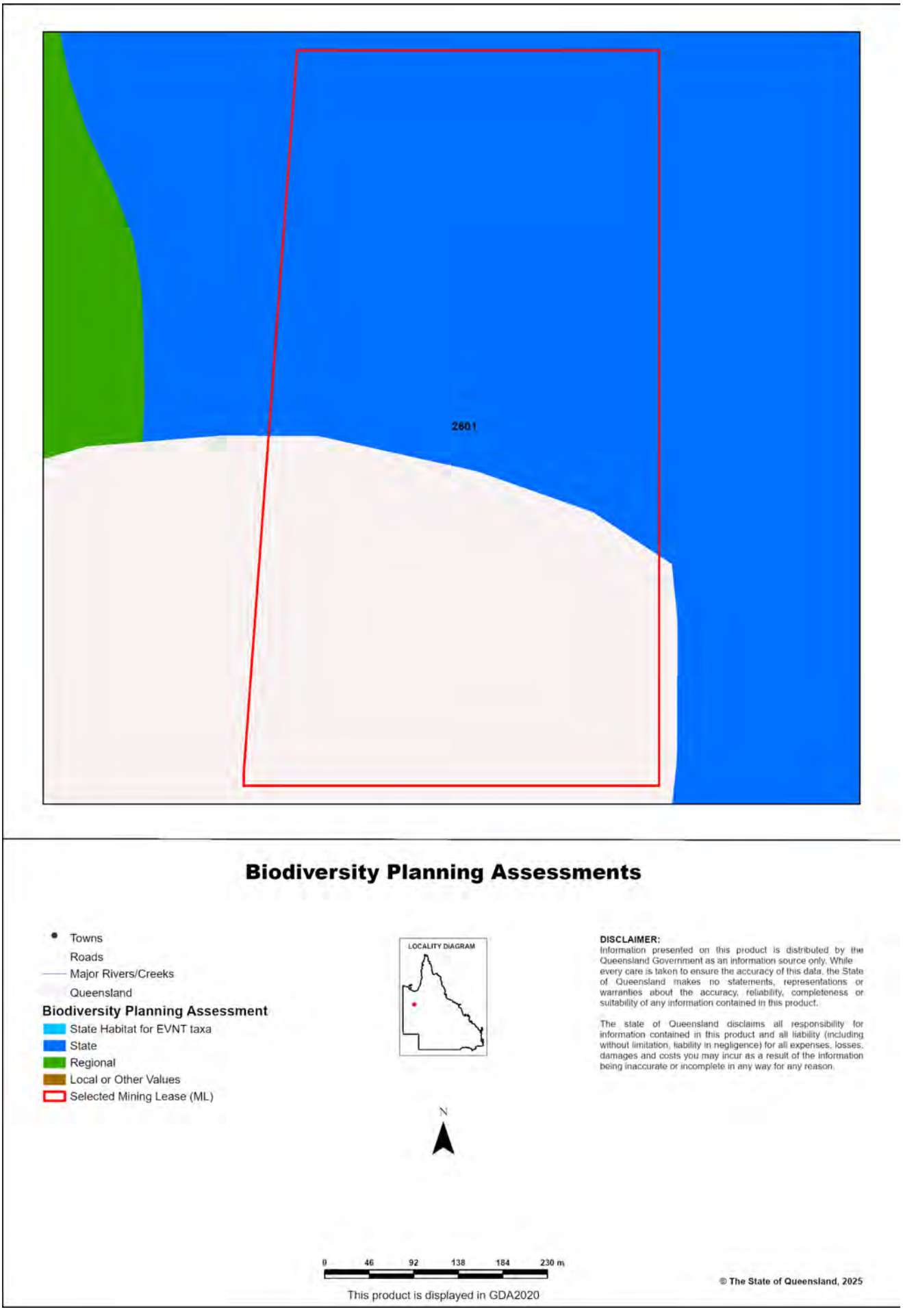
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

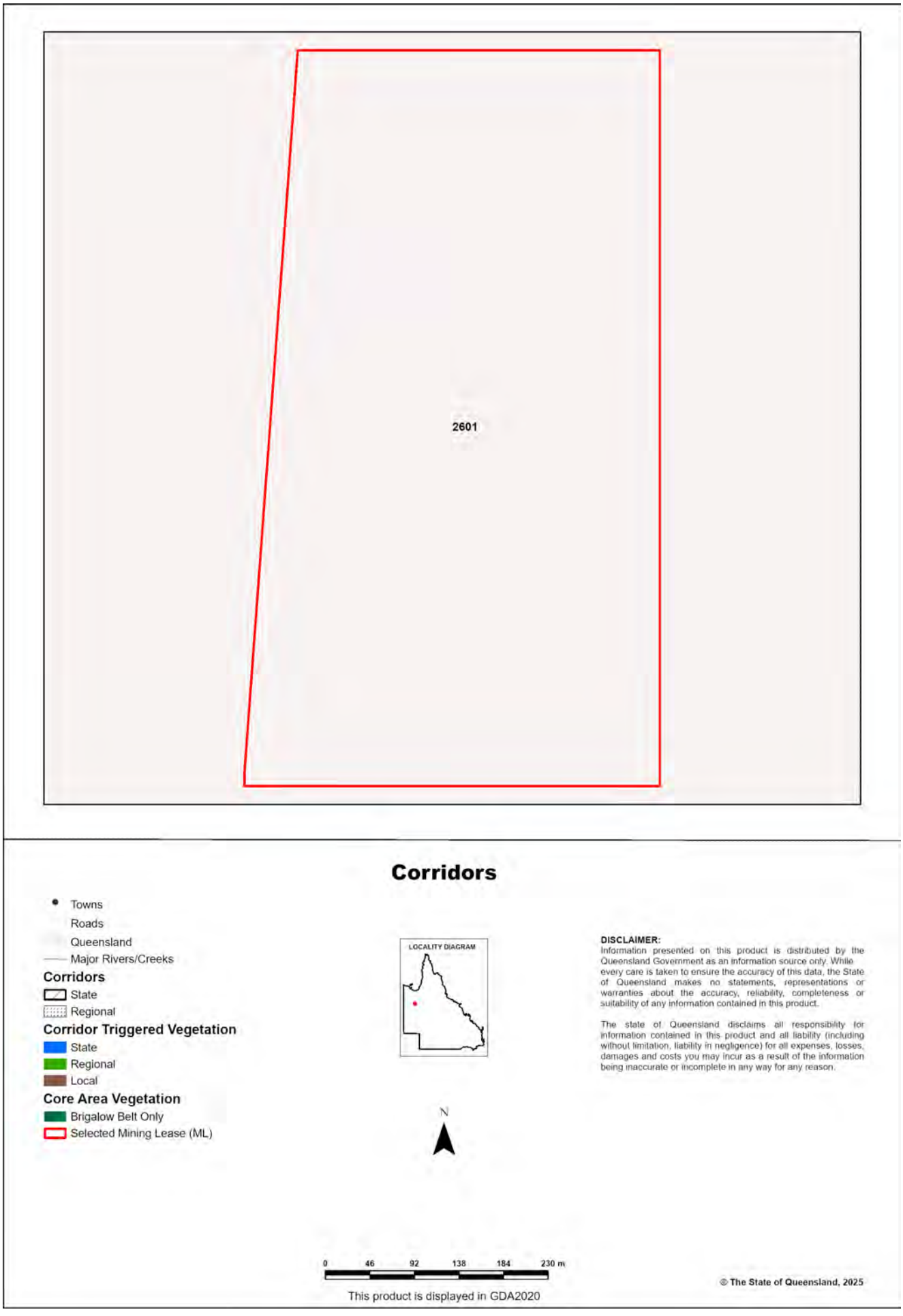
Map 1 - Locality Map



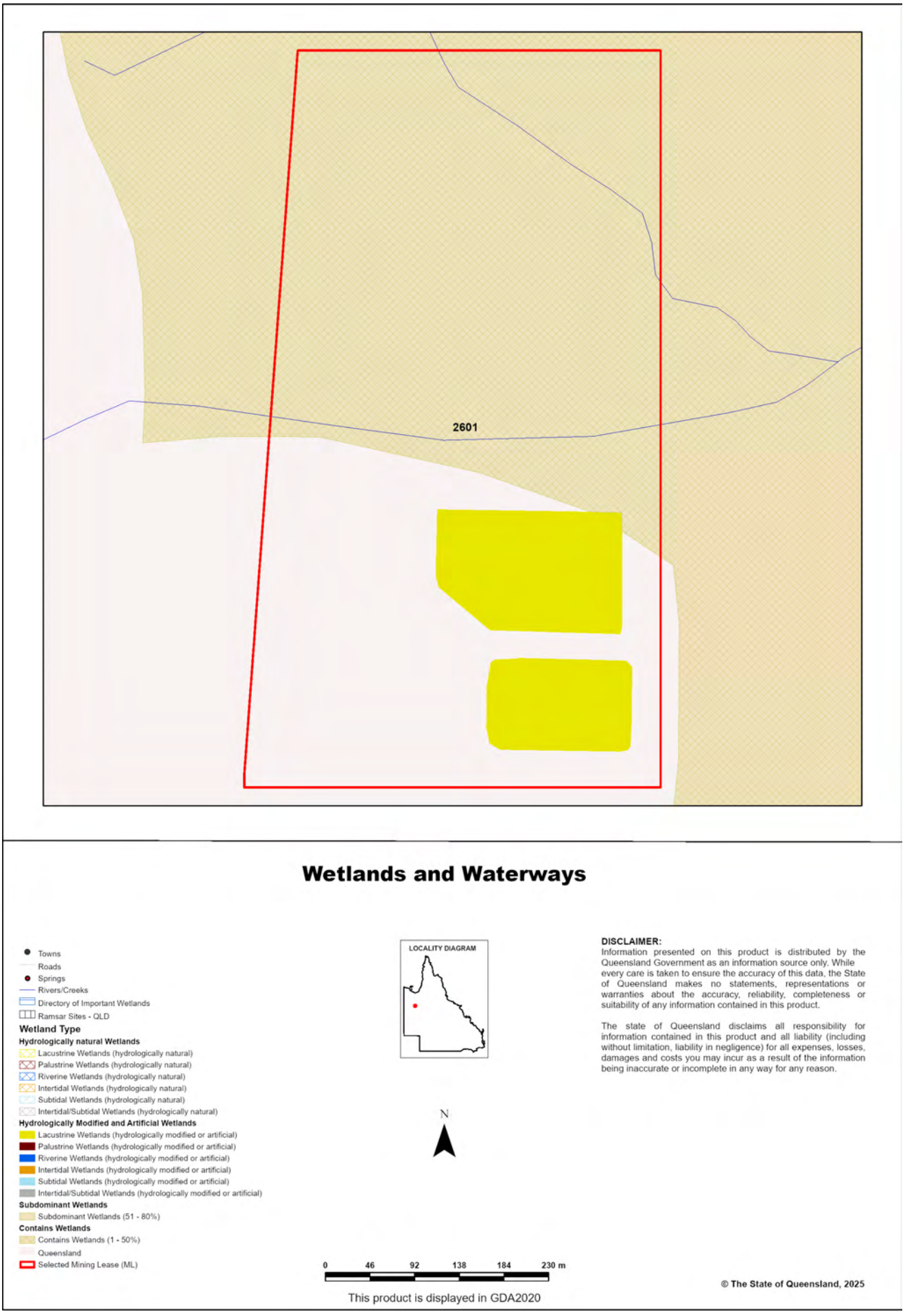
Map 2 - Biodiversity Planning Assessment (BPA)



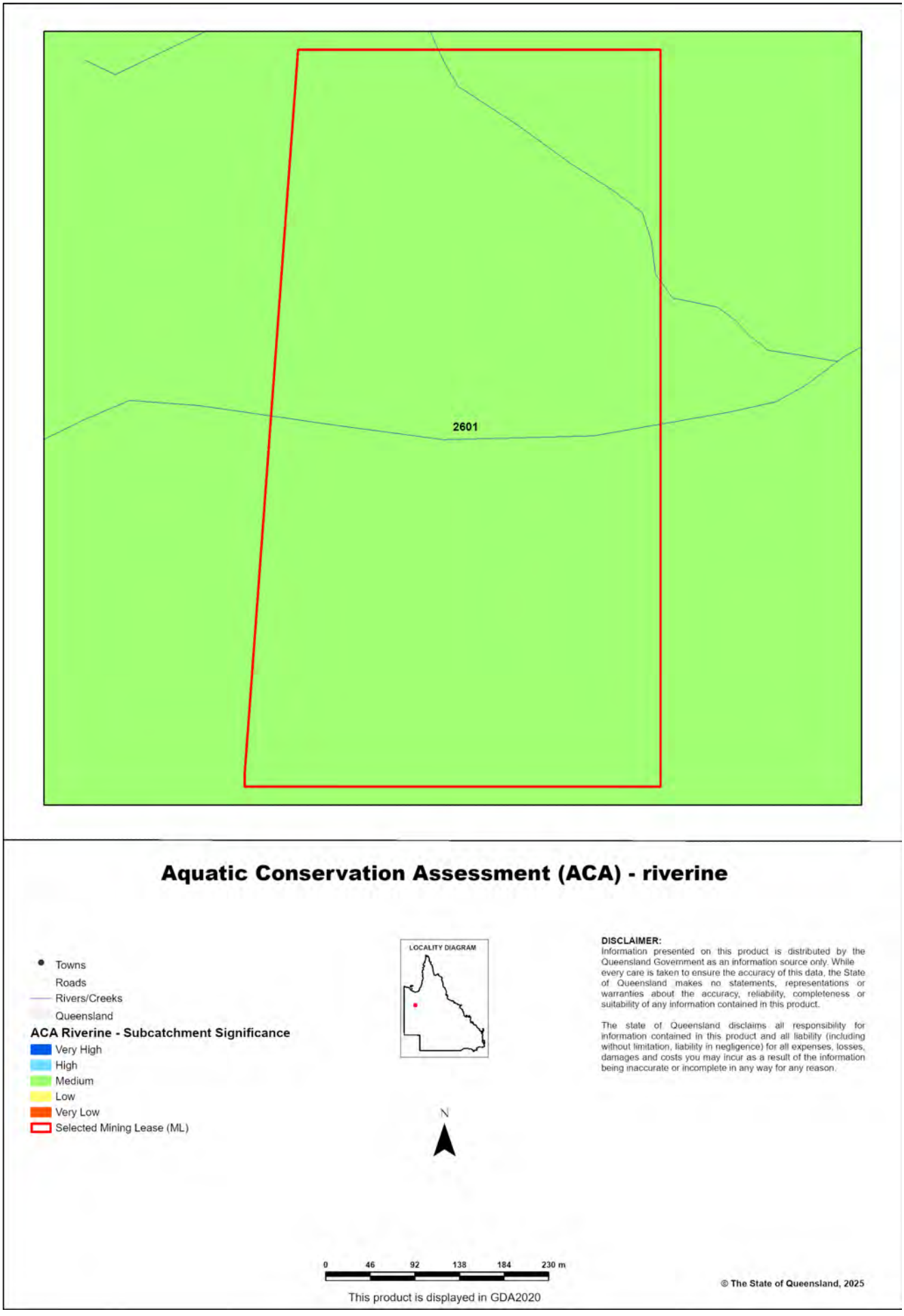
Map 3 - Corridors



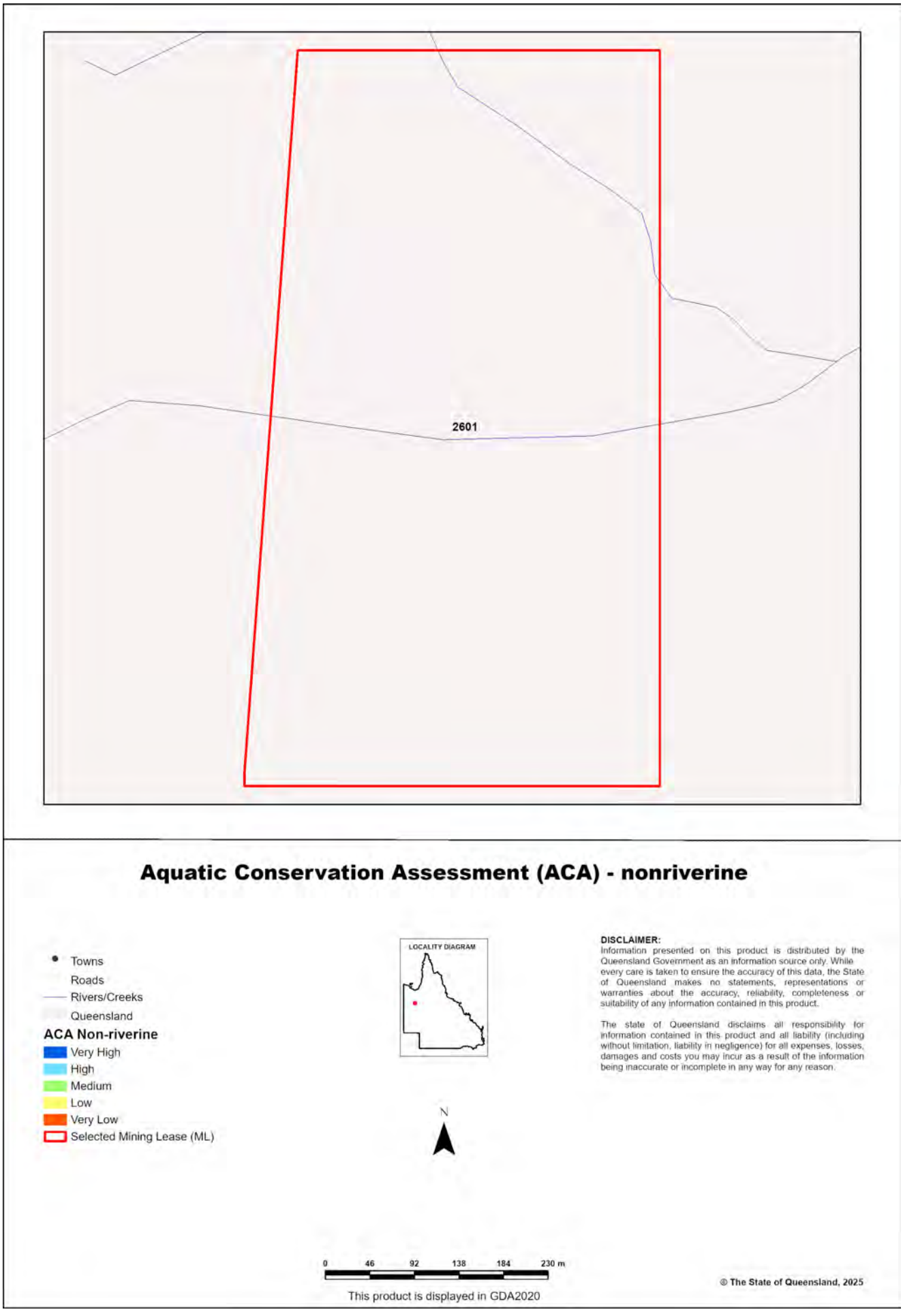
Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment.* Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Environment and Heritage Protection 2014*, Biodiversity Assessment and Mapping Methodology.* Version 2.2. Department of Environment and Heritage Protection, Brisbane.

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). *Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series*, Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDBB Non-riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1 WBBGBRCC Non-riverine ACA v2.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDBB Riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1 WBBGBRCC Riverine ACA v2.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v3.1 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.7
Threatened Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.

These datasets are available at:
http://dds.information.qld.gov.au/DDS

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DETSI	- Department of the Environment, Tourism, Science and Innovation
EPBC	- *Environment Protection and Biodiversity Conservation Act 1999*
EVNT	- Endangered, Vulnerable, Near Threatened
GDA2020	- Geocentric Datum of Australia 2020
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest

ML: 2470

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Details for area of interest: ML: 2470, with area 16.19 ha

Local Government(s)	
Cloncurry Shire	
Bioregion(s)	**Subregion(s)**
Northwest Highlands	Mount Isa Inlier
Catchment(s)	
Flinders	

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Biodiversity Planning Assessment(s)	Aquatic Conservation Assessment(s) (riverine)	Aquatic Conservation Assessment(s) (non-riverine)
Northwest Highlands v1.1	Eastern Gulf of Carpentaria v1.1	Eastern Gulf of Carpentaria v.1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.22	1.36
Of concern	0.00	0.00
No concern at present	6.13	37.89

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	4.40	27.17
Regional	1.96	12.08

Table 5: Non-riverine wetlands intersecting the AOI

(No Records)

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

(No Records)

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	16.19	99.98

Table 8: Summary table, aquatic conservation significance (non-riverine)

(No Records)

Biodiversity Planning Assessments

Introduction

The Department of the Environment, Tourism, Science and Innovation (DETSI) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DETSI. Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	4.40	27.17
Regional	1.96	12.08

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the *Environment Protection and Biodiversity Conservation Act 1999*. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in

protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has high connectivity or buffers an endangered RE or Sig. Wetland (G)	4.40	27.17
Regional	Remnant contains at least 1 Vulnerable or Near Threatened species (A)	1.96	12.08

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa	0.00	0.00	6.35	39.25	0.00	0.00	0.00	0.00
B1: Ecosystem Value (Bioregion)	0.00	0.00	0.00	0.00	6.35	39.25	0.00	0.00
B2: Ecosystem Value (Subregion)	0.00	0.00	0.00	0.00	6.35	39.25	0.00	0.00
C: Tract Size	0.00	0.00	6.35	39.25	0.00	0.00	0.00	0.00
D1: Relative RE Size (Bioregion)	4.40	27.17	0.00	0.00	0.00	0.00	1.96	12.08
D2: Relative RE Size (Subregion)	4.40	27.17	0.00	0.00	0.00	0.00	1.96	12.08

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
F: Ecosystem Diversity	0.00	0.00	4.40	27.17	1.96	12.08	0.00	0.00
G: Context and Connection	6.35	39.25	0.00	0.00	0.00	0.00	0.00	0.00

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

(No Records)

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al*. 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ia: Centres of Endemism	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ib: Wildlife Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ic: Disjunct Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Id: Limits of Geographic Ranges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ie: High Species Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
If: Relictual Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ig: Variation in Species Composition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ih: Artificial Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ii: Hollow Bearing Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ij: Breeding or Roosting Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ik: Climate Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

- Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;
- Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;
- Maintaining large scale seasonal/migratory species processes and movement of fauna;
- Maximising connectivity between large tracts/patches of remnant vegetation;
- Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

  - Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);
  - Follow major watershed/catchment and/or coastal boundaries;
  - Incorporate major altitudinal/geological/climatic gradients;
  - Include and maximise connectivity between large tracts/patches of remnant vegetation;
  - Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

  - Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

(No Records)

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

(No Records)

Expert panel decision descriptions:

(No Records)

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning prcesses

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland *Info*:

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	16.19	99.98

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	16.19	99.98	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	16.19	99.98	0.00	0.00
3. Diversity and richness	0.00	0.00	16.19	99.98	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	16.19	99.98	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	16.19	99.98	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

(No Records)

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Diversity and richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/ Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, Herbrecs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

Species	Common name	NCA status	EPBC status	Migratory species*	Wetland species**	Identified flora/fauna
Petrogale purpureicollis	purple-necked rock-wallaby	V				FA
Varanus mertensi	Mertens' water monitor	E	E		I	FA

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DETSI internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

**B - Convention on the Conservation of Migratory Species; C - China-Australia Migratory Bird Agreement; J - Japan-Australia Migratory Bird Agreement; E - East Asian-Australasian Flyway Partnership; R - Republic of Korea-Australia Migratory Bird Agreement.*

***I - wetland indicator species; D - wetland dependent species.*

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Identified flora/fauna
Amytornis ballarae	Kalkadoon grasswren	FA

Species	Common name	Identified flora/fauna
Artamus cinereus	black-faced woodswallow	FA
Barnardius zonarius macgillivrayi	Cloncurry parrot	FA
Ctenotus decaneurus	ten-lined ctenotus	FA
Ctenotus striaticeps	stripe-headed finesnout ctenotus	FA
Egernia hosmeri	Hosmer's skink	FA
Gehyra robusta	robust dtella	FA
Heteromunia pectoralis	pictorella mannikin	FA
Neosilurus hyrtlii	Hyrtl's catfish	FA
Varanus mertensi	Mertens' water monitor	FA

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

Species	Common name	Identified flora/fauna
Leiopotherapon unicolor	Spangled Perch	FA

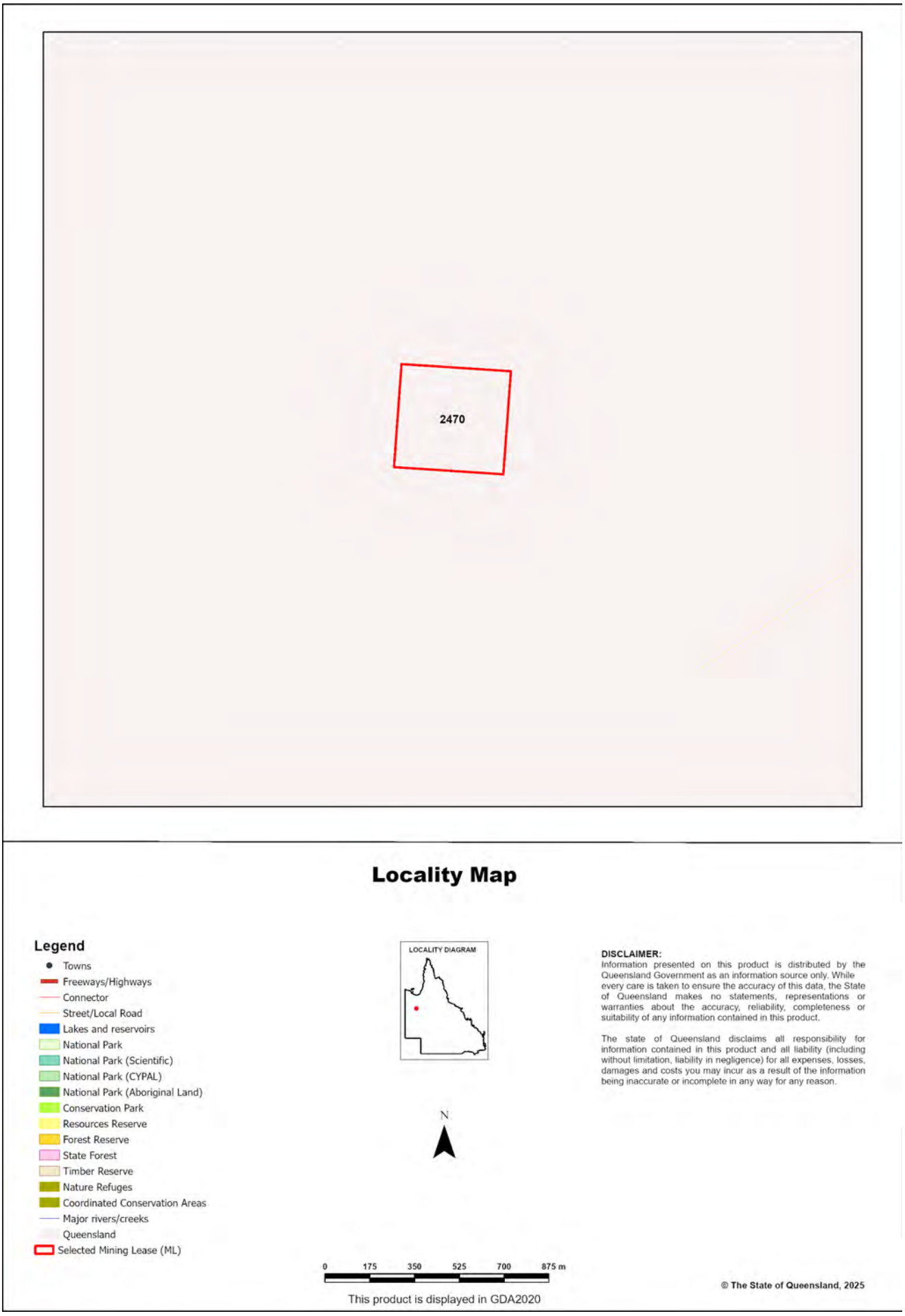
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

Species	Common name	Identified flora/fauna
Leiopotherapon unicolor	Spangled Perch	FA

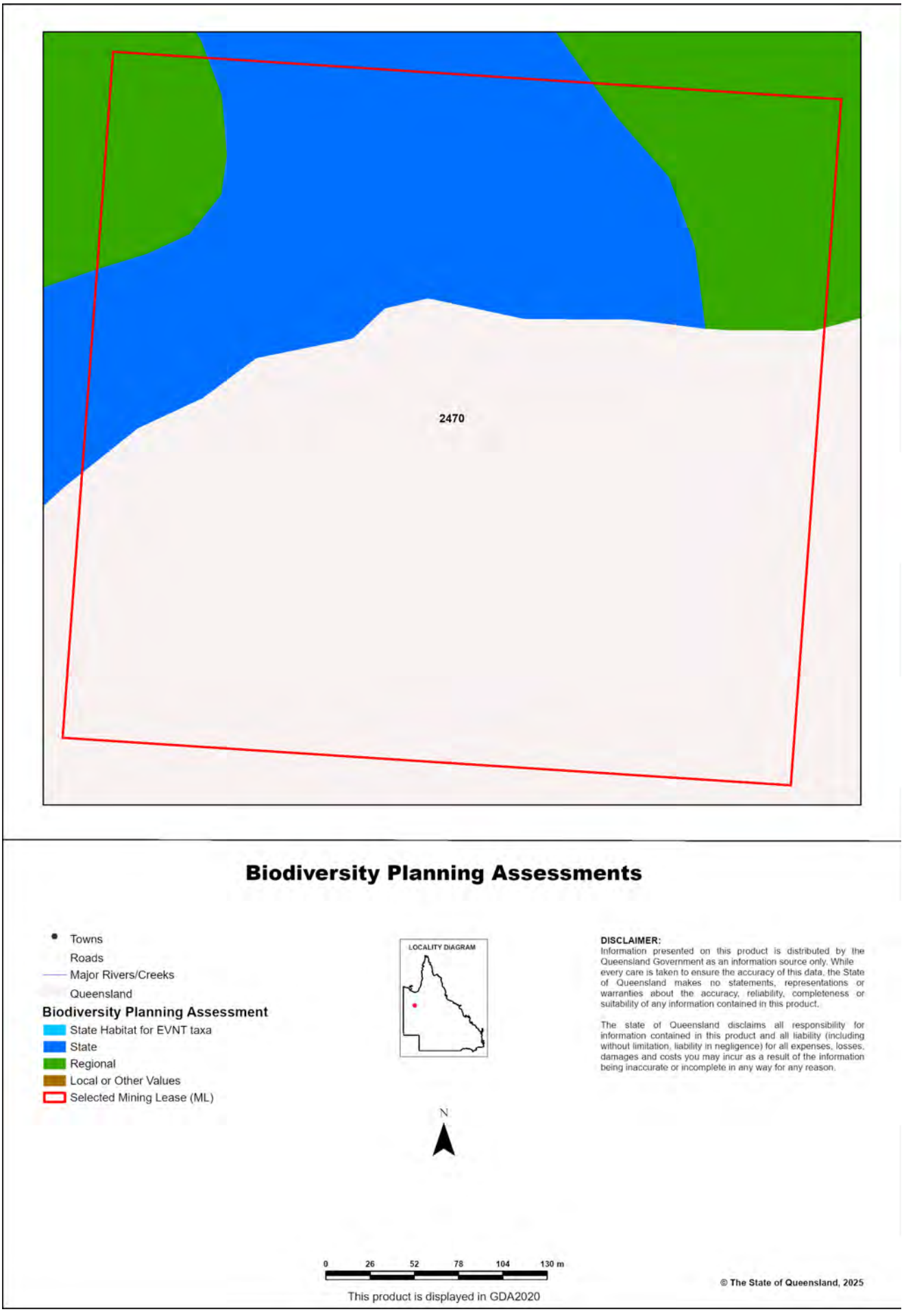
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

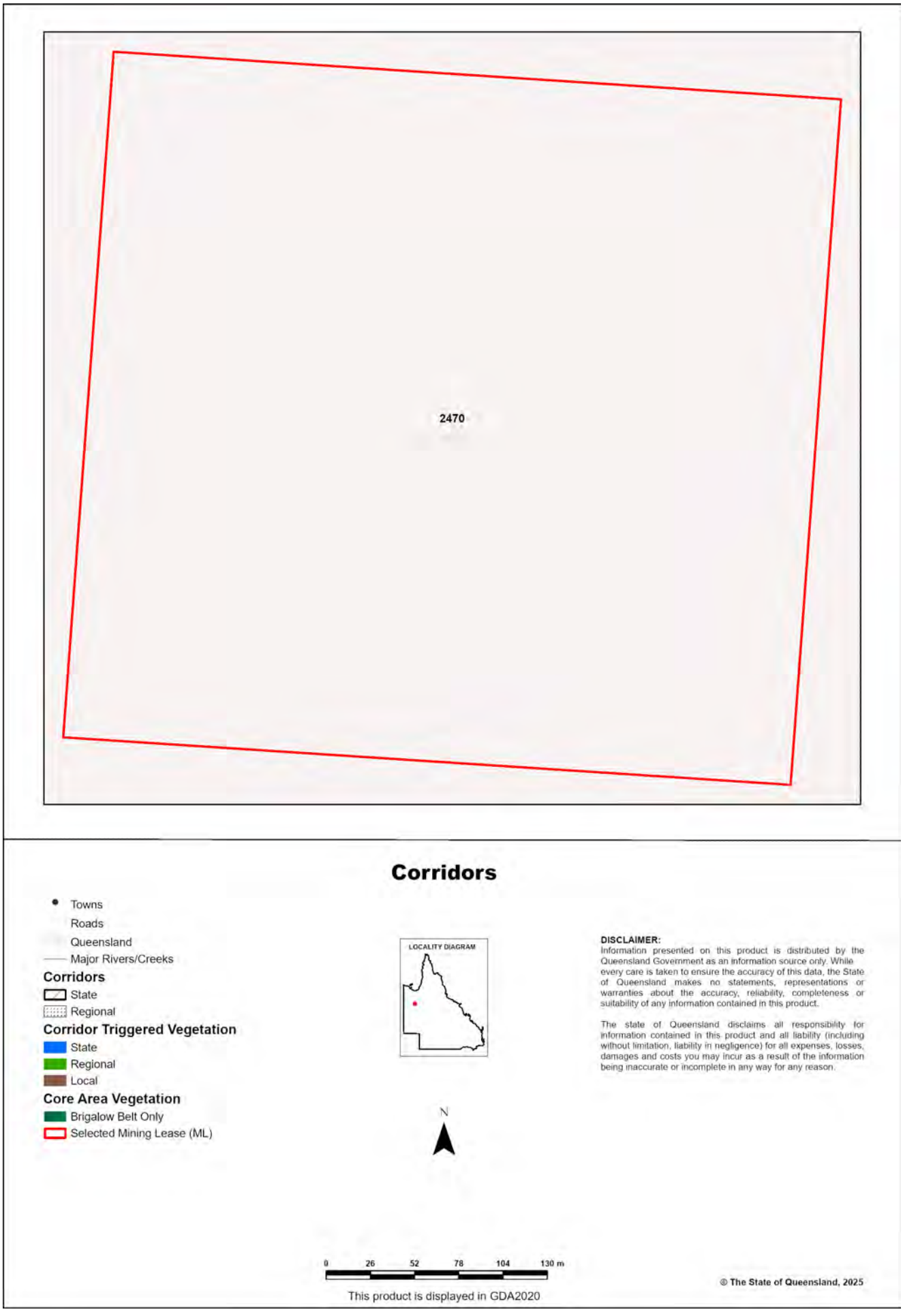
Map 1 - Locality Map



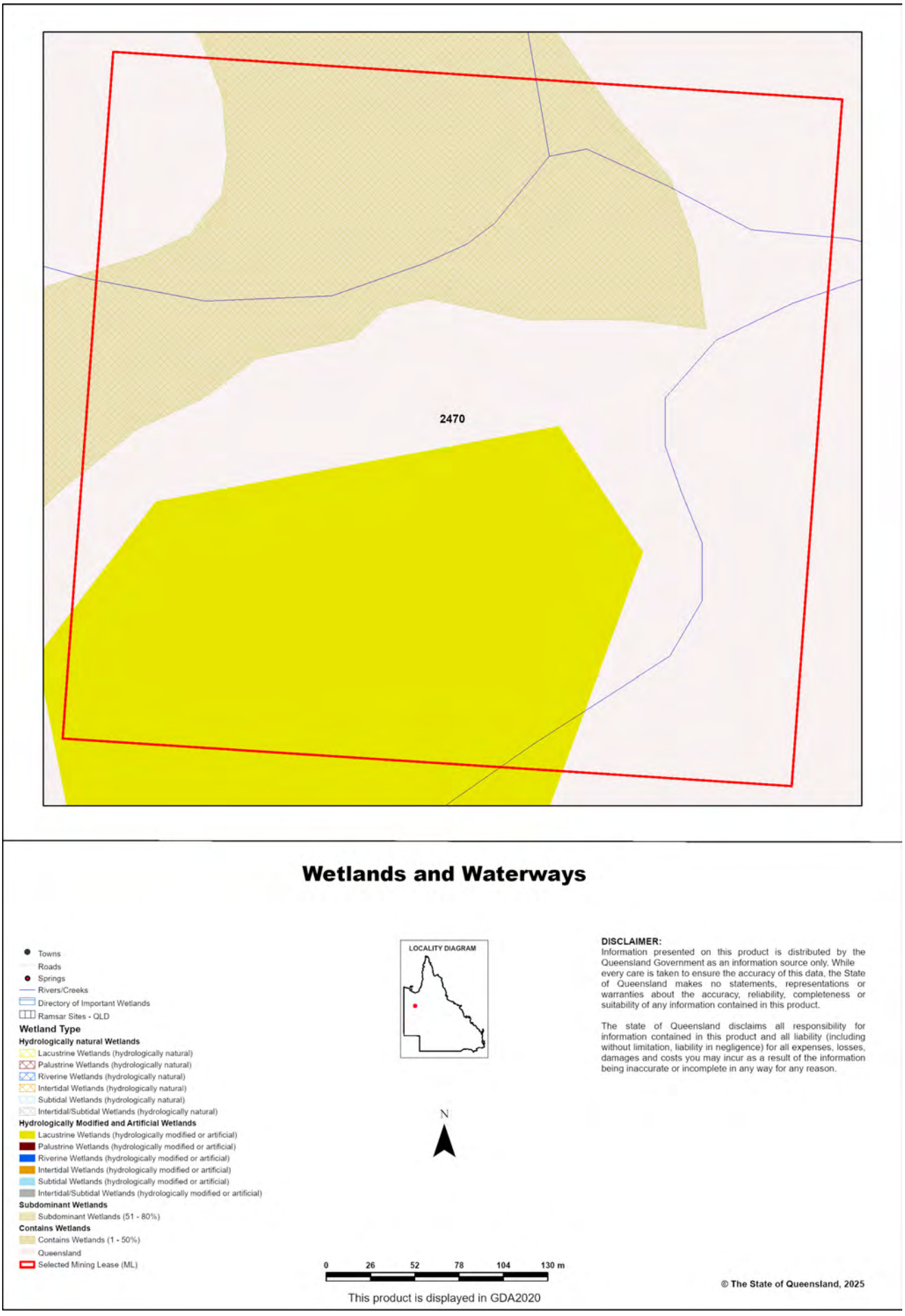
Map 2 - Biodiversity Planning Assessment (BPA)



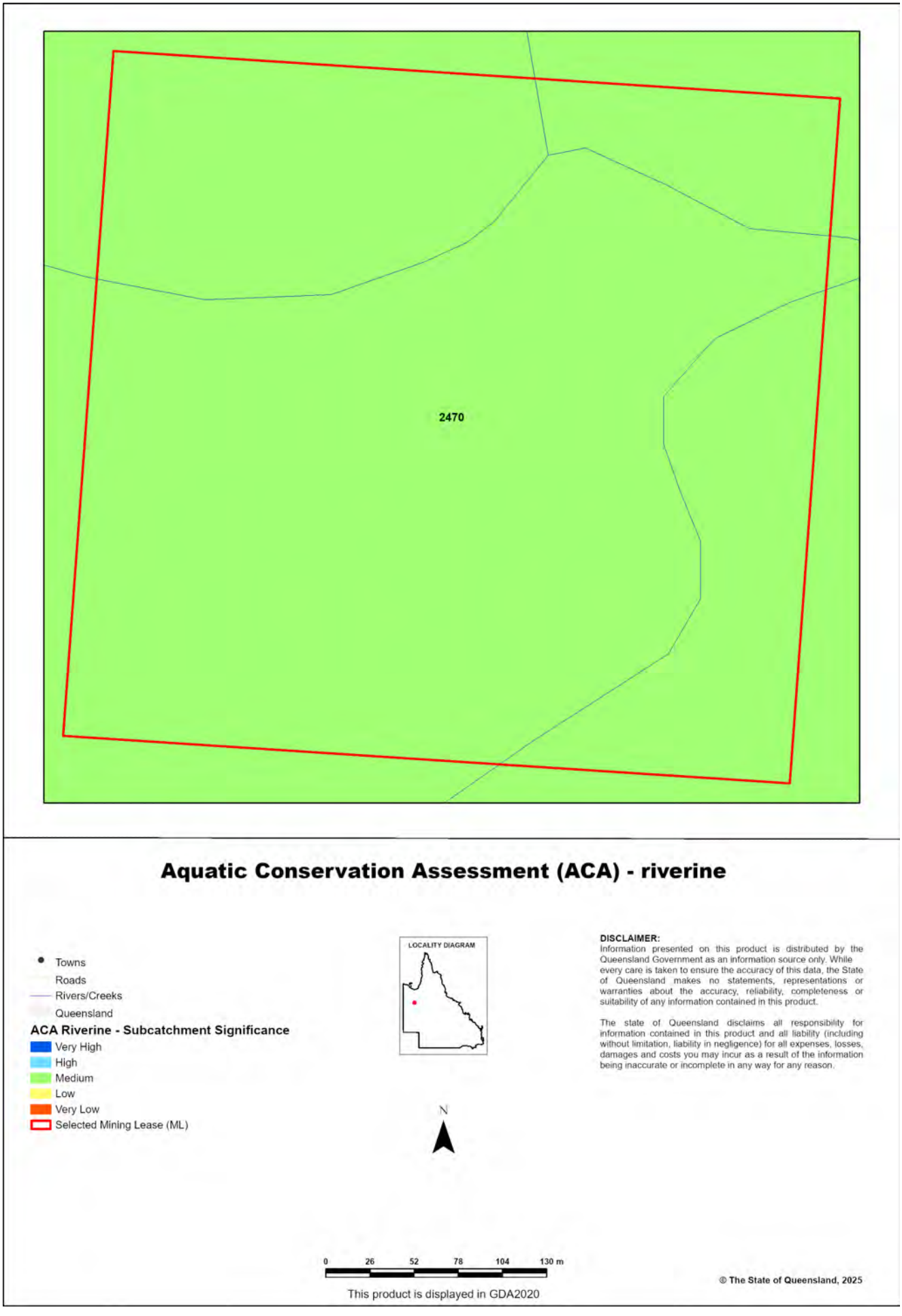
Map 3 - Corridors



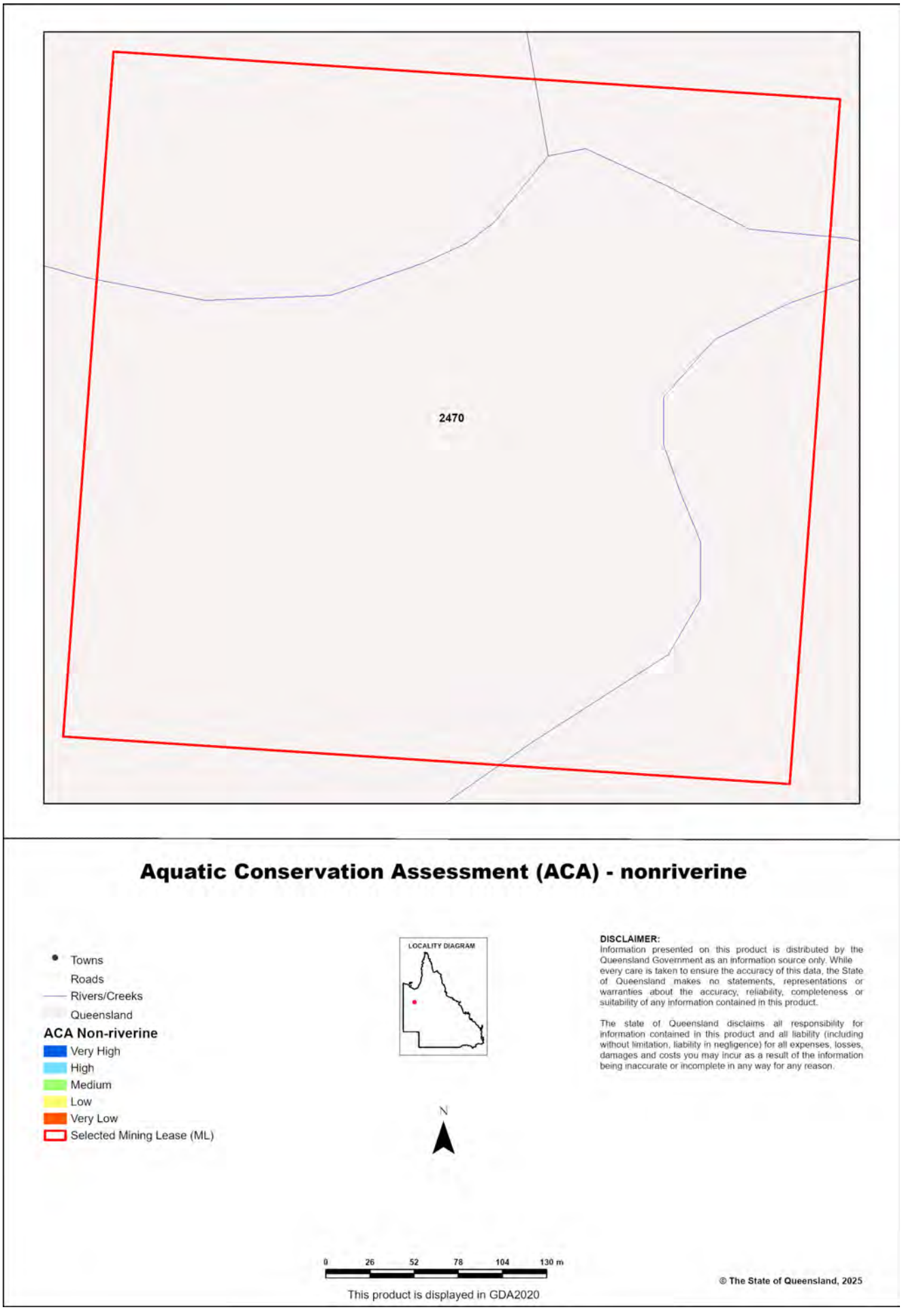
Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment.* Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Environment and Heritage Protection 2014*, Biodiversity Assessment and Mapping Methodology.* Version 2.2. Department of Environment and Heritage Protection, Brisbane.

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). *Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series*, Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDBB Non-riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1 WBBGBRCC Non-riverine ACA v2.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDBB Riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1 WBBGBRCC Riverine ACA v2.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v3.1 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.7
Threatened Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.

These datasets are available at:
http://dds.information.qld.gov.au/DDS

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DETSI	- Department of the Environment, Tourism, Science and Innovation
EPBC	- *Environment Protection and Biodiversity Conservation Act 1999*
EVNT	- Endangered, Vulnerable, Near Threatened
GDA2020	- Geocentric Datum of Australia 2020
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest

ML: 2498

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Details for area of interest: ML: 2498, with area 29.06 ha

Local Government(s)
Cloncurry Shire

Bioregion(s)	Subregion(s)
Northwest Highlands	Mount Isa Inlier

Catchment(s)
Flinders

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Biodiversity Planning Assessment(s)	Aquatic Conservation Assessment(s) (riverine)	Aquatic Conservation Assessment(s) (non-riverine)
Northwest Highlands v1.1	Eastern Gulf of Carpentaria v1.1	Eastern Gulf of Carpentaria v.1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.40	1.36
Of concern	0.00	0.00
No concern at present	18.49	63.64

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	7.92	27.25
Regional	10.97	37.75

Table 5: Non-riverine wetlands intersecting the AOI

(No Records)

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

(No Records)

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	29.06	100.00

Table 8: Summary table, aquatic conservation significance (non-riverine)

(No Records)

Biodiversity Planning Assessments

Introduction

The Department of the Environment, Tourism, Science and Innovation (DETSI) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DETSI. Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	7.92	27.25
Regional	10.97	37.75

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the *Environment Protection and Biodiversity Conservation Act 1999*. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in

protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has high connectivity or buffers an endangered RE or Sig. Wetland (G)	7.92	27.25
Regional	Remnant contains at least 1 Vulnerable or Near Threatened species (A)	10.97	37.75

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa	0.00	0.00	18.89	65.01	0.00	0.00	0.00	0.00
B1: Ecosystem Value (Bioregion)	0.00	0.00	0.00	0.00	18.89	65.01	0.00	0.00
B2: Ecosystem Value (Subregion)	0.00	0.00	0.00	0.00	18.89	65.01	0.00	0.00
C: Tract Size	0.00	0.00	18.89	65.01	0.00	0.00	0.00	0.00
D1: Relative RE Size (Bioregion)	7.92	27.25	0.00	0.00	0.00	0.00	10.97	37.75
D2: Relative RE Size (Subregion)	7.92	27.25	0.00	0.00	0.00	0.00	10.97	37.75

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
F: Ecosystem Diversity	0.00	0.00	7.92	27.25	10.97	37.75	0.00	0.00
G: Context and Connection	18.89	65.01	0.00	0.00	0.00	0.00	0.00	0.00

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

(No Records)

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al*. 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ia: Centres of Endemism	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ib: Wildlife Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ic: Disjunct Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Id: Limits of Geographic Ranges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ie: High Species Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
If: Relictual Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ig: Variation in Species Composition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ih: Artificial Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ii: Hollow Bearing Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ij: Breeding or Roosting Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ik: Climate Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

- Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;
- Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;
- Maintaining large scale seasonal/migratory species processes and movement of fauna;
- Maximising connectivity between large tracts/patches of remnant vegetation;
- Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

  - Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);
  - Follow major watershed/catchment and/or coastal boundaries;
  - Incorporate major altitudinal/geological/climatic gradients;
  - Include and maximise connectivity between large tracts/patches of remnant vegetation;
  - Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

  - Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

(No Records)

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

(No Records)

Expert panel decision descriptions:

(No Records)

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning prcesses

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland *Info*:

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	29.06	100.00

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	29.06	100.00	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	29.06	100.00	0.00	0.00
3. Diversity and richness	0.00	0.00	29.06	100.00	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	29.06	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	29.06	100.00	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

(No Records)

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Diversity and richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/ Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, Herbrecs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

Species	Common name	NCA status	EPBC status	Migratory species*	Wetland species**	Identified flora/fauna
Petrogale purpureicollis	purple-necked rock-wallaby	V				FA
Varanus mertensi	Mertens' water monitor	E	E		I	FA

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DETSI internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

**B - Convention on the Conservation of Migratory Species; C - China-Australia Migratory Bird Agreement; J - Japan-Australia Migratory Bird Agreement; E - East Asian-Australasian Flyway Partnership; R - Republic of Korea-Australia Migratory Bird Agreement.*

***I - wetland indicator species; D - wetland dependent species.*

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Identified flora/fauna
Amytornis ballarae	Kalkadoon grasswren	FA

Species	Common name	Identified flora/fauna
Artamus cinereus	black-faced woodswallow	FA
Barnardius zonarius macgillivrayi	Cloncurry parrot	FA
Ctenotus decaneurus	ten-lined ctenotus	FA
Ctenotus striaticeps	stripe-headed finesnout ctenotus	FA
Egernia hosmeri	Hosmer's skink	FA
Gehyra robusta	robust dtella	FA
Heteromunia pectoralis	pictorella mannikin	FA
Neosilurus hyrtlii	Hyrtl's catfish	FA
Varanus mertensi	Mertens' water monitor	FA

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

Species	Common name	Identified flora/fauna
Leiopotherapon unicolor	Spangled Perch	FA

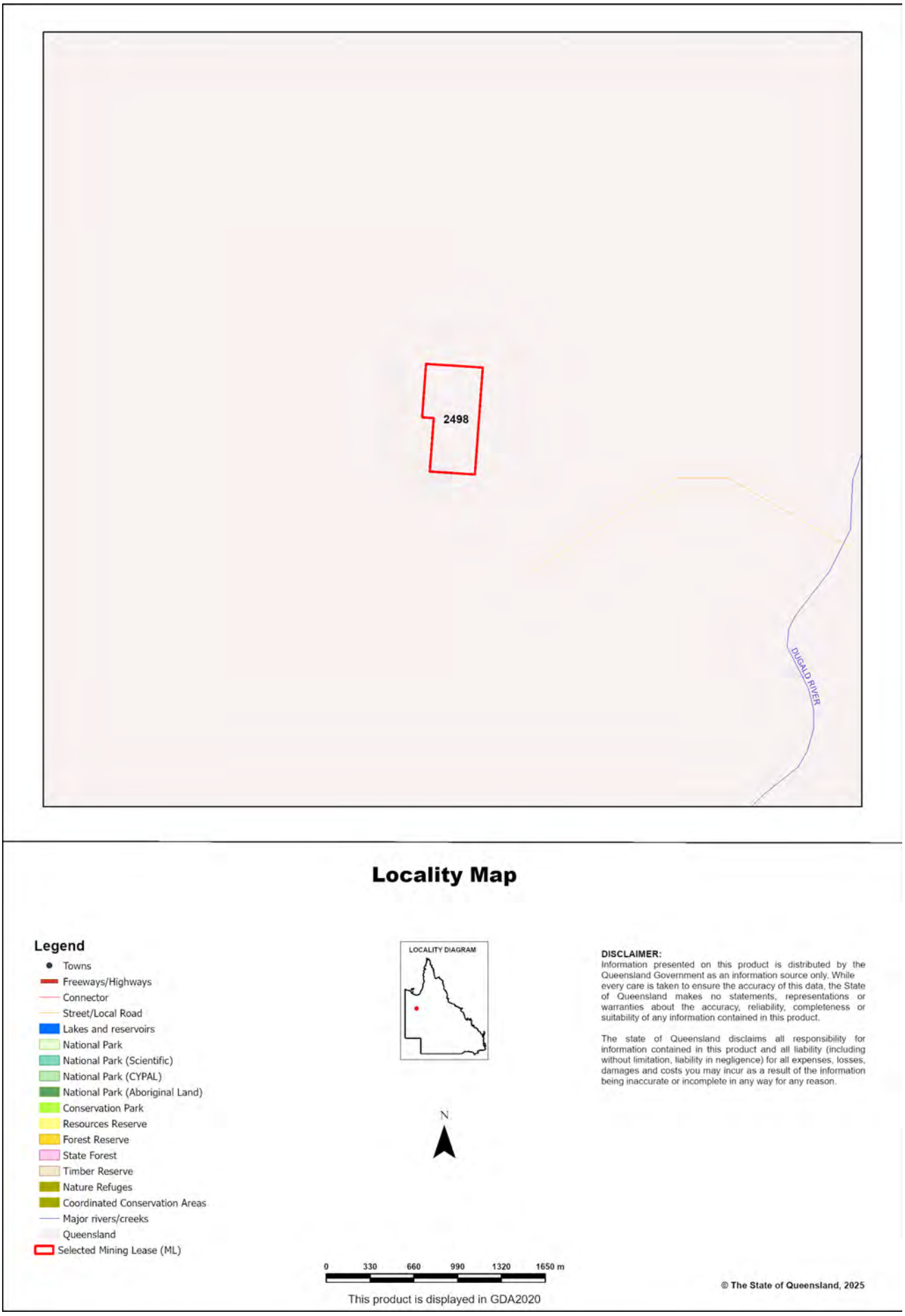
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

Species	Common name	Identified flora/fauna
Leiopotherapon unicolor	Spangled Perch	FA

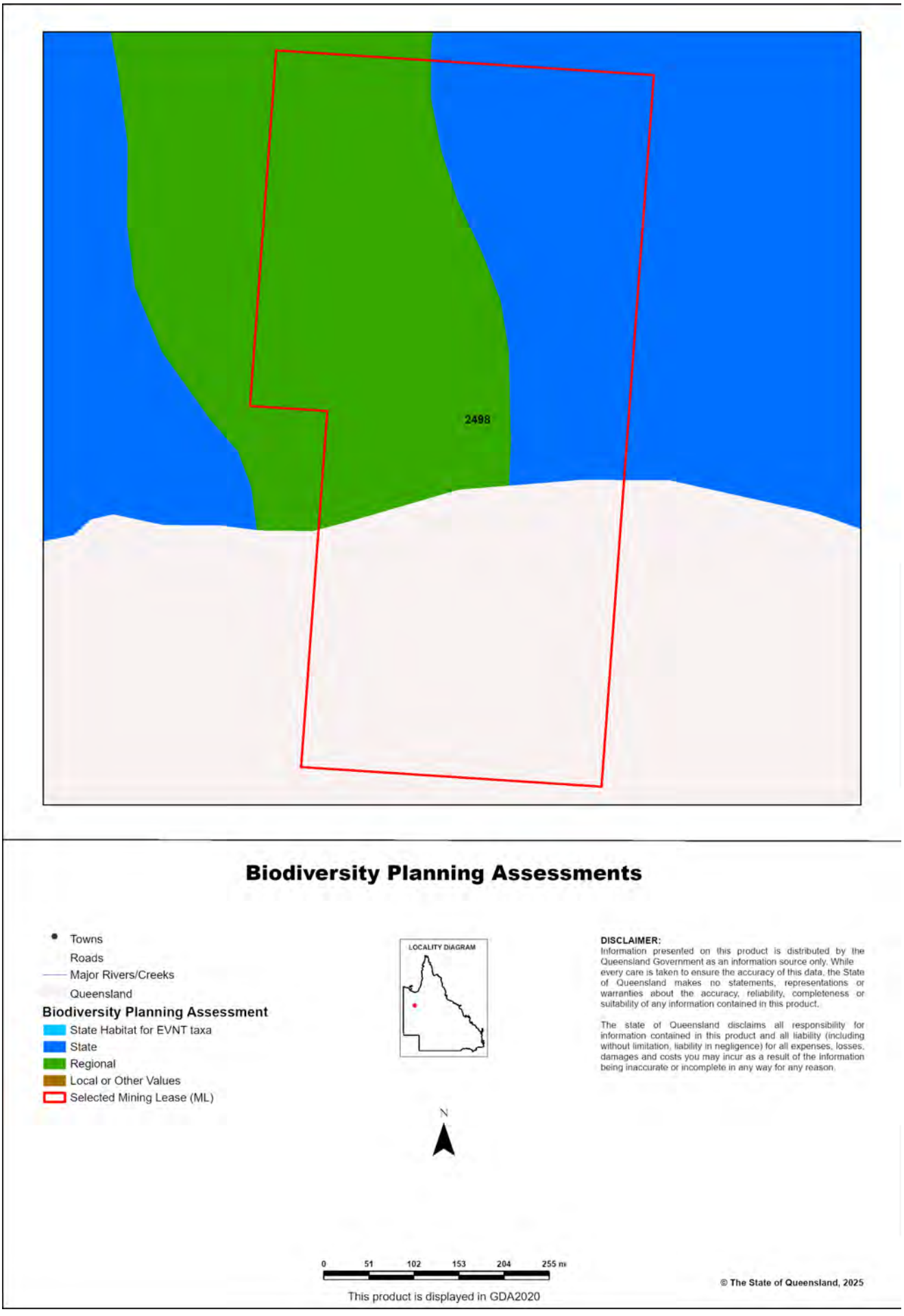
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

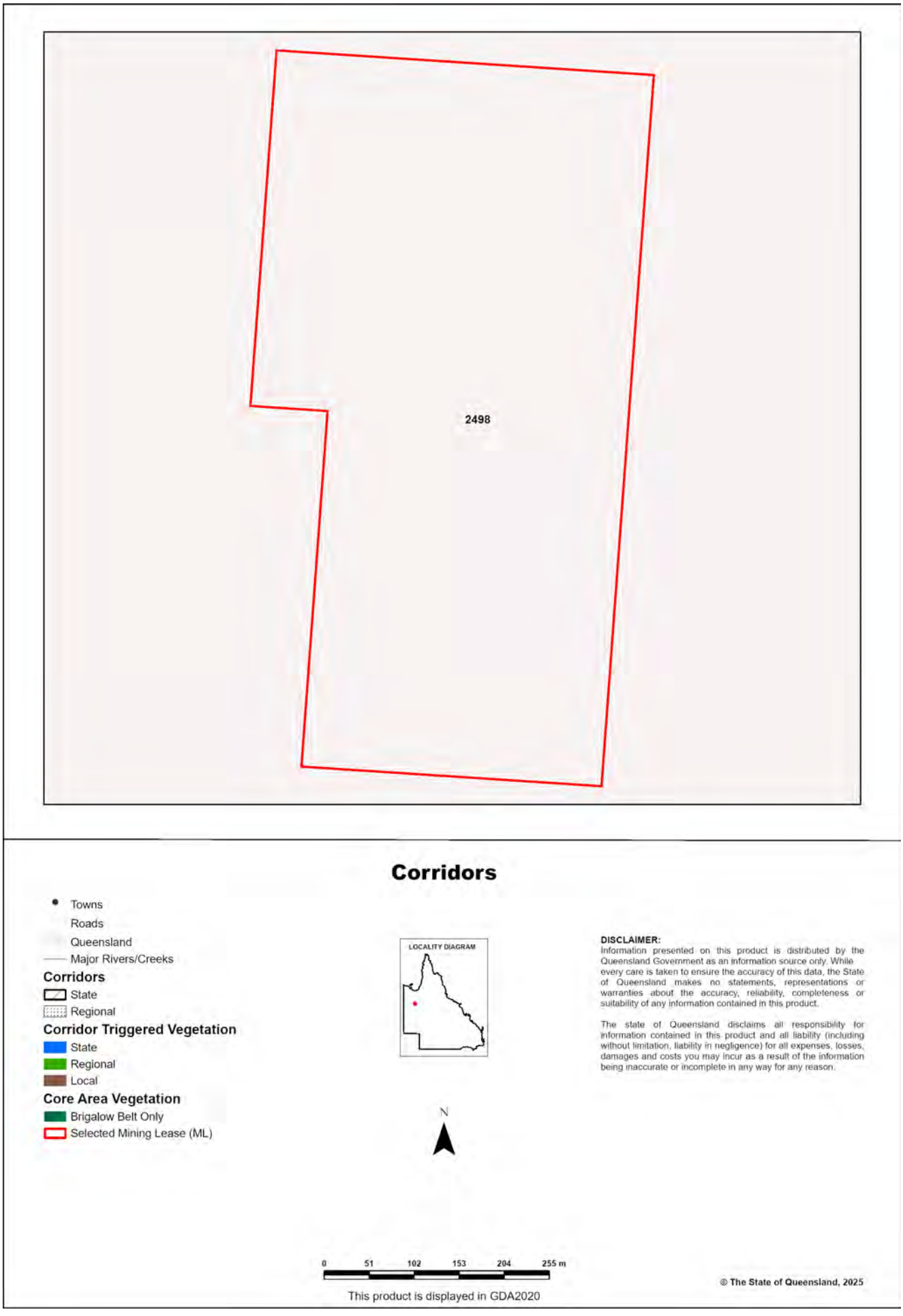
Map 1 - Locality Map



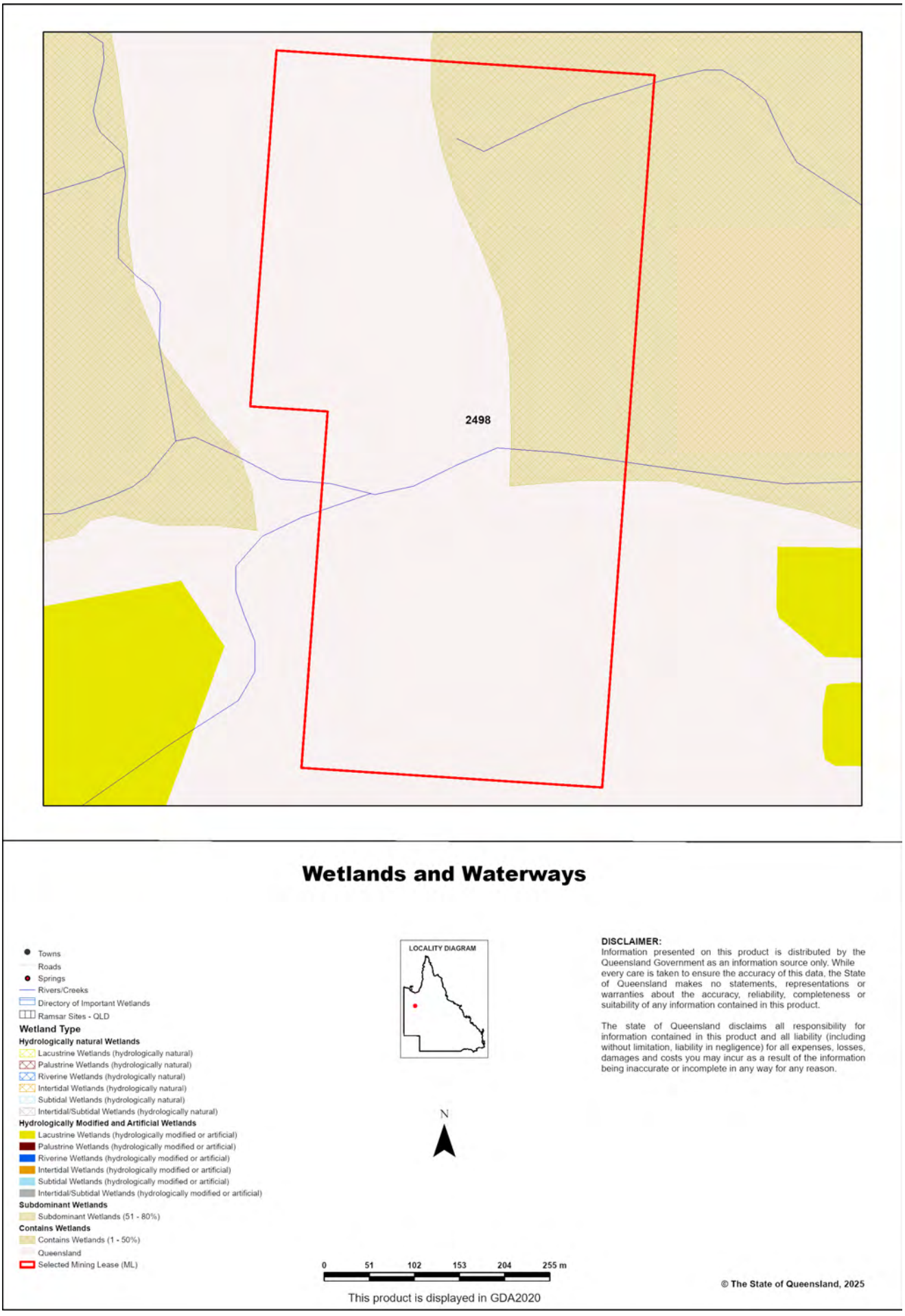
Map 2 - Biodiversity Planning Assessment (BPA)



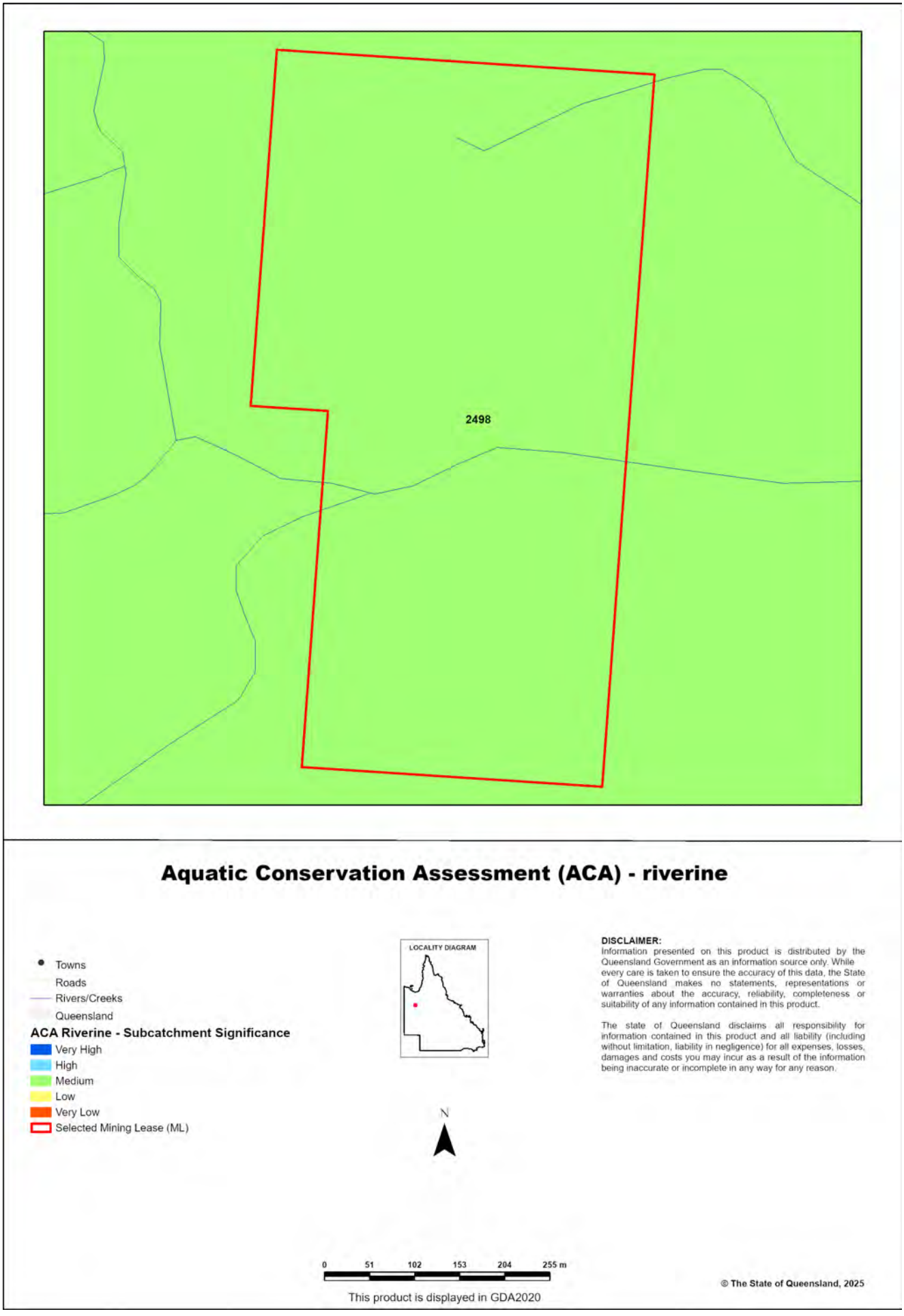
Map 3 - Corridors



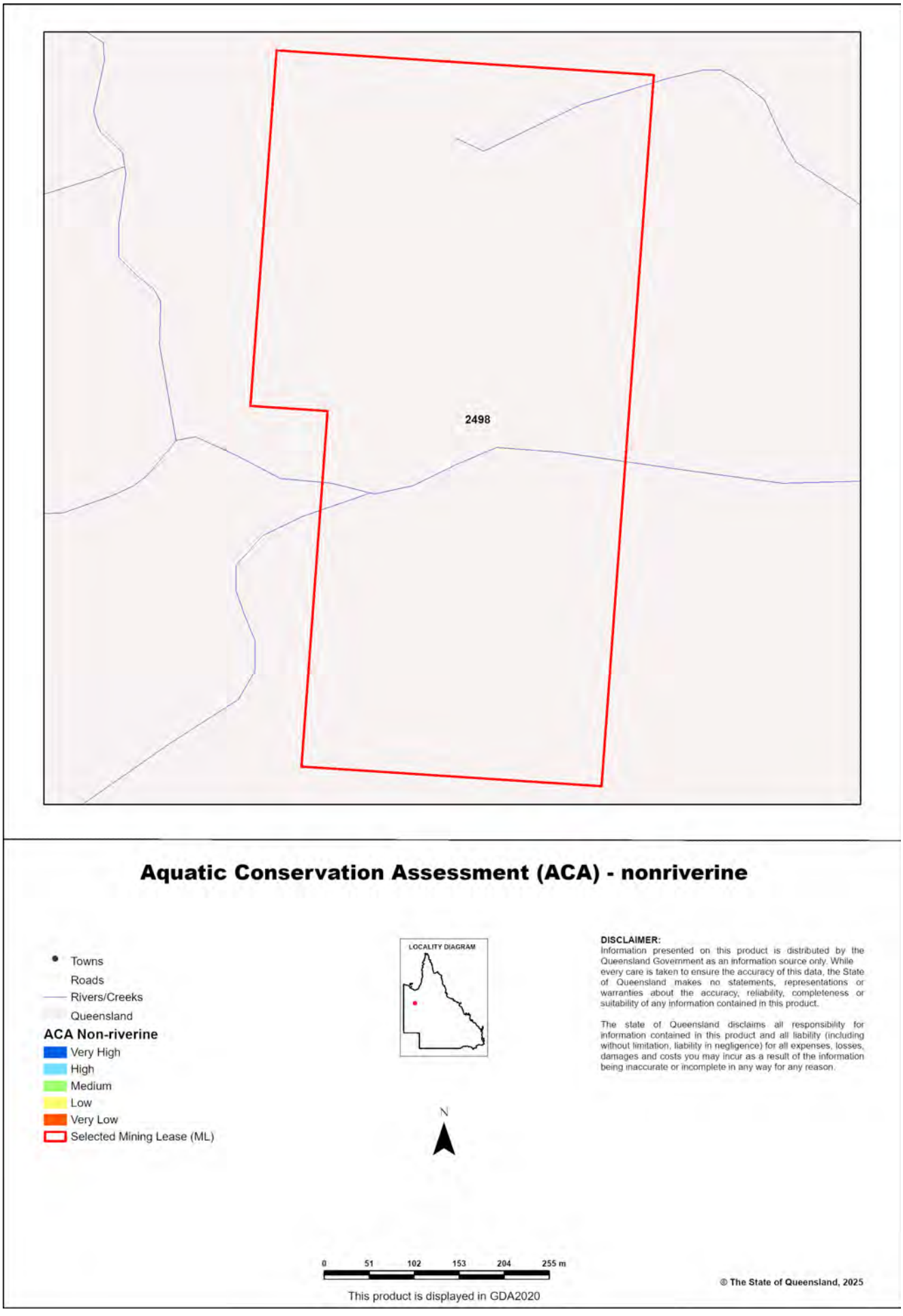
Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment.* Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Environment and Heritage Protection 2014*, Biodiversity Assessment and Mapping Methodology.* Version 2.2. Department of Environment and Heritage Protection, Brisbane.

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). *Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series*, Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDBB Non-riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1 WBBGBRCC Non-riverine ACA v2.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDBB Riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1 WBBGBRCC Riverine ACA v2.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v3.1 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.7
Threatened Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.

These datasets are available at:
http://dds.information.qld.gov.au/DDS

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DETSI	- Department of the Environment, Tourism, Science and Innovation
EPBC	- *Environment Protection and Biodiversity Conservation Act 1999*
EVNT	- Endangered, Vulnerable, Near Threatened
GDA2020	- Geocentric Datum of Australia 2020
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest

ML: 2499

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Details for area of interest: ML: 2499, with area 28.08 ha

Local Government(s)	
Cloncurry Shire	
Bioregion(s)	**Subregion(s)**
Northwest Highlands	Mount Isa Inlier
Catchment(s)	
Flinders	

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Biodiversity Planning Assessment(s)	Aquatic Conservation Assessment(s) (riverine)	Aquatic Conservation Assessment(s) (non-riverine)
Northwest Highlands v1.1	Eastern Gulf of Carpentaria v1.1	Eastern Gulf of Carpentaria v.1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.12	0.43
Of concern	0.00	0.00
No concern at present	13.07	46.55

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	2.42	8.62
Regional	10.77	38.36

Table 5: Non-riverine wetlands intersecting the AOI

(No Records)

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

(No Records)

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of the Environment, Tourism, Science and Innovation's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	28.08	99.99

Table 8: Summary table, aquatic conservation significance (non-riverine)

(No Records)

Biodiversity Planning Assessments

Introduction

The Department of the Environment, Tourism, Science and Innovation (DETSI) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DETSI. Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity Status	Area (Ha)	% of AOI
State	2.42	8.62
Regional	10.77	38.36

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the *Environment Protection and Biodiversity Conservation Act 1999*. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in

protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has high connectivity or buffers an endangered RE or Sig. Wetland (G)	2.42	8.62
Regional	Remnant contains at least 1 Vulnerable or Near Threatened species (A)	10.77	38.36

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa	0.00	0.00	13.19	46.98	0.00	0.00	0.00	0.00
B1: Ecosystem Value (Bioregion)	0.00	0.00	0.00	0.00	13.19	46.98	0.00	0.00
B2: Ecosystem Value (Subregion)	0.00	0.00	0.00	0.00	13.19	46.98	0.00	0.00
C: Tract Size	0.00	0.00	13.19	46.98	0.00	0.00	0.00	0.00
D1: Relative RE Size (Bioregion)	2.42	8.62	0.00	0.00	0.00	0.00	10.77	38.36
D2: Relative RE Size (Subregion)	2.42	8.62	0.00	0.00	0.00	0.00	10.77	38.36

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
F: Ecosystem Diversity	0.00	0.00	2.42	8.62	10.77	38.36	0.00	0.00
G: Context and Connection	13.19	46.98	0.00	0.00	0.00	0.00	0.00	0.00

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

(No Records)

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al*. 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ia: Centres of Endemism	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ib: Wildlife Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ic: Disjunct Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Id: Limits of Geographic Ranges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ie: High Species Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
If: Relictual Populations	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ig: Variation in Species Composition	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ih: Artificial Wetland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ii: Hollow Bearing Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ij: Breeding or Roosting Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ik: Climate Refugia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

- Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;
- Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;
- Maintaining large scale seasonal/migratory species processes and movement of fauna;
- Maximising connectivity between large tracts/patches of remnant vegetation;
- Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

  - Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);
  - Follow major watershed/catchment and/or coastal boundaries;
  - Incorporate major altitudinal/geological/climatic gradients;
  - Include and maximise connectivity between large tracts/patches of remnant vegetation;
  - Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

  - Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

(No Records)

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

(No Records)

Expert panel decision descriptions:

(No Records)

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning prcesses

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland *Info*:

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

https://qldspatial.information.qld.gov.au/catalogue/custom/index.page

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Medium	28.08	99.99

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	28.08	99.99	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	28.08	99.99	0.00	0.00
3. Diversity and richness	0.00	0.00	28.08	99.99	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	28.08	99.99	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	28.08	99.99	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

(No Records)

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Naturalness catchment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Diversity and richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Threatened species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Priority species and ecosystems	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Special features	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Connectivity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8. Representativeness	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/ Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

Decision number	Description
(No Records)	

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, Herbrecs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

Species	Common name	NCA status	EPBC status	Migratory species*	Wetland species**	Identified flora/fauna
Petrogale purpureicollis	purple-necked rock-wallaby	V				FA

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DETSI internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

**B - Convention on the Conservation of Migratory Species; C - China-Australia Migratory Bird Agreement; J - Japan-Australia Migratory Bird Agreement; E - East Asian-Australasian Flyway Partnership; R - Republic of Korea-Australia Migratory Bird Agreement.*

***I - wetland indicator species; D - wetland dependent species.*

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Identified flora/fauna
Amytornis ballarae	Kalkadoon grasswren	FA
Barnardius zonarius macgillivrayi	Cloncurry parrot	FA

Species	Common name	Identified flora/fauna
Ctenotus decaneurus	ten-lined ctenotus	FA
Ctenotus striaticeps	stripe-headed finesnout ctenotus	FA
Cyperus cunninghamii subsp. cheradicus		FL
Egernia hosmeri	Hosmer's skink	FA
Neosilurus hyrtlii	Hyrtl's catfish	FA

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

(No Records)

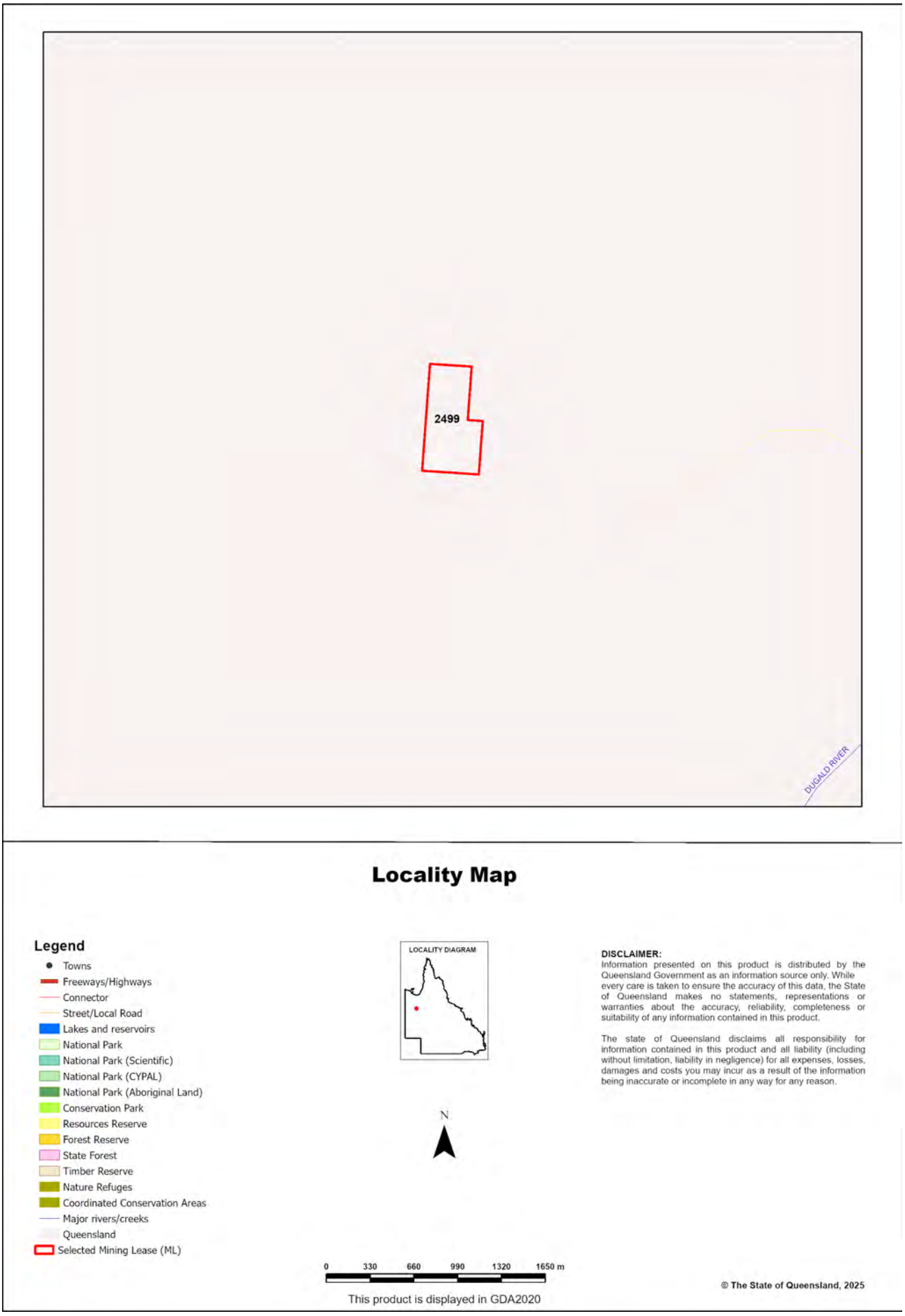
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

(No Records)

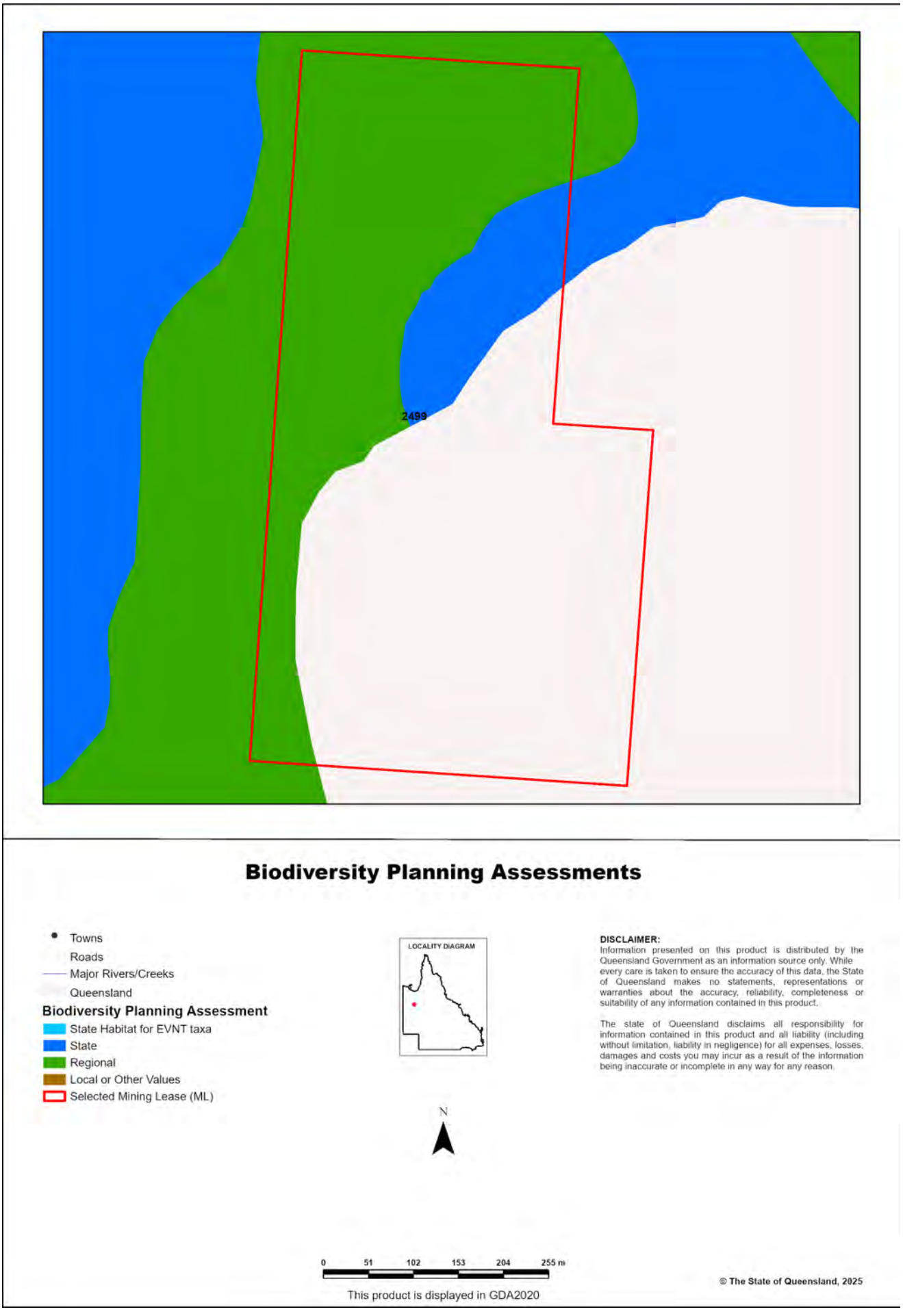
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

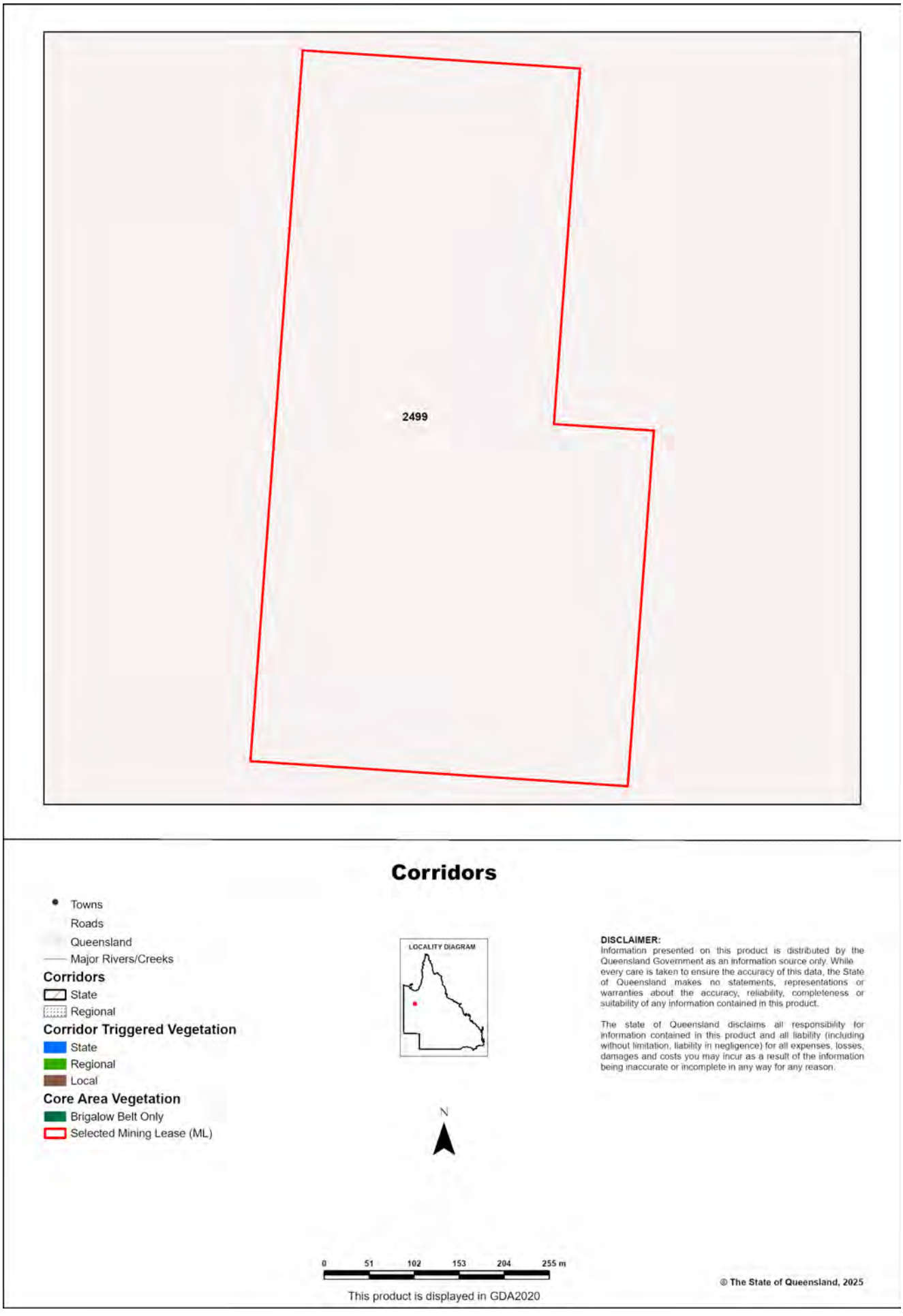
Map 1 - Locality Map



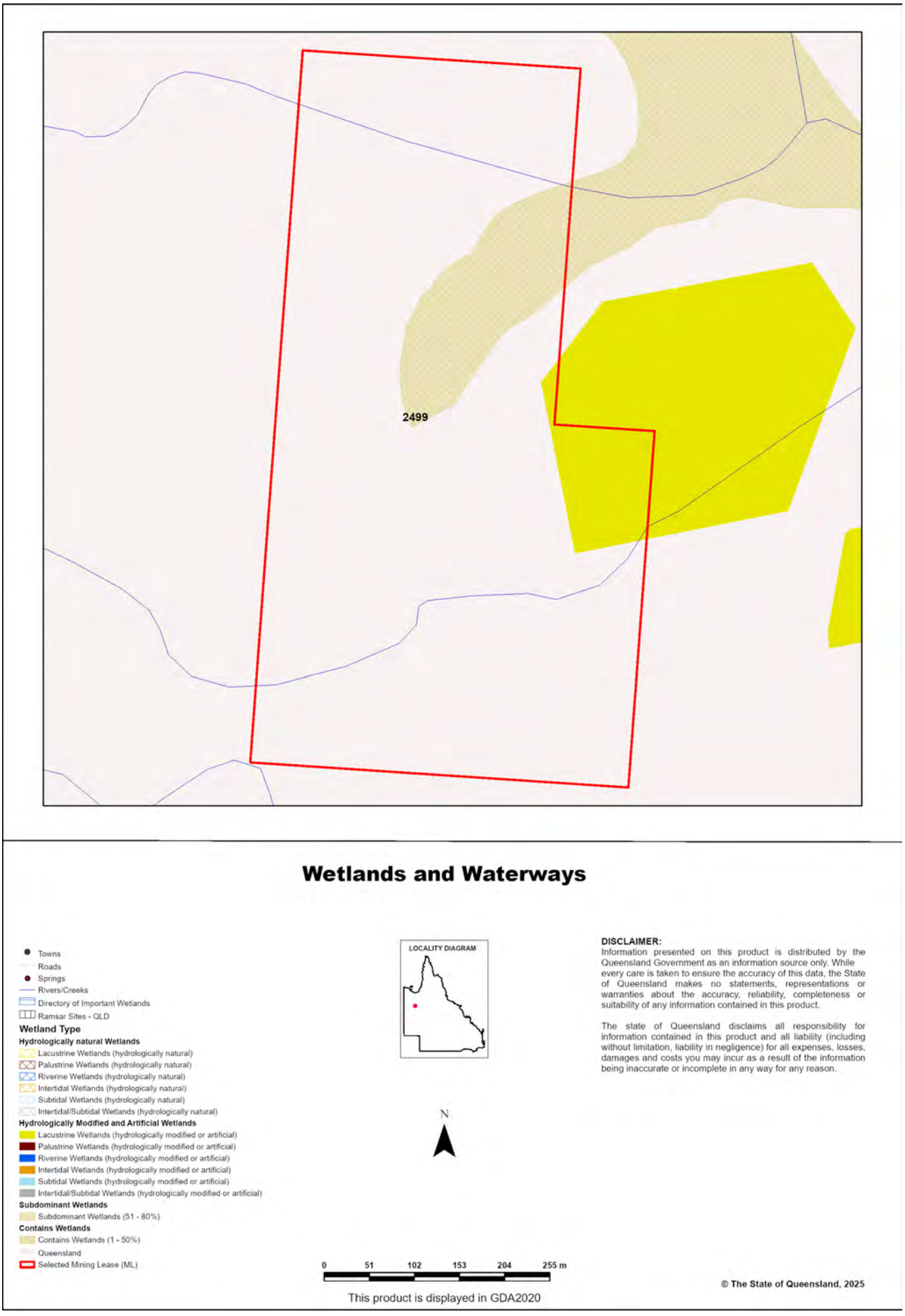
Map 2 - Biodiversity Planning Assessment (BPA)



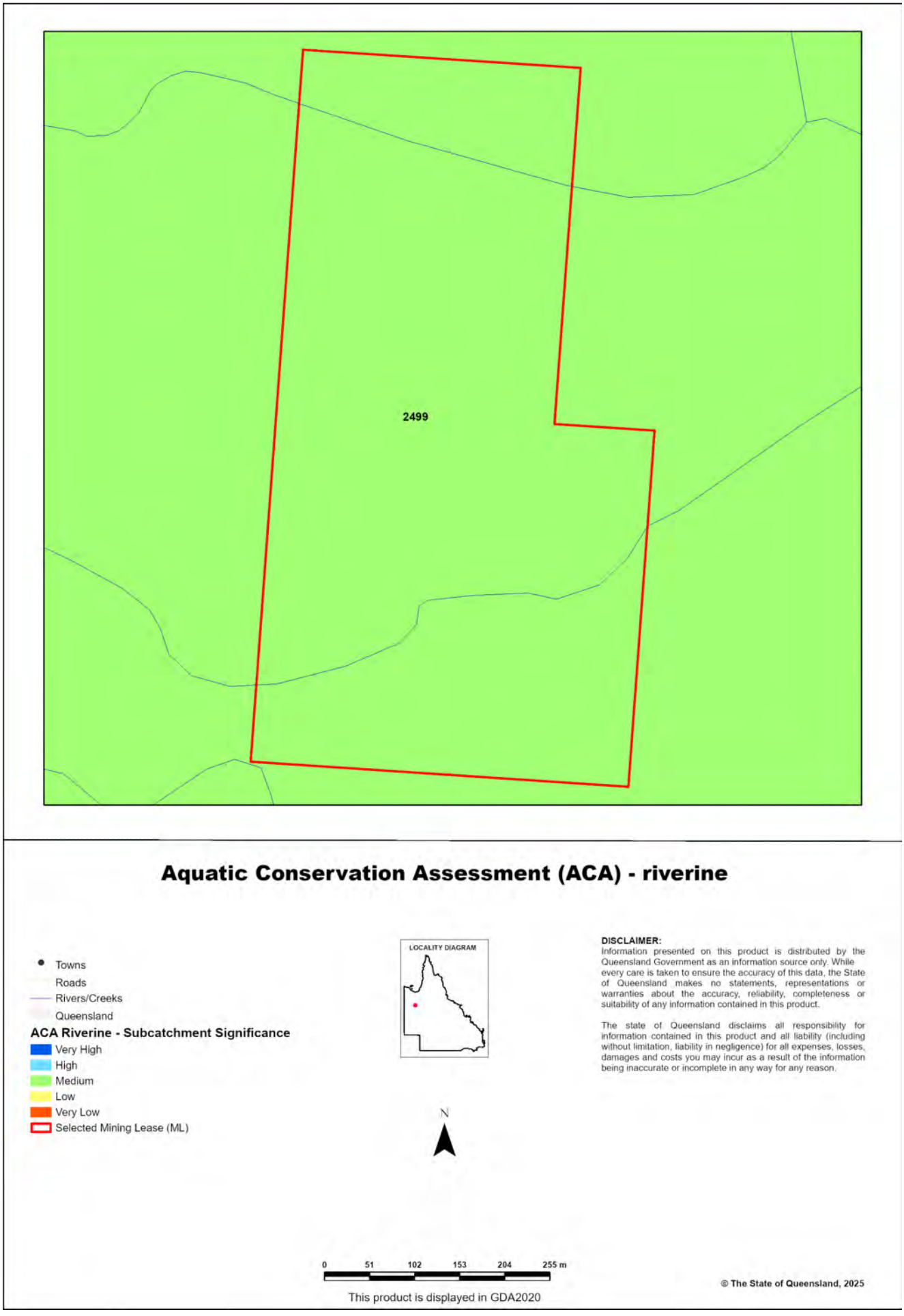
Map 3 - Corridors



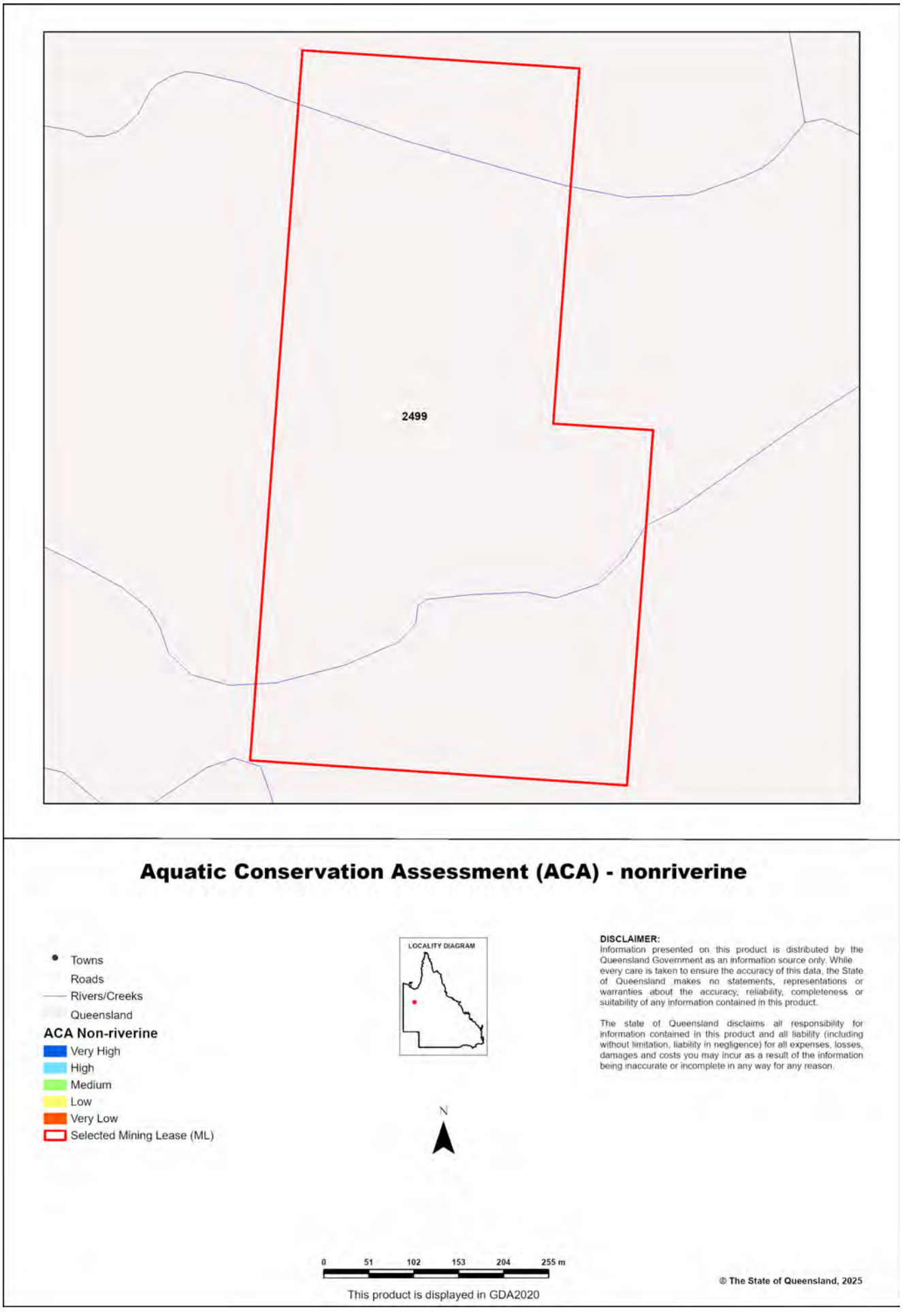
Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment.* Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Environment and Heritage Protection 2014*, Biodiversity Assessment and Mapping Methodology.* Version 2.2. Department of Environment and Heritage Protection, Brisbane.

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). *Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series*, Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDBB Non-riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1 WBBGBRCC Non-riverine ACA v2.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDBB Riverine ACA v2.1 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1 WBBGBRCC Riverine ACA v2.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v3.1 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.7
Threatened Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DETSI database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.

These datasets are available at:
http://dds.information.qld.gov.au/DDS

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DETSI	- Department of the Environment, Tourism, Science and Innovation
EPBC	- *Environment Protection and Biodiversity Conservation Act 1999*
EVNT	- Endangered, Vulnerable, Near Threatened
GDA2020	- Geocentric Datum of Australia 2020
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

APPENDIX D – ENVIRONMENTAL REPORTS – REGIONAL ECOSYSTEMS – BIODIVERSITY STATUS

TAILINGS.WATER.WASTE.

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
ML: 2499

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium & Biodiversity Science's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium & Biodiversity Science's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Details for area of interest:
ML: 2499, with area 28.08 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.12	0.43
Of concern	0.00	0.00
No concern at present	13.07	46.55
Total remnant vegetation	13.19	46.98

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and may be distinguished by differences in structure or sub-dominant species in the ecologically dominant layer. Vegetation communities with different dominant species in the ecologically dominant layer may be amalgamated in to a regional ecosystem if they are not mappable and predictable in the landscape at 1:100 000 scale. Vegetation communities may be mappable at a scale larger than 1:100 000. Vegetation communities within a regional ecosystem are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2023) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium & Biodiversity Science's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/.

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 percent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 percent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (<1000 ha); or patch size (<100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
1.11.2a	Eucalyptus leucophloia low open woodland	No concern at present	12.47	44.40
1.3.7b	Eucalyptus camaldulensis woodland on channels and levees	Endangered	0.12	0.43
1.5.13	Eucalyptus pruinosa low open woodland on older alluvial and residual soils	No concern at present	0.61	2.16
non-remnant	None	None	14.88	53.00

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.11.2a	Pre-clearing 1245000 ha; Remnant 2023 1239000 ha	19a	Not a Wetland	Low
1.3.7b	Pre-clearing 151000 ha; Remnant 2023 150000 ha	16a	Riverine	Low
1.5.13	Pre-clearing 320000 ha; Remnant 2023 319000 ha	19c	Not a Wetland	Low
non-remnant	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
1.11.2a	1.11.2: Potential habitat for NCA listed species: Eucalyptus nudicaulis, Ipomoea antonschmidii, Solanum carduiforme, Trachymene glandulosa.
1.3.7b	1.3.7: Important seasonal water bird habitat; regional corridor for fauna.
1.5.13	None
non-remnant	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at: https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	14.88	53.00
16a	Open forest and woodlands dominated by Eucalyptus camaldulensis (river red gum) (or E. tereticornis (blue gum)) and/or E. coolabah (coolabah) (or E. microtheca (coolabah)) fringing drainage lines. Associated species may include Melaleuca spp., Blakella tessellaris (carbeen), Angophora spp., Casuarina cunninghamiana (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.	0.12	0.43
19a	Low open woodlands dominated by Eucalyptus leucophloia (snappy gum) with Triodia spp. dominated ground layer, mainly on hills and ranges.	12.47	44.40
19c	Low open woodlands dominated by Eucalyptus pruinosa low open woodlands on sandplains, outwash areas and lateritised surfaces.	0.61	2.16

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium & Biodiversity Science's QBEIS database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2023 (PDF)* section 3.3 of: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community. http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

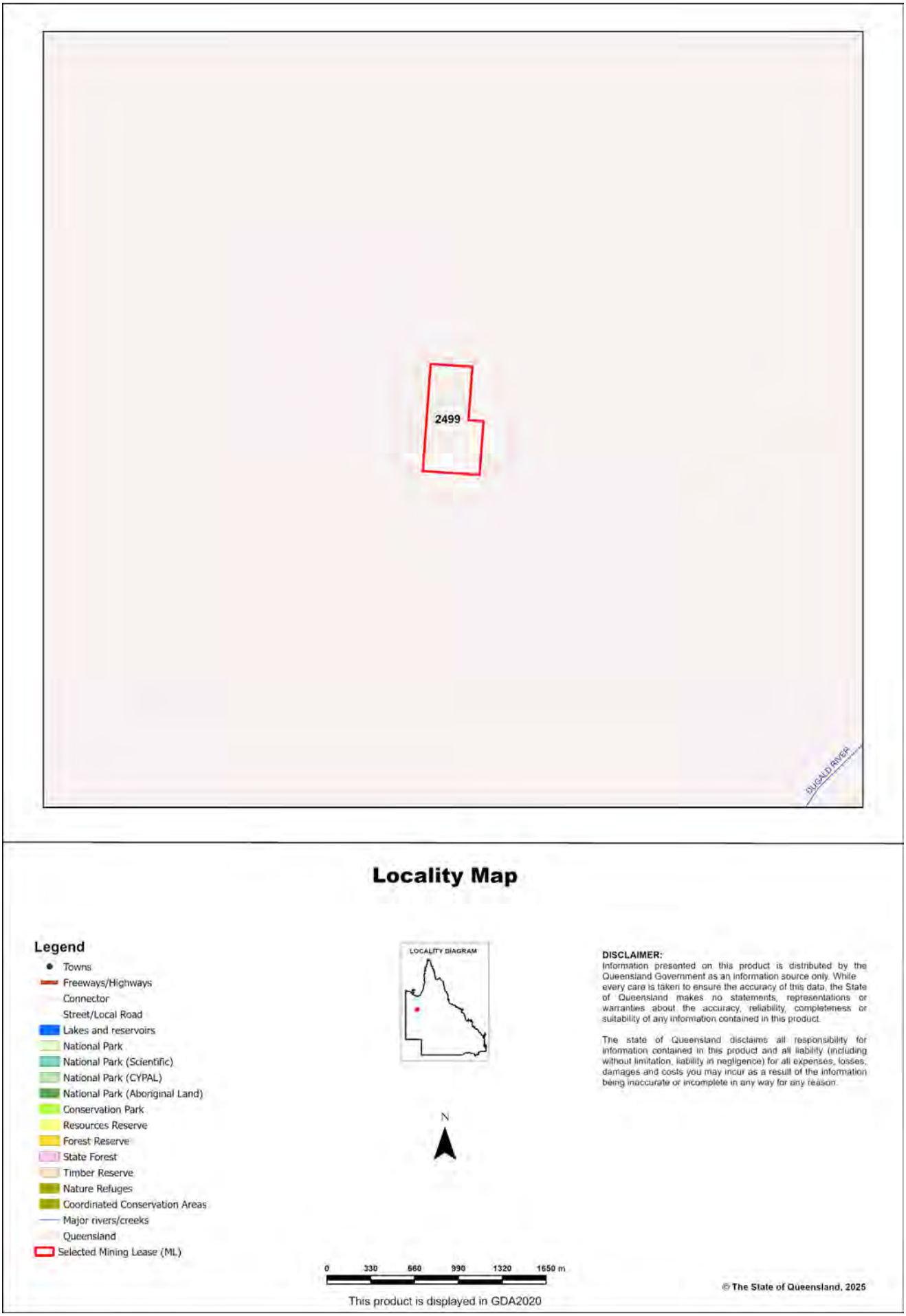
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

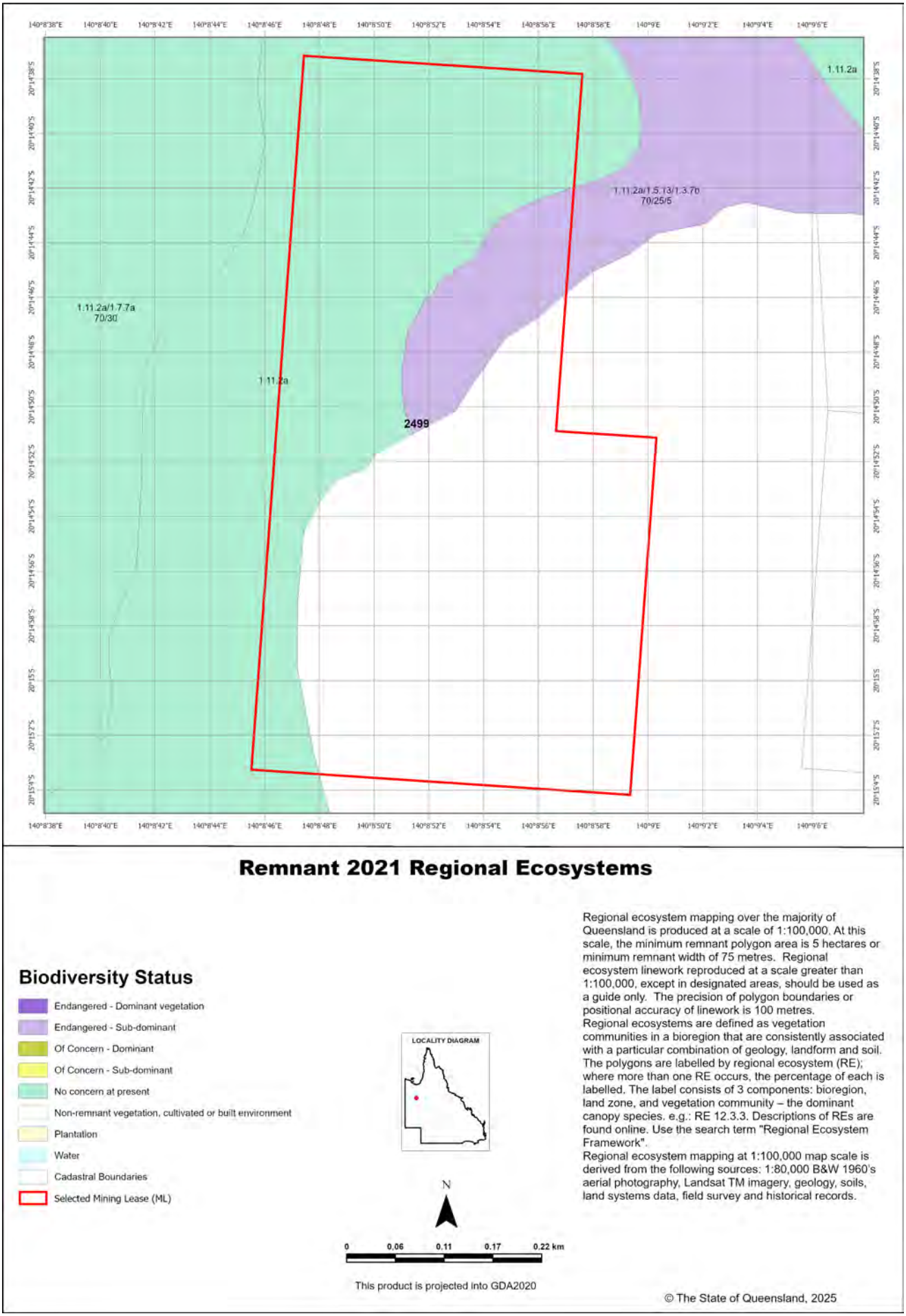
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
1.11.2a	Available	Not currently available
1.3.7b	Available	Not currently available
1.5.13	Available	Not currently available
non-remnant	Not currently available	Not currently available

Maps

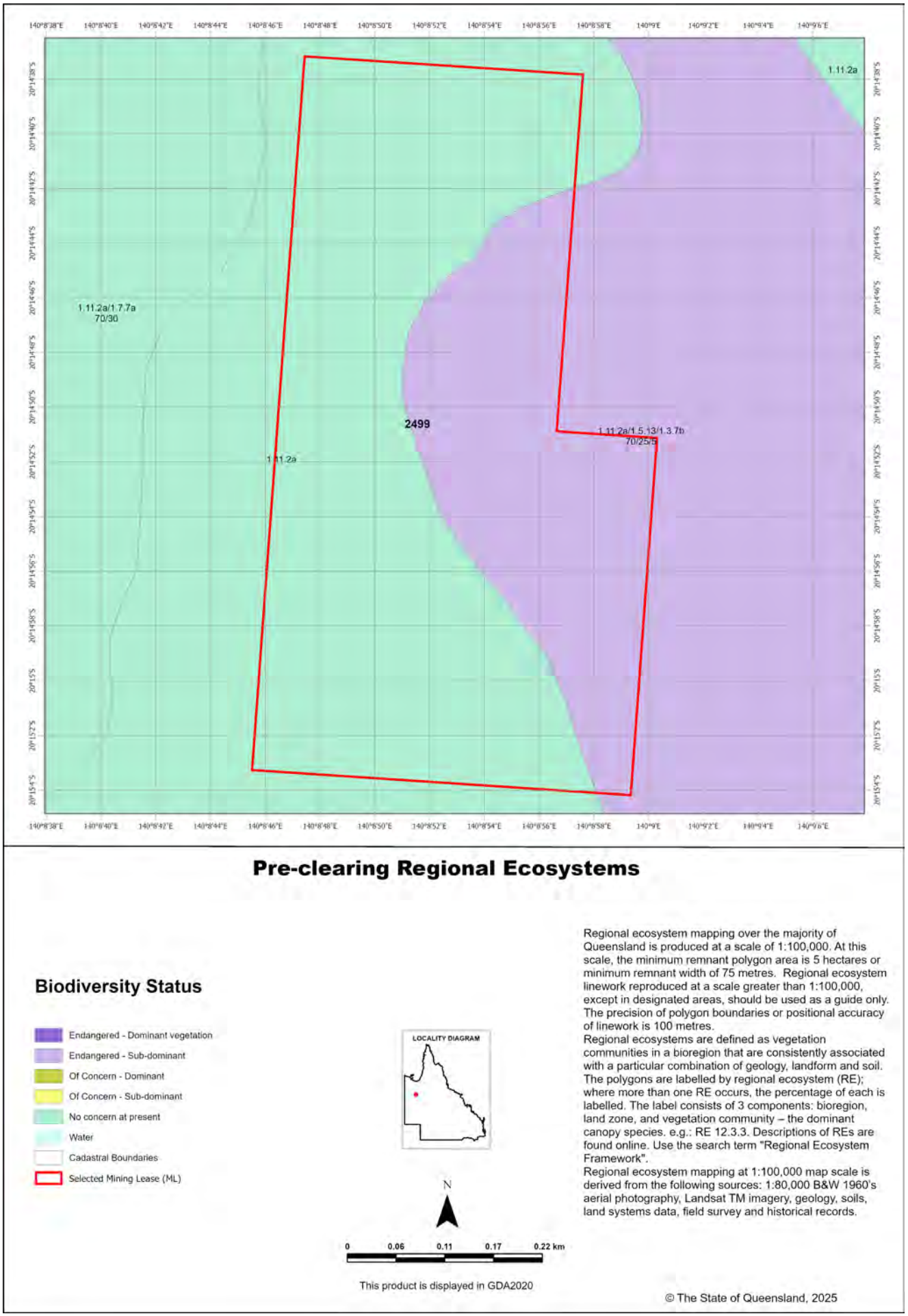
Map 1 - Location



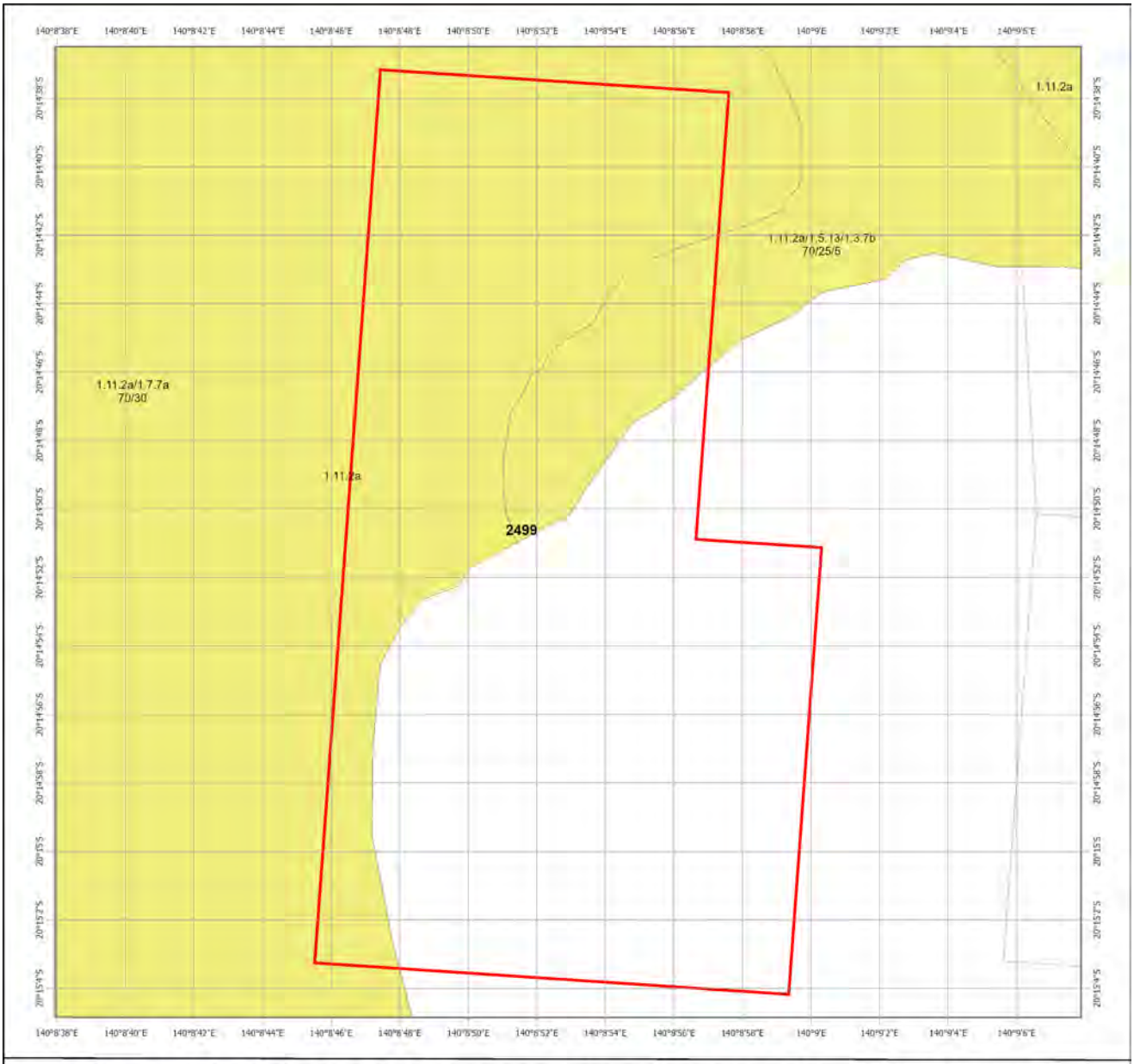
Map 2 - Remnant 2021 regional ecosystems



Map 3 - Pre-clearing regional ecosystems



Map 4 - Remnant 2021 regional ecosystems by BVG (5M)



Remnant 2021 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

1. Rainforests and scrubs (1-7b)
2. Wet eucalypt open forests (8-8b)
3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
4. Eucalypt open forests to woodlands on floodplains (16-16d)
5. Eucalypt dry woodlands on inland depositional plains (17-18d)
6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
7. Callitris woodland - open forests (20a)
8. Melaleuca open woodlands on depositional plains (21-22c)
9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
12. Other coastal communities or heaths (28-29b)
13. Tussock grasslands, forblands (30-32b)
14. Hummock grasslands (33-33b)
15. Wetlands (swamps and lakes) (34-34g)
16. Mangroves and saltmarshes (35-35b)

Non-remnant vegetation, cultivated or built environment
Water
Cadastral Boundaries
Selected Mining Lease (ML)

LOCALITY DIAGRAM

N

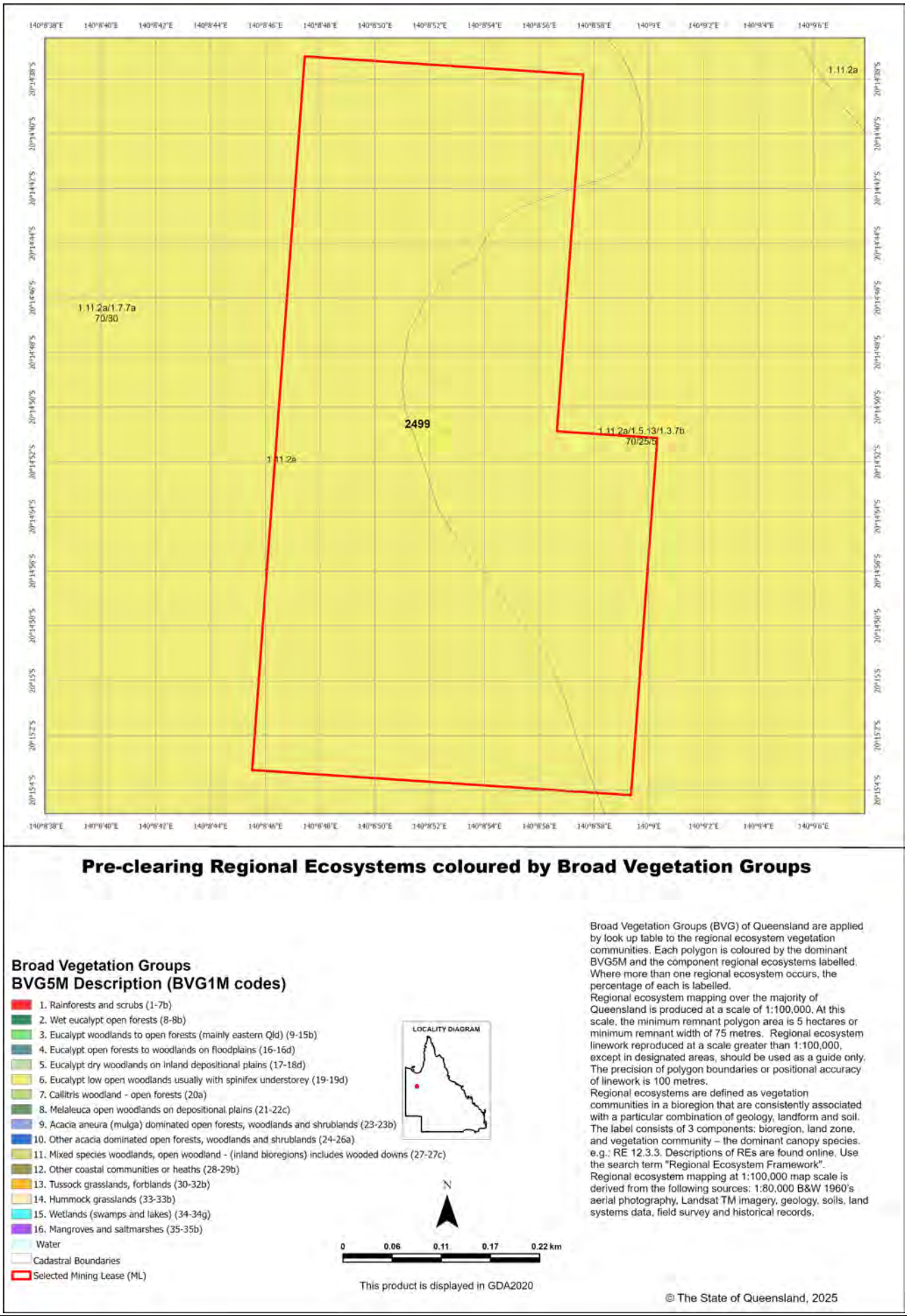
0 0.06 0.11 0.17 0.22 km

This product is displayed in GDA2020

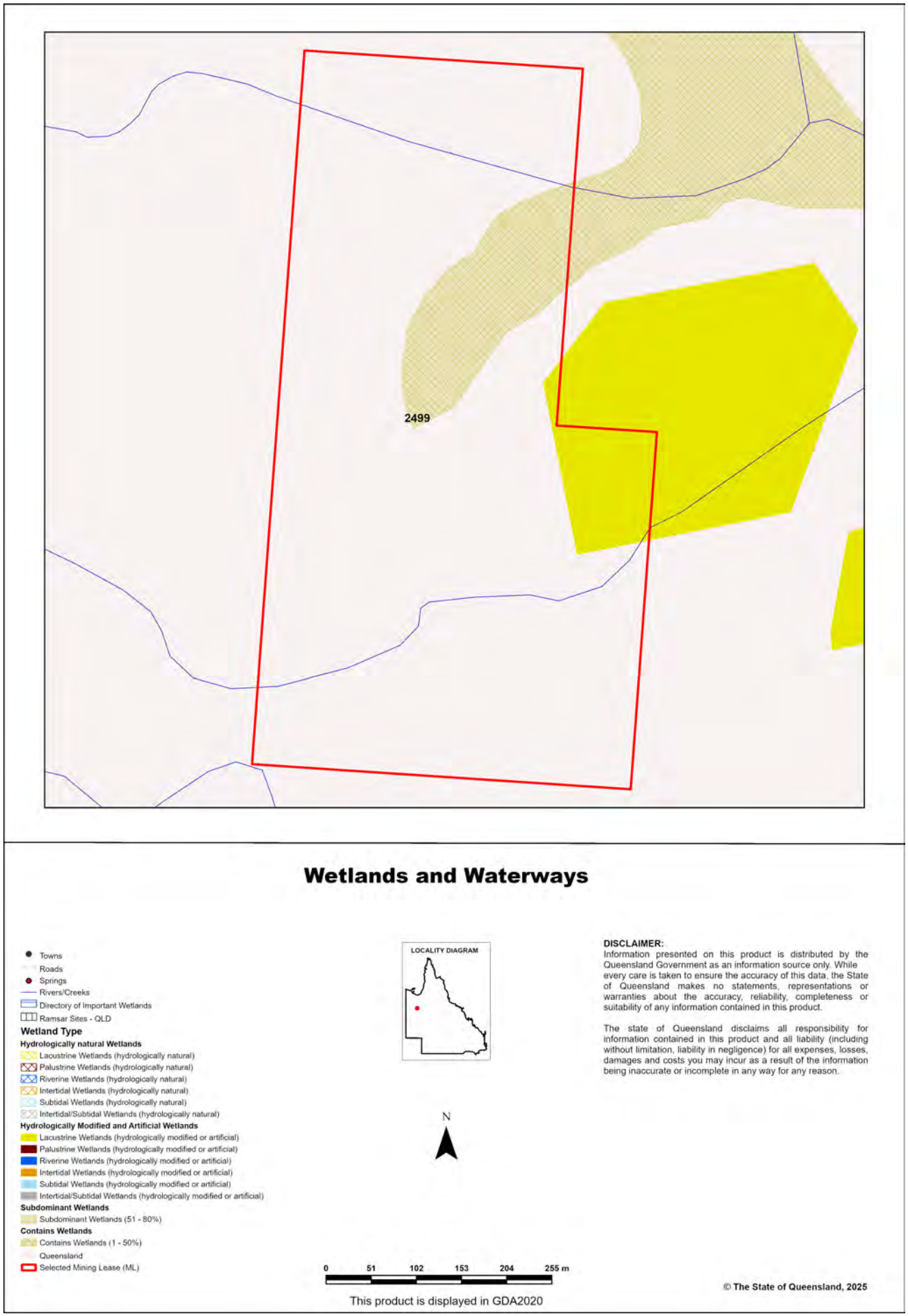
Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled. Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

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Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of the Environment, Tourism, Science and Innovation's Website - http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/ provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from: https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/broad-vegetation

The methodology for mapping regional ecosystems can be downloaded from: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

Technical descriptions for regional ecosystems can be obtained from: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from: http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Spatial Catalogue, Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link: https://qldglobe.information.qld.gov.au/

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2023). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 6.0. Queensland Herbarium, Department of Environment and Science. (https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Richter,D., Addicott, E.P. and Appelman, C.N. (2023) Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 7.0. Updated December 2023. Queensland Herbarium, Queensland Department of Environment, Science and Innovation, Brisbane. (https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf).

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems.* Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:
http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:
Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

- Biodiversity status of pre-clearing and 2021 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas
- Pre-clearing broad vegetation groups of Queensland
- Remnant 2021 broad vegetation groups of Queensland

Appendix 2 - Acronyms and Abbreviations

AOI - Area of Interest
GIS - Geographic Information System
RE - Regional Ecosystem
REDD - Regional Ecosystem Description Database
VMA - *Vegetation Management Act 1999*

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
ML: 2470

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium & Biodiversity Science's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium & Biodiversity Science's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Details for area of interest:
ML: 2470, with area 16.19 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.22	1.36
Of concern	0.00	0.00
No concern at present	6.13	37.89
Total remnant vegetation	6.35	39.24

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and may be distinguished by differences in structure or sub-dominant species in the ecologically dominant layer. Vegetation communities with different dominant species in the ecologically dominant layer may be amalgamated in to a regional ecosystem if they are not mappable and predictable in the landscape at 1:100 000 scale. Vegetation communities may be mappable at a scale larger than 1:100 000. Vegetation communities within a regional ecosystem are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2023) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium & Biodiversity Science's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/.

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 percent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 percent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (<1000 ha); or patch size (<100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
1.11.2a	Eucalyptus leucophloia low open woodland	No concern at present	5.03	31.09
1.3.7b	Eucalyptus camaldulensis woodland on channels and levees	Endangered	0.22	1.36
1.5.13	Eucalyptus pruinosa low open woodland on older alluvial and residual soils	No concern at present	1.10	6.79
non-remnant	None	None	9.83	60.73

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.11.2a	Pre-clearing 1245000 ha; Remnant 2023 1239000 ha	19a	Not a Wetland	Low
1.3.7b	Pre-clearing 151000 ha; Remnant 2023 150000 ha	16a	Riverine	Low
1.5.13	Pre-clearing 320000 ha; Remnant 2023 319000 ha	19c	Not a Wetland	Low
non-remnant	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
1.11.2a	1.11.2: Potential habitat for NCA listed species: Eucalyptus nudicaulis, Ipomoea antonschmidii, Solanum carduiforme, Trachymene glandulosa.
1.3.7b	1.3.7: Important seasonal water bird habitat; regional corridor for fauna.
1.5.13	None
non-remnant	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at: https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	9.83	60.73
16a	Open forest and woodlands dominated by Eucalyptus camaldulensis (river red gum) (or E. tereticornis (blue gum)) and/or E. coolabah (coolabah) (or E. microtheca (coolabah)) fringing drainage lines. Associated species may include Melaleuca spp., Blakella tessellaris (carbeen), Angophora spp., Casuarina cunninghamiana (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.	0.22	1.36
19a	Low open woodlands dominated by Eucalyptus leucophloia (snappy gum) with Triodia spp. dominated ground layer, mainly on hills and ranges.	5.03	31.09
19c	Low open woodlands dominated by Eucalyptus pruinosa low open woodlands on sandplains, outwash areas and lateritised surfaces.	1.10	6.79

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium & Biodiversity Science's QBEIS database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2023 (PDF)* section 3.3 of: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community. http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

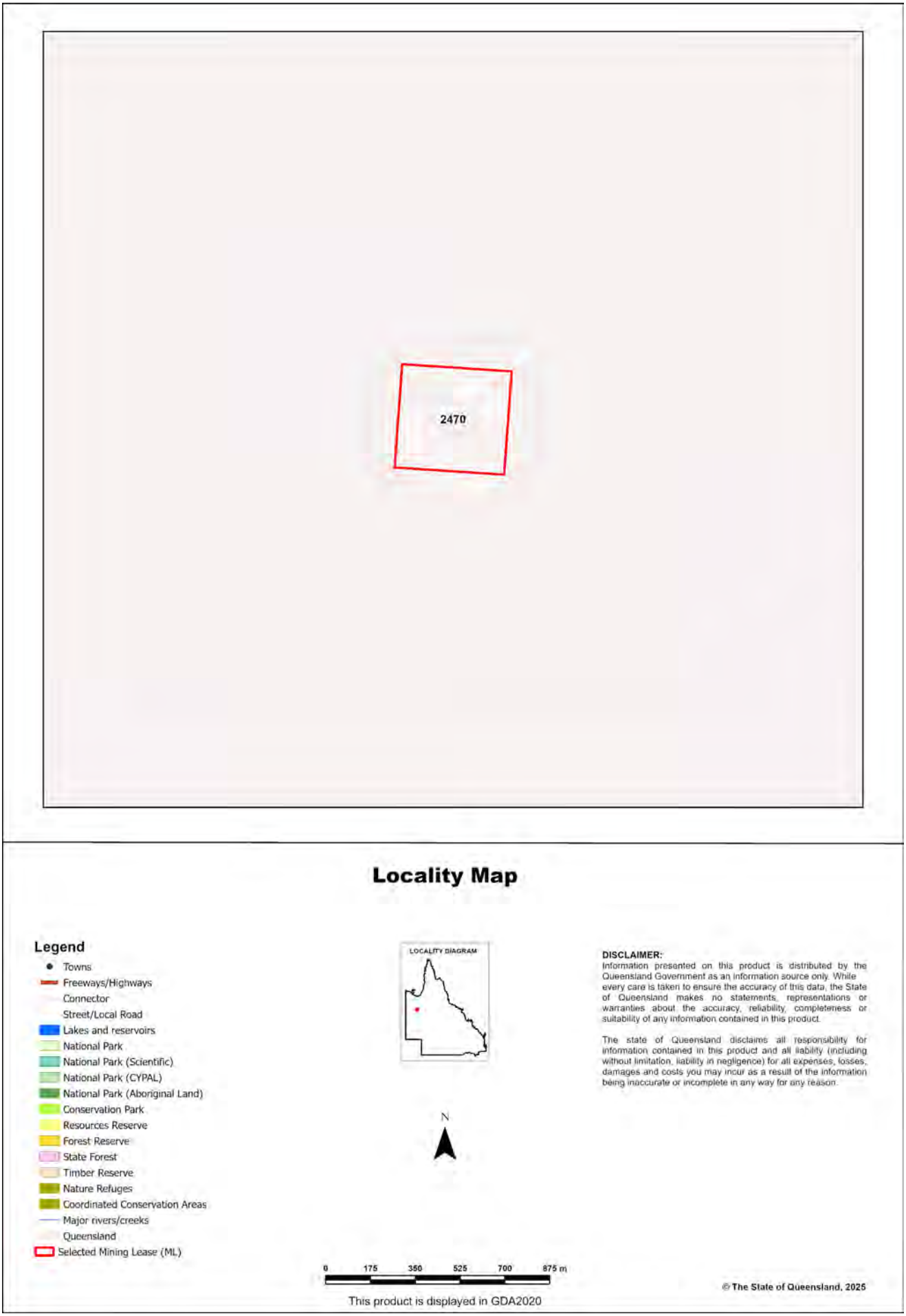
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

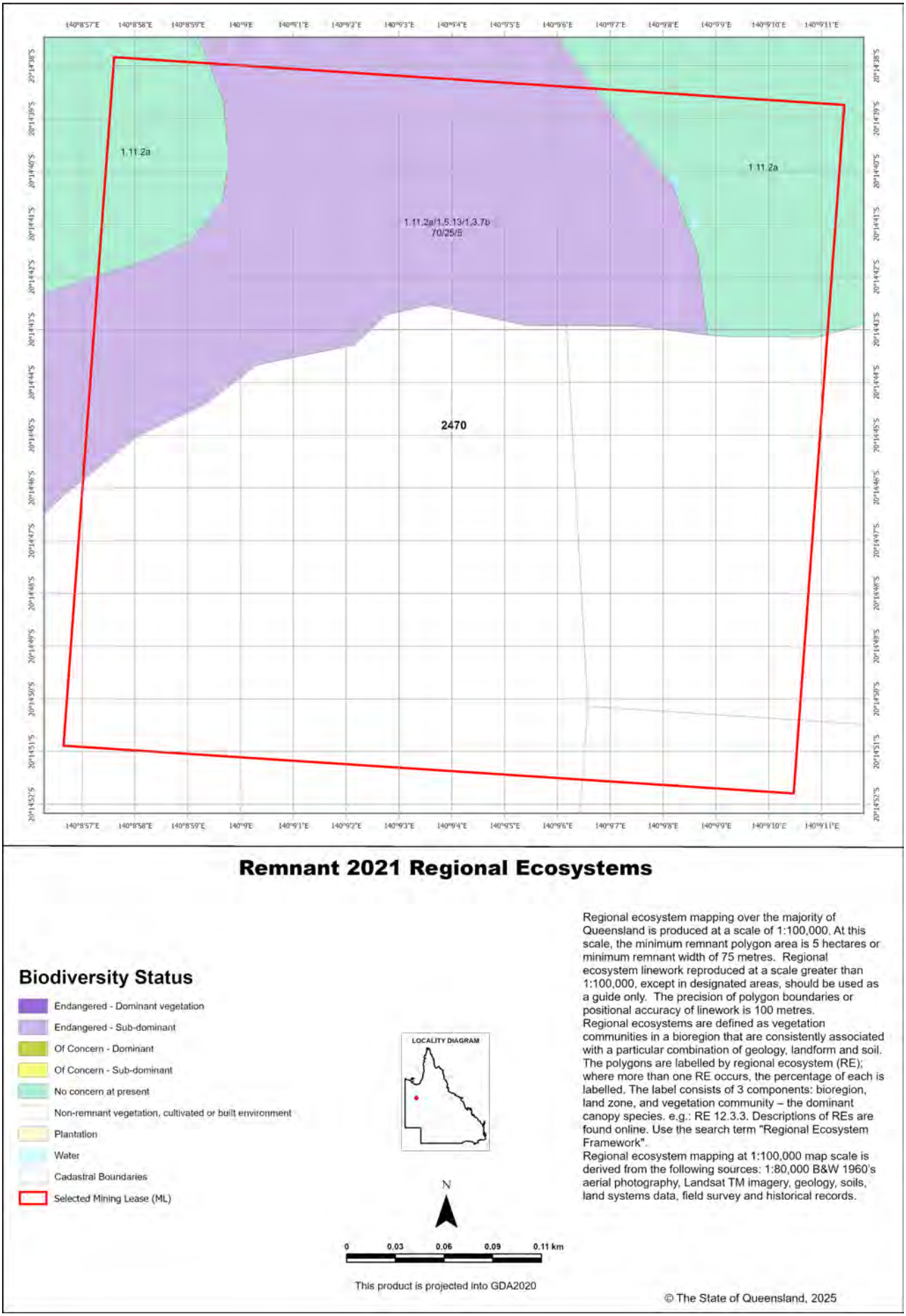
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
1.11.2a	Available	Not currently available
1.3.7b	Available	Not currently available
1.5.13	Available	Not currently available
non-remnant	Not currently available	Not currently available

Maps

Map 1 - Location



Map 2 - Remnant 2021 regional ecosystems



Map 3 - Pre-clearing regional ecosystems



Pre-clearing Regional Ecosystems

Biodiversity Status

- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Water
- Cadastral Boundaries
- Selected Mining Lease (ML)

LOCALITY DIAGRAM

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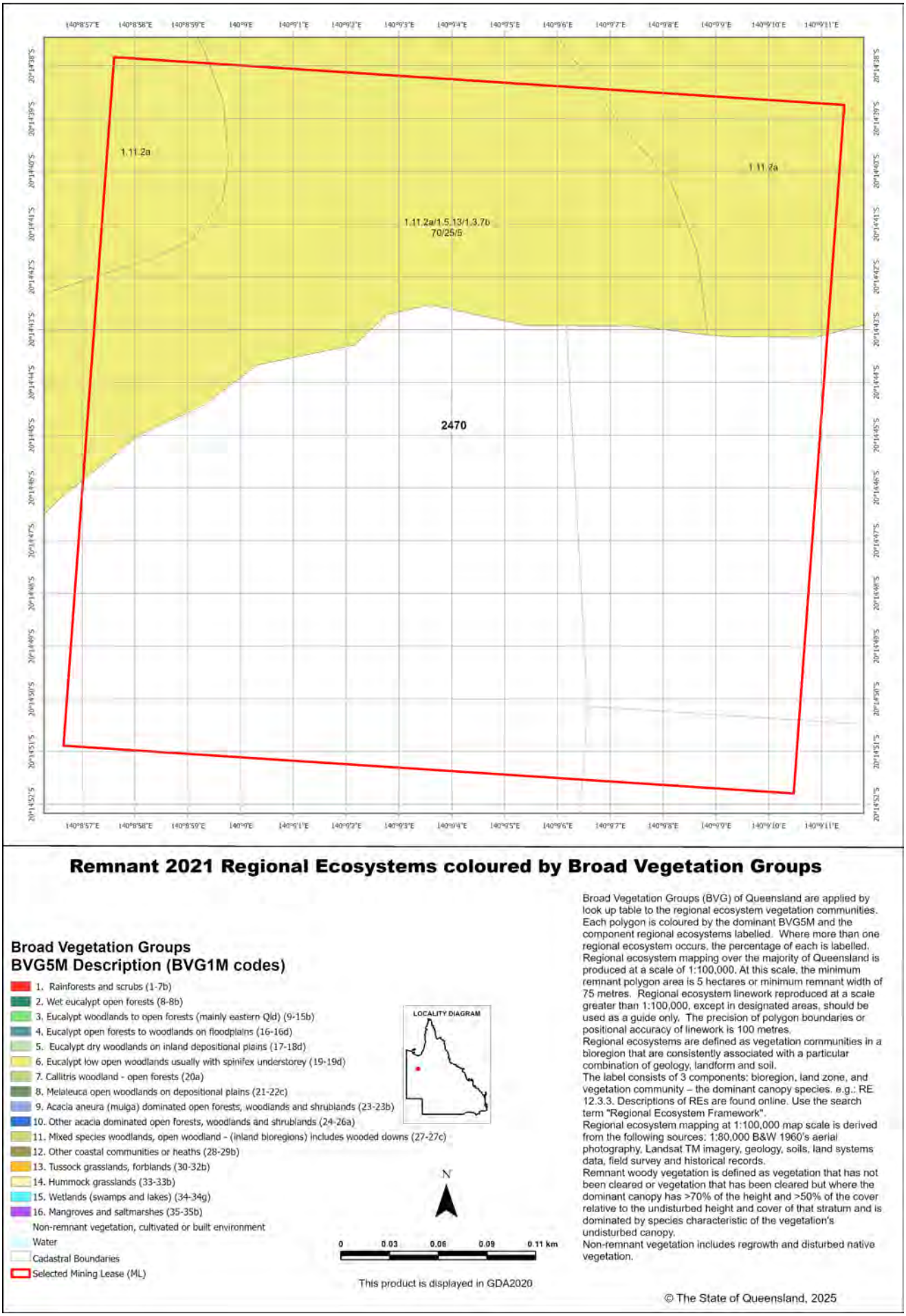
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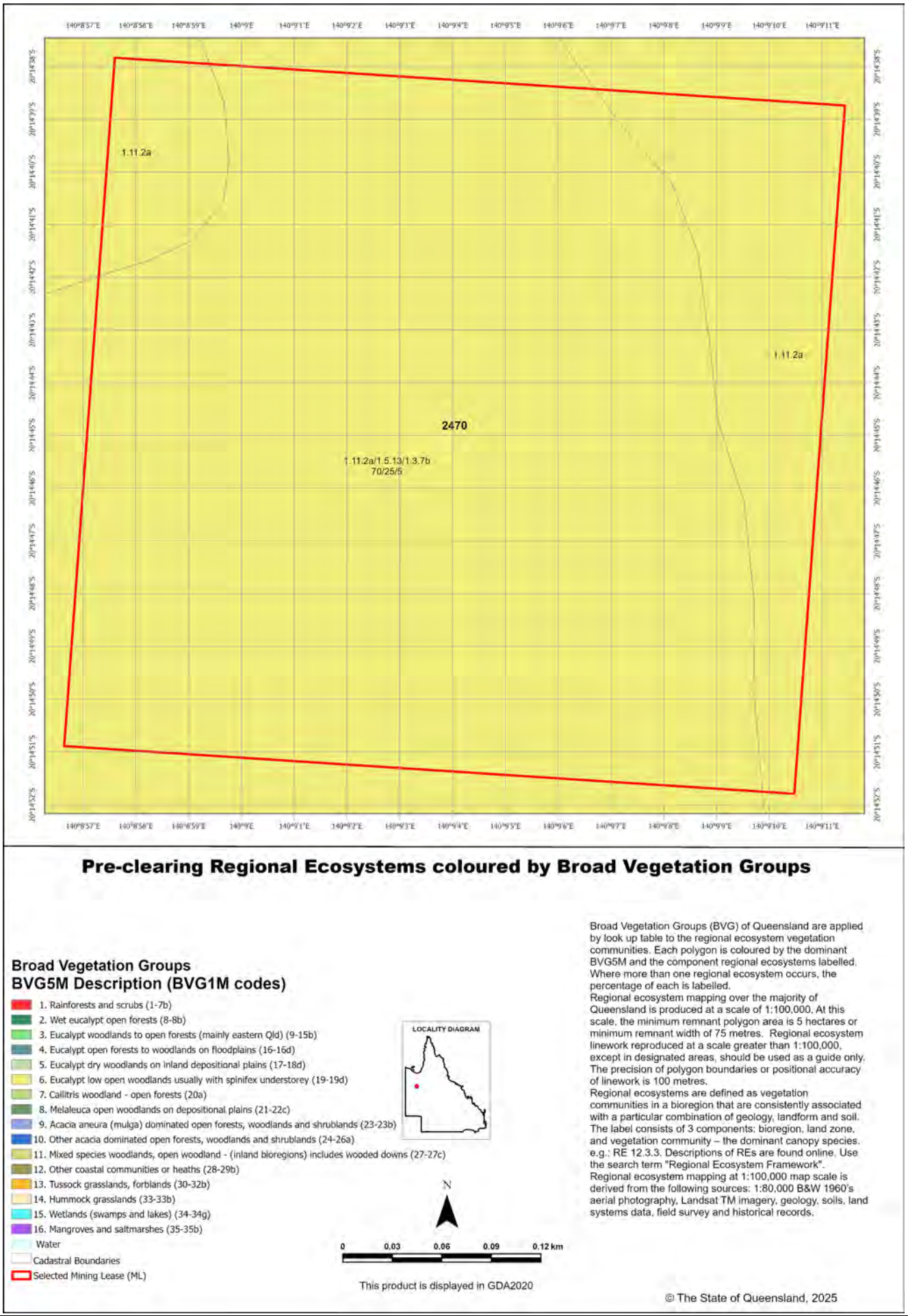
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

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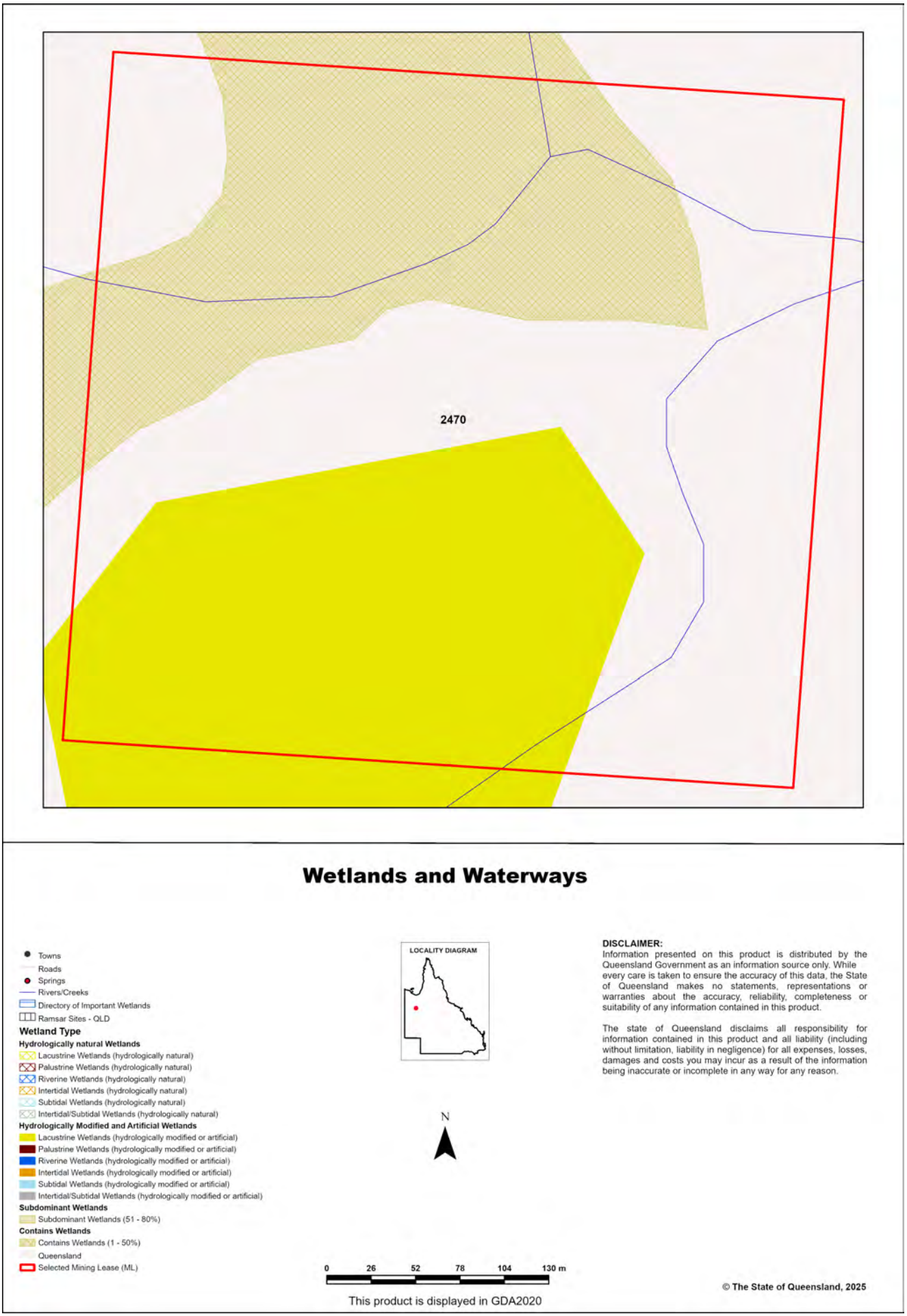
Map 4 - Remnant 2021 regional ecosystems by BVG (5M)



Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of the Environment, Tourism, Science and Innovation's Website - http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/ provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from: https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/broad-vegetation

The methodology for mapping regional ecosystems can be downloaded from: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

Technical descriptions for regional ecosystems can be obtained from: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from: http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Spatial Catalogue, Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link: https://qldglobe.information.qld.gov.au/

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2023). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 6.0. Queensland Herbarium, Department of Environment and Science. (https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Richter,D., Addicott, E.P. and Appelman, C.N. (2023) Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 7.0. Updated December 2023. Queensland Herbarium, Queensland Department of Environment, Science and Innovation, Brisbane. (https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf).

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems.* Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:
http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:
Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

- Biodiversity status of pre-clearing and 2021 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas
- Pre-clearing broad vegetation groups of Queensland
- Remnant 2021 broad vegetation groups of Queensland

Appendix 2 - Acronyms and Abbreviations

AOI - Area of Interest
GIS - Geographic Information System
RE - Regional Ecosystem
REDD - Regional Ecosystem Description Database
VMA - *Vegetation Management Act 1999*

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
ML: 2498

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium & Biodiversity Science's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium & Biodiversity Science's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Details for area of interest:
ML: 2498, with area 29.06 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.40	1.36
Of concern	0.00	0.00
No concern at present	18.49	63.64
Total remnant vegetation	18.89	65.01

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and may be distinguished by differences in structure or sub-dominant species in the ecologically dominant layer. Vegetation communities with different dominant species in the ecologically dominant layer may be amalgamated in to a regional ecosystem if they are not mappable and predictable in the landscape at 1:100 000 scale. Vegetation communities may be mappable at a scale larger than 1:100 000. Vegetation communities within a regional ecosystem are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2023) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium & Biodiversity Science's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/.

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 percent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 percent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (<1000 ha); or patch size (<100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
1.11.2a	Eucalyptus leucophloia low open woodland	No concern at present	16.51	56.83
1.3.7b	Eucalyptus camaldulensis woodland on channels and levees	Endangered	0.40	1.36
1.5.13	Eucalyptus pruinosa low open woodland on older alluvial and residual soils	No concern at present	1.98	6.81
non-remnant	None	None	10.17	35.00

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.11.2a	Pre-clearing 1245000 ha; Remnant 2023 1239000 ha	19a	Not a Wetland	Low
1.3.7b	Pre-clearing 151000 ha; Remnant 2023 150000 ha	16a	Riverine	Low
1.5.13	Pre-clearing 320000 ha; Remnant 2023 319000 ha	19c	Not a Wetland	Low
non-remnant	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
1.11.2a	1.11.2: Potential habitat for NCA listed species: Eucalyptus nudicaulis, Ipomoea antonschmidii, Solanum carduiforme, Trachymene glandulosa.
1.3.7b	1.3.7: Important seasonal water bird habitat; regional corridor for fauna.
1.5.13	None
non-remnant	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at: https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	10.17	35.00
16a	Open forest and woodlands dominated by Eucalyptus camaldulensis (river red gum) (or E. tereticornis (blue gum)) and/or E. coolabah (coolabah) (or E. microtheca (coolabah)) fringing drainage lines. Associated species may include Melaleuca spp., Blakella tessellaris (carbeen), Angophora spp., Casuarina cunninghamiana (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.	0.40	1.36
19a	Low open woodlands dominated by Eucalyptus leucophloia (snappy gum) with Triodia spp. dominated ground layer, mainly on hills and ranges.	16.51	56.83
19c	Low open woodlands dominated by Eucalyptus pruinosa low open woodlands on sandplains, outwash areas and lateritised surfaces.	1.98	6.81

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium & Biodiversity Science's QBEIS database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2023 (PDF)* section 3.3 of: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community. http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

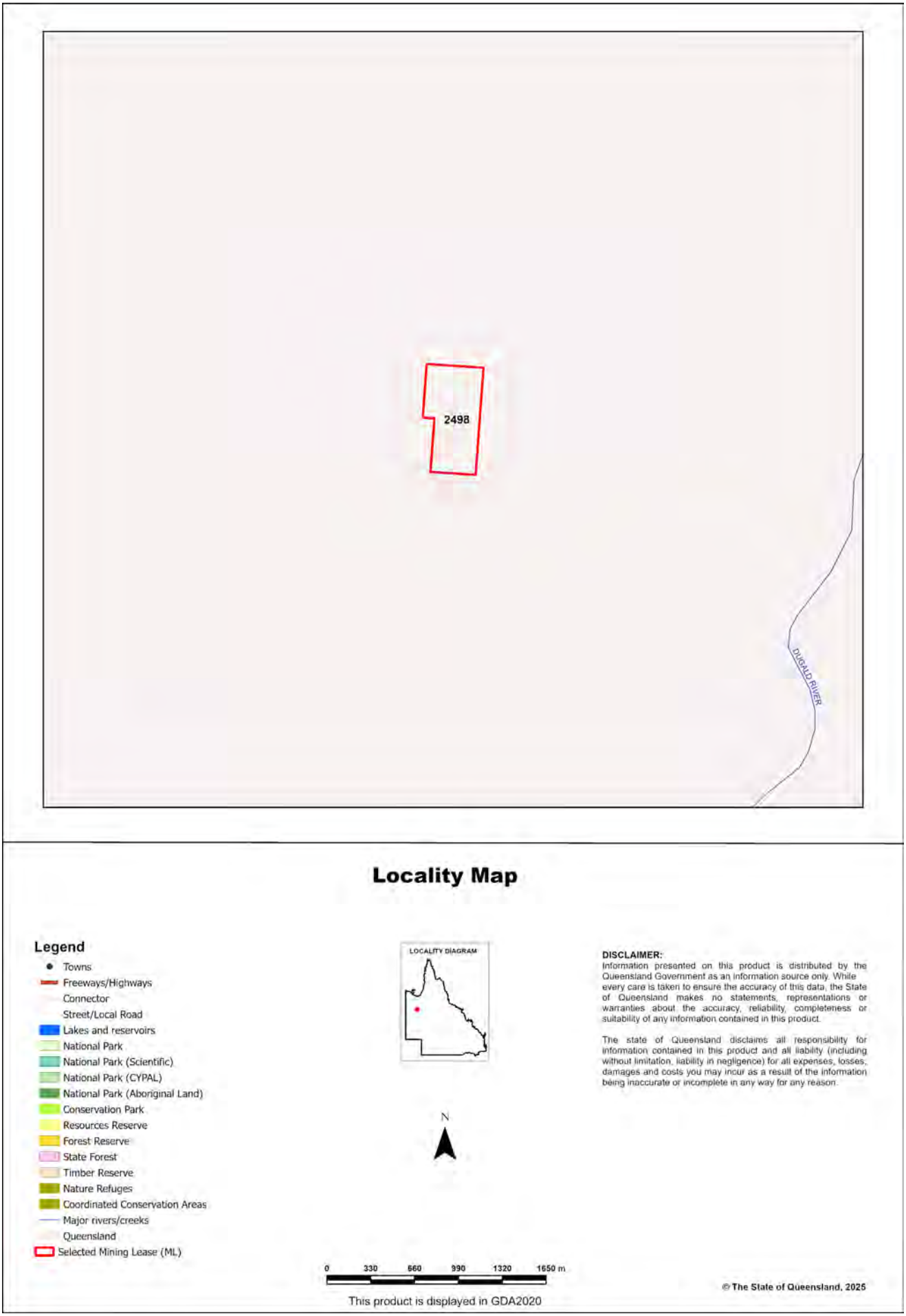
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

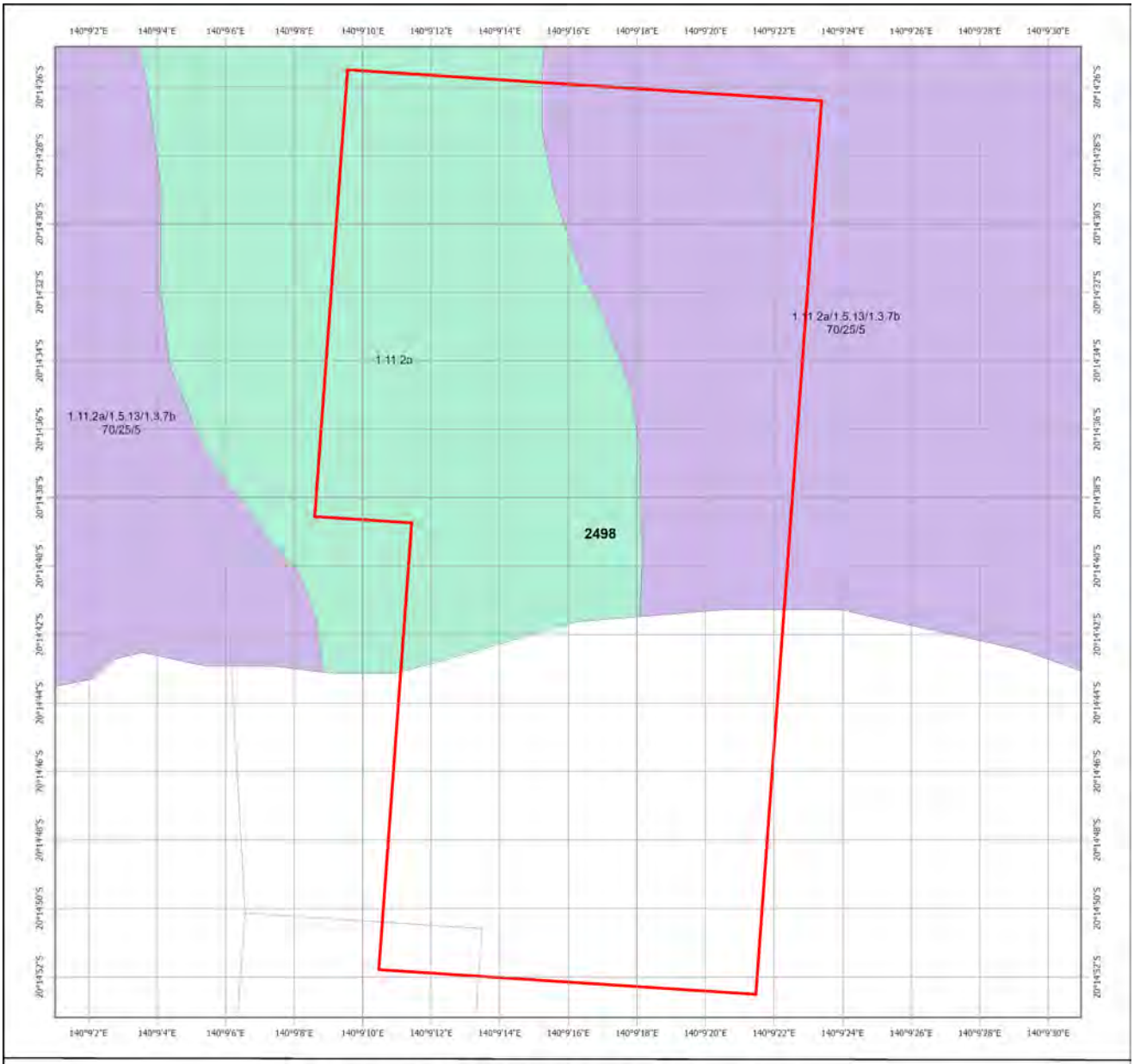
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
1.11.2a	Available	Not currently available
1.3.7b	Available	Not currently available
1.5.13	Available	Not currently available
non-remnant	Not currently available	Not currently available

Maps

Map 1 - Location



Map 2 - Remnant 2021 regional ecosystems



Remnant 2021 Regional Ecosystems

Biodiversity Status

- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Non-remnant vegetation, cultivated or built environment
- Plantation
- Water
- Cadastral Boundaries
- Selected Mining Lease (ML)

LOCALITY DIAGRAM

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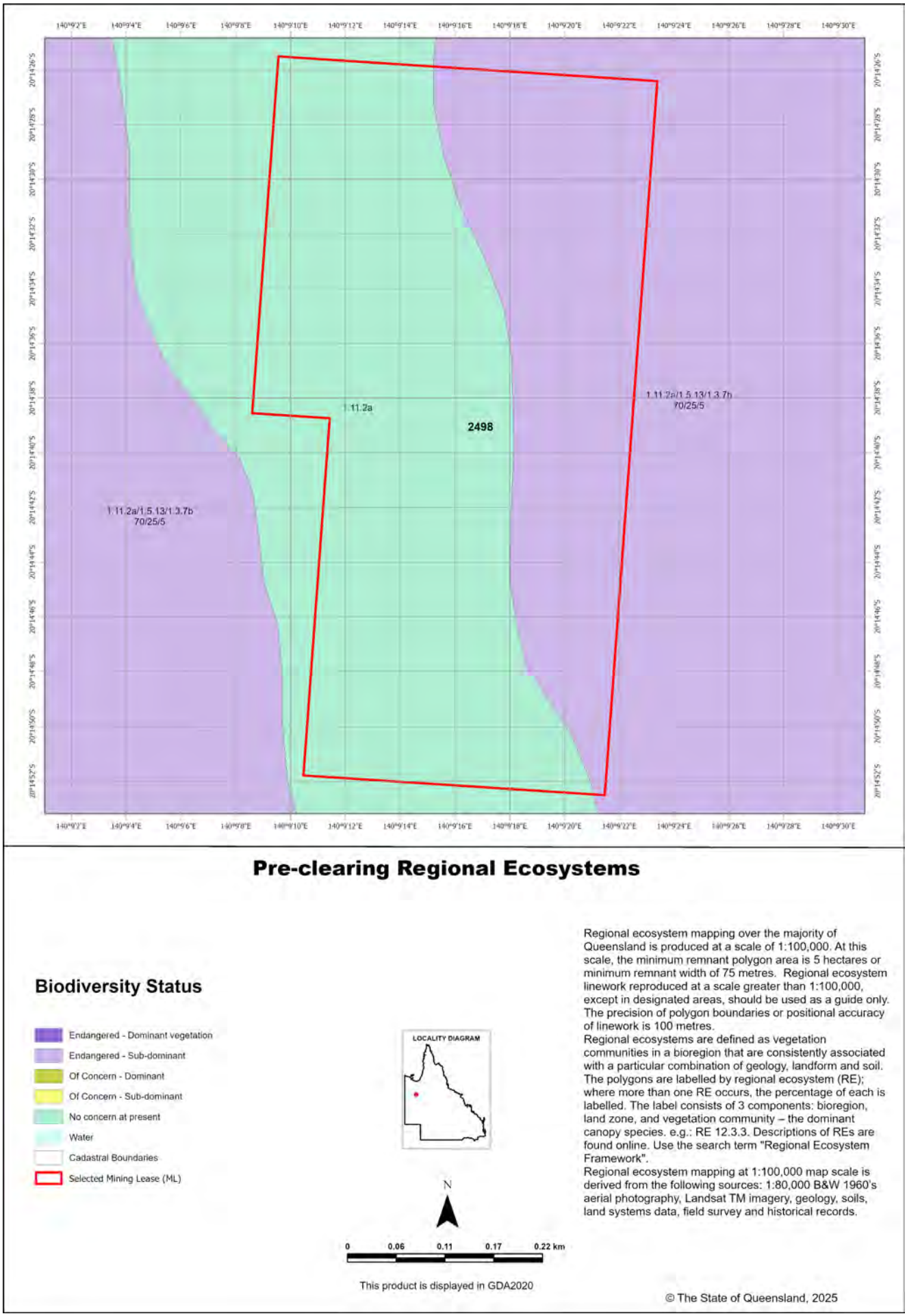
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This product is projected into GDA2020

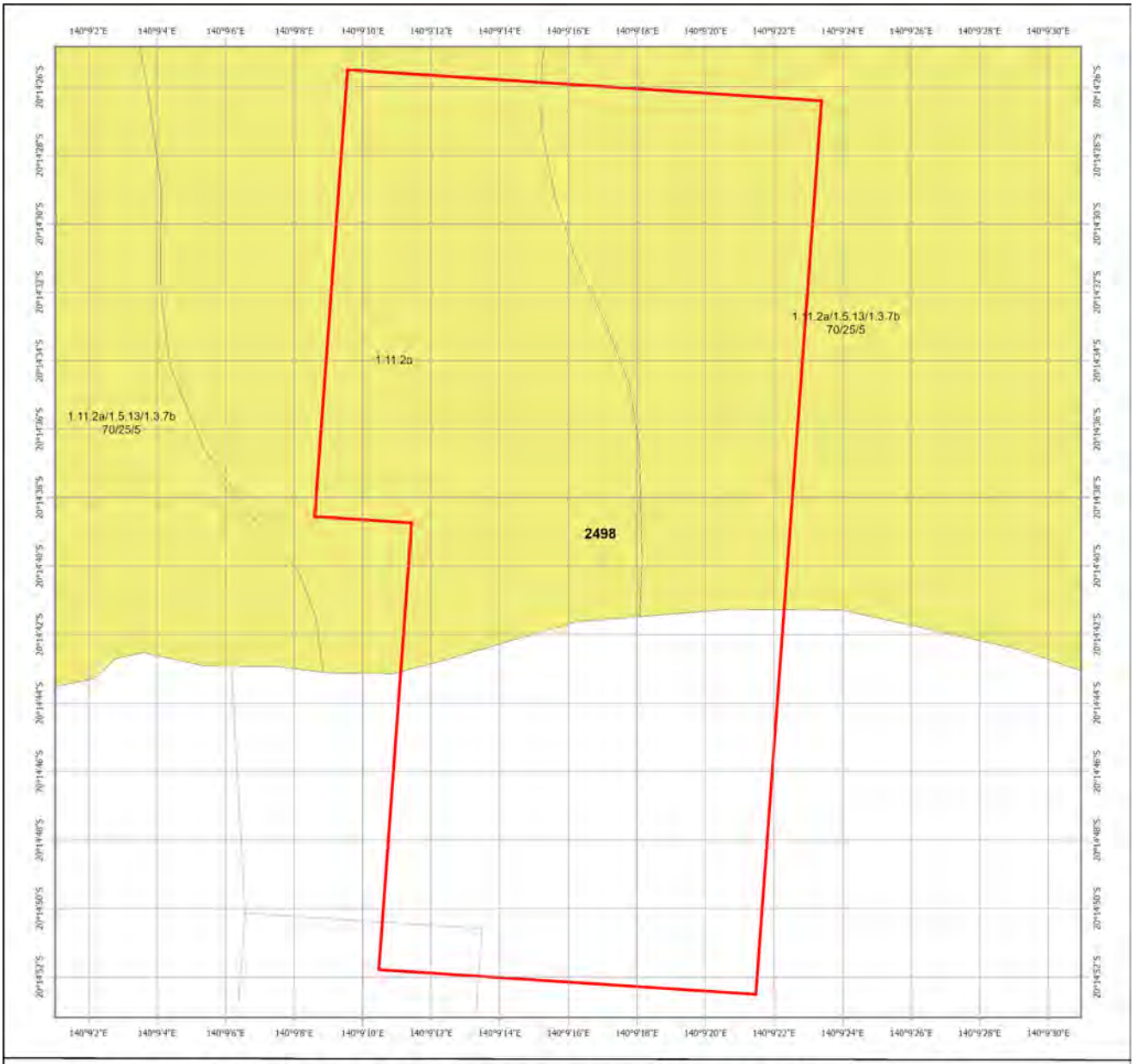
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Map 3 - Pre-clearing regional ecosystems



Map 4 - Remnant 2021 regional ecosystems by BVG (5M)



Remnant 2021 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

1. Rainforests and scrubs (1-7b)
2. Wet eucalypt open forests (8-8b)
3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
4. Eucalypt open forests to woodlands on floodplains (16-16d)
5. Eucalypt dry woodlands on inland depositional plains (17-18d)
6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
7. Callitris woodland - open forests (20a)
8. Melaleuca open woodlands on depositional plains (21-22c)
9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
12. Other coastal communities or heaths (28-29b)
13. Tussock grasslands, forblands (30-32b)
14. Hummock grasslands (33-33b)
15. Wetlands (swamps and lakes) (34-34g)
16. Mangroves and saltmarshes (35-35b)

Non-remnant vegetation, cultivated or built environment
Water
Cadastral Boundaries
Selected Mining Lease (ML)

LOCALITY DIAGRAM

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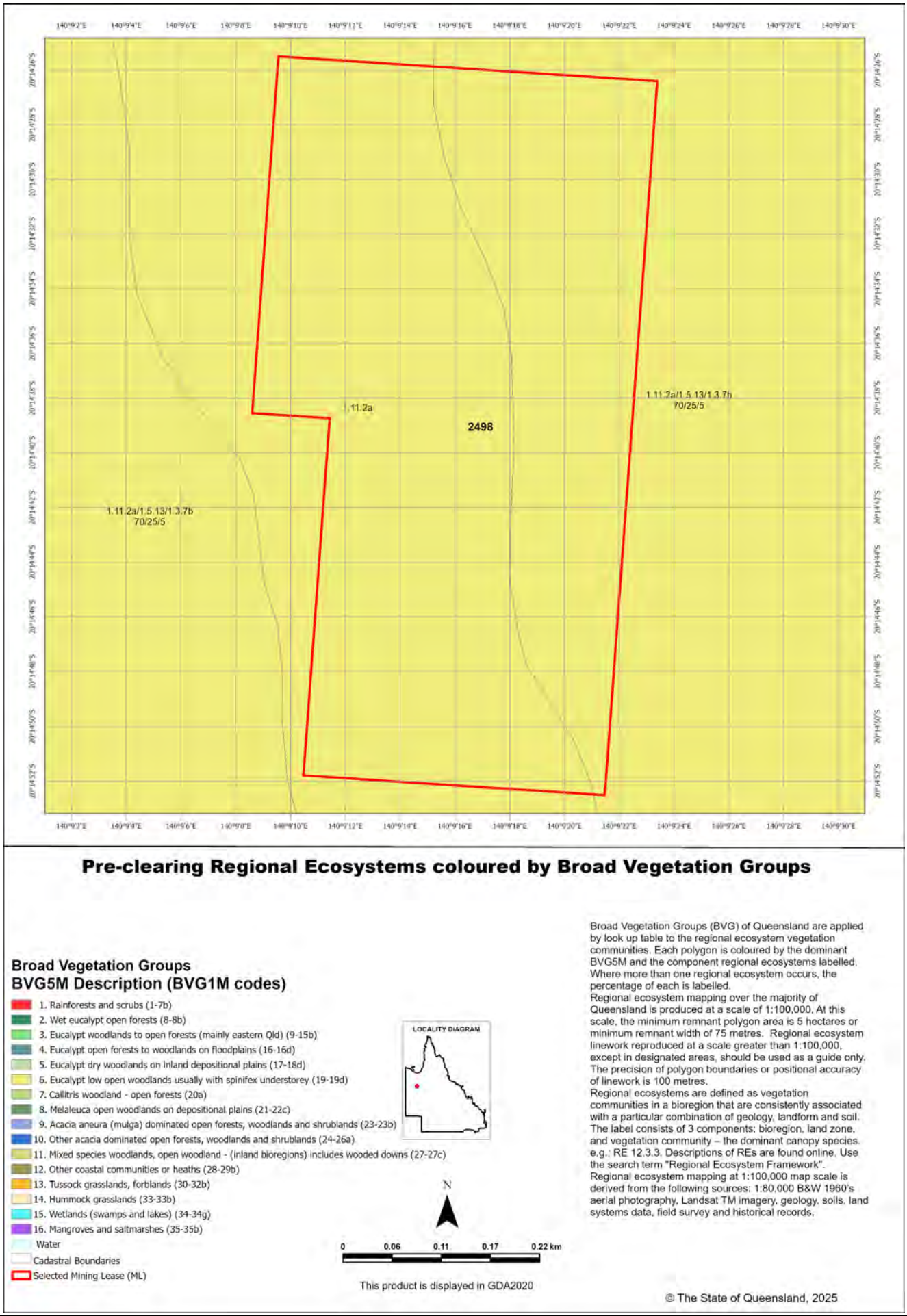
0 0.06 0.11 0.17 0.22 km

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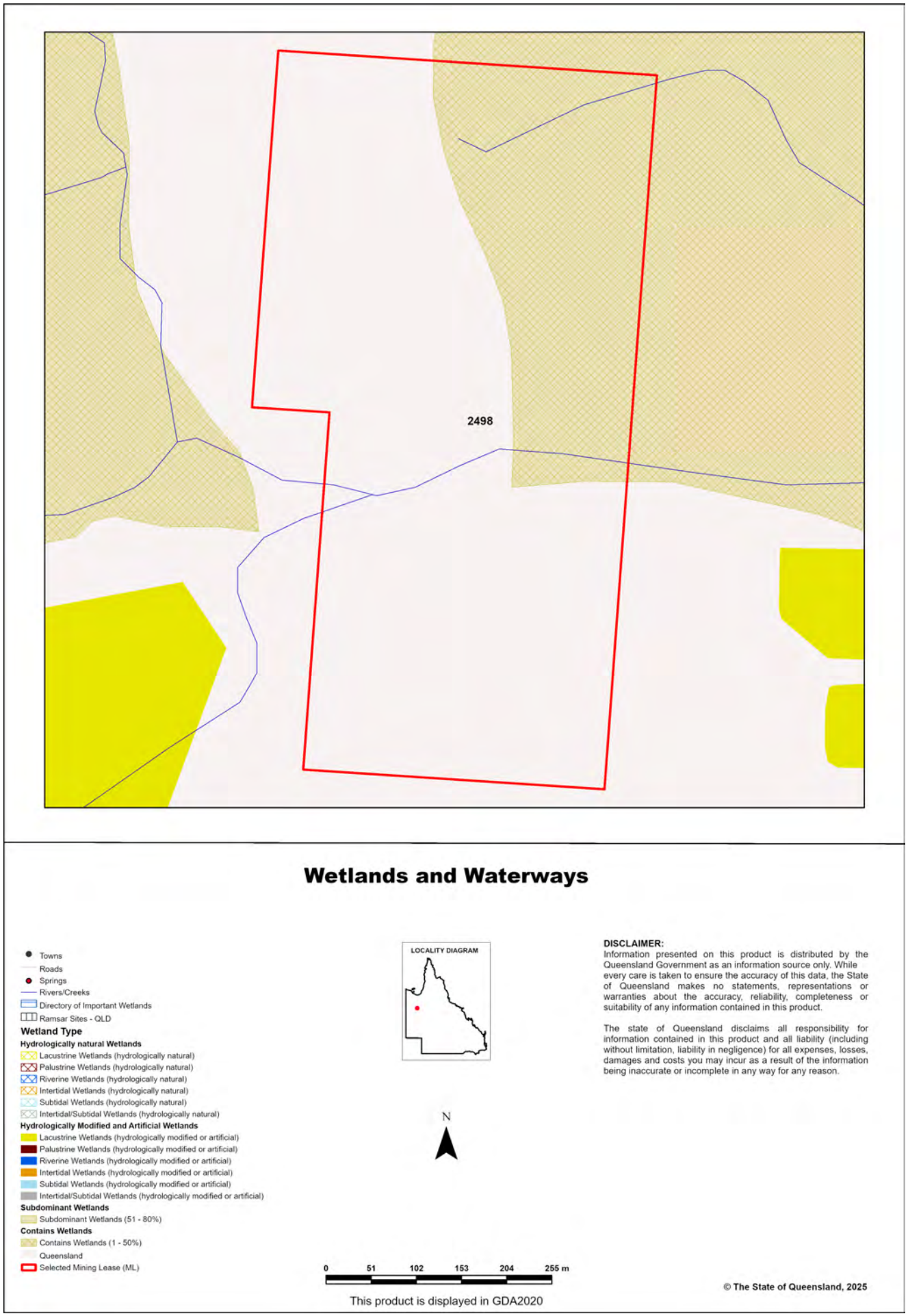
Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled. Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
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The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

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Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of the Environment, Tourism, Science and Innovation's Website - http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/ provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

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Technical descriptions for regional ecosystems can be obtained from: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from: http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Spatial Catalogue, Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link: https://qldglobe.information.qld.gov.au/

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2023). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 6.0. Queensland Herbarium, Department of Environment and Science. (https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Richter,D., Addicott, E.P. and Appelman, C.N. (2023) Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 7.0. Updated December 2023. Queensland Herbarium, Queensland Department of Environment, Science and Innovation, Brisbane. (https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf).

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems.* Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:
http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:
Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

- Biodiversity status of pre-clearing and 2021 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas
- Pre-clearing broad vegetation groups of Queensland
- Remnant 2021 broad vegetation groups of Queensland

Appendix 2 - Acronyms and Abbreviations

AOI - Area of Interest
GIS - Geographic Information System
RE - Regional Ecosystem
REDD - Regional Ecosystem Description Database
VMA - *Vegetation Management Act 1999*

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
ML: 2601

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium & Biodiversity Science's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium & Biodiversity Science's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Details for area of interest:
ML: 2601, with area 28.5 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Cloncurry Shire	Flinders	Northwest Highlands	Mount Isa Inlier

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.80	2.81
Of concern	0.00	0.00
No concern at present	15.23	53.43
Total remnant vegetation	16.03	56.24

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and may be distinguished by differences in structure or sub-dominant species in the ecologically dominant layer. Vegetation communities with different dominant species in the ecologically dominant layer may be amalgamated in to a regional ecosystem if they are not mappable and predictable in the landscape at 1:100 000 scale. Vegetation communities may be mappable at a scale larger than 1:100 000. Vegetation communities within a regional ecosystem are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2023) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium & Biodiversity Science's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/.

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 percent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 percent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (<1000 ha); or patch size (<100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
1.11.2a	Eucalyptus leucophloia low open woodland	No concern at present	11.22	39.37
1.3.7b	Eucalyptus camaldulensis woodland on channels and levees	Endangered	0.80	2.81
1.5.13	Eucalyptus pruinosa low open woodland on older alluvial and residual soils	No concern at present	4.01	14.06
non-remnant	None	None	12.47	43.77

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.11.2a	Pre-clearing 1245000 ha; Remnant 2023 1239000 ha	19a	Not a Wetland	Low
1.3.7b	Pre-clearing 151000 ha; Remnant 2023 150000 ha	16a	Riverine	Low
1.5.13	Pre-clearing 320000 ha; Remnant 2023 319000 ha	19c	Not a Wetland	Low
non-remnant	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
1.11.2a	1.11.2: Potential habitat for NCA listed species: Eucalyptus nudicaulis, Ipomoea antonschmidii, Solanum carduiforme, Trachymene glandulosa.
1.3.7b	1.3.7: Important seasonal water bird habitat; regional corridor for fauna.
1.5.13	None
non-remnant	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at: https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	12.47	43.77
16a	Open forest and woodlands dominated by Eucalyptus camaldulensis (river red gum) (or E. tereticornis (blue gum)) and/or E. coolabah (coolabah) (or E. microtheca (coolabah)) fringing drainage lines. Associated species may include Melaleuca spp., Blakella tessellaris (carbeen), Angophora spp., Casuarina cunninghamiana (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.	0.80	2.81
19a	Low open woodlands dominated by Eucalyptus leucophloia (snappy gum) with Triodia spp. dominated ground layer, mainly on hills and ranges.	11.22	39.37
19c	Low open woodlands dominated by Eucalyptus pruinosa low open woodlands on sandplains, outwash areas and lateritised surfaces.	4.01	14.06

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium & Biodiversity Science's QBEIS database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2023 (PDF)* section 3.3 of: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community. http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

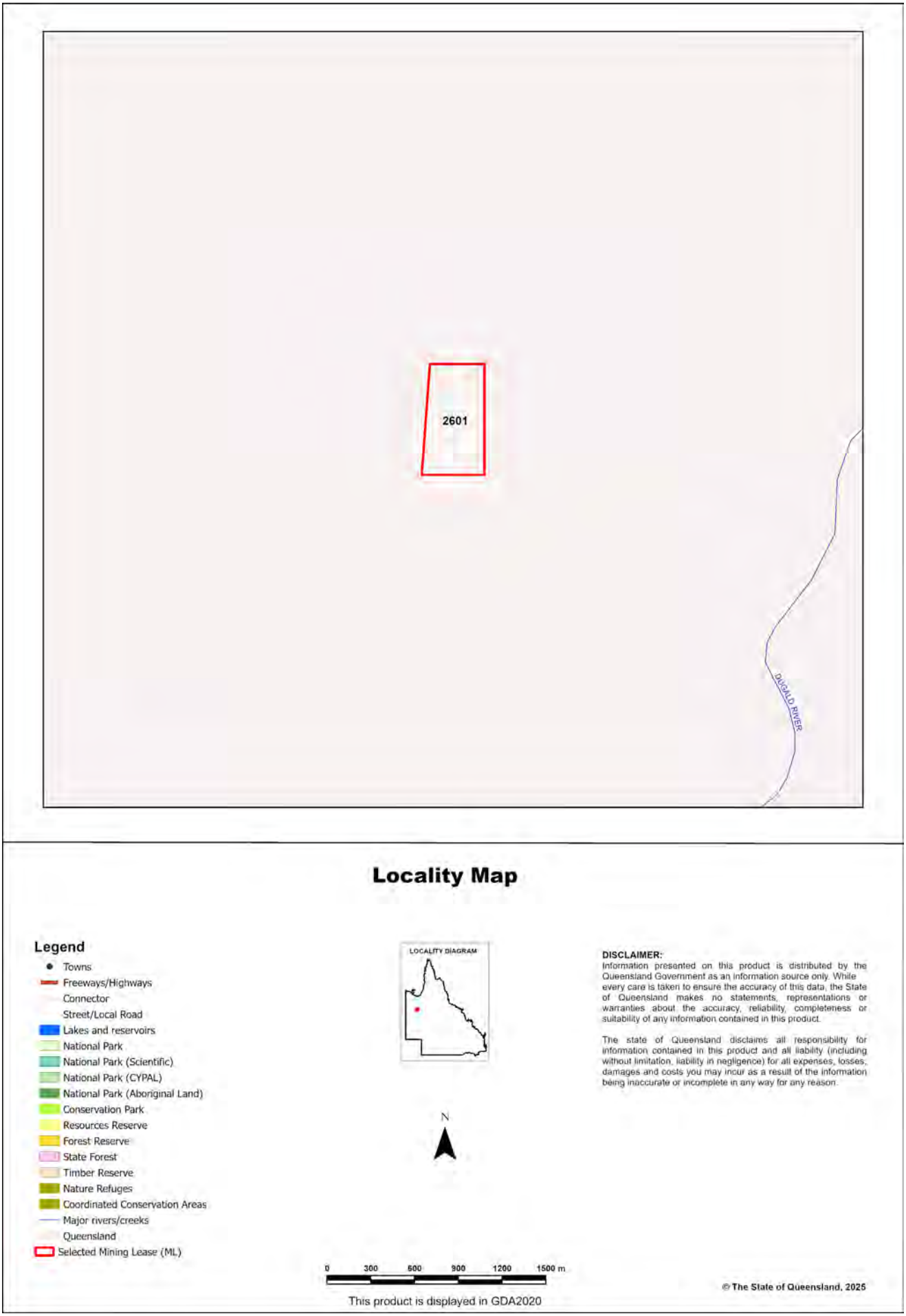
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

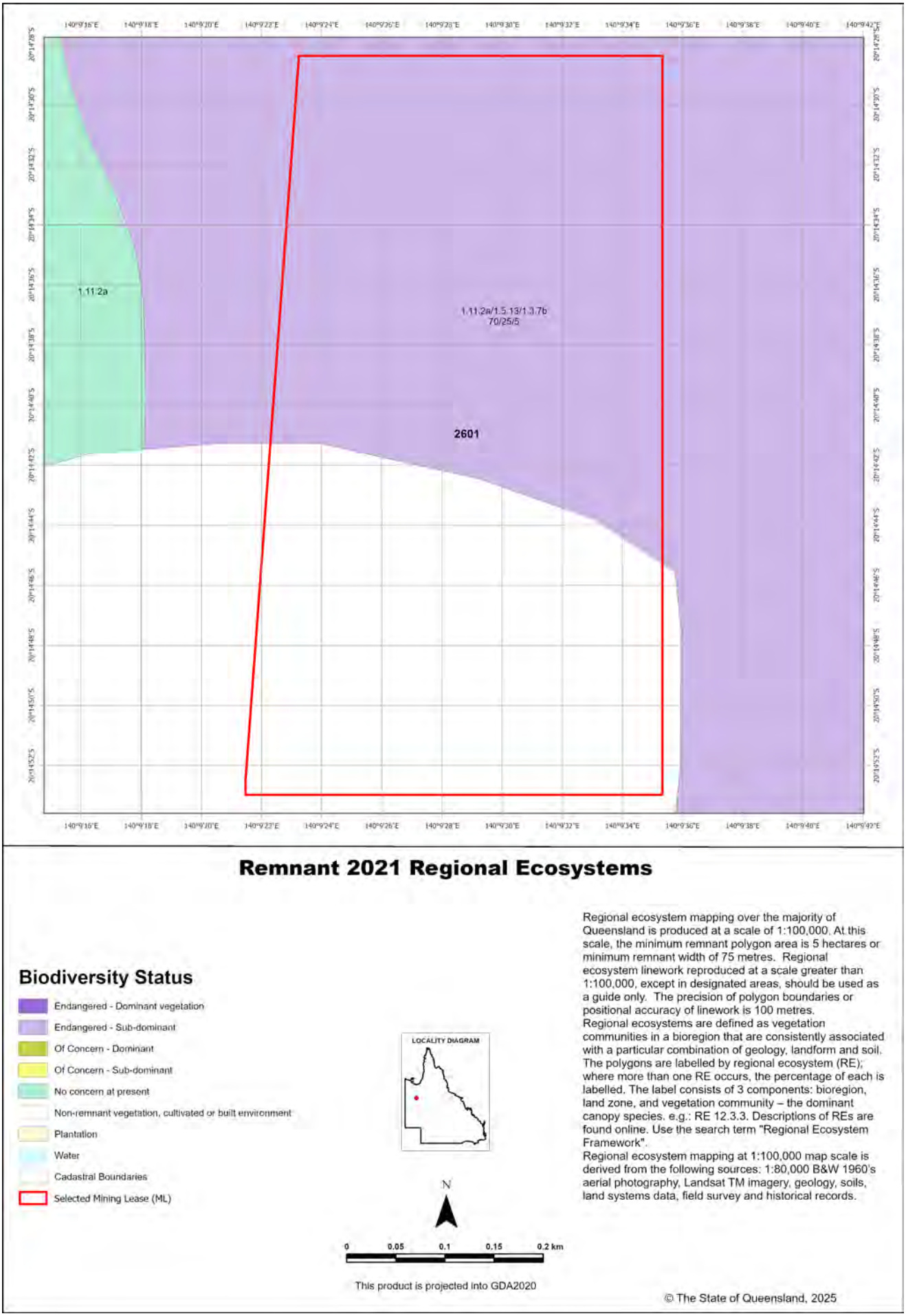
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
1.11.2a	Available	Not currently available
1.3.7b	Available	Not currently available
1.5.13	Available	Not currently available
non-remnant	Not currently available	Not currently available

Maps

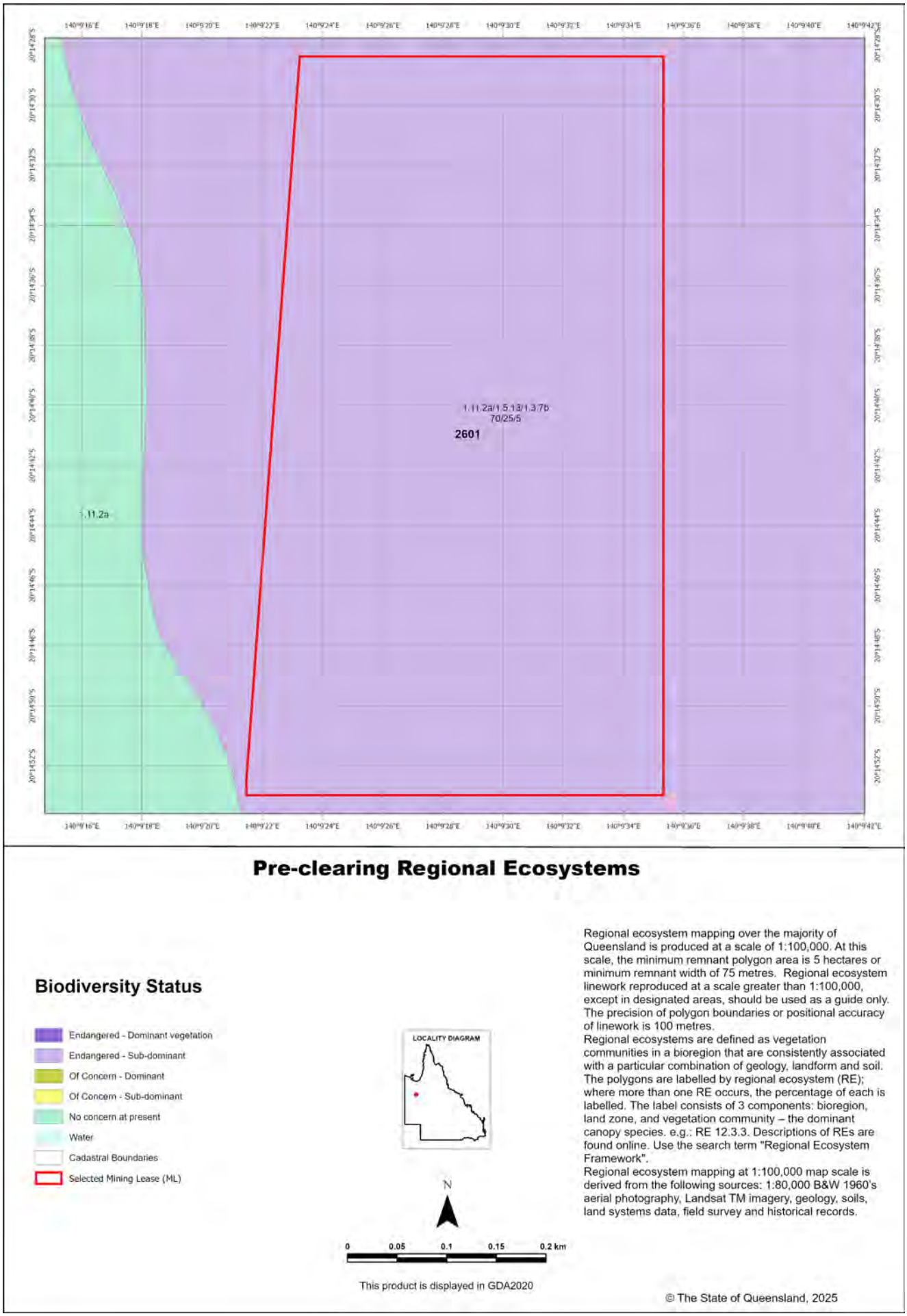
Map 1 - Location



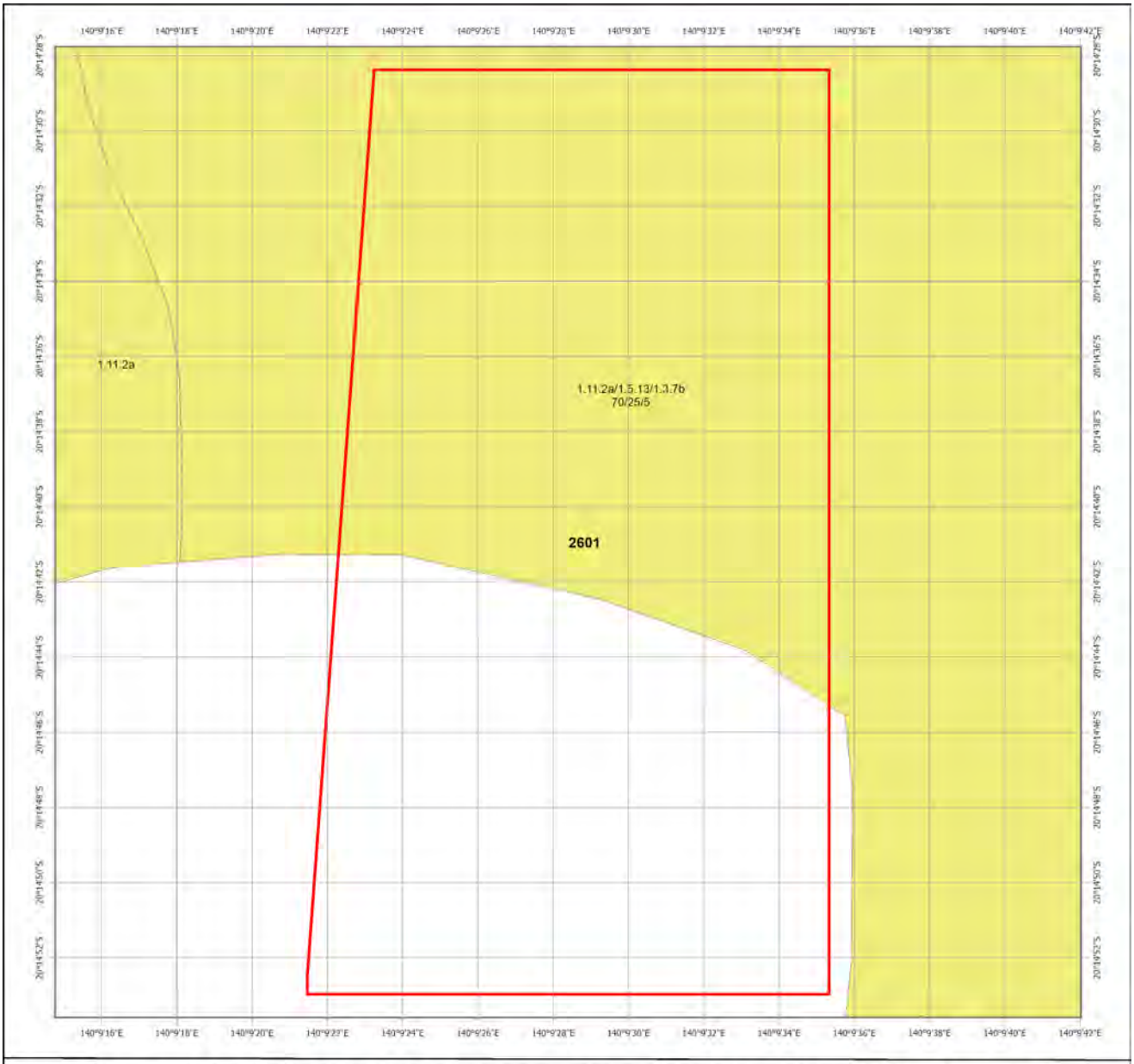
Map 2 - Remnant 2021 regional ecosystems



Map 3 - Pre-clearing regional ecosystems



Map 4 - Remnant 2021 regional ecosystems by BVG (5M)



Remnant 2021 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

1. Rainforests and scrubs (1-7b)
2. Wet eucalypt open forests (8-8b)
3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
4. Eucalypt open forests to woodlands on floodplains (16-16d)
5. Eucalypt dry woodlands on inland depositional plains (17-18d)
6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
7. Callitris woodland - open forests (20a)
8. Melaleuca open woodlands on depositional plains (21-22c)
9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
12. Other coastal communities or heaths (28-29b)
13. Tussock grasslands, forblands (30-32b)
14. Hummock grasslands (33-33b)
15. Wetlands (swamps and lakes) (34-34g)
16. Mangroves and saltmarshes (35-35b)

Non-remnant vegetation, cultivated or built environment
Water
Cadastral Boundaries
Selected Mining Lease (ML)

LOCALITY DIAGRAM

N

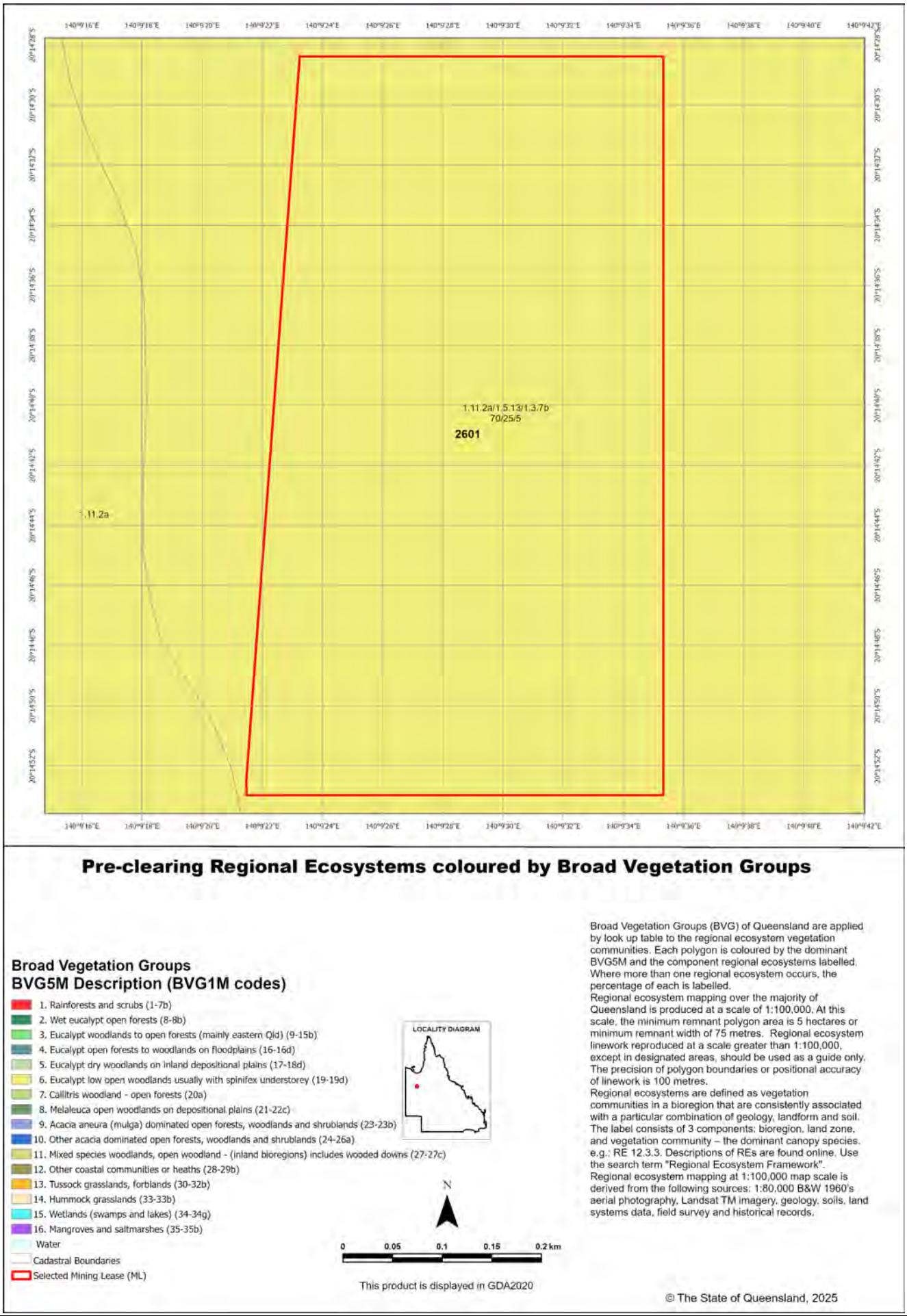
0 0.05 0.1 0.15 0.2 km

This product is displayed in GDA2020

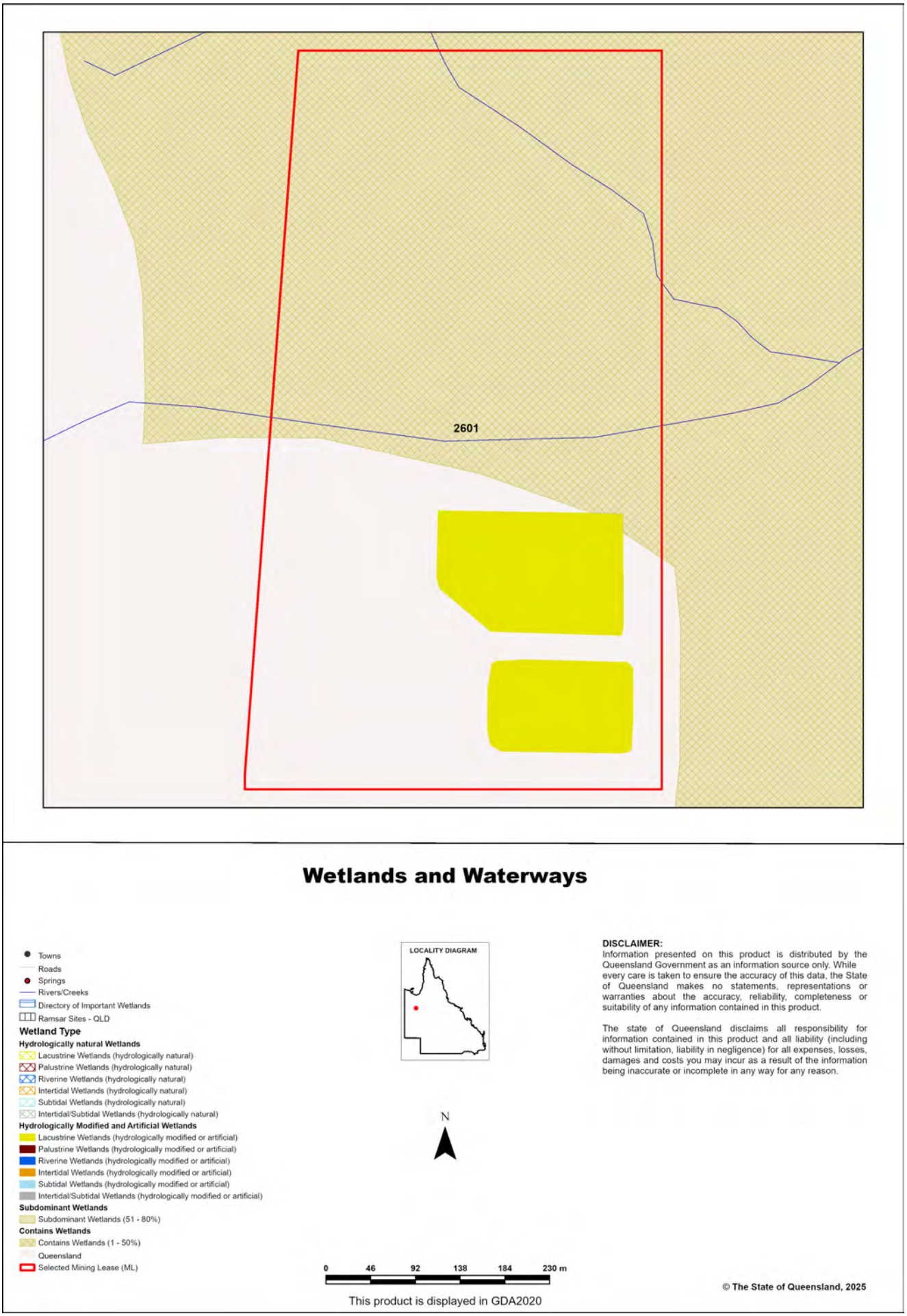
Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled. Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

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Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of the Environment, Tourism, Science and Innovation's Website - http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/ provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from: https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/broad-vegetation

The methodology for mapping regional ecosystems can be downloaded from: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

Technical descriptions for regional ecosystems can be obtained from: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from: http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Spatial Catalogue, Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link: https://qldglobe.information.qld.gov.au/

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2023). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 6.0. Queensland Herbarium, Department of Environment and Science. (https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Richter,D., Addicott, E.P. and Appelman, C.N. (2023) Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 7.0. Updated December 2023. Queensland Herbarium, Queensland Department of Environment, Science and Innovation, Brisbane. (https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf).

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems.* Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:
http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:
Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

- Biodiversity status of pre-clearing and 2021 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
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- Queensland Wetland Data Version - Wetland areas
- Pre-clearing broad vegetation groups of Queensland
- Remnant 2021 broad vegetation groups of Queensland

Appendix 2 - Acronyms and Abbreviations

AOI - Area of Interest
GIS - Geographic Information System
RE - Regional Ecosystem
REDD - Regional Ecosystem Description Database
VMA - *Vegetation Management Act 1999*

APPENDIX E – FORM OF CERTIFICATION

TAILINGS.WATER.WASTE.

ATC WILLIAMS PTY LTD
Melbourne
t +61 3 8587 0900
222-225 Beach Road,
Mordialloc, VIC, 3195
atcwilliams.com.au
ABN 64 005 931 288

Certification Form – Consequence Category Assessment

Dugald River Mine – PAF Dam 2 (Stage 4 PAF Pad Expansion)

Name and address of Registered Professional Engineer providing certification:

Craig Noske
Senior Principal Engineer, ATC Williams Pty. Ltd. (RPEQ 21885)
222 Beach Road, Mordialloc, Victoria, 3195

Statement of relevant experience:
I hereby state that I am a Registered Professional Engineer of Queensland and meet the requirements of the definition of 'suitably qualified and experienced person'.

Statement of certification:
All relevant material relied upon by me, including subsidiary certifications of specialist components, where required by the environmental authority, is provided in the report "*Dugald River Mine – PAF Dam 2 (Stage 4 PAF Pad Expansion) - Consequence Category Assessment"; Reference 250893.01.R01_Rev0*", dated 19 December 2025, to which this certificate is appended.

I hereby certify that the "*Dugald River Mine – PAF Dam 2 (Stage 4 PAF Pad Expansion) - Consequence Category Assessment*":

1. Identifies which regulated structure(s) is the subject of the certification;
2. Identifies the relevant environmental authority condition which is the subject of the certification;
3. Identifies, where appropriate, what is not included in the certification—including information about any limitations, restrictions or exclusions that apply to the certification; and
4. Has identified that the PAF Stage 2 Dam has a consequence category of 'Significant' based on a 'failure to contain – dam break' scenario, and is therefore considered to be a regulated structure.

I, Craig Noske, declare that the information provided as part of this certification is true to the best of my knowledge. I acknowledge that it is an offence under Section 480 of the *Environmental Protection Act 1994* to give the administering authority a document containing information that I know is false, misleading or incomplete in a material particular.



Signed: _____(RPEQ 21885)

Date: 19 December 2025

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APPENDIX S: Tailings Storage Facility – Stage 3 Dam Break and Consequence Category Assessment (ATCW, 2026a)

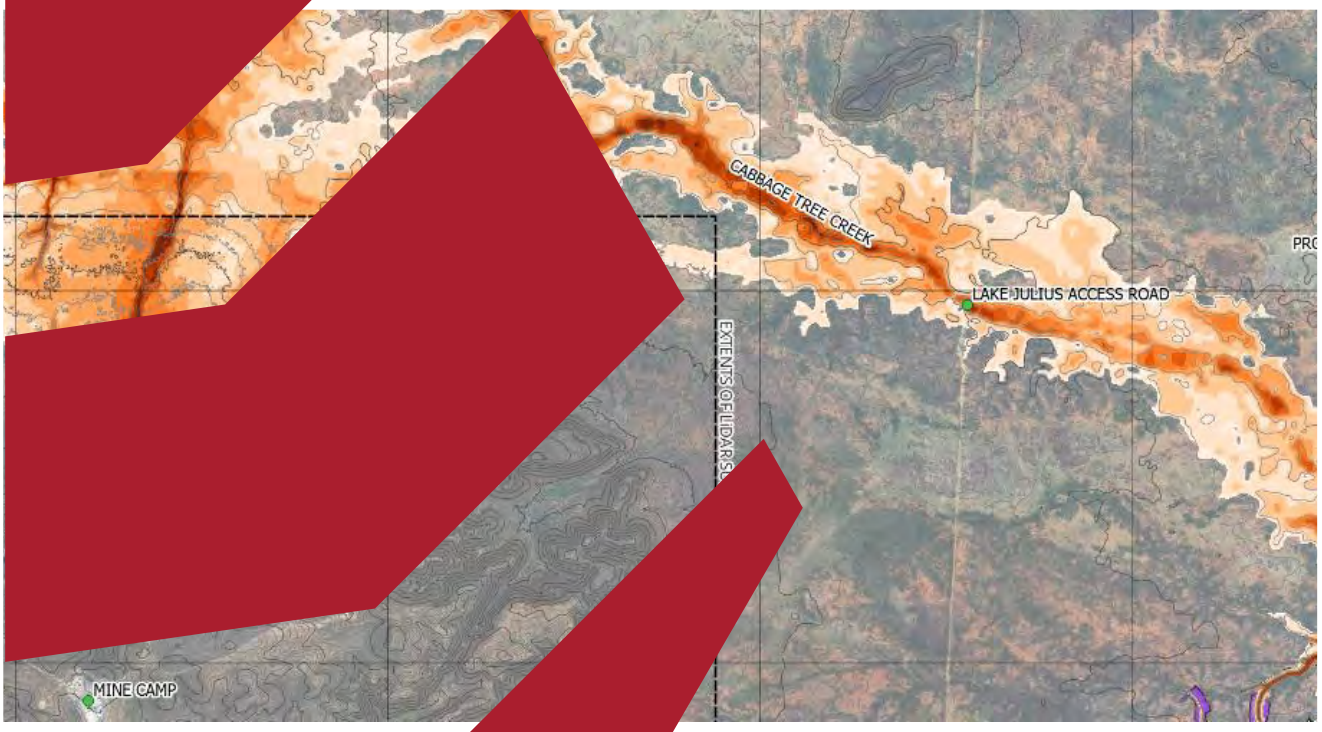
REPORT

MMG DUGALD RIVER
ABN: 19 083 405 556

DUGALD RIVER MINE

TAILINGS STORAGE FACILITY – STAGE 3 DAM BREAK AND CONSEQUENCE CATEGORY ASSESSMENT

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1 INTRODUCTION

1.1 Overview

MMG Limited (MMG) owns and operates the Dugald River Mine (DRM), located approximately 65 kilometres north-west of Cloncurry and 85 kilometres north-east of Mt Isa in Queensland, Australia.

MMG has engaged ATC Williams (ATCW) to produce a detailed design for a 9.25 m raise to the existing Dugald River (DR) Tailings Storage Facility (TSF) to a crest level of RL 253.5 m, hereafter referred to as 'Stage 3'.

This report documents the dam break and consequence category assessments undertaken as part of the Stage 3 detailed design works.

1.2 Scope of Works

The scope of work for this assessment is as follows:

- Dam break modelling and inundation mapping; and
- Consequence category determination.

The consequence category assessment has been carried out in accordance with the following guidelines:

- Queensland Department of Environment, Tourism, Science and Innovation (DETSI) – Manual for assessing consequence categories and hydraulic performance of structures **[1]**
- Australian National Committee on Large Dams (ANCOLD) – Guidelines on the Consequence Category for Dams **[2]**
- Global Industry Standard on Tailings Management (GISTM) **[3]**

2 PROJECT BACKGROUND

2.1 General

The TSF is located within the Knapdale Valley with tailings deposited in a down valley discharge method encapsulated by a cross-valley embankment.

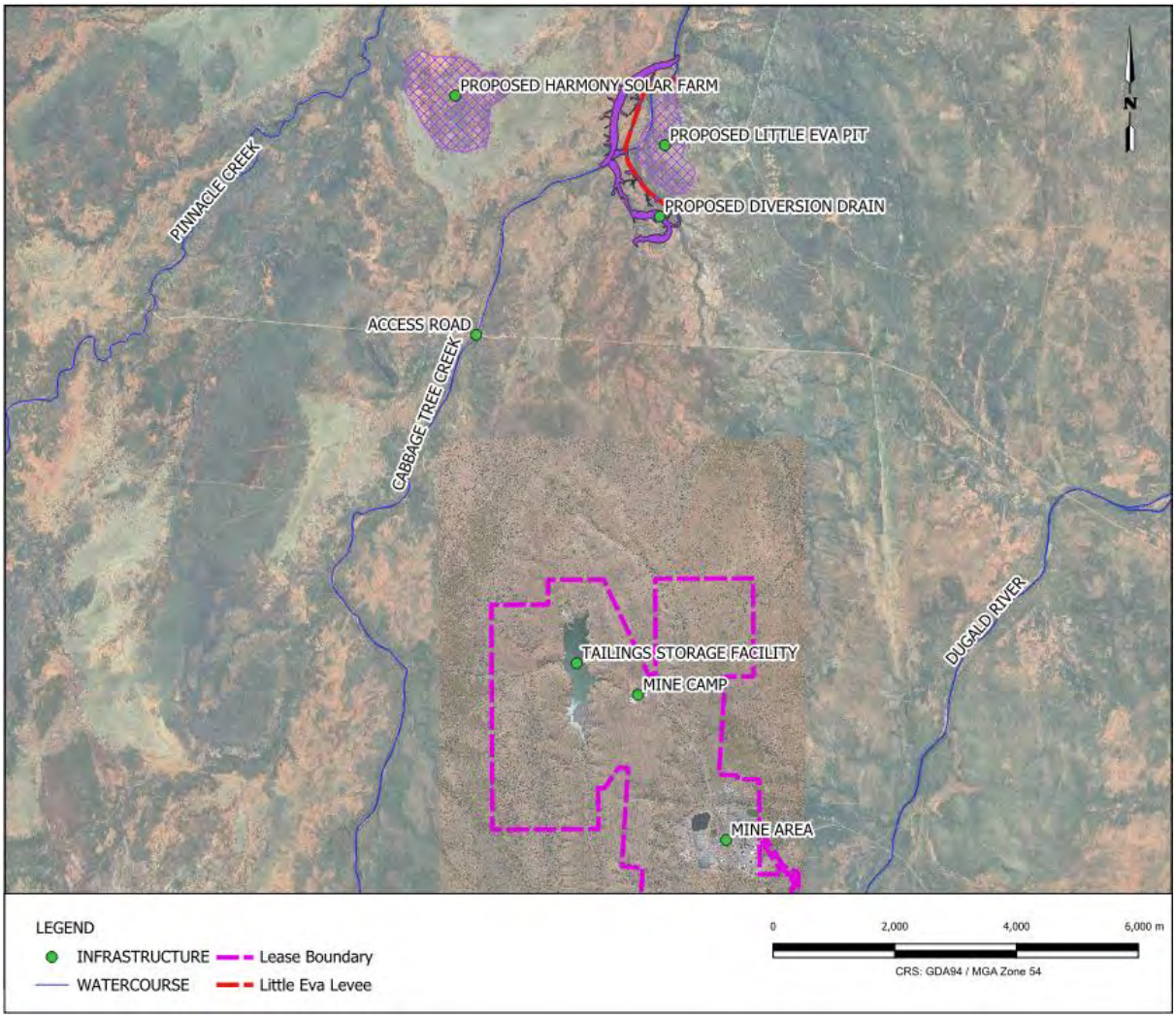
The main purpose of the TSF is to provide storage for tailings, which are produced at the DRM process plant. When the tailings are not transferred to the paste plant (to be used as backfill within the underground mine), the tailings are pumped via a 4 km long pipeline to the TSF.

Another function of the TSF is to provide temporary water storage for mineral processing and various other mining activities (dust sprays, mine service water streams, etc.). The water stored within the TSF originates from decant (bleed) water emerging from the deposited tailings, as well as from rainfall runoff from the catchment area.

A general layout of the existing DR TSF in relation to other mine infrastructure is illustrated in **Map 1** and **Figure 1**.

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MAP 1 – GENERAL LAYOUT



2.2 Basic Dam Details

The Stage 3 configuration comprises a downstream raise to the existing Stage 2 embankment. To accommodate the new height of the facility an additional bund (the Northern Discharge Bund) is proposed to be constructed at the northern end of the impoundment. The Northern Discharge Bund is approximately 7 m in height and 80 m in length. This bund has been designed to be used as a deposition platform for the continuation of deposition and has not been designed to be water retaining. The detailed design of Stage 3 is documented in the detailed design report **[4]**.

Details of the DR TSF under the Stage 2 (existing) and Stage 3 (design) configurations are summarised in **Table 1**.

TABLE 1 – BASIC DAM DETAILS

Item	Stage 1 & 2	Stage 3
Crest Level	RL 244.25 m	RL 253.5 m
Maximum Embankment Height	38.25 m	47.5 m
Crest Width	10 m	10 m
Crest Length	225 m	292 m

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Upstream Slope (H:V)	1.75:1	1.75:1 with a 3 m bench
Downstream Slope (H:V)	1.5:1 with two 5 m benches	1.5:1 with three 5 m benches
Spillway Width	10 m	50 m
Spillway Depth	2.15 m	2.15 m
Spillway Invert	RL 242.1 m	RL 251.35 m
Northern Discharge Bund Level	-	RL 253.5 m
Construction Method	Starter Embankment	Downstream Raise

2.3 Downstream Receiving Area

The TSF Embankment is located within a narrow gully which drains the Knapdale Range valley impoundment into an unnamed tributary of Cabbage Tree Creek. Cabbage Tree Creek is located in the Leichardt River Basin, which discharges north to the Gulf of Carpentaria. Apart from Cabbage Tree Creek, the downstream receiving area is considered generally flat, with a slight gradient dropping in a south to north direction.

A local access road is located approximately 5 km to the north of the TSF Embankment. This road is on an east west alignment, connecting Burke Development Rd to Lake Julius.

The nearest third-party asset is a future proposed mining project, owned by Harmony Gold Mining Co. Ltd. (Harmony). The project will consist of a mining pit, called “Little Eva” Pit, approximately 14 km downstream of the DR TSF Embankment and in close proximity to Cabbage Tree Creek. The Little Eva Pit infrastructure is proposed to include a diversion drain and a flood protection levee designed to divert the flood levels recorded during the extreme, 2009 wet season Cabbage Tree Creek flood event **[5]**.

2.4 Previous Studies

ATCW completed a dam break assessment in 2015 as part of the detailed design of the Stage 2 configuration **[6]**. The assessment was carried out for a Sunny Day Failure (SDF) scenario. The findings of the assessment can be summarised as follows:

- Tailings runout: Approximately 300,000 m^3 of tailings estimated to mobilise, travelling some 750 m downstream of the TSF embankment and inundating an area of 6 ha.
- Decant pond water: Approximately 3,500 ML of decant water released (predominantly comprising rainfall runoff), inundating a maximum area of approximately 2,100 ha.
- Harmony Gold Mining Co. Ltd. (Harmony) “Little Eva Pit” infrastructure is not expected to be impacted by the tailings runout. The maximum depth of water flow is estimated to be less than 1 m and maximum velocity estimated to be less than 0.3 m/s. These estimates do not consider the proposed diversion channel and flood protection levee around the pit.
- In terms of environmental damage to the Cabbage Tree Creek catchment, it is generally considered that significant erosion and stripping of vegetation would be limited to the 2.8 km long unnamed tributary of Cabbage Tree Creek. Once flows intersect Cabbage Tree Creek and flow north, the estimated maximum velocity does not exceed 1 m/s, which is not considered to be sufficient to do long-term damage to the low to moderately erosive surficial soils which overlay the floodplain.

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3 FAILURE MODE ASSESSMENT

3.1 Credible Failure Modes

In accordance with ANCOLD **[2]** and GISTM **[3]**, the dam break assessment shall be based on credible failure modes, and consider both Sunny Day Failure (SDF) and Flood Failure (FF) conditions to determine the worst-case scenario.

A Failure Mode and Effects Analysis (FMEA) workshop was conducted on 20th May 2025 which included representatives from ATCW, MMG, and the DRM Independent Tailings Review Board. The outcomes of the workshop are documented in the Stage 3 Quantitative Risk Assessment Report **[7]**.

In the workshop, all Potential Failure Modes (PFM) of the Stage 3 TSF were identified and consensus was reached on whether or not each PFM is credible or non-credible. The following credible failure mode was identified for the Stage 3 TSF embankment based on the FMEA workshop:

TABLE 2 – CREDIBLE FAILURE MODES

Failure Mode ID	Failure Mode	Scenario
DR TSF-Emb-SS-6	Overtopping due to instability of the downstream slope causing slumping and loss of freeboard	Sunny Day/Flood

The dam break analysis has been carried out to ensure that the credible failure mode listed in **Table 2** is represented accordingly in the modelling outcomes.

3.2 Modelled Scenarios

The following dam break scenarios are considered to be representative of the draft credible failure modes listed in **Section 3.1**:

- **Sunny Day Failure (SDF)** – Embankment instability causing significant deformation of the crest and a loss of freeboard. Water begins overtopping the embankment, resulting in gradual erosion of the embankment crest. The loss of confining stress also causes static liquefaction of the tailings, which begin overtopping the embankment once the crest erodes to the level of the tailings. The release of water and liquefied tailings is into a dry downstream environment.
- **Flood Failure (FF)** – Embankment instability failure during an extreme storm event, causing significant deformation of the crest and a loss of freeboard. Water begins overtopping the embankment, resulting in gradual erosion of the embankment crest. The loss of confining stress also causes static liquefaction of the tailings, which begin overtopping the embankment once the crest erodes to the level of the tailings. The release of water and liquefied tailings is into a flooded downstream environment.

Under an FF scenario, it is expected that all downstream receptors would have evacuated prior to the dam break; or be subject to pre-dam break flooding that already exceeds safe levels. Therefore, it is expected that the incremental impact from the dam break during an extreme flood event would be negligible and that the SDF outcomes will govern the Consequence Category assessment.

Hence, only modelling of the SDF scenario has been carried out. The dam failure consequence category assessments have been based upon the outcomes of the SDF assessments.

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3.3 Initial Conditions

The initial conditions that have been assumed for the DR TSF dam break modelling are summarised in **Table 3** and are shown in **Figure 2**.

TABLE 3 – INITIAL CONDITIONS PRIOR TO DAM BREAK

Parameter	SDF
Embankment	Stage 3 configuration RL 253.5 m
Tailings Level	Stage 3 end of filling
Decant Pond Level	Full Supply Level (Spillway Invert) RL 251.35 m
Downstream Conditions	Normal flow conditions (i.e., little to no water present in Cabbage Tree Creek)

3.4 Breach Location and Depth

The embankment breach is assumed to occur at the location coincident with the greatest embankment height in order to maximise the potential released volumes.

One of the key considerations in the dam break modelling is the vertical extent of the breach propagation. This is essentially an engineering judgement, based on an understanding of embankment construction materials; compaction methodology; and the erosive actions of mobilised materials flowing through the breach.

For the purpose of this study, the breach depth has been limited to approximately two-thirds of the full embankment height for the following reasons:

1. The identified credible failure mode relates to overtopping and progressive erosion of the crest, rather than a global failure of the entire structure, such as an instability failure through the foundation;
2. The embankment will be constructed predominantly from quarried quartzite rockfill and lined with a Bituminous Geomembrane Liner, and therefore will be less susceptible to erosion;
3. A portion of the liquefied tailings is assumed to mobilise and continue the breach propagation, however it is expected that a point of equilibrium will be reached with increased depth as higher strength, more consolidated tailings are exposed;
4. The embankment will be approximately 130 m wide at the base of the breach; and
5. A portion of the mobilised tailings and embankment materials will likely be deposited against the downstream toe of the embankment, providing additional resistance against continued breach propagation to the full height.

Notwithstanding, a sensitivity assessment has also been carried out assuming a full-height breach to understand the potential increase in the failure impact.

4 DAM BREAK MODELLING

4.1 Modelling Methodology

The dam break modelling undertaken for this study consists of the following primary steps:

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1. Topographic modelling assembly: establishment of the 3-dimensional topographic modelling of the potential impact area based on recent site survey and publicly available Digital Elevation Model (DEM);
2. Estimation of dam break released volumes: assessment of the proportion of stored tailings and water released for each respective failure scenario;
3. Breach geometry modelling: estimation of embankment breach parameters and derivation of the outflow hydrographs; and
4. Hydraulic dam break modelling: carrying out hydraulic modelling to route the breach outflow and generate flood inundation mapping.

4.2 Adopted Modelling Techniques

Various techniques have been used in combination to carry out the dam break modelling. The selected modelling techniques for each component of the dam break assessment are summarised in **Table 4**.

TABLE 4 – ADOPTED MODELLING TECHNIQUES

Component	Model
Breach Parameter Estimation	Froehlich (2016) Empirical Equations **[8]**
Breach Hydrograph Model	HEC-RAS **[9]**
Hydraulic Dam Break Model	FLO-2D **[10]**

4.3 Topographic Modelling Assembly

The following survey sources have been used to compile the topographic model domain:

- October 2024 site-wide LiDAR survey, provided by MMG (dated 15/10/24);
- July 2024 site-wide LiDAR survey, provided by MMG (dated 12/07/24); and
- Publicly available DEM **[11]**

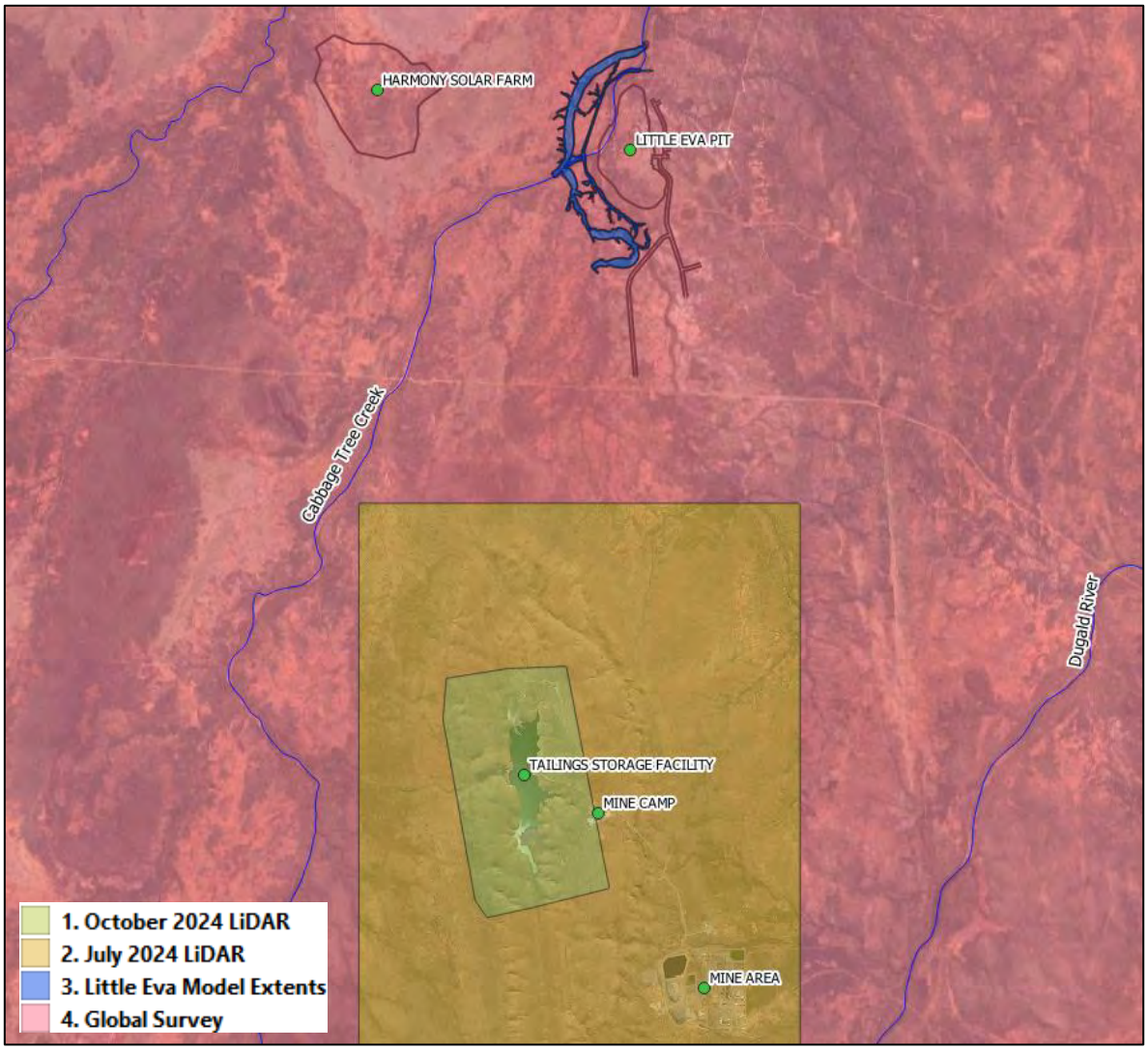
In addition to the topographic survey data, design models have also been incorporated into the model, including:

- Little Eva Pit diversion drain and flood protection levee models, provided by Harmony (dated 08/12/2023); and
- Stage 3 embankment and tailings beach models, created by ATCW.

The compiled model topography is shown in **Map 2**.

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MAP 2 – TOPOGRAPHIC MODEL ASSEMBLY



4.4 Released Volume Assessment

4.4.1 Tailings Liquefaction

The DRM tailings have been deemed to be potentially liquefiable when saturated based upon the tailings characteristics **[12]**. It has therefore been conservatively assumed that for the purpose of this study, at the time of a hypothetical dam break event, the tailings are fully saturated and liquefied, and will consequently flow like a non-Newtonian fluid.

4.4.2 Post-failure Residual Slope

The adopted approach for the evaluation of the potential liquefied tailings released volume has been to estimate a post-failure residual surface of the liquefied tailings, with the gradient being a function of the consolidation density and shear strength profiles within the tailings storage.

When a dam breach scenario occurs, the embankment supporting the tailings deposit is removed, and the liquefied tailings will flow out until a stable residual storage condition is achieved. The post-failure residual condition of the deposit is normally defined by the stable slope of the tailings backscarp into the storage, which is then dependant on the in-situ conditions (deposits shear strength and density) at the time of the failure.

This failure slope has been estimated using Infinite Slope Theory. The theory assumes that at the residual condition, the shear strength of the tailings will be the same as the weight component that triggers additional rejects mobilisation (i.e., a Factor of Safety of 1). This equation is given by:

$$S_u = \gamma h \sin\beta \cos\beta$$

where

S_u = *undrained, post-liquefaction shear strength,* $S_{u,res} = k\sigma'_{vo}$ *(kPa)*
k = *residual post-liquefaction shear strength ratio*
σ'_{vo} = *vertical effective stress (kPa)*
γ = *bulk unit weight of tailings (kN/m³)*
h = *depth of rejects (m)*
β = *failure slope angle (°)*

For fully saturated tailings, the infinite slope theory equation can be re-arranged to estimate the final stable slope angle of the tailings. A typical lower bound post-liquefied undrained shear strength ratio of 0.07 **[13]** has been conservatively adopted for the DRM tailings. Based on this assumption, the estimated failure slopes resulting from a breach-induced mobilisation of the stored tailings is approximately 3.3%.

It is recommended that the post-liquefied undrained shear strength ratio assumption is validated from site-specific investigations as part of a future study, if the decant pond is able to be drawn down and a CPT campaign undertaken.

4.4.3 Released Volume

The estimated released volume is dependent on the assumed breach depth. The estimated water released volume has been determined as the volume of stored decant water above the breach base.

The tailings released volume has been estimated from 3D modelling of the tailings backscarp based on the post-failure slope of 3.3% derived in **Section 4.4.2**. The calculated failure slope has been projected through the tailings mass as a cone of depression, and the tailings material within this cone of depression has been assessed as the mobilised failure volume. Schematics of the assumed post-failure residual condition for both the Base Case and Sensitivity Case are provided in **Diagram 1** and **Diagram 2**.

DIAGRAM 1 – FAILURE SCHEMATIC FOR BASE CASE

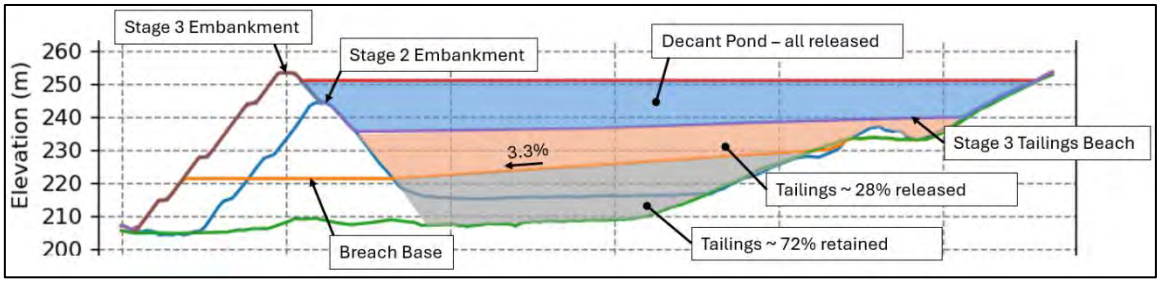
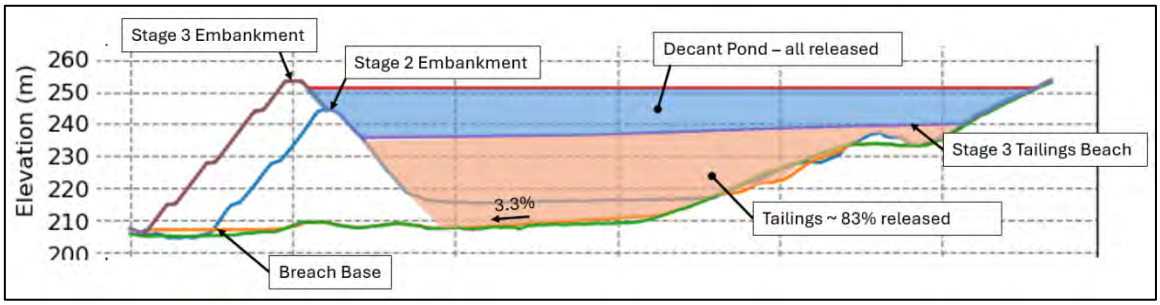


DIAGRAM 2 – FAILURE SCHEMATIC FOR SENSITIVITY CASE



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As illustrated in **Diagram 1**, the Base Case assessment is estimated to result in the release of approximately 28% of the total stored tailings, whilst the Sensitivity Case assessment is estimated to result in the release of approximately 83% of the stored tailings.

The estimated released volumes are summarised in **Section 4.5**.

4.5 Breach Geometry Modelling

For the assessed SDF scenario, it is assumed that embankment instability would lead to significant crest deformations and a loss of freeboard, resulting in the overtopping of decant water over the embankment. The overtopping is assumed to cause progressive erosion of the embankment face, until the breach progresses to the level of the tailings deposit. The loss of confining stress causes static liquefaction of the tailings, which begin overtopping and continuing the breach propagation.

The characteristics of the embankment breach have been estimated using Froehlich's empirical equations **[8]**. Froehlich's equations consist of estimator equations based on historical dam failure case studies. The equations estimate the breach width and breach development time and specify the breach geometry side slopes based on the failure mode (i.e. piping or overtopping). The equations are:

$$B_{AVE} = 0.28\, K_M K_H V_W^{1/3} W_{avg}^{-1/6} H_b^{1/6} \quad (1)$$

$$t_f = 50 \sqrt{\frac{V_W}{g H_b^2}} \left(\frac{W_{avg}}{H_b}\right)^{1/4} \quad (2)$$

where

B_{AVE} = *average breach width (m)*
K_M = *failure mode coefficient* ($K_{piping} = 1.0, K_{overtopping} = 1.5$)
V_W = *volume above breach level (m^3)*
H_b = *depth of breach measured from embankment crest level (m)*
t_f = *breach progression time (hrs)*
W_{avg} = *average width of the embankment (m)*

The adopted breach parameters are summarised in **Table 5**. The breach layouts for the Base Case and Sensitivity Case are shown **Figure 3** and **Figure 4** respectively.

TABLE 5 – ADOPTED BREACH PARAMETERS

Parameter	Base Case (Two Thirds Height Breach)	Sensitivity Case (Full Height Breach)
Tailings Release Volume	3,859,700 m^3	11,415,500 m^3
Water Release Volume	7,248,500 m^3	7,248,500 m^3
Breach Base Level	RL 221.5 m	RL 206.0 m
Breach Height	32.0 m	47.5 m
Average Breach Width	82.6 m	100.1 m
Breach Side Slopes	1H:1V	1H:1V
Breach Development Time	0.56 hrs (34 mins)	0.47 hrs (28 mins)

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4.6 Hydraulic Model Setup

4.6.1 Background

To estimate the nature and extent of inundation and flooding caused by the dam break scenario, numerical modelling software HEC-RAS **[9]** and FLO-2D **[10]** have been used in combination to create the hydraulic models.

Most dam break numerical models have been developed for water dams and Newtonian fluids (water). These models intend to predict conventional flood characteristics depending on dam types, failure mechanisms and breach size. For the predictive modelling of tailings dam breaches, models need to account for the hyper-concentrated flow (i.e., non-Newtonian fluid) behaviours.

The predictive modelling of the DR TSF dam break has been conducted using the FLO-2D volume conservation flood routing program. This program is capable of simulating both Newtonian and non-Newtonian flows and can be used for modelling unconventional flood routing problems such as mine tailings, mud, and debris flows. The software models non-Newtonian flows by allowing the user to assign fluid concentration, dynamic viscosity, and yield stress parameters.

HEC-RAS has been used to establish the breach flow hydrographs to be used as input to the FLO-2D model. FLO-2D then routes the dam break flows resembling a fluid continuum by predicting viscous fluid motion as a function of solids concentration. A quadratic rheological model was used to define the viscosity and yield stress of the fluid as a function of solids concentration, and solids continuity is observed. This provides FLO-2D with the advantage over other programs in the capability of modelling tailings and rejects flow discharged into water and becoming diluted. As solids concentration changes for a given grid element, dilution effects, tailings flow cessation and remobilisation of deposits are simulated. Moreover, FLO-2D considers both turbulent and laminar flow in its governing energy loss equations, whilst most other commercially available tools consider only laminar flow. For these reasons, FLO-2D is considered to represent the best available, and most appropriate modelling tool to simulate non-Newtonian runout of the rejects.

4.6.2 Model Inputs

The FLO-2D models consist of a three-dimensional topographic domain, based on a 10 m x 10 m gridded elevation raster model for the dam break assessments. This computational grid has been sampled from the assembled data described in **Section 4.3** to form the base topographic model domain.

In the context of the tailings flow routing, relevant rheological and hydraulic inputs to FLO-2D software include the following:

- Tailings properties;
- Breach outflow hydrograph;
- Boundary conditions; and
- Surface roughness conditions.

FLO-2D does not require a pre-determined flow path, which helps to determine realistic failure impact zones. The model estimates the flow paths, velocities and depths based on the input hydrograph and topography and allows assessment of inundation of critical infrastructure and locations caused by dam break flows.

4.6.3 Tailings Properties

The material properties used in the FLO-2D dam break models have been derived from rheological testing undertaken by ATCW on thickener underflow samples from DRM. The results from the laboratory testing are presented in the Factual Report **[14]** and are reproduced in **Appendix A**.

The laboratory data **[14]** indicate a representative Specific Gravity (G_S) of 2.97 for the tailings. A representative in-situ dry density of 1.35 t/m^3 has been assumed, corresponding to the Overall In-situ Densities (OID) achieved to date **[15]**.

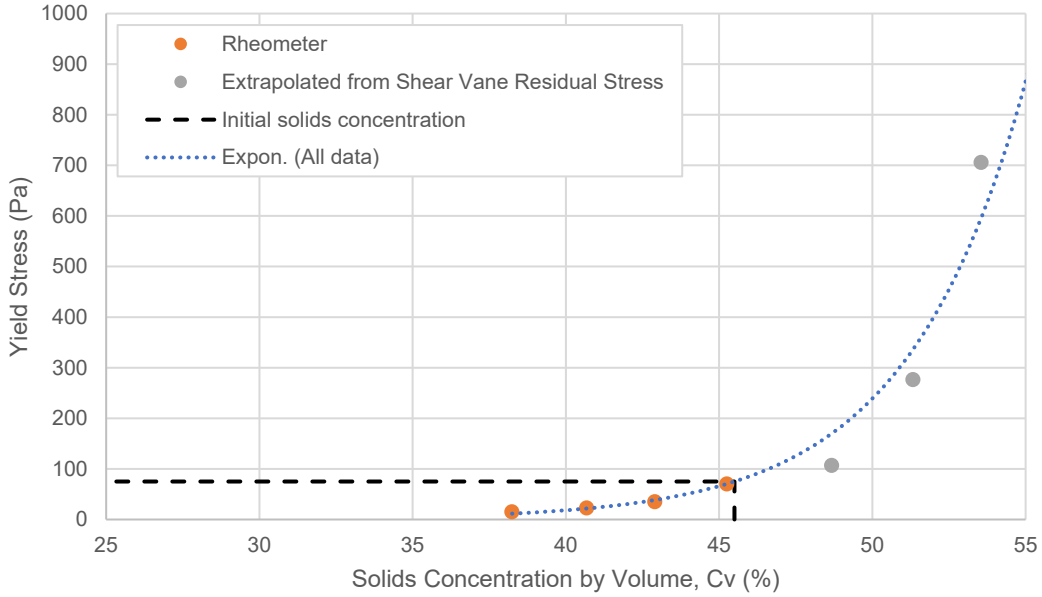
Exponential relationships have been derived for the rheological parameters (i.e., Yield Stress and Bingham Plastic Viscosity) of the tailings samples at different solids concentrations, and the data has

been extrapolated to estimate the rheology at higher solids concentrations. **Graph 1** and **Graph 2** display the estimated Yield Stress and Bingham Viscosity plots respectively. The adopted tailings parameters utilised in the dam break assessments are summarised in **Table 6**.

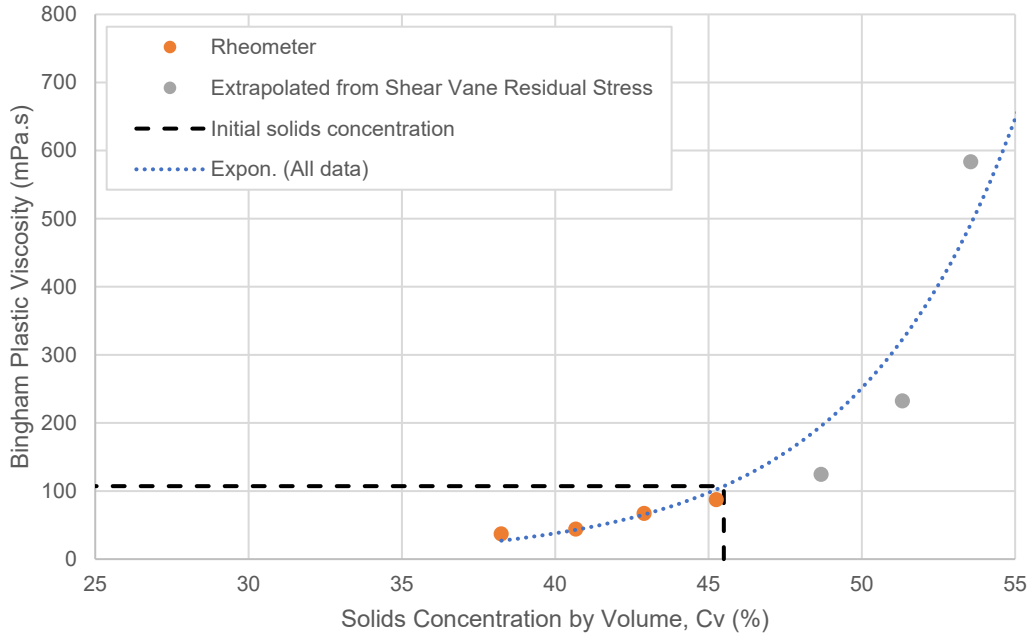
TABLE 6 – ADOPTED TAILINGS PARAMETERS FOR DAM BREAK MODELLING

Solids Specific Gravity	In-Situ Dry Density (t/m^3)	Solids Concentration by Weight (%)	Solids Concentration by Volume (%)	Rheology	
				Yield Stress (Pa)	Bingham Plastic Viscosity (Pa·s)
2.79	1.35	71.2	45.5	74.2	0.11

GRAPH 1 – BINGHAM PLASTIC YIELD STRESS



GRAPH 2 – BINGHAM PLASTIC VISCOSITY



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4.6.4 Breach Flow Hydrographs

FLO-2D routes the breach flow as inflow hydrographs in the two-dimensional model domain. To establish the breach flow hydrograph in a failure scenario, it is assumed that the shape of the hydrograph would be similar to water flow due to the rapid outflow rates (i.e., rapid shearing, low dynamic viscosity) at the breach opening. Hence, two-dimensional unsteady flow simulation software HEC-RAS has been used to establish the breach flow hydrographs to be used as input for FLO-2D.

In HEC-RAS, the dam is defined as a storage area with stage-volume information for the mixture of the tailings and water. The storage area is then connected to the 2D mesh floodplain using an embankment connection with the breach formation parameters defined in **Section 4.5**. The simulations are then run, in which the combined breach volume is gradually released from the storage area into the 2D mesh floodplain, to extract flow hydrographs at the connection.

The breach flow hydrographs for the assessed failure scenarios are shown in **Figure 5** and are summarised in **Table 7**.

TABLE 7 – PEAK BREACH OUTFLOW RATES

Scenario	Peak Outflow	Time to Peak
Base Case (Two Thirds Height Breach)	9,780 m^3/s	21 mins
Sensitivity Case (Full Height Breach)	18,490 m^3/s	26 mins

4.6.5 Boundary Conditions

The breach flow hydrographs described in **Section 4.6.4** are applied in the dam break modelling domain as inflow boundary conditions.

Outflow boundary conditions are defined along the model domain boundaries where flow is expected to remain steady. Normal flow conditions are defined at these flow boundaries to remove dam break flows that reach these locations from the modelling domain.

4.6.6 Surface Roughness

Manning's roughness coefficients (i.e., n-values) were assigned to different land uses within the modelled downstream receiving area. The information from Engineers Australia **[16]** has been adopted as a reference for the selection of these values.

The following Manning's roughness coefficients have been adopted:

- General downstream area – 0.04
- Waterways – 0.03
- Heavily Vegetated areas – 0.10

4.6.7 Modelling Duration and Time Steps

The FLO-2D model was run for a total duration of 24 hours to allow for the full propagation of the breach flow. The time steps used for modelling are dynamically adjusted by the software based on Courant condition (which define the stability of the model) dependant on the velocity of the released volume at any specific time step.

4.6.8 Modelling Output

The dam break simulation results are presented in terms of inundation maps as follows:

- Maximum Flow Depth – depicting maximum inundation depths at the downstream area during the model runtime;

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- Maximum Flow Velocity – depicting maximum flow velocity in the flood plain during the model runtime;
- Maximum Flow Impact – depicting the maximum product of inundation depth and velocity (i.e., D×V) at the downstream area during the model runtime;
- Arrival Time (300 mm) – depicting the time it takes after the breach for the flood to reach a flow depth of 300 mm in the downstream area;
- Maximum Flow Elevation – depicting maximum flow surface elevations in the downstream area throughout the model runtime; and

It is important to note that whilst these figures present the maximum impact in the downstream receiving area, the maximum values shown in the figures do not necessarily occur at the same time. They are rather a representation of the collective maximum values achieved during the model runtime.

4.7 Results and Discussion

4.7.1 Base Case

Figure 6 to **Figure 15** show the inundation maps from the dam break simulations for the Base Case assessment. A summary of the inundation characteristics at key locations is provided in **Table 8** and **Table 9**.

As seen from the figures, the dam break flows initially propagate westward through the unnamed tributary until intersecting the Cabbage Tree Creek drainage path. It is noted that the dam break flows may inundate multiple drainage paths before turning into Cabbage Tree Creek and flowing northwards towards the Little Eva Pit.

The results indicate that the proposed diversion drain and flood protection levee around Little Eva Pit are capable of diverting the majority of the mobilised flood volumes away from the Little Eva Pit. The results indicate that some minor overtopping of the proposed flood protection levee is anticipated at the northern extents where the crest of the proposed flood protection levee is at its lowest.

After being diverted away from the Little Eva Pit, the dam break flows continue northwards along the Cabbage Tree Creek before joining the Leichardt River at the Cabbage Tree Creek-Leichardt River confluence.

TABLE 8 – INUNDATION SUMMARY AT KEY AREAS-OF-INTEREST (BASE CASE)

Location	Inundation Length (m)	Max Depth (D) (m)	Max Velocity (V) (m/s)	Max D×V (m^2/s)	Arrival Time $(hrs)^2$
Unnamed Tributary of Cabbage Tree Creek	-	21.4	14.2	251.6	0.1
Cabbage Tree Creek (Upstream of Little Eva Pit)	-	8.7	6.6	27.0	0.3
Lake Julius Access Road	780	5.9	3.4	13.9	1.8
Little Eva Pit footprint[1]	-	2.6	1.4	0.8	4.9
Harmony Solar Farm	-	-	-	-	-
Cabbage Tree Creek (Downstream of Little Eva Pit)	-	4.6	3.2	4.2	3.9
Kajabbi Normanton Road	1,680	2.8	2.1	1.3	9.8

Note 1: Values represent flooding above the natural terrain; no topographic modelling of the proposed Little Eva Pit is available.
Note 2: Arrival time defined as time to reach 300 mm of inundation.

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TABLE 9 – INUNDATION SUMMARY AT KEY INFRASTRUCTURE (BASE CASE)

Location	Minimum Crest Level (AHD)	Max Flow Level (AHD)	Max Depth (m)	Length Overtopped (m)	Time to Overtopping (hrs)
Little Eva Pit Flood Protection Levee	RL 162.23 m	RL 163.30 m	1.3	720	4.9

4.7.2 Sensitivity Case

Figure 16 to **Figure 25** show the inundation maps from the dam break simulations for the Sensitivity Case assessment. A summary of the inundation characteristics at key locations is provided in **Table 10** and **Table 11**.

As seen from the figures, the dam break flows follow a similar flow path to the Base Case assessment, but with a wider footprint along both the unnamed Tributary of Cabbage Tree Creek and Cabbage Tree Creek itself.

The results indicate that the increased volume of liquefied tailings results in significant overtopping of the proposed Little Eva Pit flood protection levee. No topographic modelling of the Little Eva Pit has been included in the model domain, however flood depths of up to 4.3 m have been estimated above natural ground within the proposed Little Eva Pit footprint.

It is evident that the performance of the Little Eva Pit flood protection levee is sensitive to the mobilised tailings volume (and by extension the assumed breach depth).

It is understood that the design of the flood protection infrastructure surrounding the Little Eva Pit is ongoing. Based on the outcomes of the Sensitivity Case assessment, it is recommended that the dimensions of the flood protection levee are reviewed to ensure adequate protection from potential dam break flooding.

TABLE 10 – INUNDATION SUMMARY AT KEY AREAS-OF-INTEREST (SENSITIVITY CASE)

Location	Inundation Length (m)	Max Depth (D) (m)	Max Velocity (V) (m/s)	Max D×V (m^2/s)	Arrival Time (hrs)[1]
Unnamed Tributary of Cabbage Tree Creek	-	28.3	17.4	364.0	0.1
Cabbage Tree Creek (Upstream of Little Eva Pit)	-	9.8	6.9	31.6	0.3
Lake Julius Access Road	1,230	6.8	3.5	17.1	1.4
Little Eva Pit footprint[1]	-	4.3	2.2	2.3	3.9
Harmony Solar Farm	-	-	-	-	-
Cabbage Tree Creek (Downstream of Little Eva Pit)	-	5.7	3.7	7.1	3.3
Kajabbi Normanton Road	1,800	3.2	1.7	2.4	8.0

Note 1: Values represent flooding above the natural terrain; no topographic modelling of the proposed Little Eva Pit is available.
Note 2: Arrival time defined as time to reach 300 mm of inundation.

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TABLE 11 – INUNDATION SUMMARY AT KEY INFRASTRUCTURE (SENSITIVITY CASE)

Location	Minimum Crest Level (AHD)	Max Flow Level (AHD)	Max Depth (m)	Length Overtopped (m)	Time to Overtopping (hrs)
Little Eva Pit Flood Protection Levee	RL 162.23	RL 165.4 m	2.1	2,300	3.7

5 GROUNDWATER IMPACTS

5.1 Overview

A Groundwater Impact Assessment (GIA) was undertaken for the Dugald River TSF by CDM Smith in 2025 **[17]**. The outcomes of the GIA are summarised in the following sections.

5.2 Numerical Modelling

As part of the GIA, a numerical model was developed to predict the groundwater seepage rates in response to the Stage 3 TSF raise.

The modelling comprised both the Stage 2 and Stage 3 geometries to determine the impact of the Stage 3 raise (calculated as the difference between the two scenarios).

The numerical modelling indicated that the Stage 3 TSF raise will not result in increased groundwater levels, suggesting no significant impact on regional groundwater conditions. The modelling also indicated that there will be no increase in seepage from the TSF as a result of the proposed Stage 3 raise.

5.3 Impact Assessment

The GIA **[17]** concluded the following:

- No impacts to groundwater resources are predicted as a result of the Stage 3 raise;
- No groundwater supply bores are expected to experience any change to groundwater levels or groundwater quality as a result of the Stage 3 raise;
- The Stage 3 TSF raise is not predicted to have any impact on the baseflow or natural flow regime of Cabbage Tree Creek and its tributaries;
- The project is not expected to give rise to any adverse impacts on any aquatic habitats and ecosystems associated with creeks, nor any downstream surface water users;
- No impacts on wetlands or other surface water features are predicted;
- There will be no impacts to groundwater dependent ecosystems as a result of the Stage 3 TSF raise; and
- The Stage 3 TSF raise has the potential to affect local groundwater quality due to limited seepage of potential acid mine drainage contaminated water migrating from the TSF into the underlying groundwater regime. However, impacts on groundwater quality associated with local contamination from TSF seepage are considered highly unlikely.

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6 CONSEQUENCE CATEGORY ASSESSMENT

6.1 Overview

For tailings dams in Queensland, two primary Consequence Category Assessment (CCA) methodologies apply. The outcomes of the two assessments have different applications and are not necessarily the same, as different criteria apply.

The first CCA method is that which is required by the Queensland DETSI **[1]**, with the other being the approach described by ANCOLD **[2]**. MMG have also requested ATCW to assess the TSF consequence category against the GISTM **[3]**.

These applications can be summarised as follows:

- DETSI – three separate scenarios for which different design criteria apply
  - Failure to Contain (seepage) – sets the required containment and detection measures;
  - Failure to Contain (overtopping) – sets the required flood management criteria (i.e., Design Storage Allowance and Mandatory Reporting Level); and
  - Dam Break – sets the required spillway capacity.

    The DETSI assessment criteria does not consider the internal (i.e. mine site) Population At Risk (PAR), internal environmental damage, nor the owner's business risks.

    The highest CCA ("Significant" or higher) defines whether the dam becomes a Regulated Structure for licensing by DETSI.
- ANCOLD – two separate scenarios for which different design criteria apply
  - Dam Failure – sets the required spillway capacity and seismic design ground motions; and
  - Environmental Spill – sets the required flood management criteria (i.e., Design Storage Allowance, Extreme Storm Storage Allowance and Contingency Freeboard).

    The ANCOLD assessment differs from DETSI, in that the criteria includes the internal PAR, internal environmental damage, and the owner's business risks.
- GISTM
  - Dam Failure – sets the required earthquake and flood management criteria, differentiating between active care and passive care.

    The GISTM assessment methodology requires that the CCA is informed by a dam breach analysis based on a *credible failure mode* assessment.

In summary, the DETSI CCA is used as the basis for obtaining regulatory approvals for the TSF, and generates hydrological and hydraulic design criteria, provided they meet or exceed the requirements of ANCOLD. The ANCOLD CCA is used by MMG for internal business risk ranking and application of critical controls, whilst the GISTM CCA is assessed to demonstrate compliance with the GISTM.

6.2 Population at Risk (PAR)

Following ANCOLD guidelines **[2]**, the PAR is considered to be "all those persons who would be directly exposed to floodwaters within the dam break affected zone if they took no action to evacuate".

The ANCOLD and GISTM assessments consider both internal (i.e. MMG personnel) and external populations; whilst the DETSI assessments only consider third-party (external) populations.

A specific location is included in the PAR assessment if it is within the inundation zone, and insufficient warning time is provided for evacuation.

The assessment of PAR has been based upon information provided by MMG and considers the proportion of time the individual or group can be expected to be exposed to the dam break inundation area. Where there is limited information available with respect to PAR frequencies, conservative

assumptions have been made. Separate PAR estimates have been carried out for Day and Night periods.

MMG have advised that the potential PAR will comprise those listed in **Table 12.** The time-weighted estimate of the PAR is summarised in **Table 13**. ATCW consider that the PAR estimates listed in

Table 13 are representative of both the Base Case and Sensitivity Case in consideration of the comparable flooding extents and severity between the two scenarios.

TABLE 12 – POTENTIAL POPULATIONS AT RISK

Task	No. People	Frequency (day time)	Frequency (night time)
Daily Inspections	1 person	1 hrs per inspection, once per day	Day shift only
Weekly Inspections	2 people	2 hrs per inspection, once per week	Day shift only
Monthly Inspections	1 person	2 hrs per inspection, once per month	Day shift only
Annual Surveillance Inspections	5 people	10 hrs per inspection, once per year	Day shift only
SCP Pump Maintenance	2 people	2 hrs a week	Day shift only
Environmental Sampling	2 people	2 hrs, once per month 3 hrs, once per quarter	Day shift only
Land Owner Inspections	1 person	6 hrs, twice per year	Day shift only
Drilling	2 people	12 hrs, once per year	Day shift only
Ad hoc Inspections	2 people	2 hrs, once per month	Day shift only
Little Eva Pit[1]	10 people	12 hrs shift	Day shift and night shift

Note 1: Conservative assumptions due to limited available information.

TABLE 13 – ESTIMATED POPULATION AT RISK

Task	Frequency	People Hours/Week	
		Day Time	Night Time
Daily Inspections	1 person x 1 hrs per inspection x once per day	7.000	-
Weekly Inspections	2 people x 2 hrs per inspection x once per week	4.000	-
Monthly Inspections	1 person x 2 hrs per inspection x once per month	0.462	-

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Annual Surveillance Inspections	5 people x 10 hrs per inspection x once per year	0.962	-
SCP Pump Maintenance	2 people x 2 hrs a week	4.000	-
Environmental Sampling	(2 people x 2 hrs x once per month) + (2 people x 3 hrs x once per quarter)	1.385	-
Land Owner Inspections	1 person x 6 hrs x twice per year	0.231	-
Drilling	2 people x 12 hrs x once per year	0.462	-
Ad hoc Inspections	2 people x 2 hrs x once per month	0.923	-
Little Eva Pit	10 people x 12 hrs	840.000	840.000
	Total People Hours/Week	859.424	840.000
	Total Hours per Week	84	84
	Equivalent PAR (Time-Weighted)	**10.231**	**10.000**

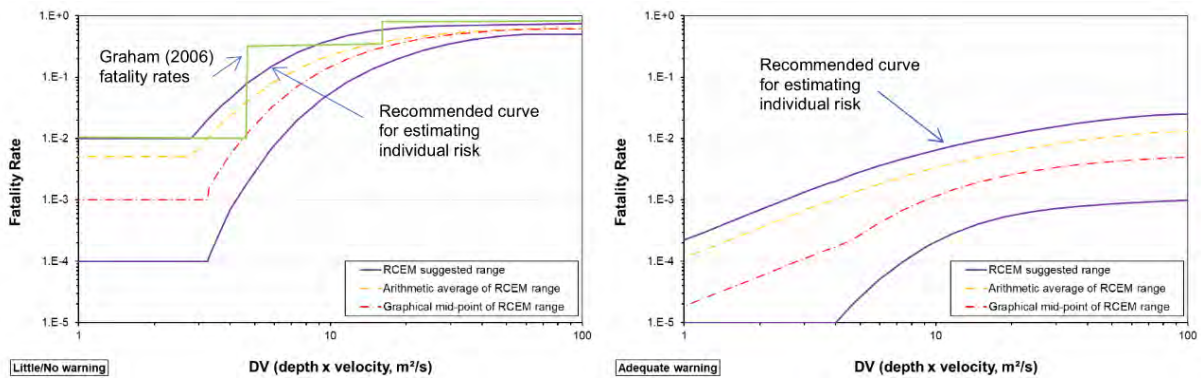
6.3 Potential Loss of Life (PLL)

Estimates of the PLL have been carried out in accordance with ANCOLD **[18]**. As recommended by ANCOLD, the RCEM approach **[19]** has been used to estimate the PLL.

6.3.1 RCEM Methodology

The RCEM methodology proposes a graphical approach to estimating the fatality rate due to dam failures, by considering flood severity and warning time. The charts are reproduced in **Graph 3** and have been developed based on an extensive database of case histories.

GRAPH 3 – RCEM FATALITY RATE GRAPHS [20]



Limited guidance is provided on what constitutes “Little/No Warning” or “Adequate Warning” within the RCEM methodology. For the purposes of the PLL assessment, it is conservatively assumed that

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"Little/No Warning" has been provided to the populations listed in **Table 12**. The upper bound of the RCEM suggested range has been considered to determine the fatality rates.

The Weighted PLL has been calculated as follows:

$$Weighted\ PLL = \sum (PAR \times Fatality\ Rate)$$

The fatality rates and Weighted PLL for each population is shown in **Table 14**.

TABLE 14 – ESTIMATED POTENTIAL LOSS OF LIFE

Task	People Hours/Week	Weighted PAR		Fatality Rate	Weighted PLL	
		Day	Night		Day	Night
Daily Inspections	7.000	0.083	-	0.8	0.067	-
Weekly Inspections	4.000	0.048	-	0.8	0.038	-
Monthly Inspections	0.462	0.005	-	0.8	0.004	-
Annual Surveillance Inspections	0.962	0.011	-	0.8	0.009	-
SCP Pump Maintenance	4.000	0.048	-	0.8	0.038	-
Environmental Sampling	1.385	0.016	-	0.8	0.013	-
Land Owner Inspections	0.231	0.003	-	0.8	0.002	-
Drilling	0.462	0.005	-	0.8	0.004	-
Ad hoc Inspections	0.924	0.011	-	0.8	0.009	-
Little Eva Pit	840.000	10.000	10.000	0.01	0.100	0.100
Total PAR		10.231	10.000	**Total PLL**	0.285	0.100

6.4 General Environmental Harm

The DETSI Manual **[1]** requires that consequence category assessments are undertaken in consideration of the following 'environmental harms':

- Harms to humans;
- General environmental harm; and
- General economic loss or property damage.

When considering general environmental harm, the receiving environment for the failure of a structure includes, but is not limited to, ephemeral waterways; creeks; and rivers. The main receiving environment for the Stage 3 TSF includes:

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- Unnamed tributary of Cabbage Tree Creek; and
- Cabbage Tree Creek.

Cabbage Tree Creek flows to the Leichardt River 36 km downstream of the TSF.

In accordance with the DETSI Manual **[1]**, a general environmental harm assessment is concerned with effects to areas with 'Significant Values' and 'Moderate Values' within the receiving environment. The values are defined as follows:

- Significant Values
  - Matters of National Environmental Significance (MNES)
  - Matters of State Environmental Significance (MSES)
  - High Ecological Value (HEV) waters as per the Queensland Environmental Protection (Water) Policy 2009 (EPP Water)
- Moderate Values
  - Slightly or moderately disturbed waters as per the EPP Water,
  - Wetland of general ecological significance (GES) as mapped on the Queensland Government referable wetland mapping,
  - Riverine areas, springs or lakes and associated flora and fauna.

An assessment of the general environmental harm from an overtopping scenario was carried out as part of the 2022 Consequence Category and Design Storage Allowance Review **[21]**. The following section summarises the outcomes from this assessment in the context of a Stage 3 dam break scenario.

6.4.1 Matters of National Environmental Significance

The Protected Matter Report (PMR) **[22]** for the project area is provided in **Appendix B.** The report lists the MNES that may occur within the estimated inundation extents.

There are no World Heritage Properties, National Heritage Places, Wetlands of International Importance, Great Barrier Reef Marine Park, Commonwealth Marine Areas, or Listed Threatened Ecological Communities listed for the receiving environment in the PMR.

The PMR identifies 17 Listed Threatened Species and 12 Listed Migratory Species within the potential receiving environment. The Listed Threatened Species identified in the PMR are summarised in **Table 15**.

TABLE 15 – MNES LISTED THREATENED SPECIES

Species ID	Common Name	Class	Threatened Category
856	Curlew Sandpiper	Bird	Critically Endangered
59350	Night Parrot	Bird	Endangered
1568	Mertens' Water Monitor, Mertens's Water Monitor	Reptile	Endangered
77037	Australian Painted Snipe	Bird	Endangered
942	Red Goshawk	Bird	Endangered
67197	Gulf Snapping Turtle	Reptile	Endangered
558	Carpentarian Grasswren	Bird	Endangered

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90091	Gouldian Finch	Bird	Endangered
60756	Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish	Shark	Vulnerable
305	Julia Creek Dunnart	Mammal	Vulnerable
282	Greater Bilby	Mammal	Vulnerable
863	Latham's Snipe, Japanese Snipe	Bird	Vulnerable
83821	Plains Death Adder	Reptile	Vulnerable
929	Grey Falcon	Bird	Vulnerable
470	Painted Honeyeater	Bird	Vulnerable
174	Ghost Bat	Mammal	Vulnerable
874	Sharp-tailed Sandpiper	Bird	Vulnerable

6.4.2 Matters of State Environmental Significance

There are several areas of Matters of State Environmental Significance (MSES) **[23]** within ML90211 (which extends 1.2 km to the west of the TSF) and Lot 59 on TG40, which extends 11 km to the north of the TSF pertaining to:

- Regulated vegetation (intersecting a watercourse) along the unnamed tributary of Cabbage Tree Creek; and
- Regulated vegetation (essential habitat) downstream of the TSF on the unnamed tributary of Cabbage Tree Creek and along Cabbage Tree Creek.

These areas are shown in the MSES documentation in **Appendix C – Map 4**.

6.4.3 High Ecological Value Wetlands and Waterways

Assessment of the available data MSES data **[23]** (**Appendix C**) showed that no High Ecological Value (HEV) wetlands or waterways were identified in the receiving environment within ML90211 and Lot 59 on TG40.

6.4.4 Aquatic Conservation Significance

Cabbage Tree Creek (and its unnamed tributary on which the TSF is located) is in the Northwest Highlands bioregion, the Mount Isa Inlier subregion, which falls within the Flinders and Leichardt River catchments. Cabbage Tree Creek and its unnamed tributary were assessed against the characteristics for riverine areas, lakes and springs, as per the Queensland Government Wetland Maps **[23]**.

Review of the available wetland mapping, MNES **[22]**, MSES **[23]**, Biodiversity and Conservation Values **[24]** and Regional Ecosystems **[25]** identified riverine waterbodies along the unnamed tributary of Cabbage Tree Creek and Cabbage Tree Creek.

Cabbage Tree Creek and its unnamed tributary were identified as areas of 'Medium' riverine subcatchment significance as depicted in **Appendix D – Map 5**. 'Medium' riverine values refer to riverine wetlands in deep-water habitat in a natural or artificial channel.

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6.4.5 Groundwater Supply

An assessment of the local registered private boreholes within ML90211 and Lot 59 on TG40 was carried out in 2022 **[21]** and is summarised in **Table 16**. The identified boreholes to the west of the TSF and are shown on

Map 3.

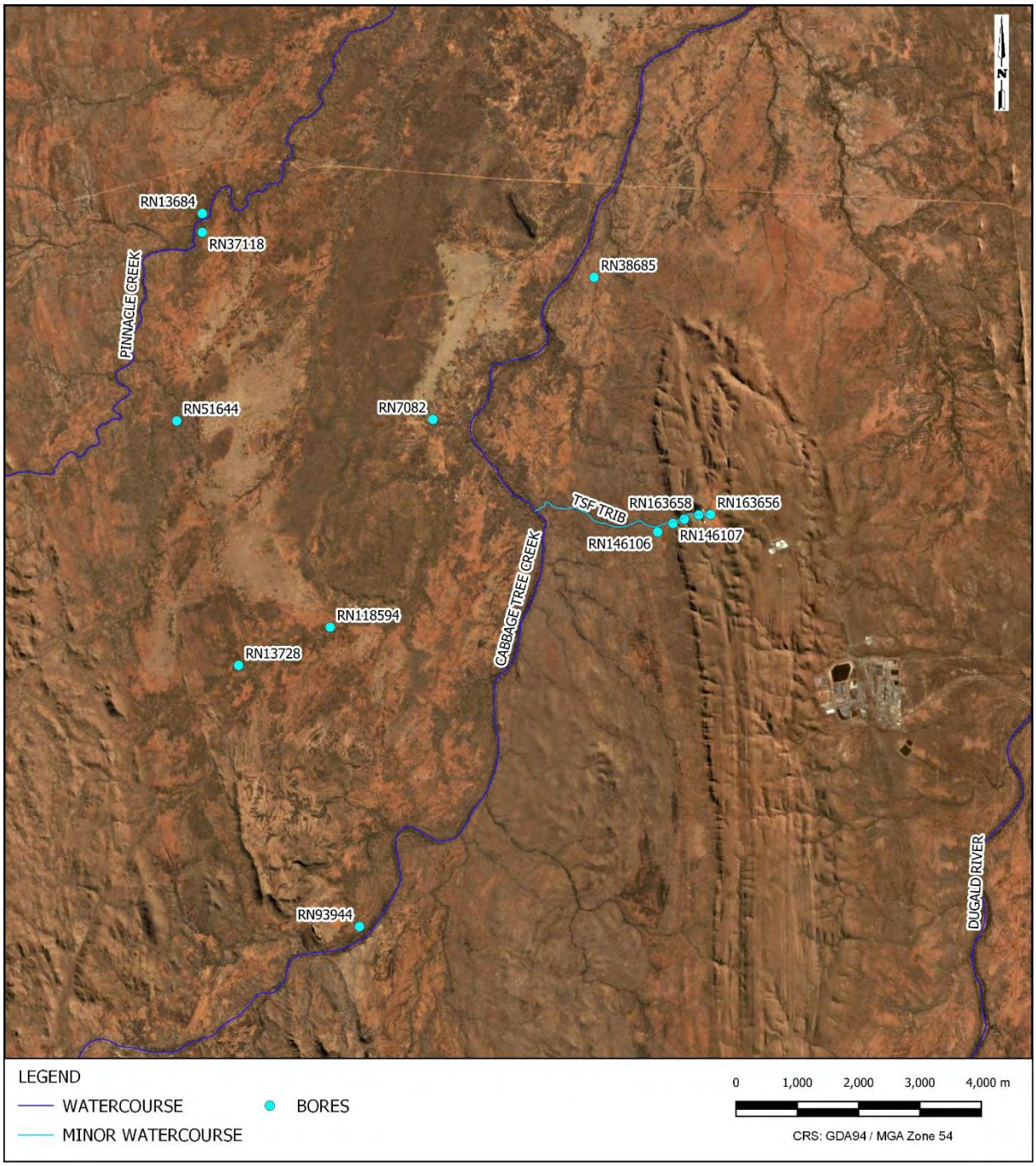
TABLE 16 – REGISTERED LOCAL BOREHOLES ON ML90211 AND LOT 59 ON TG40

Local Bore Locations and Details				
Bore[1]	**Coordinates (GDA94, Zone 54)**	**Location on Site**	**Date Drilled**	**Type/Role**
RN7082	404621 E 7765062 N	4.7 km west northwest of TSF	No data	Sub-Artesian Facility, Abandoned/Destroyed
RN13684	400858 E 7768422 N	9.5 km northwest of TSF	2/07/1958	Sub-Artesian Facility
RN13728	401452 E 7761047 N	7.9 km west south of TSF	28/07/1958	Sub-Artesian Facility, Abandoned/Destroyed
RN37118	400860 E 7768115 N	9.5 km northwest of TSF	14/12/1971	Sub-Artesian Facility
RN38685	407250 E 7767382 N	4.2 km north northwest of TSF	1/01/1972	Sub-Artesian Facility
RN51644	400442 E 7765038 N	8.6 km west of TSF	1/01/1982	Sub-Artesian Facility
RN93944	403422 E 7756784 N	8.7 km southwest of TSF	6/10/2004	Sub-Artesian Facility
RN118594	402946 E 7761669 N	6.4 km west southwest of TSF	7/10/2004	Sub-Artesian Facility
RN146106	408287 E 7763224 N	790 m west of TSF	25/11/2008	Sub-Artesian Facility
RN146107	408537 E 7763364 N	510 m west of TSF	26/11/2008	Sub-Artesian Facility
RN163656	409148 E 7763508 N	120 m east of TSF	1/12/2010	Sub-Artesian Facility
RN163657	409149 E 7763509 N	120 m east of TSF	1/12/2010	Sub-Artesian Facility
RN163658	408956 E 7763501 N	At base of TSF	1/12/2010	Sub-Artesian Facility
RN163659	408958 E 7763502 N	At base of TSF	1/12/2010	Sub-Artesian Facility
RN163660	408724 E 7763433 N	310 m west of TSF	1/12/2010	Sub-Artesian Facility
RN163661	408723 E 7763433 N	310 m west of TSF	1/12/2010	Sub-Artesian Facility

Note 1: Details provided by Queensland Globe **[26]** and Business Queensland **[27]**. Accessed 29 July 2022.

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MAP 3 – BORES TO THE WEST OF THE TSF AND WITHIN CABBAGE TREE CREEK



6.5 DETSI Consequence Category

The DETSI Manual **[1]** sets out the requirements for consequence category assessments for the following failure event scenarios:

- 'Failure to contain – seepage': concerning spills or releases to ground and/or groundwater via seepage from the floor and/or sides of the structure;
- 'Failure to contain – overtopping': concerning spills or releases from the structure that result from loss of containment due to overtopping of the structure; and
- 'Dam break': concerning collapse of the structure due to any possible cause.

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A review of the 'failure to contain – overtopping' scenario was carried out in 2022 **[21]**. It is considered that the outcomes from this study are also representative of the Stage 3 geometry. A summary of the outcomes from the 2022 study, alongside assessments for the 'failure to contain – seepage' and 'dam break' scenarios is provided in **Table 17**.

TABLE 17 – DETSI CONSEQUENCE CATEGORY ASSESSMENT (STAGE 3)

Failure Scenario	Harm Category	Consequence Category	Rationale
Failure to Contain - Seepage	Harm to humans	LOW	Contamination of water used for human consumption is not expected to occur as a result of impoundment seepage (**Section 5.3**).
	General environmental	LOW	Seepage from the Knapdale Valley TSF impoundment entering the Cabbage Tree Creek catchment is not expected (**Section 5.3**).
	General economic loss	LOW	No risk of harm to third party assets costing > $1M.
Failure to Contain - Overtopping	Harm to humans	LOW	Overtopping flows (uncontrolled spillway release) would not impact public roads or areas where non-site personnel would be expected to be routinely present. Bores located within the overtopping failure impact zone are not used for human consumption.
	General environmental	**SIGNIFICANT**	Overtopping flows (uncontrolled spillway release) would be directed to the unnamed tributary of Cabbage Tree Creek and Cabbage Tree Creek. These watercourses contain MSES. There are also areas of state biodiversity significance which may be impacted. Impacts would likely involve remediation of damage that takes more than 6 months but less than 3 years; and result in an impact area of between 1 km^2 to 5 km^2.
	General economic loss	LOW	No risk of harm to third party assets costing > $1M.
Dam Break	Harm to humans	LOW	People are routinely in the failure path (Little Eva Pit) however loss of life is not expected. Estimated PLL of <1 as discussed in **Section 6.3.**
	General environmental	**HIGH**	Dam break flows would be directed to the unnamed tributary of Cabbage Tree Creek and Cabbage Tree Creek. These watercourses contain MSES. There are also areas of state biodiversity significance which may be impacted. Impacts would likely involve permanent alteration to existing ecosystems; and result in an impact area of greater than 5 km^2.
	General economic loss	**HIGH**	Dam break flows are estimated to reach the Little Eva Pit diversion drain and flood protection levee. Some overtopping of the flood protection levee is expected. The harm to these third-party assets is estimated to require $10M or more in rehabilitation, compensation, repair, or rectification costs.

Hence, the overall assigned DETSI Consequence Categories for both the Base Case and Sensitivity Case are as follows:

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- Failure to Contain – Seepage: **'Low**'
- Failure to Contain – Overtopping: **'Significant'**
- Dam Break: **'High'**

6.6 ANCOLD Consequence Category

6.6.1 Severity of Damage and Loss

A severity level impact assessment has been carried out for the Base Case and Sensitivity assessments. The estimation of the severity of damage and loss has been determined in accordance with the ANCOLD Consequence Category Guidelines **[2]**.

This method requires the grouping of the potential severity of damage and losses into like consequences related to:

- Total infrastructure costs;
- Impact on dam owner's business;
- Health and social impacts; and
- Environmental impacts.

Estimates of the Severity of Damage and Loss for the Base Case and Sensitivity Case are presented in **Table 18**.

A 'Medium' severity has been selected for estimating the total infrastructure costs for both the Base Case and Sensitivity Case. This represents the potential damage and subsequent repair of the TSF embankment; Seepage Collection System; access roads; and the Little Eva Pit diversion drain and flood protection levee.

A 'Major' severity has been selected for estimating the total impact on MMG's operations for both the Base Case and the Sensitivity Case. This represents the fact that the DRM will no longer be able to operate following the failure and loss of function of the TSF.

A 'Minor' severity has been selected for estimating the health and social impacts for both the Base Case and Sensitivity Case. This represents the fact that there are no areas of human habitation or infrastructure within the estimated inundation footprint.

A 'Major' severity has been selected for estimating the environmental impacts for both the Base Case and Sensitivity Case. This represents an estimated impact area of less than 20 km^2 and significant effects on MSES. It should be noted that the impact area defined by ANCOLD excludes land prone to natural flooding (i.e., the Unnamed tributary of Cabbage Tree Creek and Cabbage Tree Creek).

An overall severity of damage and loss of 'Major' has been selected for both the Base Case and Sensitivity Case.

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TABLE 18 – DAM FAILURE SEVERITY OF DAMAGE AND LOSS (ANCOLD)

Damage Type	Minor	Medium	Major	Catastrophic
Infrastructure (dam, houses, commerce, farms, community)	<$10M	$10M - $100M	$100M - $1B	>$1B
Business importance	Some restrictions	Significant impacts	Severe to crippling	Business dissolution, bankruptcy
Public health	<100 people affected	100 - 1000 people affected	<1000 people affected for more than one month	>10,000 people affected for over one year
Social dislocation	<100 person or <20 business months	100 – 1000 person months or 20 – 2000 business months	>1000 person months or >200 business months	>10,000 person months or numerous business failure
Impact area	<1km^2	<5km^2	<20km^2	>20km^2
Impact duration	<1 (wet) year	<5 years	<20 years	>20 years
Impact on natural environment	Damage limited to items of low conservation value (e.g., degraded or cleared land, ephemeral streams, non-endangered flora and fauna). Reclamation possible	Significant effects on rural land and local flora & fauna. Limited effects on: A. Item(s) of local & state natural heritage B. Native flora and fauna within forestry, aquatic and conservation reserves, or recognised habitat corridors, wetlands or fish breeding areas	Extensive rural effects. Significant effects on river system and areas A & B. Limited effects on: C. Item(s) of National or World natural heritage D. Native flora and fauna within national parks, recognised wilderness areas, RAMSAR wetlands and nationally protected aquatic reserves. Remediation difficult	Extensively effects areas A & B. Significantly affects areas C & D. Remediation involves significantly altered ecosystems.

6.6.2 Dam Failure Consequence Category

The ANCOLD Dam Failure Consequence Category is determined by evaluating the consequences of a dam failure resulting in the release of stored water and tailings. The Dam Failure Consequence Category has been assessed based on the PLL assessment (**Table 19**).

The DRM TSF Stage 3 dam failure consequence category, in accordance with **Table 19**, given a PLL < 1 and a 'Major' severity of damage or loss is **'High C'** for both the Base Case and Sensitivity Case.

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TABLE 19 – ASSESSED ANCOLD DAM FAILURE CONSEQUENCE CATEGORY

Potential Loss of Life (PLL)	Severity of Damage and Loss			
	Minor	Medium	Major	Catastrophic
<0.1	Very Low	Low	Significant	High C
≥0.1 to <1	Significant	Significant	High C	High B
≥1 to <5	(Note 1)	High C	High B	High A
≥5 to <50		High A (Note 2)	High A	Extreme
≥50		(Note 1)	Extreme	Extreme

Note 1: With a PLL equal to or greater than one (1), it is unlikely Damage will be minor. Similarly with a PLL in excess of 50 it is unlikely Damage will be classified as Medium.
Note 2: Where PLL is in the range ≥5 to<10, the Category level can be reduced to High B.

6.6.3 Environmental Spill Consequence Category

The ANCOLD Environmental Spill Consequence Category is determined by evaluating the consequences of spilling of water from the dam during a flood event or extreme wet weather period.

An overall severity of damage and loss is assessed to be 'Medium' in consideration of the potentially acidic decant water and the presence of MSES within the receiving environment; and the estimated impact area of between 1 km^2 to 5 km^2 based on the 2022 study for Stage 2 **[21]**.

No loss of life is expected as water spilling from the facility is controlled by the emergency spillway.

Hence an Environmental Spill Consequence Category of **'Low'** is considered appropriate for the DR Stage 3 TSF as summarised in **Table 20**.

TABLE 20 – ASSESSED ANCOLD ENVIRONMENTAL SPILL CONSEQUENCE CATEGORY

Potential Loss of Life (PLL)	Severity of Damage and Loss			
	Minor	Medium	Major	Catastrophic
<0.1	Very Low	Low	Significant	High C
≥0.1 to <1	Significant	Significant	High C	High B
≥1 to <5	(Note 1)	High C	High B	High A
≥5 to <50		High A (Note 2)	High A	Extreme
≥50		(Note 1)	Extreme	Extreme

Note 1: With a PLL equal to or greater than one (1), it is unlikely Damage will be minor. Similarly with a PLL in excess of 50 it is unlikely Damage will be classified as Medium.
Note 2: Where PLL is in the range ≥5 to<10, the Category level can be reduced to High B.

6.7 GISTM Consequence Category

The GISTM consequence category assessment methodology considers the resulting incremental losses to the environment, community, infrastructure and economics, and the potential PAR and PLL.

The GISTM consequence category assessment is summarised in **Table 21** in consideration of the commentary provided in **Section 6.5** and **Section 6.6**.

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TABLE 21 – ASSESSED GISTM CONSEQUENCE CATEGORY

Dam Failure CC	Incremental Losses				
	PAR	PLL	Environment	Health, Social and Cultural	Infrastructure and Economics
Low	None	None expected	Minimal short-term loss or deterioration of habitat or rare and endangered species.	Minimal effects and disruption of business and livelihoods. No measurable effect on human health. No disruption of heritage, recreation, community or cultural assets.	Low economic losses: area contains limited infrastructure or services. <US$1M
Significant	1–10	Unspecified	No significant loss or deterioration of habitat. Potential contamination of livestock/fauna water supply with no health effects. Process water low potential toxicity. Tailings not potentially acid generating and have low neutral leaching potential. Restoration possible within 1 to 5 years.	Significant disruption of business, service or social dislocation. Low likelihood of loss of regional heritage, recreation, community, or cultural assets. Low likelihood of health effects.	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes. <US$10M.
High	10–100	Possible (1–10)	Significant loss or deterioration of critical habitat or rare and endangered species. Potential contamination of livestock/ fauna water supply with no health effects. Process water moderately toxic. Low potential for acid rock drainage or metal leaching effects of released tailings. Potential area of impact 10 km^2 – 20 km^2. Restoration possible but difficult and could take > 5 years.	500-1,000 people affected by disruption of business, services or social dislocation. Disruption of regional heritage, recreation, community or cultural assets. Potential for short term human health effects.	High economic losses affecting infrastructure, public transportation, and commercial facilities, or employment. Moderate relocation/compensation to communities. <US$100M.
Very High	100–1,000	Likely (10 – 100)	Major loss or deterioration of critical habitat or rare and endangered species. Process water highly toxic. High potential for acid rock drainage or metal leaching effects from released tailings. Potential area of impact > 20 km^2. Restoration or compensation possible but very difficult and requires a long time (5 years to 20 years).	1,000 people affected by disruption of business, services or social dislocation for more than one year. Significant loss of national heritage, community or cultural assets. Potential for significant long-term human health effects.	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities, for dangerous substances), or employment. High relocation/ compensation to communities. < US$1B

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Dam Failure CC	Incremental Losses				
	PAR	PLL	Environment	Health, Social and Cultural	Infrastructure and Economics
Extreme	> 1,000	Many (> 100)	Catastrophic loss of critical habitat or rare and endangered species. Process water highly toxic. Very high potential for acid rock drainage or metal leaching effects from released tailings. Potential area of impact > 20 km^2. Restoration or compensation in kind impossible or requires a very long time (> 20 years).	5,000 people affected by disruption of business, services or social dislocation for years. Significant National heritage or community facilities or cultural assets destroyed. Potential for severe and/or long- term human health effects.	Extreme economic losses affecting critical infrastructure or services, (e.g., hospital, major industrial complex, major storage facilities for dangerous substances) or employment. Very high relocation/compensation to communities and very high social readjustment costs. >US$1B

6.8 Consequence Category Summary

A summary of the adopted Consequence Categories is provided in **Table 22**.

TABLE 22 – ASSESSED CONSEQUENCE CATEGORY SUMMARY

Methodology	Scenario	Base Case	Sensitivity Case
DETSI	Failure to Contain - Seepage	**Low**	
	Failure to Contain – Overtopping	**Significant**	
	Dam Break	**High**	**High**
ANCOLD	Dam Failure	**High C**	**High C**
	Environmental Spill	**Low**	
GISTM	Consequence Classification	**High**	**High**

7 DISCUSSION AND CONCLUSIONS

In consideration of the dam break assessment outcomes discussed above, the following should be noted:

- The resolution of the downstream topography between the Unnamed Tributary / Cabbage Tree Creek confluence and the Little Eva Pit infrastructure (and beyond) is limited. In particular, the Cabbage Tree Creek watercourse is not accurately defined, specifically at the tie-in with the proposed Little Eva Pit diversion drains. Better resolution of Cabbage Tree Creek may result in the dam break flows being more confined within the creek banks than the current results indicate, and hence less potential for overtopping of the proposed flood protection levee.
- The current dam break modelling results incorporate the design tailings beach from the Stage 3 Detailed Design, which makes assumptions on the achieved tailings beach slopes and the total stored volumes at the end of deposition. It is recommended that the dam break assessment is updated in the future under a separate work scope if the achieved tailings beach slopes and the stored tailings volumes are notably different to the Stage 3 design assumptions.

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- The specific gravity and rheological properties of the tailings have been derived from laboratory testing on thickener underflow samples and are unlikely to differ significantly with time. However, the assumed OID and post-liquefied shear strength parameters have the potential to influence the released volumes and flow characteristics of the tailings. Conservative estimates of these parameters have been adopted for the purpose of the current dam break assessments. However, it is likely that the achieved densities and shear strength characteristics will improve with time as tailings consolidation occurs and more sub-aerial deposition is carried out. If efforts are successful to reduce the decant pond size, it is recommended that CPT field investigation is carried out through the exposed tailings beach to inform the density and shear strength profiles within the tailings deposit to confirm these assumptions. It is likely that the results of the CPT investigation would improve the angle of the post-failure tailings backscarp and consequently reduce the estimated released volumes.
- The results of the Sensitivity Case assessments indicate that the Consequence Category assessments **are not sensitive** to the assumed released volumes – and by extension, the assumed failure height. However, the Consequence Category assessment may be sensitive to the assumed number of Harmony personnel frequenting the Little Eva Pit area. It is recommended that the assumptions made in this Consequence Category assessment be reviewed frequently to ensure that they are representative and current.

8 CLOSURE

Your attention is drawn to the “Conditions of Report” which are located at the end of this document.

REFERENCES

[1] Queensland Government Department of Environment and Science (DETSI), “Manual for Assessing Consequence Categories and Hydraulic Performance of Dams,” ESR/2016/1933 Version 5.03, 23/02/2024.

[2] ANCOLD (2012), “Guidelines on Consequence Categories for Dams”, Australian National Committee on Large Dams, October 2012.

[3] ICMM (2020), “Global Industry Standard on Tailings Management”, International Council on Mining & Metals, August 2020.

[4] ATC Williams (2025), “MMG Dugald River – Tailings Storage Facility – Stage 3 Raise Detailed Design Report”, Ref 250542-R04 (September 2025).

[5] Altona Mining Limited (2011), “Roseby Copper Project – Environmental Management Plan Volume 1 – Text”, (May 2011).

[6] ATC Williams (2015), “MMG Dugald River – Tailings Storage Facility – Dam Break Study”, Ref 108003.18-R01, December 2015.

[7] ATC Williams (2025), “MMG Dugald River – Tailings Storage Facility – Stage 3 Quantitative Risk Assessment (QRA) Report”, Ref 250542-R02 (RevB) (November 2025).

[8] Froehlich, D.C. (2016), “Empirical Model of Embankment Dam Breaching”.

[9] U.S. Army Corps of Engineers Hydrologic Engineering Centre, (2024), "HEC-RAS River Analysis System”, Ver. 6.6.

[10] FLO-2D Software (2024), “FLO-2D Pro Build No. 23.10.25”.

[11] European Space Agency, Sinergise (2025) “Copernicus Global Digital Elevation Model”, retrieved from OpenTopography: https://doi.org/10.5069/G9028PQB

[12] ATC Williams (2016), “MMG Dugald River – Tailings Storage Facility – Design Report”, Ref 108003.18-R03, May 2016.

[13] Seddon, K. D. (2007), “Post-Liquefaction Stability of Thickened Tailings Beaches”, Australian Tailings Consultants.

[14] ATC Williams (2025), “Dugald River TSF Stage 3 Raise – Detailed Design - Laboratory Factual Report”, Ref L250542-R01-RevA, May 2025.

[15] ATC Williams (2025), “Dugald River Mine – Tailings Storage Facility Intermediate Dam Inspection Report 2024”, Ref 108003.65-R02, December 2024.

[16] Engineers Australia, (2012), “Australian Rainfall & Runoff Projects: Two-Dimensional Modelling in Urban and Rural floodplains”, Australia, Project 15, P15/S1/009.

[17] CDM Smith (2025), “Groundwater Impact Assessment for the Dugald River Mine TSF”, Rev 1, April 2025.

[18] ANCOLD (2022), “Guidelines on Risk Assessment”, Australian National Committee on Large Dams, July 2022.

[19] USBR (2015) “RCEM – Reclamation Consequence Estimating Methodology: Guidelines for Estimating Life Loss for Dam Safety Risk Analysis”. Interim, July 2015. United States Bureau of Reclamation, Denver, Colorado.

[20] Lang, S., & Foster, M. (2019), “Estimating the Individual Risk from Dam Failure”, NZSOLD ANCOLD Proceedings of Technical Groups.

[21] ATC Williams (2022), “Dugald River Mine – Tailings Storage Facility – Consequence Category and Design Storage Allowance Review”, Ref 108003.60.R01 (Rev0), December 2022.

[22] Department of Agriculture, Water and Environment (2025), “EPBC Act Protected Matter Report”, accessed 01 April 2025, for 1km buffer around estimated inundation extents, http://www.environment.gov.au/epbc/pmst/, Australian Government.

[23] Department of Environment and Science (2022), “Environmental Reports - Matters of State Environmental Significance”, accessed 11 November 2022 for ML10137, https://apps.des.qld.gov.au/report-request/environment/, Queensland Government.

[24] Department of Environment and Science (2022), “Environmental Reports - Biodiversity and Conservation Values – Biodiversity Planning Assessments and Aquatic Conservation Assessments”, accessed 11 November 2022 for ML10137, https://apps.des.qld.gov.au/report-request/environment/, Queensland Government.

[25] Department of Environment and Science (2022), “Environmental Reports - Regional Ecosystems – Biodiversity Status”, accessed 11 November 2022 for ML10137, https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions, Queensland Government.

[26] Queensland Government, “Queensland Globe”, accessed 29 July 2022, https://qldglobe.information.qld.gov.au/help-info/, Queensland Government.

[27] Business Queensland (2021), “Bore Reports” accessed 11 November 2022, https://www.business.qld.gov.au/industries/mining-energy-water/water/bores-and-groundwater/bore-reports, Queensland Government.

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FIGURES

7760000N
7765000N
7770000N
7775000N
405000E
410000E
415000E
N
CABBAGE TREE CREEK
PINNACLE CREEK
LAKE JULIUS ACCESS ROAD
PROPOSED HARMONY SOLAR FARM
EXTENTS OF LiDAR SURVEY
TAILINGS STORAGE FACILITY
MINE CAMP
MINE AREA
POWER CORRIDOR
PROPOSED DIVERSION DRAIN
PROPOSED LITTLE EVA PIT
DUGALD RIVER
0
1,000
2,000
3,000
4,000 m
CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND
- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee
- Lease Boundary

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LOCALITY PLAN

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FIGURE 1

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:50000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762000N 7763000N 7764000N

409000E 409000E

410000E 410000E

PROPOSED STAGE 3 SEEPAGE COLLECTION SUMP

PROPOSED STAGE 3 SPILLWAY

PROPOSED STAGE 3 EMBANKMENT

NORTHERN DISCHARGE BUND

TAILINGS STORAGE FACILITY

RETURN WATER SYSTEM

0 200 400 600 800 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND
- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Full Supply Level (RL 251.35 m)
- Lease Boundary

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TAILINGS STORAGE FACILITY - STAGE 3

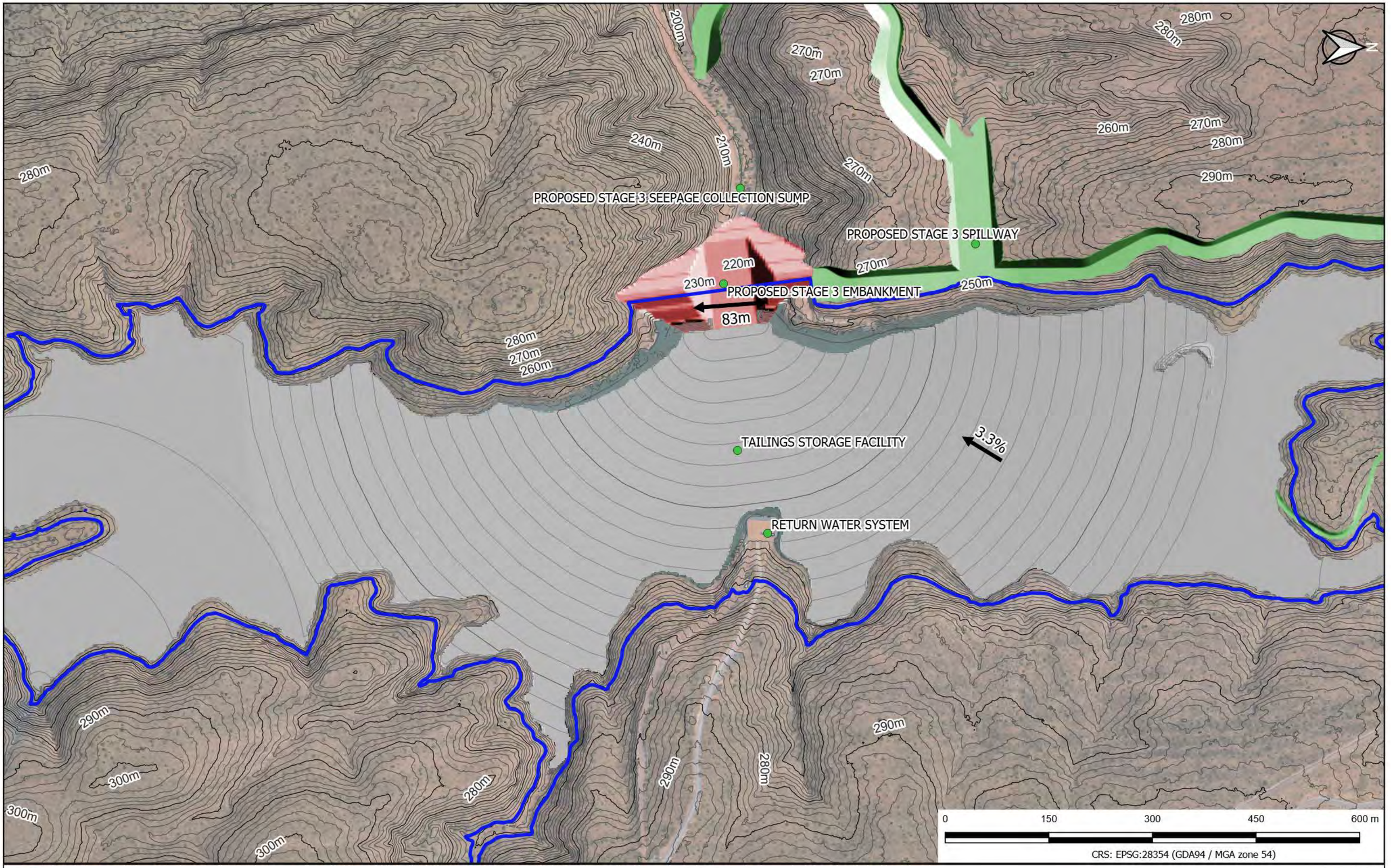
GENERAL ARRANGEMENT

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FIGURE 2

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:7500 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz



LEGEND
- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Full Supply Level (RL 251.35 m)

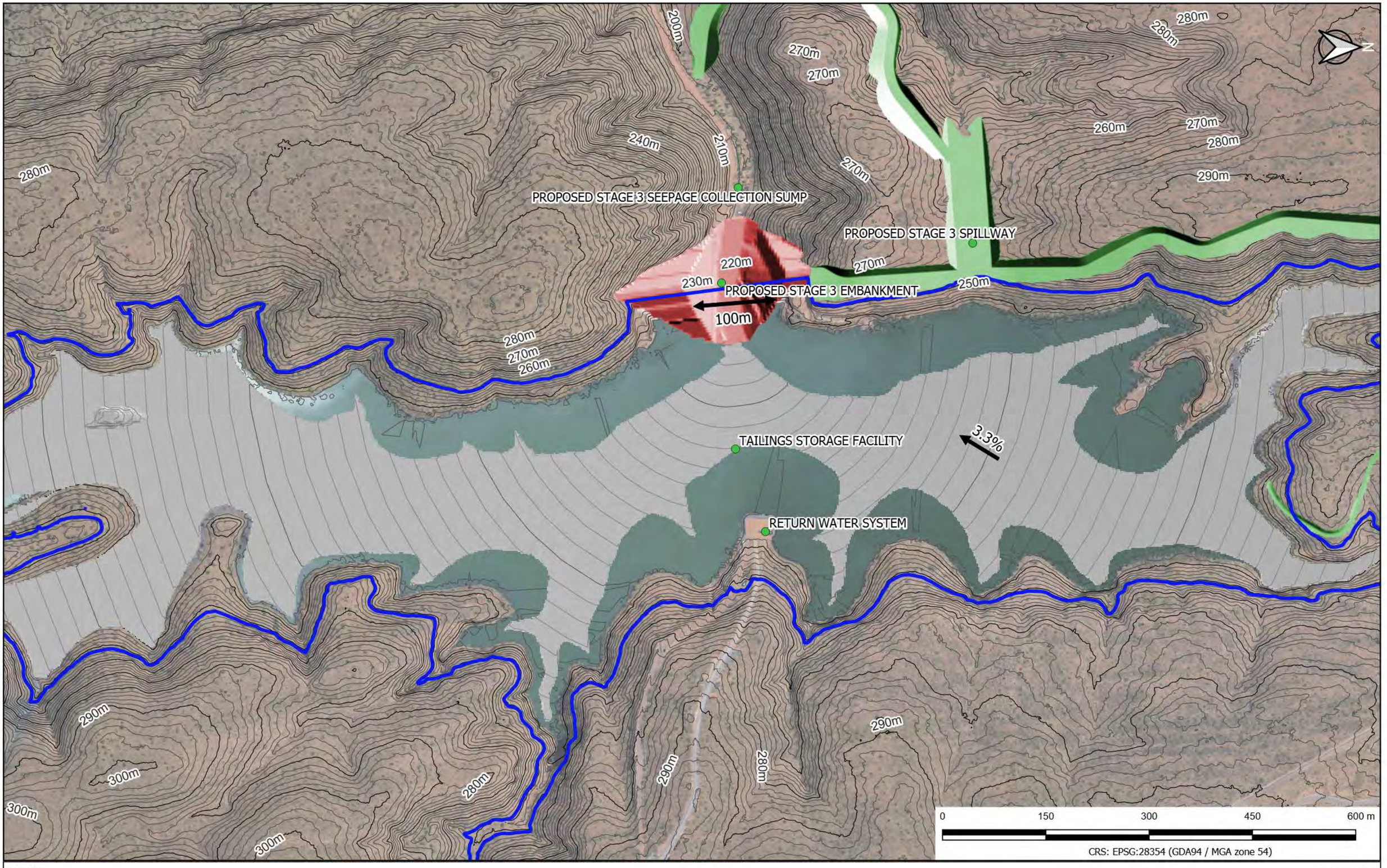
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SDF BREACH LAYOUT (BASE CASE)

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FIGURE 3
JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:5000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz



LEGEND
- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Full Supply Level (RL 251.35 m)

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TAILINGS STORAGE FACILITY - STAGE 3

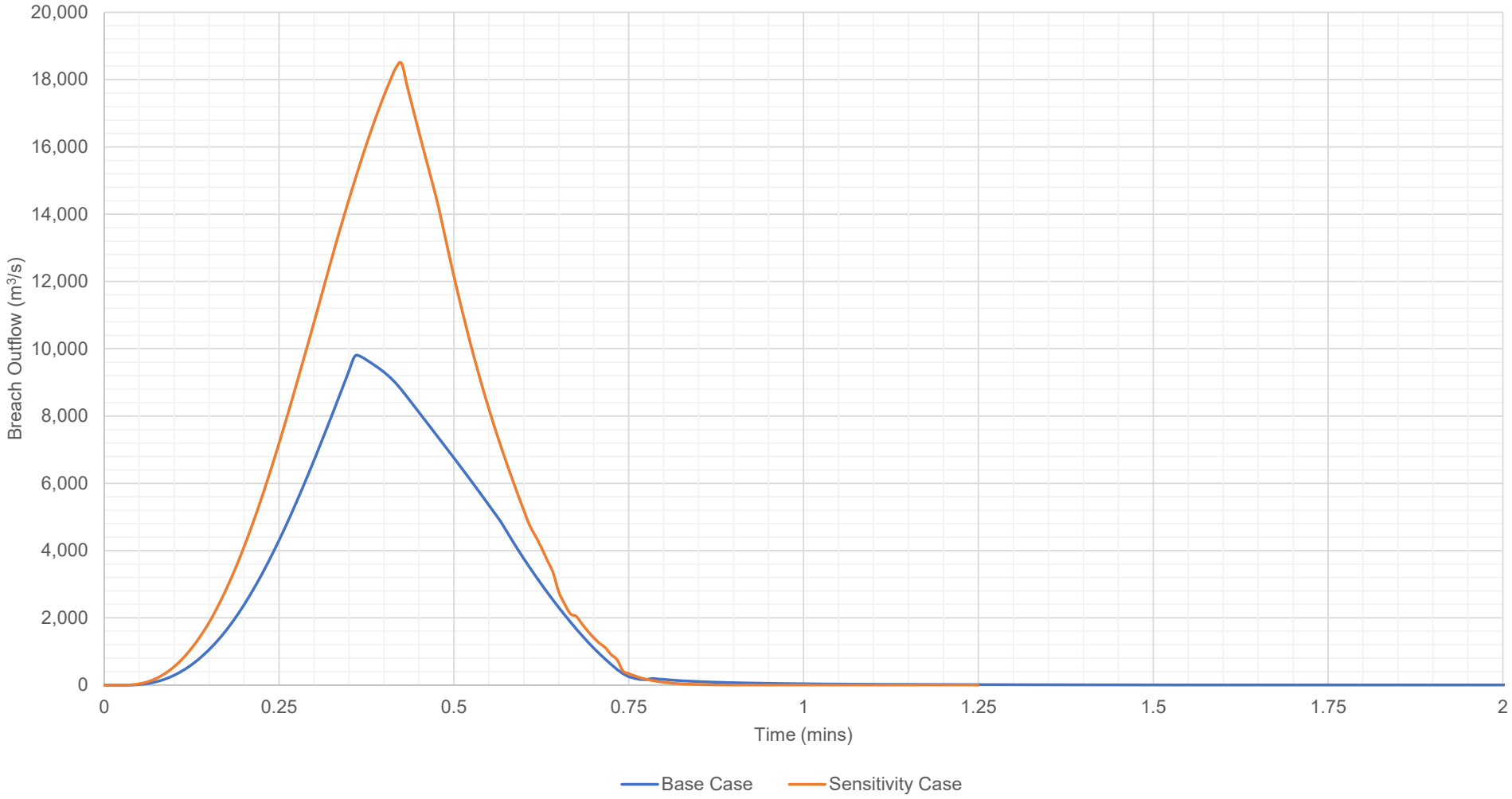
SDF BREACH LAYOUT (SENSITIVITY CASE)

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FIGURE 4

JOB NO. 250542
DATE: 19/06/2025
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SCALE: 1:5000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz



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DAM BREAK HYDROGRAPHS

Date: 19/06/2025 **Job No:** 250542.00

FIGURE 5

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\TDBA Summary and Calcs Dugald v2 Breach Hydrograph

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

MINE AREA

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

REFER FIGURE 7

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

SALLY CREEK

LEICHHARDT RIVER

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Depth

- <= 0.3 m
- 0.3 - 1.0 m
- 1.0 - 2.0 m
- 2.0 - 3.0 m
- 3.0 - 4.0 m
- 4.0 - 5.0 m
- 5.0 - 6.0 m
- 6.0 - 7.0 m
- > 7.0 m

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DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

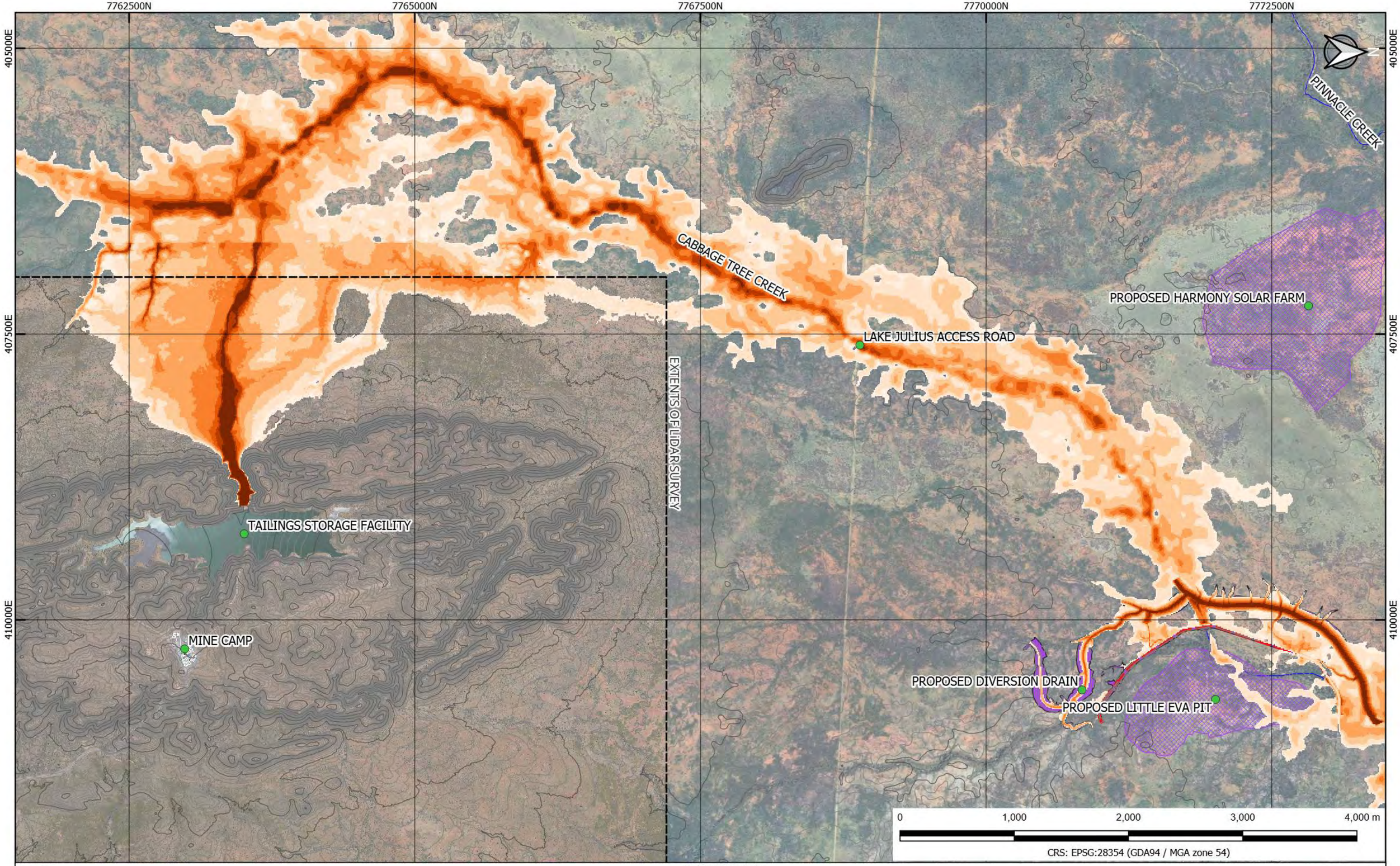
SDF (BASE CASE)
MAXIMUM INUNDATION DEPTH (1 OF 2)

ATC WILLIAMS

FIGURE 6

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz



LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Depth

- <= 0.3 m
- 0.3 - 1.0 m
- 1.0 - 2.0 m
- 2.0 - 3.0 m
- 3.0 - 4.0 m
- 4.0 - 5.0 m
- 5.0 - 6.0 m
- 6.0 - 7.0 m
- > 7.0 m

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
MAXIMUM INUNDATION DEPTH (2 OF 2)

ATC WILLIAMS

FIGURE 7

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N
7770000N
7780000N
7790000N
400000E
410000E
420000E
N
PINNACLE CREEK
CABBAGE TREE CREEK
LAKE JULIUS ACCESS ROAD
TAILINGS STORAGE FACILITY
MINE CAMP
PROPOSED DIVERSION DRAIN
PROPOSED LITTLE EVA PIT
MINE AREA
REFER FIGURE 9
PROPOSED HARMONY SOLAR FARM
KAJABBI NORMANTON RD
LEICHHARDT RIVER
SALLY CREEK
DUGALD RIVER
0
2,500
5,000
7,500
10,000 m
CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Velocity

- <= 0.5 m/s
- 0.5 - 1.0 m/s
- 1.0 - 1.5 m/s
- 1.5 - 2.0 m/s
- 2.0 - 2.5 m/s
- 2.5 - 3.0 m/s
- 3.0 - 3.5 m/s
- 3.5 - 4.0 m/s
- > 4.0 m/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
MAXIMUM INUNDATION VELOCITY (1 OF 2)

ATC WILLIAMS

FIGURE 8

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N
7765000N
7767500N
7770000N
7772500N
405000E
407500E
410000E
N
PINNACLE CREEK
CABBAGE TREE CREEK
PROPOSED HARMONY SOLAR FARM
LAKE JULIUS ACCESS ROAD
EXTENTS OF LIDAR SURVEY
TAILINGS STORAGE FACILITY
MINE CAMP
PROPOSED DIVERSION DRAIN
PROPOSED LITTLE EVA PIT
0
1,000
2,000
3,000
4,000 m
CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Velocity

- <= 0.5 m/s
- 0.5 - 1.0 m/s
- 1.0 - 1.5 m/s
- 1.5 - 2.0 m/s
- 2.0 - 2.5 m/s
- 2.5 - 3.0 m/s
- 3.0 - 3.5 m/s
- 3.5 - 4.0 m/s
- > 4.0 m/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
MAXIMUM INUNDATION VELOCITY (2 OF 2)

ATC WILLIAMS

FIGURE 9

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

MINE AREA

REFER FIGURE 11

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

SALLY CREEK

LEICHHARDT RIVER

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Depth x Velocity

- <= 1.0 m2/s
- 1.0 - 2.0 m2/s
- 2.0 - 4.0 m2/s
- 4.0 - 6.0 m2/s
- 6.0 - 8.0 m2/s
- 8.0 - 10.0 m2/s
- 10.0 - 15.0 m2/s
- 15.0 - 20.0 m2/s
- > 20.0m2/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
MAXIMUM DEPTH TIMES VELOCITY (1 OF 2)

ATC WILLIAMS

FIGURE 10

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N 7765000N 7767500N 7770000N 7772500N

405000E 407500E 410000E

CABBAGE TREE CREEK

PINNACLE CREEK

PROPOSED HARMONY SOLAR FARM

LAKE JULIUS ACCESS ROAD

EXTENTS OF LIDAR SURVEY

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

N

0 1,000 2,000 3,000 4,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Depth x Velocity

- <= 1.0 m2/s
- 1.0 - 2.0 m2/s
- 2.0 - 4.0 m2/s
- 4.0 - 6.0 m2/s
- 6.0 - 8.0 m2/s
- 8.0 - 10.0 m2/s
- 10.0 - 15.0 m2/s
- 15.0 - 20.0 m2/s
- > 20.0m2/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
MAXIMUM DEPTH TIMES VELOCITY (2 OF 2)

ATC WILLIAMS

FIGURE 11

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

MINE AREA

REFER FIGURE 13

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

SALLY CREEK

LEICHHARDT RIVER

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Time For 300 mm Inundation

- <= 0.5 hr
- 0.5 - 1.0 hr
- 1.0 - 2.0 hr
- 2.0 - 4.0 hr
- 4.0 - 6.0 hr
- 6.0 - 8.0 hr
- 8.0 - 10.0 hr
- 10.0 - 12.0 hr
- 12.0 - 24.0 hr

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
TIME FOR 300 mm INUNDATION (1 OF 2)

ATC WILLIAMS

FIGURE 12

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N
7765000N
7767500N
7770000N
7772500N
405000E
407500E
410000E
N
PINNACLE CREEK
CABBAGE TREE CREEK
PROPOSED HARMONY SOLAR FARM
LAKE JULIUS ACCESS ROAD
EXTENTS OF LIDAR SURVEY
TAILINGS STORAGE FACILITY
MINE CAMP
PROPOSED DIVERSION DRAIN
PROPOSED LITTLE EVA PIT
0
1,000
2,000
3,000
4,000 m
CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Time For 300 mm Inundation

- <= 0.5 hr
- 0.5 - 1.0 hr
- 1.0 - 2.0 hr
- 2.0 - 4.0 hr
- 4.0 - 6.0 hr
- 6.0 - 8.0 hr
- 8.0 - 10.0 hr
- 10.0 - 12.0 hr
- 12.0 - 24.0 hr

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
TIME FOR 300 mm INUNDATION (2 OF 2)

ATC WILLIAMS

FIGURE 13

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

MINE AREA

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

REFER FIGURE 15

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

SALLY CREEK

LEICHHARDT RIVER

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Level (RL)

- <= 145 m
- 145 - 155 m
- 155 - 165 m
- 165 - 175 m
- 175 - 185 m
- 185 - 195 m
- 195 - 205 m
- 205 - 215 m
- > 215 m

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
MAXIMUM INUNDATION LEVEL (1 OF 2)

ATC WILLIAMS

FIGURE 14

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N 7765000N 7767500N 7770000N 7772500N

405000E 407500E 410000E

CABBAGE TREE CREEK

PINNACLE CREEK

EXTENTS OF LIDAR SURVEY

PROPOSED HARMONY SOLAR FARM

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

0 1,000 2,000 3,000 4,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Level (RL)

- <= 145 m
- 145 - 155 m
- 155 - 165 m
- 165 - 175 m
- 175 - 185 m
- 185 - 195 m
- 195 - 205 m
- 205 - 215 m
- > 215 m

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (BASE CASE)
MAXIMUM INUNDATION LEVEL (2 OF 2)

ATC WILLIAMS

FIGURE 15

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E

410000E

420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

MINE AREA

REFER FIGURE 17

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

LEICHHARDT RIVER

SALLY CREEK

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Depth

- <= 0.3 m
- 0.3 - 1.0 m
- 1.0 - 2.0 m
- 2.0 - 3.0 m
- 3.0 - 4.0 m
- 4.0 - 5.0 m
- 5.0 - 6.0 m
- 6.0 - 7.0 m
- > 7.0 m

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM INUNDATION DEPTH (1 OF 2)

ATC WILLIAMS

FIGURE 16

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N 7765000N 7767500N 7770000N 7772500N

405000E 407500E 410000E

CABBAGE TREE CREEK

PINNACLE CREEK

PROPOSED HARMONY SOLAR FARM

LAKE JULIUS ACCESS ROAD

EXTENTS OF LIDAR SURVEY

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

N

0 1,000 2,000 3,000 4,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Depth

- <= 0.3 m
- 0.3 - 1.0 m
- 1.0 - 2.0 m
- 2.0 - 3.0 m
- 3.0 - 4.0 m
- 4.0 - 5.0 m
- 5.0 - 6.0 m
- 6.0 - 7.0 m
- > 7.0 m

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM INUNDATION DEPTH (2 OF 2)

ATC WILLIAMS

FIGURE 17

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

MINE AREA

REFER FIGURE 19

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

LEICHHARDT RIVER

SALLY CREEK

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Velocity

- <= 0.5 m/s
- 0.5 - 1.0 m/s
- 1.0 - 1.5 m/s
- 1.5 - 2.0 m/s
- 2.0 - 2.5 m/s
- 2.5 - 3.0 m/s
- 3.0 - 3.5 m/s
- 3.5 - 4.0 m/s
- > 4.0 m/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM INUNDATION VELOCITY (1 OF 2)

ATC WILLIAMS

FIGURE 18

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N 7765000N 7767500N 7770000N 7772500N

405000E 407500E 410000E

CABBAGE TREE CREEK

PINNACLE CREEK

LAKE JULIUS ACCESS ROAD

PROPOSED HARMONY SOLAR FARM

EXTENTS OF LIDAR SURVEY

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

N

0 1,000 2,000 3,000 4,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Velocity

- <= 0.5 m/s
- 0.5 - 1.0 m/s
- 1.0 - 1.5 m/s
- 1.5 - 2.0 m/s
- 2.0 - 2.5 m/s
- 2.5 - 3.0 m/s
- 3.0 - 3.5 m/s
- 3.5 - 4.0 m/s
- > 4.0 m/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM INUNDATION VELOCITY (2 OF 2)

ATC WILLIAMS

FIGURE 19

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

MINE AREA

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

REFER FIGURE 21

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

SALLY CREEK

LEICHHARDT RIVER

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Depth x Velocity

- <= 1.0 m2/s
- 1.0 - 2.0 m2/s
- 2.0 - 4.0 m2/s
- 4.0 - 6.0 m2/s
- 6.0 - 8.0 m2/s
- 8.0 - 10.0 m2/s
- 10.0 - 15.0 m2/s
- 15.0 - 20.0 m2/s
- > 20.0m2/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM DEPTH TIMES VELOCITY (1 OF 2)

ATC WILLIAMS

FIGURE 20

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N 7765000N 7767500N 7770000N 7772500N

405000E 407500E 410000E

CABBAGE TREE CREEK

PINNACLE CREEK

LAKE JULIUS ACCESS ROAD

PROPOSED HARMONY SOLAR FARM

EXTENTS OF LIDAR SURVEY

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

0 1,000 2,000 3,000 4,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Depth x Velocity

- <= 1.0 m2/s
- 1.0 - 2.0 m2/s
- 2.0 - 4.0 m2/s
- 4.0 - 6.0 m2/s
- 6.0 - 8.0 m2/s
- 8.0 - 10.0 m2/s
- 10.0 - 15.0 m2/s
- 15.0 - 20.0 m2/s
- > 20.0m2/s

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM DEPTH TIMES VELOCITY (2 OF 2)

ATC WILLIAMS

FIGURE 21

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

MINE AREA

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

REFER FIGURE 23

PROPOSED HARMONY SOLAR FARM

KAJABBI NORMANTON RD

SALLY CREEK

LEICHHARDT RIVER

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Time For 300 mm Inundation

- <= 0.5 hr
- 0.5 - 1.0 hr
- 1.0 - 2.0 hr
- 2.0 - 4.0 hr
- 4.0 - 6.0 hr
- 6.0 - 8.0 hr
- 8.0 - 10.0 hr
- 10.0 - 12.0 hr
- 12.0 - 24.0 hr

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
TIME FOR 300 mm INUNDATION (1 OF 2)

ATC WILLIAMS

FIGURE 22

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N 7765000N 7767500N 7770000N 7772500N

405000E 407500E 410000E

CABBAGE TREE CREEK

PINNACLE CREEK

PROPOSED HARMONY SOLAR FARM

LAKE JULIUS ACCESS ROAD

EXTENTS OF LIDAR SURVEY

TAILINGS STORAGE FACILITY

MINE CAMP

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

N

0 1,000 2,000 3,000 4,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Time For 300 mm Inundation

- <= 0.5 hr
- 0.5 - 1.0 hr
- 1.0 - 2.0 hr
- 2.0 - 4.0 hr
- 4.0 - 6.0 hr
- 6.0 - 8.0 hr
- 8.0 - 10.0 hr
- 10.0 - 12.0 hr
- 12.0 - 24.0 hr

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
TIME FOR 300 mm INUNDATION (2 OF 2)

ATC WILLIAMS

FIGURE 23

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7760000N 7770000N 7780000N 7790000N

400000E 410000E 420000E

PINNACLE CREEK

CABBAGE TREE CREEK

LAKE JULIUS ACCESS ROAD

TAILINGS STORAGE FACILITY

MINE CAMP

MINE AREA

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

PROPOSED HARMONY SOLAR FARM

REFER FIGURE 25

SALLY CREEK

LEICHHARDT RIVER

DUGALD RIVER

N

0 2,500 5,000 7,500 10,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Level (RL)

- <= 145 m
- 145 - 155 m
- 155 - 165 m
- 165 - 175 m
- 175 - 185 m
- 185 - 195 m
- 195 - 205 m
- 205 - 215 m
- > 215 m

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM INUNDATION LEVEL (1 OF 2)

ATC WILLIAMS

FIGURE 24

JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:100000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

7762500N 7765000N 7767500N 7770000N 7772500N

405000E 407500E 410000E

CABBAGE TREE CREEK

PINNACLE CREEK

EXTENTS OF LIDAR SURVEY

TAILINGS STORAGE FACILITY

MINE CAMP

LAKE JULIUS ACCESS ROAD

PROPOSED HARMONY SOLAR FARM

PROPOSED DIVERSION DRAIN

PROPOSED LITTLE EVA PIT

0 1,000 2,000 3,000 4,000 m

CRS: EPSG:28354 (GDA94 / MGA zone 54)

LEGEND

- Points of Interest
- Major Contours (10m)
- Minor Contours (2m)
- Watercourse
- Little Eva Levee

Max Inundation Level (RL)

- <= 145 m
- 145 - 155 m
- 155 - 165 m
- 165 - 175 m
- 175 - 185 m
- 185 - 195 m
- 195 - 205 m
- 205 - 215 m
- > 215 m

MMG LIMITED
DUGALD RIVER MINE
TAILINGS STORAGE FACILITY - STAGE 3

SDF (SENSITIVITY CASE)
MAXIMUM INUNDATION LEVEL (2 OF 2)

ATC WILLIAMS

FIGURE 25

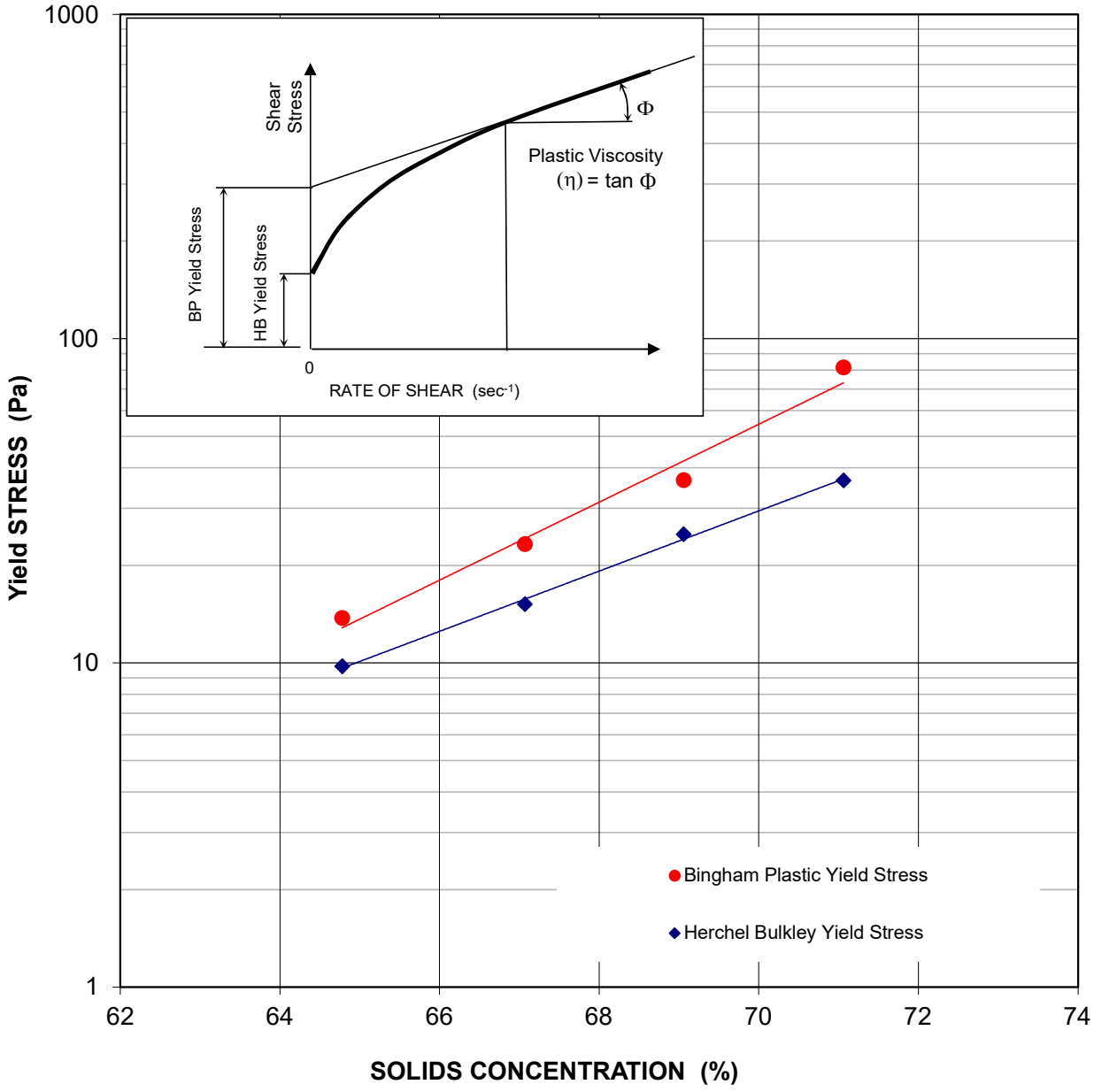
JOB NO. 250542
DATE: 19/06/2025
REVISION: A
SCALE: 1:30000 at A3

S:\Dugald\250542 - TSF Raise Design\Data and Calcs\Dam Break\QGIS\Dugald Stage 3 Dam Break.qgz

APPENDICES

APPENDIX A – RHEOLOGY TESTING

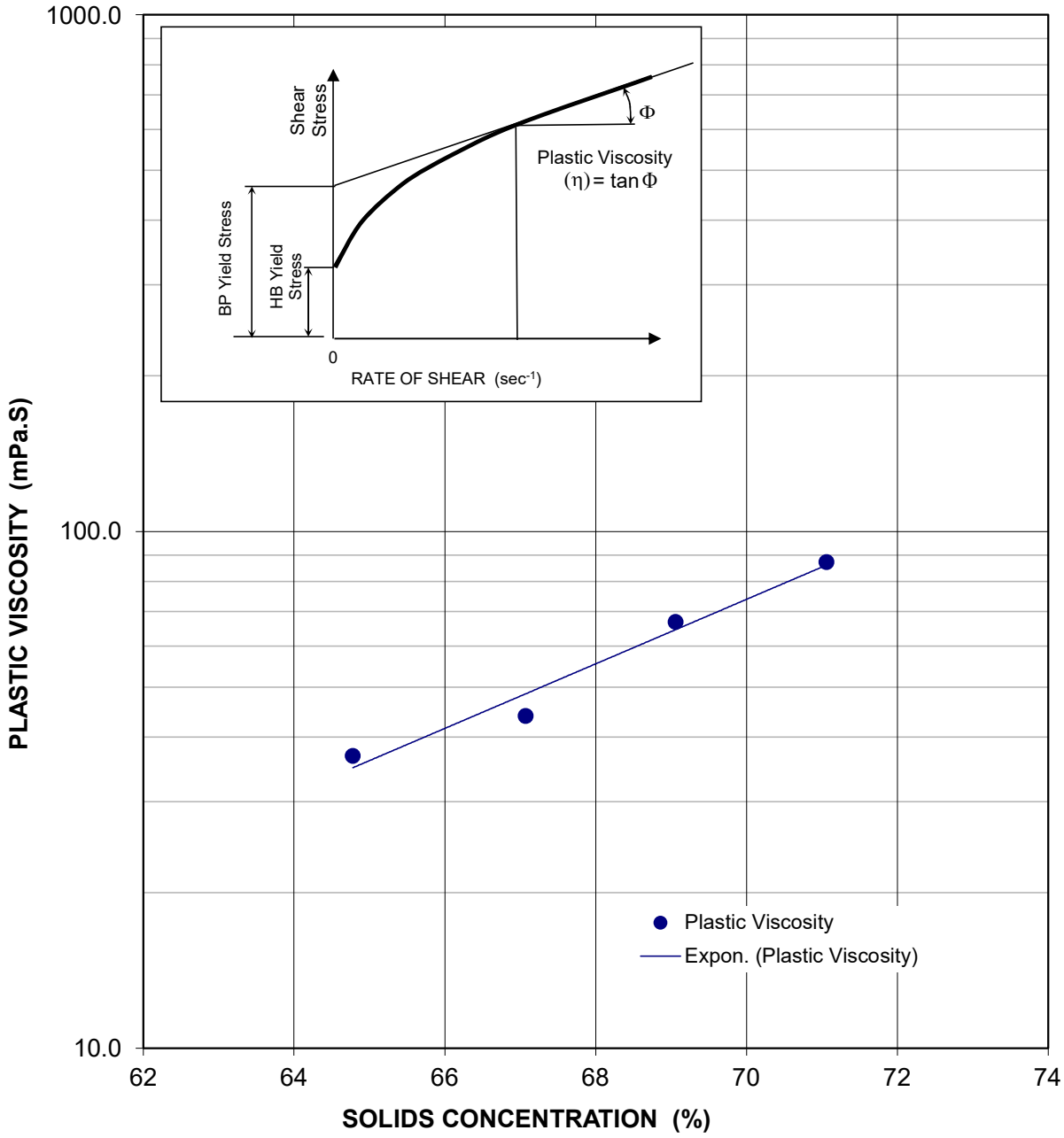
250542 - Dugald River TSF Raise Design
Sample No. 14325
SHEAR STRESS



MMG Limited **Dugald River TSF Raise Design** **Tailings Sample No. 1 - Unflocculated**	**Rheology Testing** **Yield Stress Versus** **Solids Concentration**
ATC WILLIAMS ATC Williams Pty Ltd 19 Beach Avenue Mordialloc Vic 3195 AUSTRALIA T +61 3 9590 9222 melbourne@atcwilliams.com.au www.atcwilliams.com.au	**Job No:** 250542 **Date:** 19/03/2025 **FIGURE 9**

https://atcw1.sharepoint.com/sites/Lab/Shared Documents/Lab Drive/Synergy V5 Projects/Dugald/L250542 (formerly L108003.67) Dams Support - TSF Stage 3 Raise DD/Data and Calcs/Rheology - 14325/14325 - Rheology Report

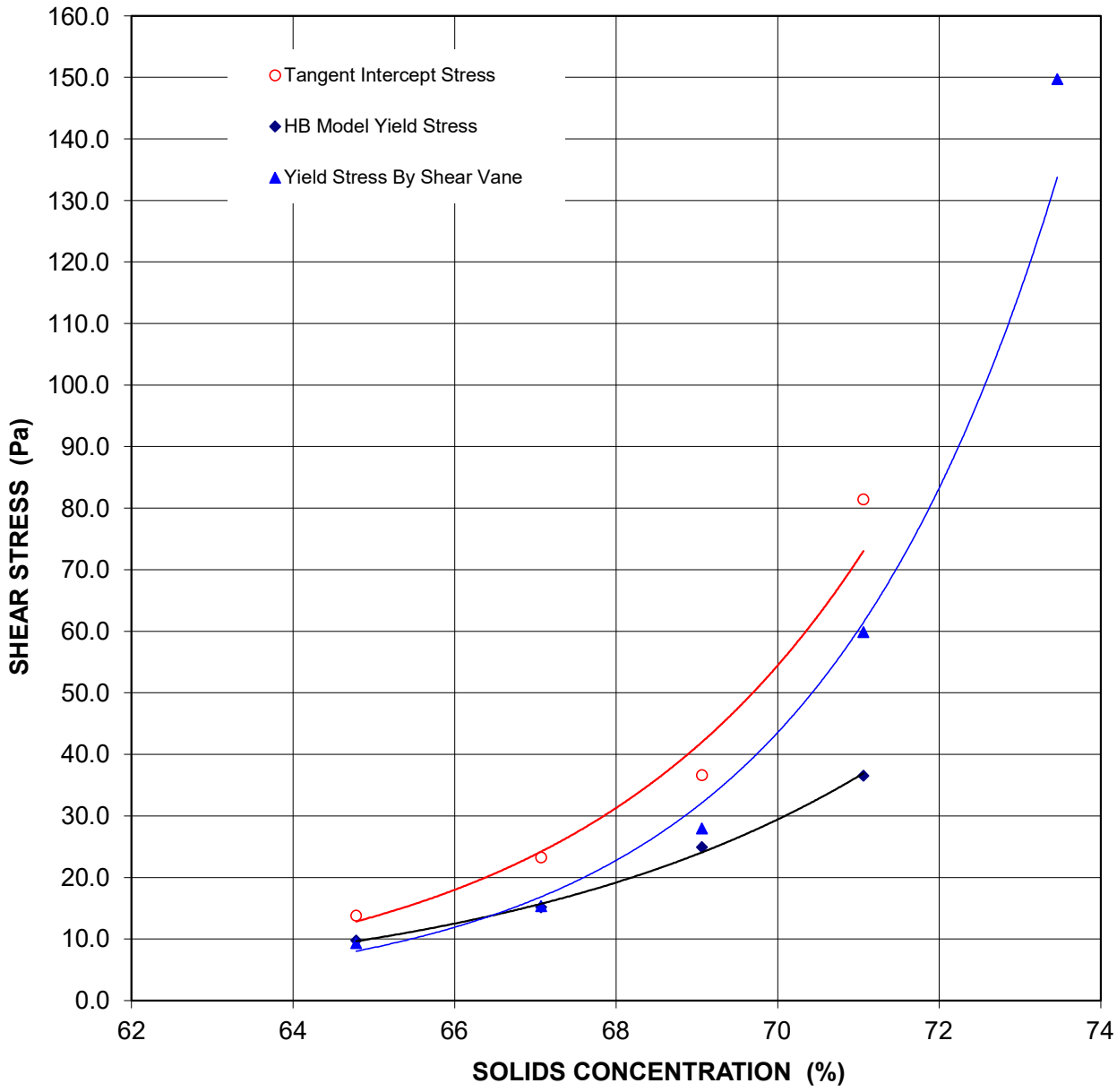
250542 - Dugald River TSF Raise Design
Sample No. 14325
PLASTIC VISCOSITY



MMG Limited **Dugald River TSF Raise Design** **Tailings Sample No. 1 - Unflocculated**	**Rheology Testing** **Plastic Viscosity Versus Solids Concentration**
ATC Williams Pty Ltd 19 Beach Avenue Mordialloc Vic 3195 AUSTRALIA T +61 3 9590 9222 melbourne@atcwilliams.com.au www.atcwilliams.com.au	**Job No:** 250542 **Date:** 19/03/2025 **FIGURE 10**

https://atcw1.sharepoint.com/sites/Lab/Shared Documents/Lab Drive/Synergy V5 Projects/Dugald/L250542 (formerly L108003.67) Dams Support - TSF Stage 3 Raise DD/Data and Calcs/Rheology - 14325/14325 - Rheology Report

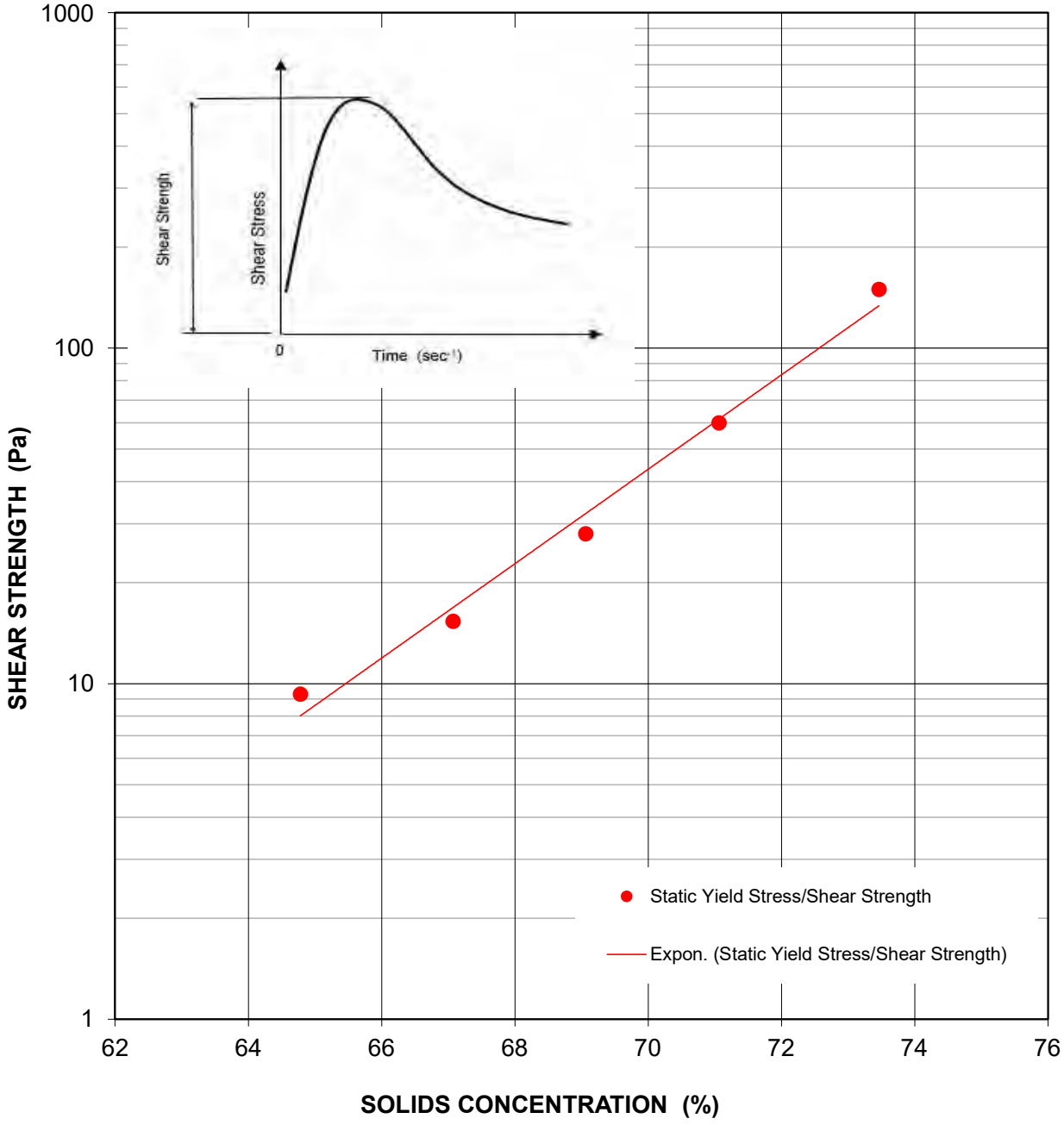
250542 - Dugald River TSF Raise Design
Sample No. 14325
SHEAR STRESS



MMG Limited **Dugald River TSF Raise Design** **Tailings Sample No. 1 - Unflocculated**	**Rheology Testing** **Yield Stress Versus** **Solids Concentration**
ATC WILLIAMS ATC Williams Pty Ltd 19 Beach Avenue Mordialloc Vic 3195 AUSTRALIA T +61 3 9590 9222 melbourne@atcwilliams.com.au www.atcwilliams.com.au	**Job No:** 250542 **Date:** 19/03/2025 **FIGURE 11**

https://atcw1.sharepoint.com/sites/Lab/Shared Documents/Lab Drive/Synergy V5 Projects/Dugald/L250542 (formerly L108003.67) Dams Support - TSF Stage 3 Raise DD/Data and Calcs/Rheology - 14325/14325 - Rheology Report

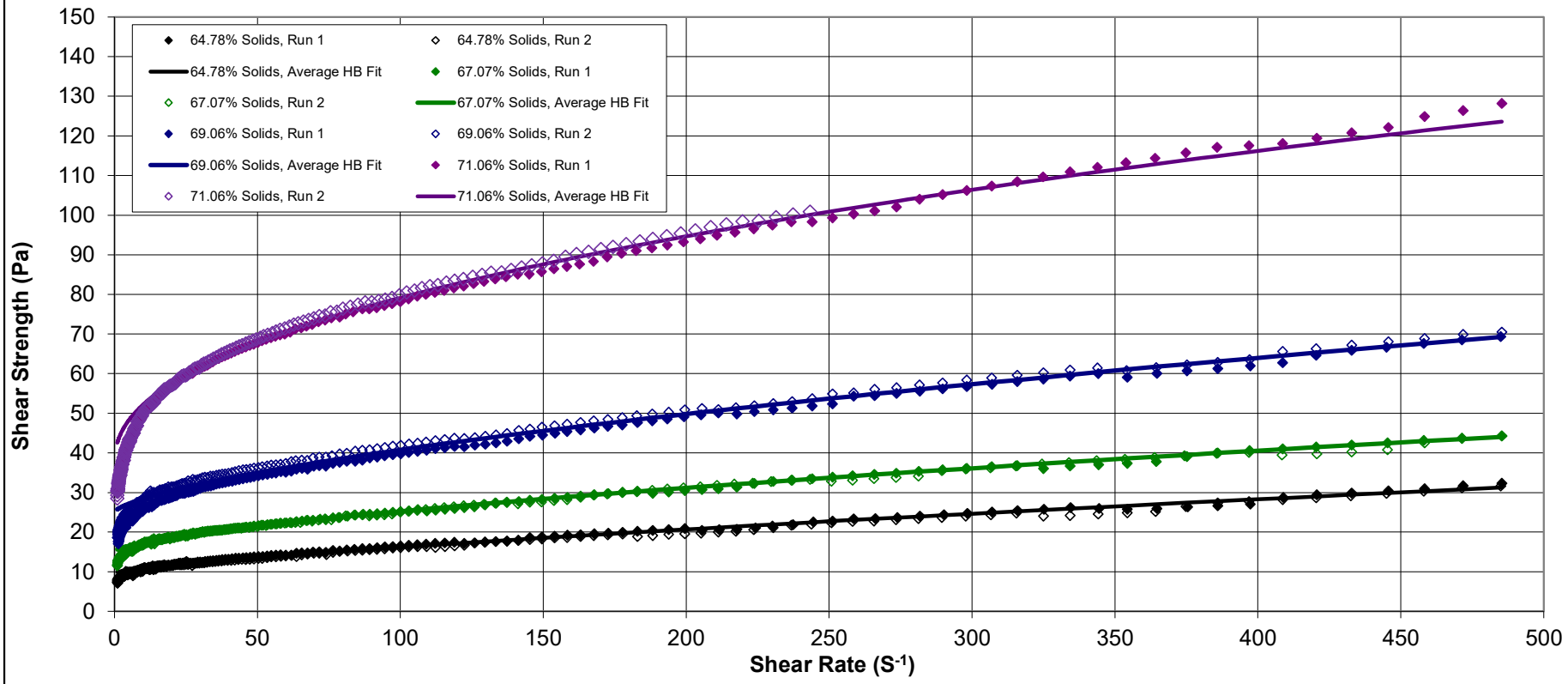
250542 - Dugald River TSF Raise Design
Sample No. 14325
SHEAR STRENGH



MMG Limited **Dugald River TSF Raise Design** **Tailings Sample No. 1 - Unflocculated**	**Rheology Testing** **Static Yield Stress Versus** **Solids Concentration**
ATC WILLIAMS ATC Williams Pty Ltd 19 Beach Avenue Mordialloc Vic 3195 AUSTRALIA T +61 3 9590 9222 melbourne@atcwilliams.com.au www.atcwilliams.com.au	**Job No:** 250542 **Date:** 19/03/2025 **FIGURE 12**

https://atcw1.sharepoint.com/sites/Lab/Shared Documents/Lab Drive/Synergy V5 Projects/Dugald/L250542 (formerly L108003.67) Dams Support - TSF Stage 3 Raise DD/Data and Calcs/Rheology - 14325/14325 - Rheology Report

250542 - Dugald River TSF Raise Design
Sample No. 14325
ALL FLOW CURVE RESULTS



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MMG Limited

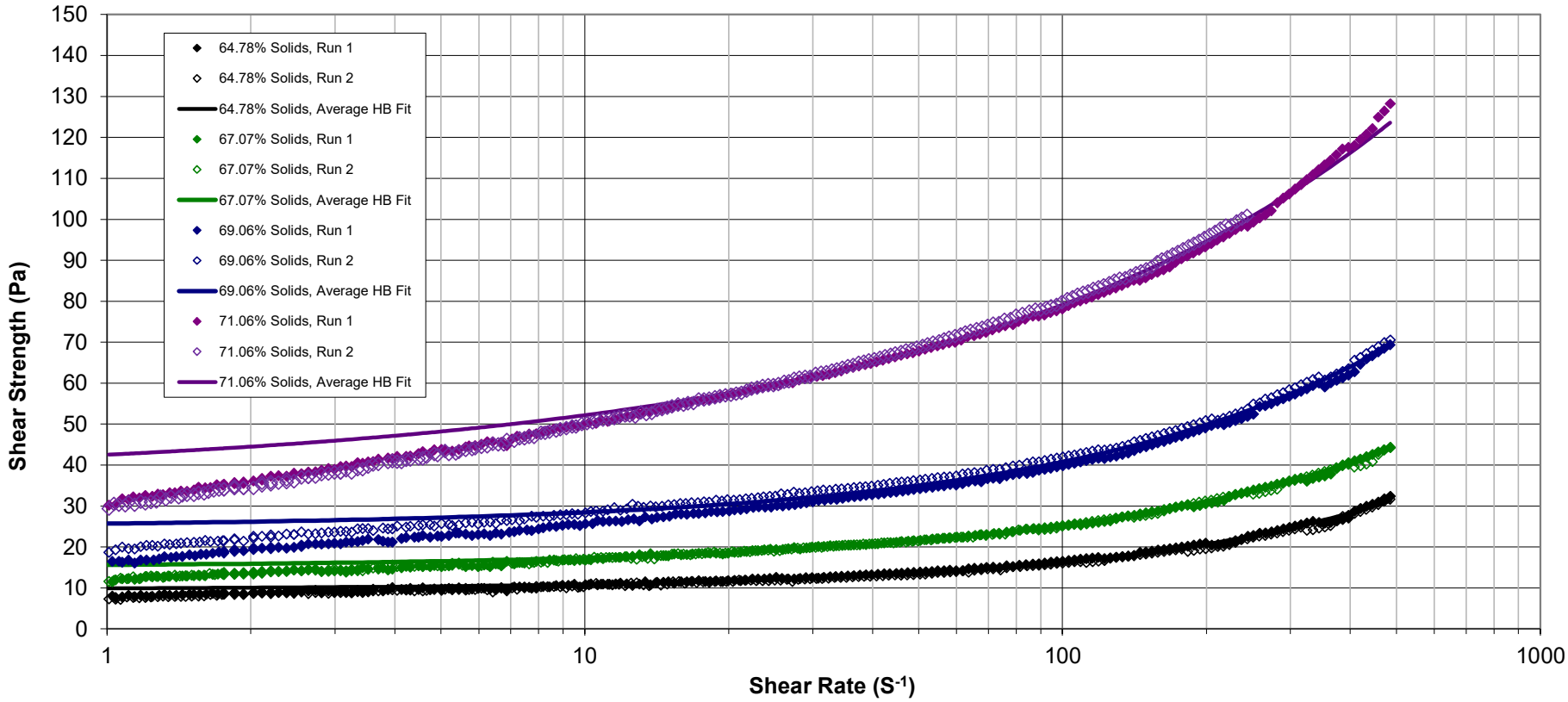
Dugald River TSF Raise Design

Tailings Sample No. 1 - Unflocculated

Rheology Testing

Date: 19/03/2025 **Job No:** 250542

Appendix B1



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MMG Limited

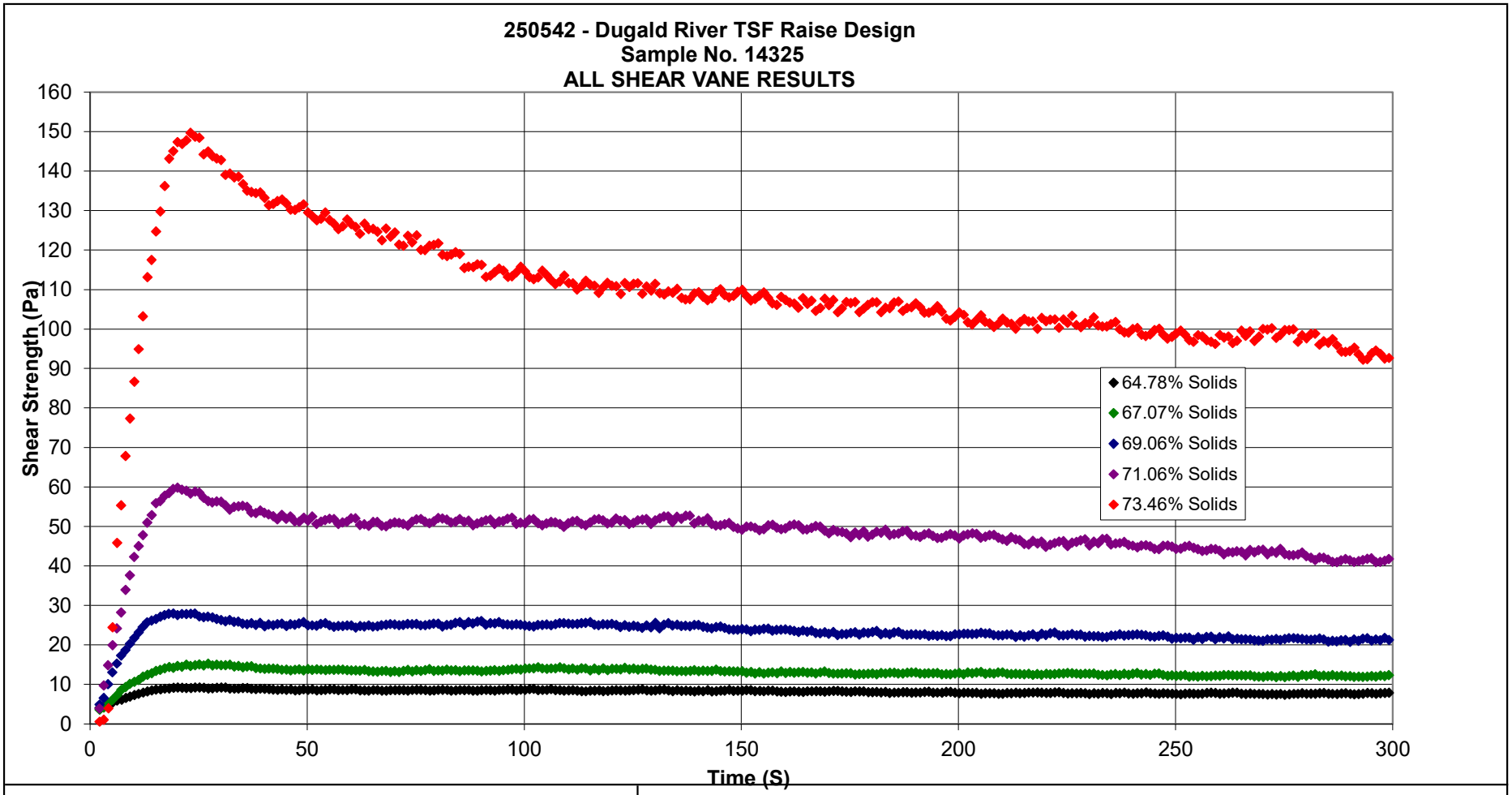
Dugald River TSF Raise Design

Tailings Sample No. 1 - Unflocculated

Rheology Testing

Date: 19/03/2025 **Job No:** 250542

Appendix B2



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MMG Limited

Dugald River TSF Raise Design

Tailings Sample No. 1 - Unflocculated

Rheology Testing

Date: 19/03/2025 **Job No:** 250542

Appendix C1

APPENDIX B – EPBC ACT PROTECTED MATTER REPORT

TAILINGS.WATER.WASTE.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 01-Apr-2025

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	5
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species			[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.			
Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Amytornis dorotheae			
Carpentarian Grasswren [558]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Chloebia gouldiae listed as Erythrura gouldiae			
Gouldian Finch [90091]	Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus			
Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos			
Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Grantiella picta			
Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Pezoporus occidentalis](#) Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area	In feature area
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
[Macrotis lagotis](#) Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area	In feature area
[Sminthopsis douglasi](#) Julia Creek Dunnart [305]	Vulnerable	Species or species habitat may occur within area	In feature area
REPTILE			
[Acanthophis hawkei](#) Plains Death Adder [83821]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Elseya lavarackorum](#) Gulf Snapping Turtle [67197]	Endangered	Species or species habitat may occur within area	In feature area
[Varanus mertensi](#) Mertens' Water Monitor, Mertens's Water Monitor [1568]	Endangered	Species or species habitat likely to occur within area	In feature area
SHARK			
[Pristis pristis](#) Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Marine Species			

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Pristis pristis](#) Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
[Hirundo rustica](#) Barn Swallow [662]		Species or species habitat may occur within area	In feature area
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Glareola maldivarum](#) Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In buffer area only
[Glareola maldivarum](#) Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
[Hirundo rustica](#) Barn Swallow [662]		Species or species habitat may occur within area overfly marine area	In feature area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
[Rostratula australis as Rostratula benghalensis (sensu lato)](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Reptile			
[Crocodylus johnstoni](#) Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Dugald River Wind Farm	2024/09807		Completed	In feature area
Dugald River Wind Farm ? Optimised Design	2024/10090		Completed	In feature area
Controlled action				
CopperString Project	2010/5581	Controlled Action	Completed	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Dugald River Zinc and Lead Mine extension, Qld	2015/7573	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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APPENDIX C – ENVIRONMENTAL REPORTS – MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

TAILINGS.WATER.WASTE.

Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
Lot: 59 Plan: TG40

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

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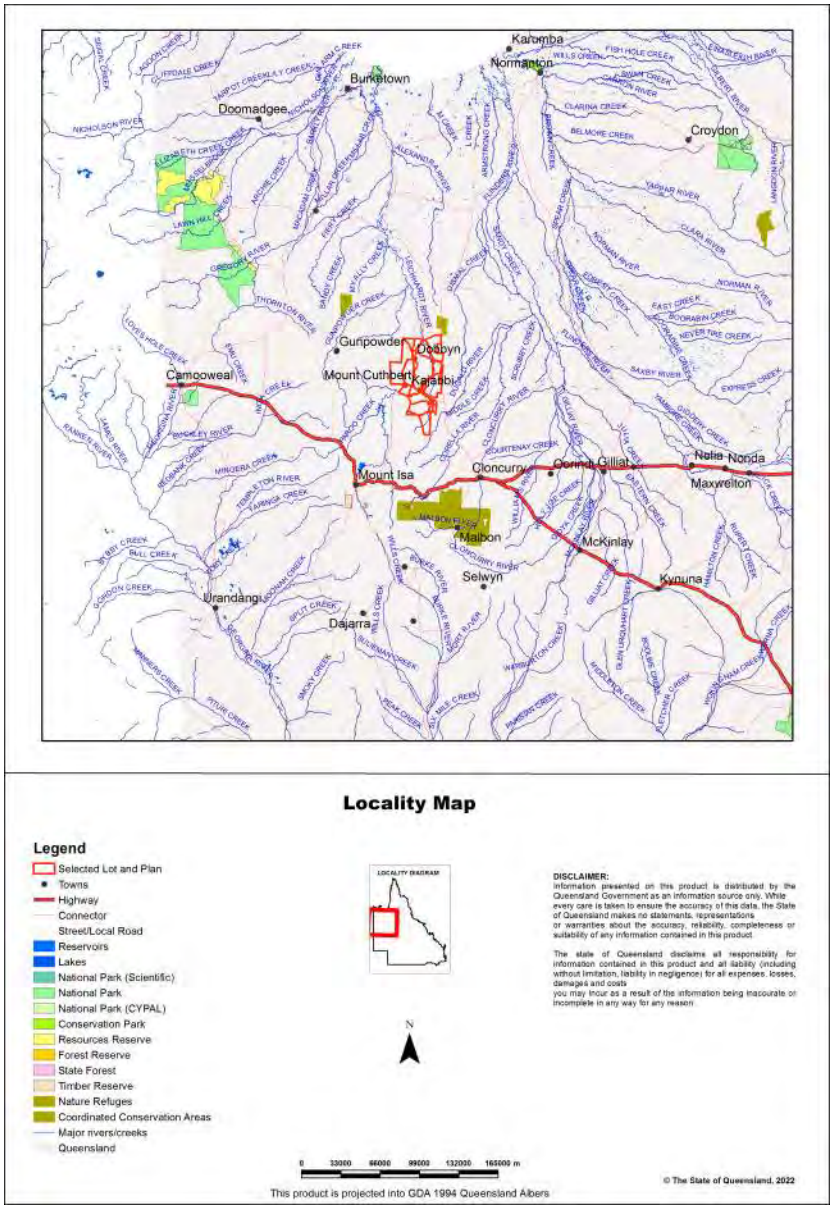
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI Lot: 59 Plan: TG40

Size (ha)	213,915.93
Local Government(s)	Cloncurry Shire
Bioregion(s)	Northwest Highlands, Gulf Plains
Subregion(s)	Armraynald Plains, Donors Plateau, Mount Isa Inlier
Catchment(s)	Flinders, Leichhardt



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the Nature Conservation Act 1992 ;

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- Threatened wildlife under the Nature Conservation Act 1992 and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the Vegetation Management Act 1999 that is:

    • Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;

    • Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;

    • Category R areas on the regulated vegetation management map;

    • Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;

    • Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the Regional Planning Interests Act 2014 ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;

- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0.0 ha	0.0 %
1b Protected Areas- nature refuges	0.0 ha	0.0 %
1c Protected Areas- special wildlife reserves	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	0.0 ha	0.0 %
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways	0.0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	2122.39 ha	1.0%
7b Special least concern animals	264.07 ha	0.1%
7c i Koala habitat area - core (SEQ)	0.0 ha	0.0 %
7c ii Koala habitat area - locally refined (SEQ)	0.0 ha	0.0 %
7d Sea turtle nesting areas	0.0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	1368.77 ha	0.6%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0.0 ha	0.0 %
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0.0 ha	0.0 %
8d Regulated Vegetation - Essential habitat	1924.11 ha	0.9%
8e Regulated Vegetation - intersecting a watercourse	3228.5 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	25.95 ha	0.0%
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(no results)

1b. Protected Areas - nature refuges

(no results)

1c. Protected Areas - special wildlife reserves

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Values are present

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii		V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Macadamia ternifolia		V	None
Macadamia tetraphylla		V	None
Melaleuca irbyana		E	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Phascolarctos cinereus	Koala - outside SEQ*	V	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

Scientific name	Common name	NCA status	EPBC status	Migratory status
Petrogale purpureicollis	purple-necked rock-wallaby	V		
Grantiella picta	painted honeyeater	V	V	
Falco hypoleucos	grey falcon	V	V	

Special least concern animal species records

Scientific name	Common name	Migratory status
Tachyglossus aculeatus	short-beaked echidna	None

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

*Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:
https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals, Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/
For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:
https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Regional ecosystem	Vegetation management polygon	Vegetation management status
2.3.49	O-dom	rem_oc
1.11.2a/1.11.7	O-subdom	rem_oc
1.11.2a/1.11.3a/1.11.7	O-subdom	rem_oc

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Regulated vegetation map category	Map number
B	6958

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

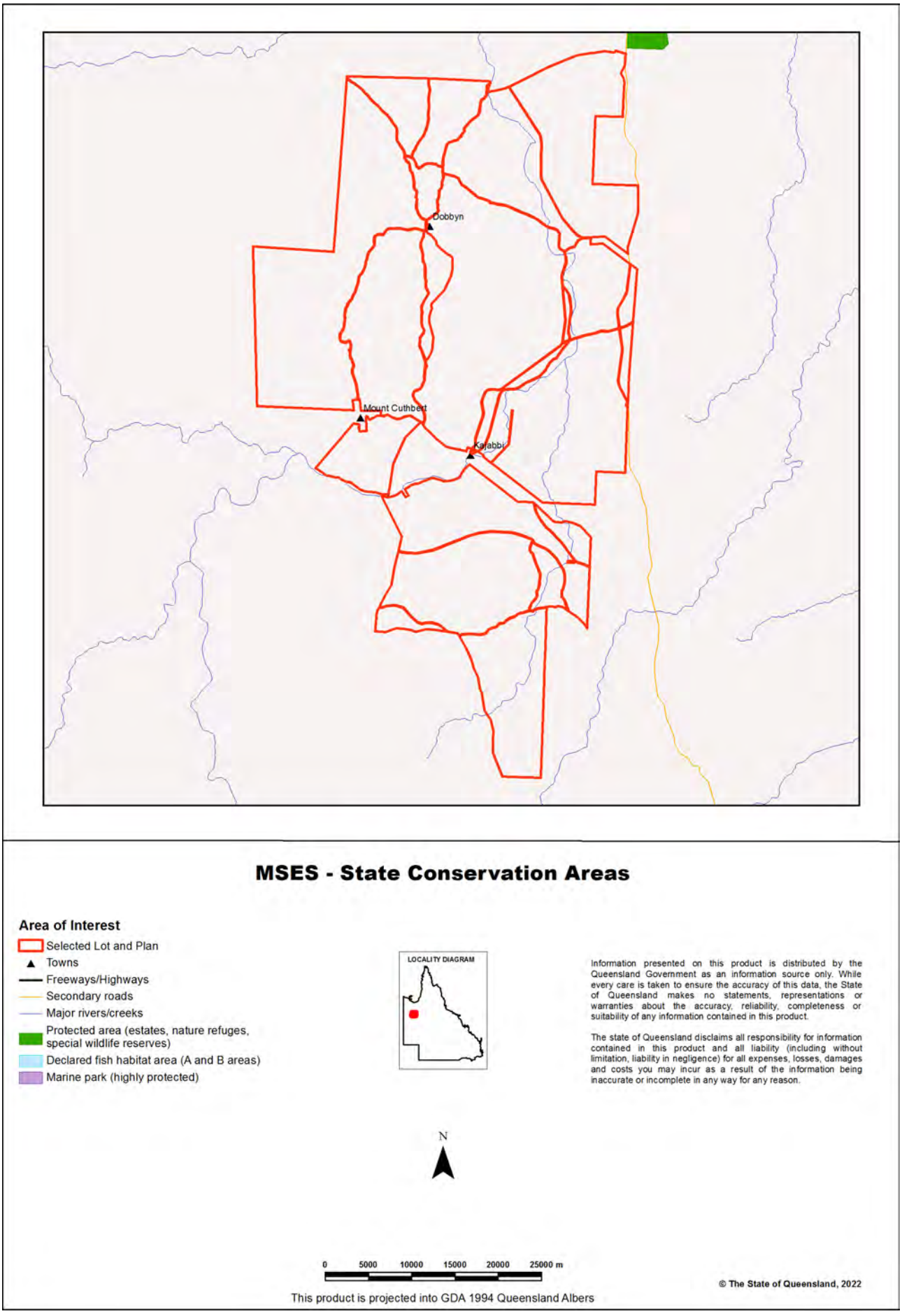
(no results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

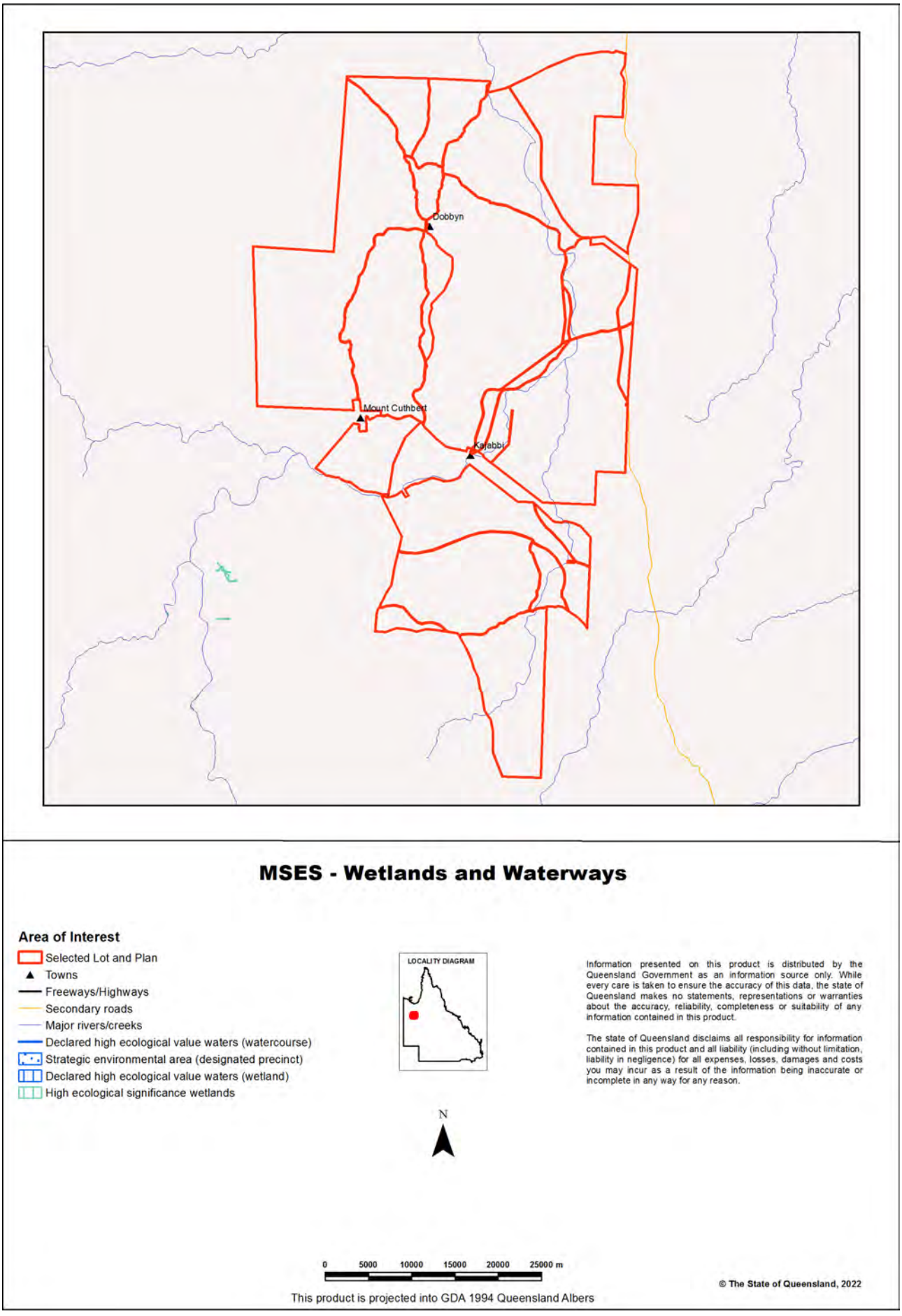
(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

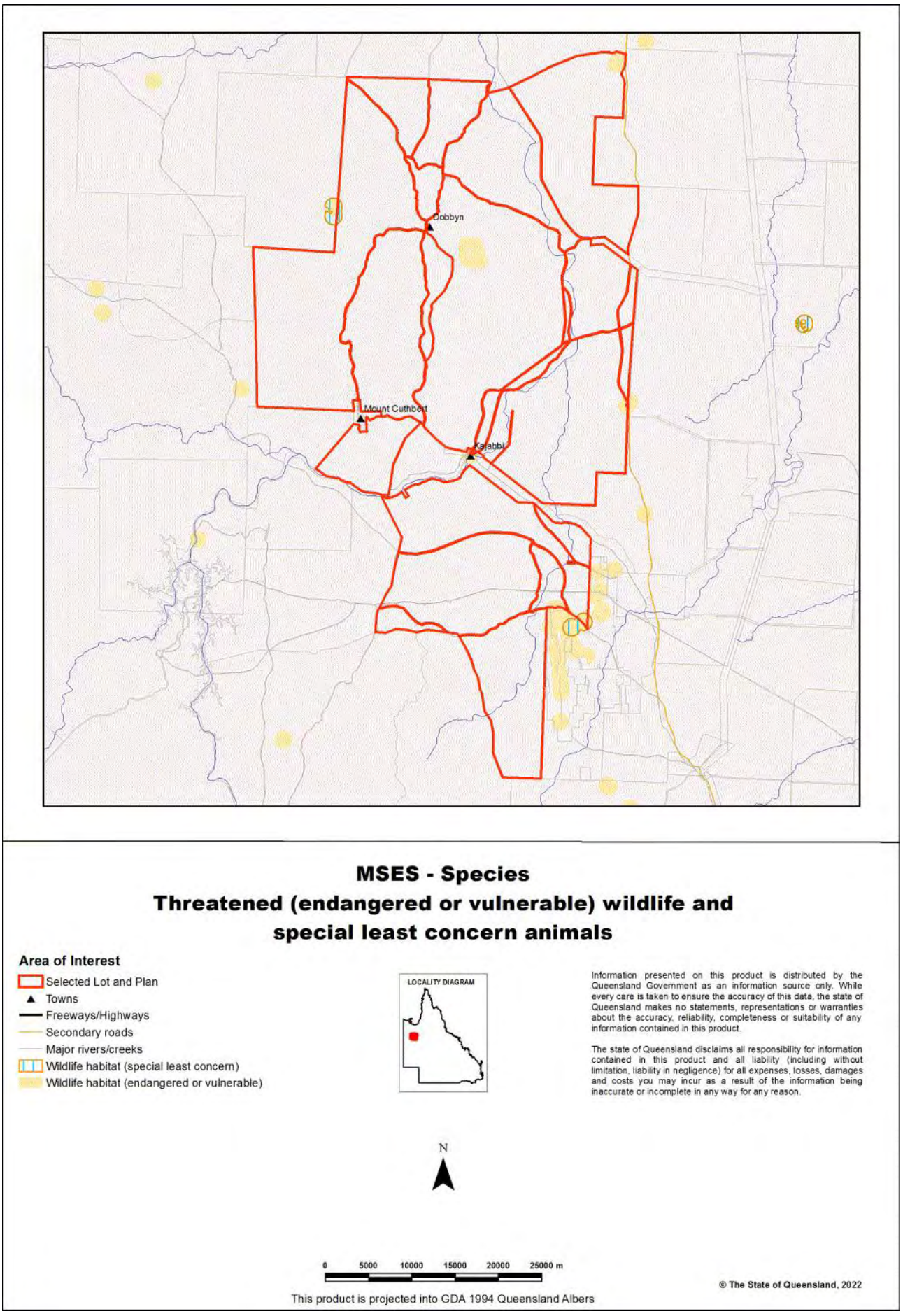
Map 1 - MSES - State Conservation Areas



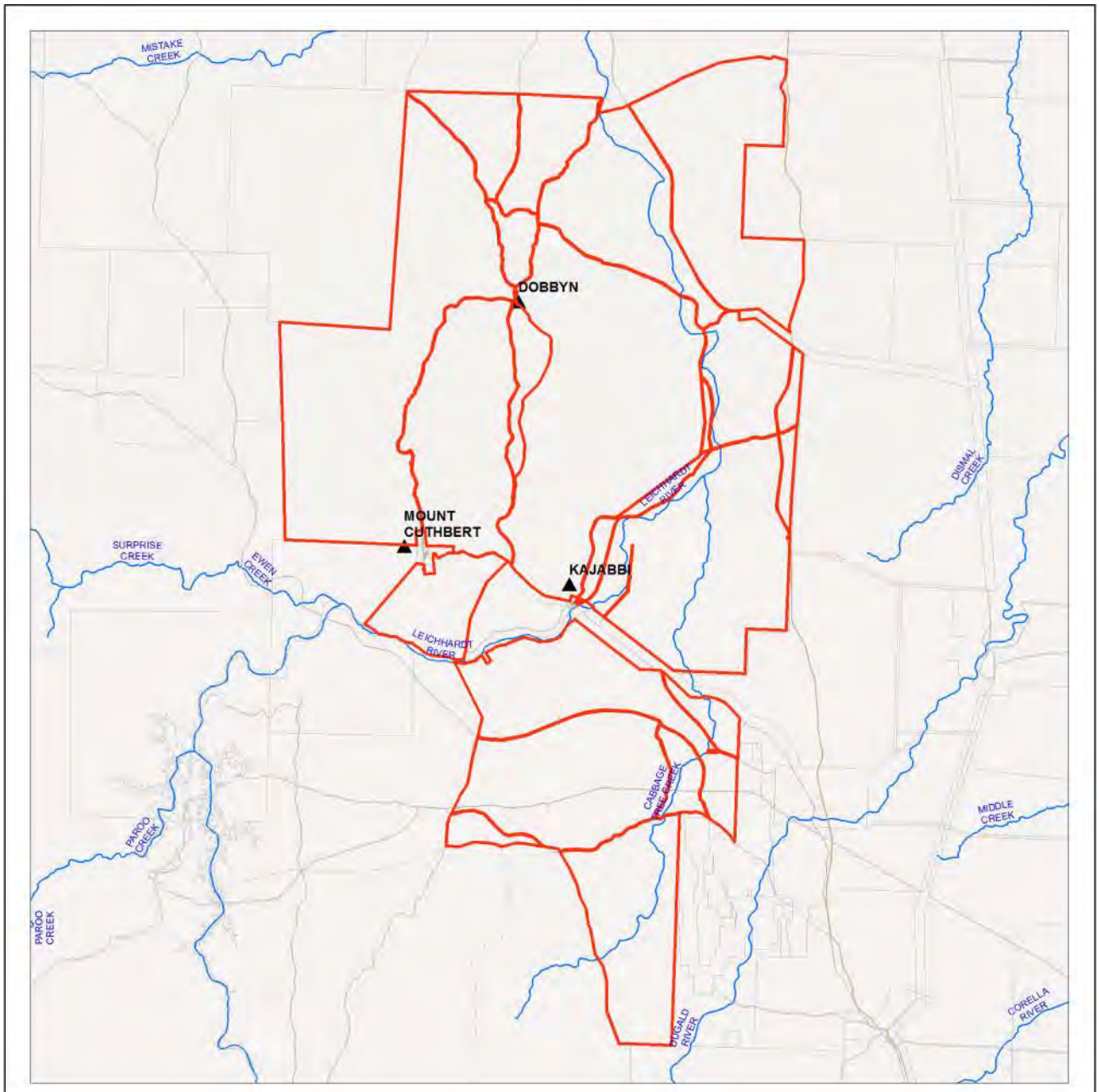
Map 2 - MSES - Wetlands and Waterways



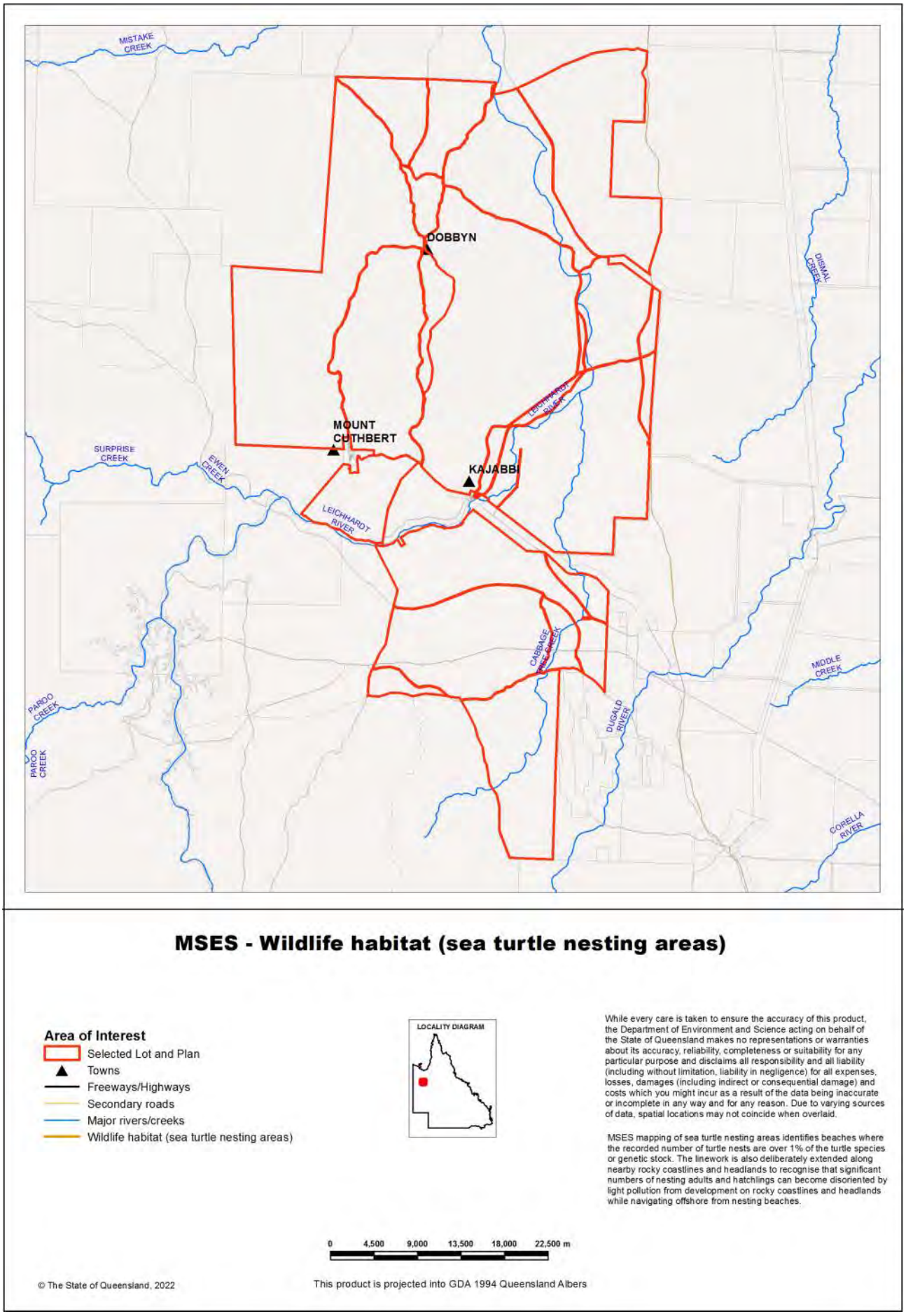
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



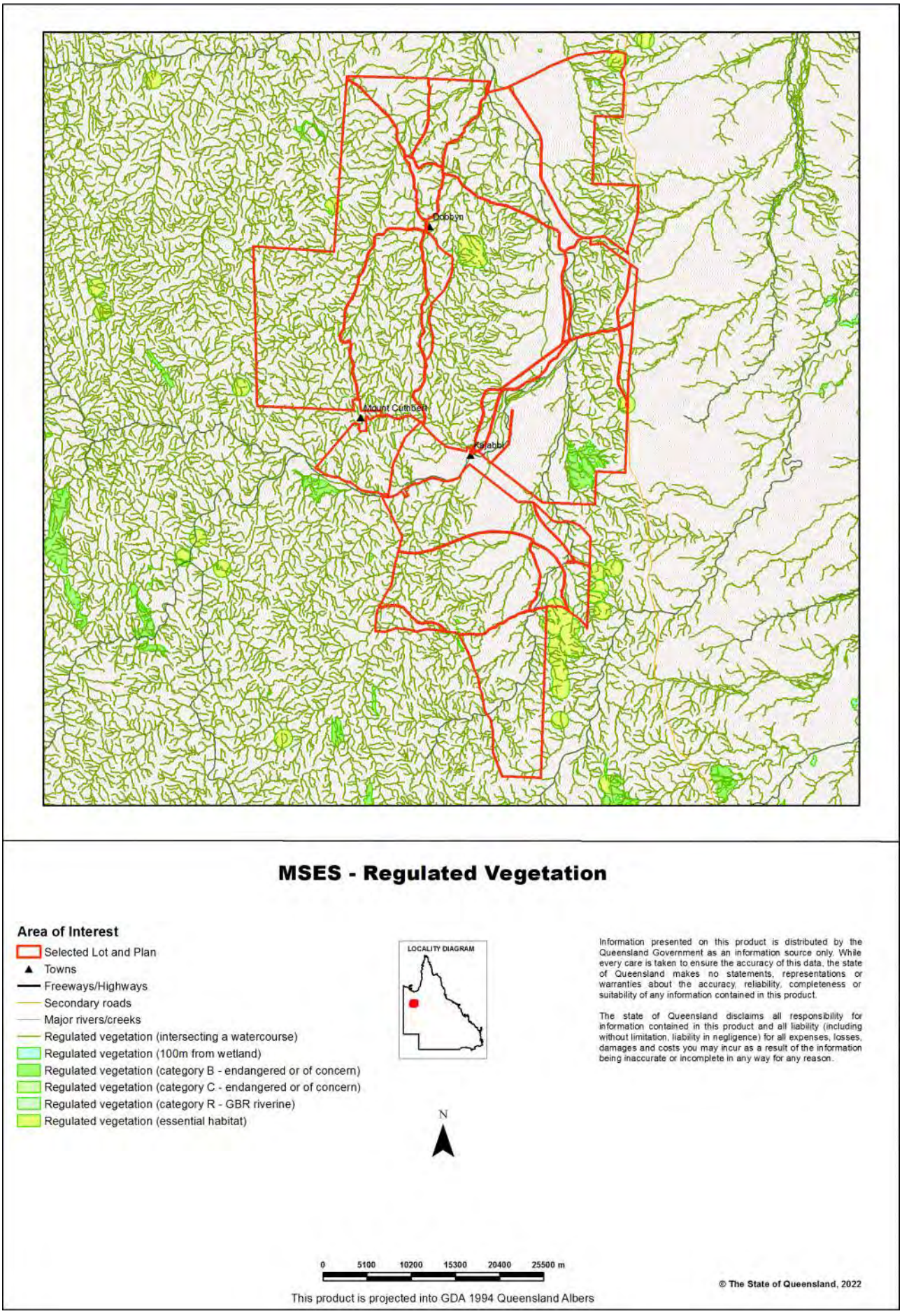
Map 3b - MSES - Species - Koala habitat area (SEQ)



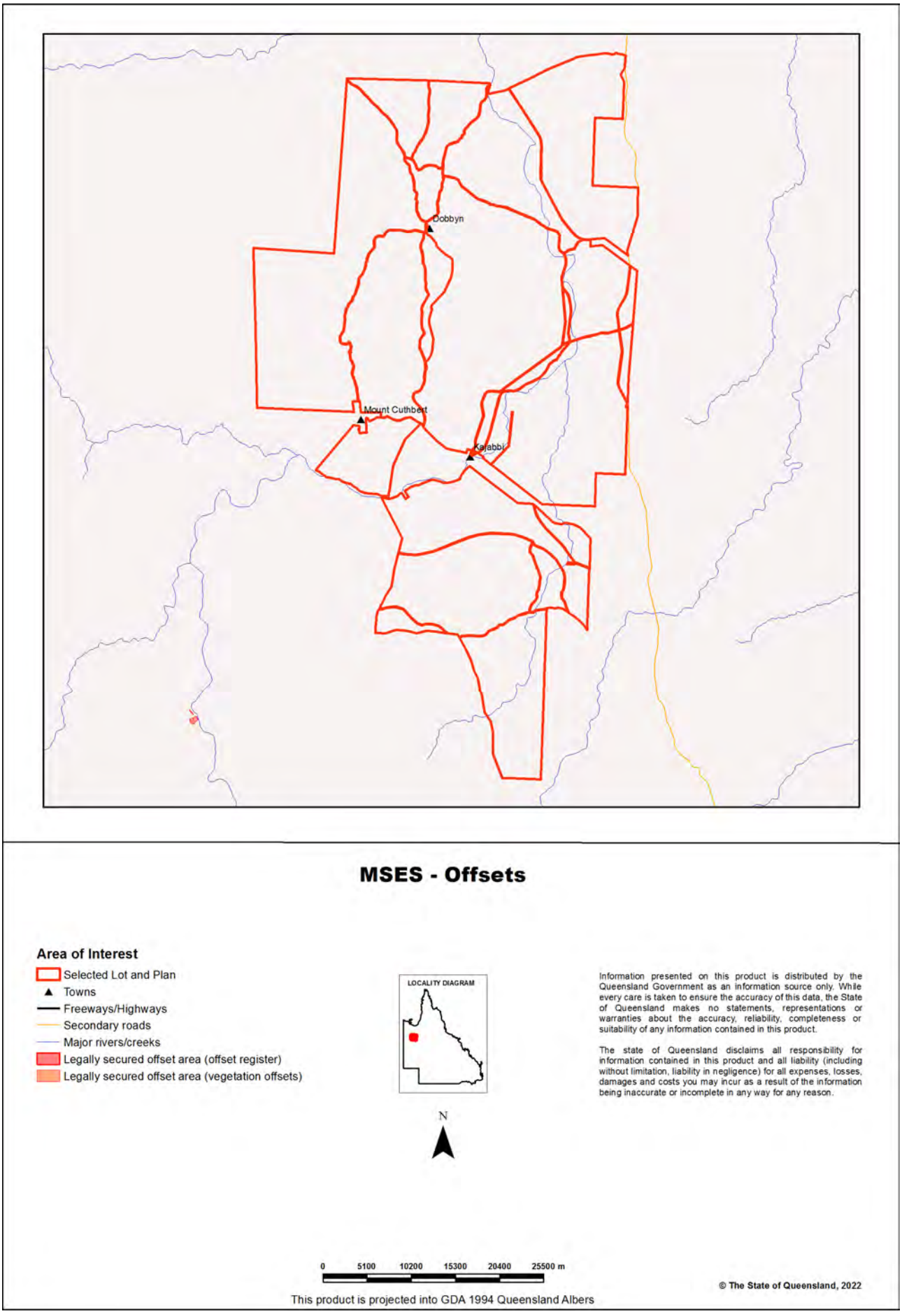
Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	- WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019 - Sea Turtle Nesting Areas records
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DES	- Department of Environment and Science
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999

APPENDIX D – ENVIRONMENTAL REPORTS – BIODIVERSITY AND CONSERVATION VALUES – BIODIVERSITY PLANNING ASSESSMENTS AND AQUATIC CONSERVATION ASSESSMENTS

TAILINGS.WATER.WASTE.

Queensland Government

Department of Environment and Science

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest
Lot: 59 Plan: TG40

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@des.qld.gov.au

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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Area of interest details: Lot: 59 Plan: TG40

Size (ha)	213,915.93
Local Government(s)	Cloncurry Shire
Bioregion(s)	Northwest Highlands, Gulf Plains
Subregion(s)	Armraynald Plains, Donors Plateau, Mount Isa Inlier
Catchment(s)	Flinders, Leichhardt

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Assessment Type	Assessment Area and Version
Biodiversity Planning Assessment(s)	Northwest Highlands v1.1, Gulf Plains v1.1
Aquatic Conservation Assessment(s) (riverine)	Eastern Gulf of Carpentaria v1.1, Southern Gulf Catchments v1.1
Aquatic Conservation Assessment(s) (non-riverine)	Eastern Gulf of Carpentaria v1.1, Southern Gulf Catchments v1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	4,053.28	1.89
Of concern	13,681.21	6.4
No concern at present	195,826.07	91.54

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of Environment and Science's Biodiversity Assessment and Mapping Methodology (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	3,052.13	1.43
State	52,362.38	24.48
Regional	24,976.20	11.68
Local or Other Values	132,222.25	61.81

Table 5: Non-riverine wetlands intersecting the AOI

Non-riverine wetland types intersecting the area of interest	#
Number of Palustrine wetlands	1
Number of Lacustrine wetlands	0
Total number of non-riverine wetlands	1

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

Name	Permanency
BULL CREEK	Non-perennial
CABBAGE TREE CREEK	Non-perennial
CENTIPEDE CREEK	Non-perennial
COPPERMINE CREEK	Non-perennial
DIORITE CREEK	Non-perennial
EIGHT MILE CREEK	Non-perennial
EUREKA CREEK	Non-perennial
HARE CREEK	Non-perennial
LADY CLAYRE CREEK	Non-perennial
LEICHHARDT RIVER	Non-perennial
MCLEAN CREEK	Non-perennial
OLD MAN CREEK	Non-perennial
PINNACLE CREEK	Non-perennial
PROSPECTOR CREEK	Non-perennial
SAINT PAUL CREEK	Non-perennial
SALLY CREEK	Non-perennial
SIX MILE CREEK	Non-perennial
SLAUGHTER CREEK	Non-perennial
SUNDAY CREEK	Non-perennial
TARGET CREEK	Non-perennial
WHITE GORGE CREEK	Non-perennial

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of Environment and Science's Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	2,419.71	1.13
High	123,195.32	57.59
Medium	88,301.26	41.28
Low	0.0	0.0
Very Low	0.0	0.0

Table 8: Summary table, aquatic conservation significance (non-riverine)

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0
High	8.27	0.0
Medium	0.0	0.0
Low	0.0	0.0
Very Low	0.0	0.0

Biodiversity Planning Assessments

Introduction

The Department of Environment and Science (DES) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the Biodiversity assessment and Mapping Methodology (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DES.

Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

http://qspatial.information.qld.gov.au/geoportal/

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	3,052.13	1.43
State	52,362.38	24.48
Regional	24,976.20	11.68
Local or Other Values	132,222.25	61.81

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the Nature Conservation Act 1992 and/or the

Environment Protection and Biodiversity Conservation Act 1999. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has Ecosystem diversity in the top quartile (F)	11,431.55	5.34
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has high connectivity or buffers an endangered RE or Sig. Wetland (G)	30,377.33	14.2
State	Remnant contains at least 1 Endangered or 2 Vulnerable or Near Threatened species (A)	3,052.13	1.43
State	Remnant contains at least 1 Endangered RE (B1)	4,882.00	2.28
State	Remnant contains at least one Of Concern RE (B1) & Remnant contains an RE that is one of the largest of its type in the bioregion (D1)	1,168.27	0.55
State	Remnant contains at least one Of Concern RE (B1) & Remnant is part of moderately large Tract (C) & Remnant contains a RE that is a moderately large RE of its type in the bioregion (D1) & Remnant has Ecosystem diversity in the top quartile (F)	41.35	0.02
Regional	Remnant contains an RE that is one of the largest of its type in the subregion (D2)	3,070.09	1.44
Regional	Remnant contains at least 1 RE with <10 pc extent remaining or rare in subregion (B2)	674.01	0.32
Regional	Remnant contains at least 1 RE with 10-30 percent extent remaining in the subregion (B2) & Remnant is part of moderately large Tract (C)	49.87	0.02
Regional	Remnant contains at least 1 RE with 10-30 percent extent remaining in the subregion (B2) & Remnant is part of moderately large Tract (C) & Remnant has high connectivity or buffers an endangered RE or Significant Wetland (G)	559.46	0.26
Regional	Remnant contains at least 1 Vulnerable or Near Threatened species (A)	4,511.72	2.11
Regional	Remnant contains at least one Of Concern RE (B1)	12,878.15	6.02
Local or Other Values	Refer to diagnostic data for additional information	139,911.09	65.4

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa	3,052.13	1.4	10,622.50	5.0	146,174.79	68.3	52,757.52	24.7
B1: Ecosystem Value (Bioregion)	4,882.01	2.3	14,087.72	6.6	193,637.21	90.5		
B2: Ecosystem Value (Subregion)	3,089.28	1.4	1,882.23	0.9	207,635.43	97.1		

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
C: Tract Size			212,606.94	99.4				
D1: Relative RE Size (Bioregion)	44,990.57	21.0	16,310.50	7.6	39,550.67	18.5	111,755.20	52.2
D2: Relative RE Size (Subregion)	49,111.46	23.0	18,840.25	8.8	41,788.07	19.5	102,867.16	48.1
F: Ecosystem Diversity	112,202.70	52.5	96,394.86	45.1	3,997.64	1.9	11.74	
G: Context and Connection	211,317.49	98.8	1,271.49	0.6	17.96			

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains Core Habitat for Priority Taxa (H) & Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I) & Remnant forms part of a bioregional corridor (J)	152.05	0.07
State	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	3,833.18	1.79
State	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I) & Remnant forms part of a bioregional corridor (J)	843.47	0.39
State	Remnant forms part of a bioregional corridor (J)	3,120.23	1.46
Regional	Refer to Expert Panel data for additional information	930.95	0.44
Regional	Remnant contains Core Habitat for Priority Taxa (H)	417.6	0.2
Regional	Remnant contains Core Habitat for Priority Taxa (H) & Remnant forms part of a bioregional corridor (J)	9.65	0.0
Regional	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	4,128.11	1.93
Regional	Remnant forms part of a bioregional corridor (J)	5,848.88	2.73
Local	Refer to Expert Panel data for additional information	5,010.51	2.34

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring

of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton et al. 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa			1,918.52	0.9	5,519.02	2.6		
Ia: Centres of Endemism	1,964.73	0.9						
Ib: Wildlife Refugia	4,774.43	2.2	4,182.38	2.0				
Ic: Disjunct Populations	2,226.48	1.0						
Id: Limits of Geographic Ranges			1,964.73	0.9				
Ie: High Species Richness	4,774.43	2.2	4,182.38	2.0				
If: Relictual Populations								
Ig: Variation in Species Composition	2,468.13	1.2	6,118.55	2.9				
Ih: Artificial Wetland								
Ii: Hollow Bearing Trees	2,547.95	1.2	290.31	0.1				
Ij: Breeding or Roosting Site	2,547.95	1.2	1,993.29	0.9				

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
Ik: Climate Refugia	341.57	0.2						

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

  • Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;

  • Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;

  • Maintaining large scale seasonal/migratory species processes and movement of fauna;

  • Maximising connectivity between large tracts/patches of remnant vegetation;

  • Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

  • Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);

  • Follow major watershed/catchment and/or coastal boundaries;

  • Incorporate major altitudinal/geological/climatic gradients;

  • Include and maximise connectivity between large tracts/patches of remnant vegetation;

  • Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

  • Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

Biodiversity Significance	Area (Ha)	% of AOI
State	4,103.03	1.92
Regional	5,871.26	2.74
Local	0.0	0.0

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

Decision Number	Description	Panel Recommended Significance	Criteria Values
gup_fa_05	Bauhinia woodlands	Regional	Ib (wildlife refugia): HIGH Ie (high species diversity): HIGH Ig (REs show distinct variation in species composition): HIGH
gup_fa_17	High precision records for priority taxa of Regional significance are contained within the remnant.	Regional	Criteria H: HIGH
gup_fl_20	High precision records for priority taxa of Regional significance are contained within the remnant.	Regional	Criteria H: HIGH
gup_l_41	Riparian ecosystems and associated areas	State	Ib (wildlife refugia): VERY HIGH Ie (high species diversity): VERY HIGH Ig (REs show distinct variation in species composition): VERY HIGH Ii (high density of hollow-bearing habitat trees):VERY HIGH Ij (significant breeding or roosting sites): VERY HIGH
gup_l_45	Wetlands	Regional	Ib (wildlife refugia): HIGH Ie (high species diversity):HIGH Ii (high density of hollow-bearing habitat trees): HIGH Ij (significant breeding or roosting sites): HIGH
gup_l_47	Riparian corridors	State	Criterion J (corridors): State
nwh_l_04	Permanent and semi-permanent instream waterholes - drought refugia	State	Ib (wildlife refugia): VH Ie (high species richness): VH Ii (habitat shelters): VH Ij (Breeding/roosting sites used by sig. no. of individuals): VH Ik (climate refugia): VH
nwh_l_07	Coarse Granites and Tor Fields	State	Ia (centre of endemism): VH Ib (wildlife refugia): VH Ic (disjunct populations): VH Id (geographic range limits): H Ie (high species richness): VH Ig (REs with distinct variation in species composition): H Ij (Breeding/roosting sites used by sig. no. of individuals): H

Decision Number	Description	Panel Recommended Significance	Criteria Values
nwh_l_11	Softwood Thickets on Metamorphic Screes	State	Ib (wildlife refugia): VH Ic (disjunct populations): VH Ie (high species richness): VH Ii (habitat shelters): H Ik (Climate refugia): VH
nwh_l_17a	Riparian bioregional corridors (landscape connections)	State)	Criterion J (riparian corridor): State
nwh_l_17b	Riparian bioregional corridors (landscape connections)	Regional	Criterion J (riparian corridor): Regional

Expert panel decision descriptions:

gup_fa_05

Seasonally important for nectarivores (honeyeaters, white-browed woodswallows Artamus supercilious, white-winged trillers Lalage sueurii and varied lorikeets Psitteuteles versicolor) (Richard Johnson in lit). Important for honeyeater diversity given relatively high fertility and productivity with shallow sands over shales.

Bauhinia woodland on alluvium may be at risk given possible future development of agriculture in the region (Richard Johnson in lit).

gup_fa_17

Remnant contains habitat for priority taxa with high precision records.

gup_fl_20

Remnant contains habitat for priority taxa with high precision records.

gup_l_41

Riparian ecosystems in the Gulf Plains provide a refuge in otherwise seasonally droughty and sparsely vegetated landscapes that dominate non-riparian areas.

See also gup_fa_08 for specific values of western riparian systems.

gup_l_45

Wetlands have a range of biodiversity values, both in their own right, and for the role they play in maintaining water quality, protecting downstream aquatic ecosystems, and as part of the wetland ecosystem continuum where they are periodically connected with other aquatic ecosystems. Wetlands act as refugia for many species, and play a vital role in the life cycle of others. Wetlands are a defining characteristic of the bioregion, in their extent, diversity, and condition.

Wetlands were given a 200m buffer with the same significance rating to ensure that all areas adjacent to them, and the areas most likely to have higher values, were also included.

Numerous decisions in southern Gulf of Carpentaria ACA relate to wetlands within the Flinders, Norman and Gilbert river catchments (Rollason and Howell 2010).

gup_l_47

Riparian corridors in the Gulf Plains are particularly significant for biodiversity, both as a climatic refuge and as a major element of habitat continuity. This decision is based on the bioregional corridor values of major riparian areas. The refugial and other values of riparian areas are covered by decision gup_l_41.

nwh_l_04

Within the Mount Isa and Southwestern Plateaus and Floodouts subregions, permanent waterholes and surrounding riparian vegetation support aquatic and terrestrial flora and fauna in an otherwise arid environment. Systems, such as Gunpowder Creek and its tributary Eastern Creek, retreat to become isolated waterholes which persist during long dry periods and provide drought refugia. The more permanent and deeper waterholes may act as important climate refugia.

The waterholes are important for common species within the region and often encompass a high species richness relative to the surrounding landscape. The large deep permanent pools provide habitat for aquatic species like freshwater crocodiles (**Crocodylus johnsoni**), diamond head turtle (**Emydura subglobosa worrelli**) and blue catfish (**Neoarius graeffei**), whilst the adjoining riparian vegetation (1.3.7) provides a diverse habitat structure with numerous hollows and habitat shelters along the terraces and supports species such as **Ipomoea antonschmidii**, purple-necked rock-wallaby (**Petrogale purpureicollis**), Cloncurry parrot (**Barnardius zonarius macgillivrayi**), **Brachychiton collinus**, **Cyperus cunninghamii** ssp**. cheradicus**, **Eucalyptus leucophylla** and pictorella mannikin (**Heteromunia pectoralis**). This special area type is a critical dry season refugia for fauna that require regular access to drinking water.

nwh_l_07

Regional ecosystems 1.12.2 and 1.12.7, occur on ancient weathered skeletal and relatively infertile soils. Deeply fractured coarse grained granite tors which house caves and crevices, characterise the landscape. The unique habitat created by the coarse nature of the soils and fractured rock allow water to be absorbed and retained in the soil profile. These unique habitat niches and characteristics support high flora and fauna species richness and provide a fire refugia, however, are potentially at risk from more intense and frequent climate induced fires (Low, 2011).

Whilst likely to house a wide range of currently unidentified taxa, notable fauna values include the presence of the purple-necked rock-wallabies (**Petrogale purpureicollis**), Carpentarian pseudantechinus (**Pseudantechinus mimulus**) and it's likely that micro bat colonies occupy crevices. Priority taxa such as the Kalkadoon grasswren (**Amytornis ballarae**), Cloncurry parrot (**Barnardius zonarius macgillivrayi**), ten-lined ctenotus (**Ctenotus decaneurus**), stripe-headed finesnout ctenotus (**Ctenotus striaticeps**), gulf fat-tailed gecko (**Diplodactylus barraganae**), Hosmer's skink (**Egernia hosmeri**), robust dtella (**Gehyra robusta**), spectacled hare-wallaby (**Lagorchestes conspicillatus**), white-striped gecko (**Strophurus taeniatus**), **Eucalyptus leucophylla** and **Heliotropium frohlichii** have been recorded. There is a probable night parrot (**Pezoporus occidentalis**) sighting in this habitat from the vicinity of Galah Creek, south of Mt Isa. Also the western range limit of **E. melanophloia** ssp. nana

n.b. Relates to an adjoining bioregional decision eiu_l_23.

nwh_l_11

Regional ecosystem 1.11.8 occurs on rock outcrops on hills and ranges on strongly folded siliceous sedimentary and metamorphic pre-Cambrian rocks (Queensland Herbarium, 2019). Some occurrences of this community are dominated by **Terminalia aridicola** and **Brachychiton collinus** softwood thickets.

The softwood thickets are characterised by large crown trees with >30% foliage projection cover. The dense canopy and hill shade results in cooler conditions allowing species to survive in an otherwise dry hot environment. Small areas of surface water can be present and along with deeper organic matter accumulation and higher soil moisture, provide a cooler microclimate. In comparison to surrounding ecosystems, the thickets have high species richness and support significant habitat for birds (e.g., bower birds). Due to their topographic position, they represent a refuge from grazing, whilst instances of this community situated on steep rock dominated slopes, also provide a refuge from fire.

Threatened species recorded include **Eucalyptus nudicaulis** and purple-necked rock-wallaby (**Petrogale purpureicollis**) and priority species Kalkadoon grasswren (**Amytornis ballarae**), sandstone frog (**Litoria coplandi**), giant rocketfrog (**Litoria watjulumensis**) and Carpentarian pseudantechinus (**Pseudantechinus mimulus**).

nwh_l_17a

Riparian corridors encompass some of the most diverse, dynamic and complex habitats incorporating both environmental and topographic gradients. Comparatively, such areas tend to exhibit high species richness with respect to both flora and fauna, provide important resources in terms of water, food, shelter, nesting and nursery sites and act as a refugia during periods of drought, or in response to longer terms impacts associated with climatic change.

At the landscape scale, networks of major and minor riparian linkages are a significant element of habitat continuity and provide important migratory and dispersal pathways for a substantial number of species (especially birds, insects and flora, but also for many arboreal mammals and reptiles).

Within the NWH, remnant vegetation within 200m and 100m of selected major and minor waterways was designated as being of State and Regional significance respectively. The significance of selected riverine systems was also modified in some instances. For further information regarding the broad principles and intent, as well as more specific information relating to the Northwest Highlands riparian corridor network, refer to Section 3.3.2.2and Table 15.

nwh_l_17b

Riparian corridors encompass some of the most diverse, dynamic and complex habitats incorporating both environmental and topographic gradients. Comparatively, such areas tend to exhibit high species richness with respect to both flora and fauna, provide important resources in terms of water, food, shelter, nesting and nursery sites and act as a refugia during periods of drought, or in response to longer terms impacts associated with climatic change.

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Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton et al. 2006), was developed to assess conservation values of wetlands in queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning prcesses

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland Info:

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

http://qspatial.information.qld.gov.au/geoportal/

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For

flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the Fisheries Act 1994, Coastal Protection and Management Act 1995, or Marine Parks Act 2004. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	2,419.71	1.13

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
High	123,195.32	57.59
Medium	88,301.26	41.28
Low	0.0	0.0
Very Low	0.0	0.0

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	172,930.11	80.8	39,387.53	18.4	1,598.65	0.7		
2. Naturalness catchment			209,523.13	97.9	4,393.16	2.1		
3. Diversity and richness	16,227.86	7.6	124,432.64	58.2	73,255.79	34.2		
4. Threatened species and ecosystems	57,930.31	27.1	4,864.60	2.3	151,121.38	70.6		
5. Priority species and ecosystems	58,073.02	27.1	72,414.13	33.9	56,651.51	26.5		
6. Special features	2,419.71	1.1	67,262.23	31.4				
7. Connectivity	2,419.71	1.1						
8. Representative-ness	2,419.71	1.1						

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
lr_r_ec_31	Perennial waterholes in central southern headwaters of the Leichhardt Basin	Leichhardt	6.1.1, 6.2.1, 6.3.1, 6.3.4, 6.4.1, 7.1.1, 7.1.2, 7.2.1, 7.3.2, 7.4.1, 8.2.5	4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4
lr_r_fl_16	Riverine systems containing Terminalia bursarina	Leichhardt Nicholson Settlement	5.2.1, 6.3.1	4, 3
lr_r_fl_17	Low woodlands fringing major or minor watercourses	Leichhardt Mornington Inlet Nicholson Settlement Wellesley Islands	5.2.1	4

4 is the highest rating/value

Expert panel decision descriptions:

lr_r_ec_31

Two main subcatchments, Mistake and Surprise Creeks, of the central southern headwaters of the Leichhardt River basin contain significant numbers of perennial waterholes. This part of the basin is extremely arid and few of the surrounding subcatchments contain few natural perennial waterholes. Both creeks drain to the main Leichhardt channel, Mistake Creek via a confluence with the Gunpowder Creek main channel immediately upstream of its confluence with the Leichhardt River, and Surprise Creek via a confluence with Ewen Creek to the reach below Lake Julius. Mistake Creek has significantly more exposed bedrock and this creates greater lengths of rocky waterhole reaches with associated gorges, scarps and seasonal races. Major waterholes within Surprise Creek are sand bed channel hosted and restricted to its lowermost reach above the Leichhardt River main channel confluence with which it shares analogous habitat types but retains a hydrological regime unmodified by upstream impoundments.

Pools within these subcatchments have an important function as refugia for obligate freshwater biota and other dependent terrestrial fauna that seasonally occupy the more extensive seasonal riverine habitats within these systems. Ecological values and the geomorphic setting are very similar to those described for upper Gunpowder Creek. This special feature is subject to invasion by rubber vine (Cryptostegia grandiflora) and grazing pressure that can lead to habitat loss and erosion.

For a more detailed explanation of this special feature, please refer to Appendix III of the Southern Gulf Catchment Aquatic Conservation Assessment Expert Panel Report.

lr_r_fl_16

Terminalia bursarina is a rare species occurring within-channel deposits and levees of major watercourses or on the fringes of minor watercourses. Vegetation communities in the Gulf which contain Terminalia bursarina are important because this is the only area in Queensland where it is found. This includes woodland including river red gum (Eucalyptus camaldulensis), swamp box (Lophostemon grandiflorus), Melaleuca argentea, Terminalia bursarina, Lysiphyllum cunninghamii and Acacia holosericea (regional ecosystem 1.3.7f), and river red gum (Eucalyptus camaldulensis) woodland commonly with Terminalia bursarina, swamp box (Lophostemon grandiflorus) and paperbarks (Melaleuca spp.) in the canopy (regional ecosystem 2.3.26f).

lr_r_fl_17

This special feature consists of low open woodland to woodland coolabah (Eucalyptus microtheca) communities occurring along major watercourses or minor channels in landscapes (i.e. Wondoola and Armraynald Plains subregions) where they represent the only or most significant riparian communities. For example, they form the key riparian corridors across the large clay plains of the western Gulf Plains, whilst in the Armraynald Plain subregion they form the main (or only) source of water and shade. This decision includes vegetation communities dominated by coolabah (Eucalyptus microtheca) low open woodland to woodland, commonly with Excoecaria parvifolia, Lysiphyllum cunninghamii and Atalaya hemiglauca (regional ecosystem 2.3.17), coolabah low open woodland to woodland, commonly with Excoecaria parvifolia and Lysiphyllum cunninghamii (regional ecosystem 2.3.17a), coolabah woodland (regional ecosystem 2.3.17b), and coolabah woodland to open forest, commonly with Terminalia platyphylla (regional ecosystem 2.3.17d). These communities are diverse and ecologically complex especially in areas with braided watercourses. They are known to provide refuge for fauna, including macropods, and are the only permanent coolabah regional ecosystems in the Gulf Plains. All are generally subject to grazing pressure, widespread erosion and habitat loss. Regional ecosystems 2.3.17 and 2.3.17a are also known to be subject to extensive invasion by buffel grass (Cenchrus ciliaris) on sandier soils, whilst regional ecosystem 2.3.17d is commonly heavily invaded by Cryptostegia grandiflora (rubber vine).

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0
High	8.27	0.0
Medium	0.0	0.0
Low	0.0	0.0
Very Low	0.0	0.0

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic	8.27							
2. Naturalness catchment			8.27					
3. Diversity and richness			8.27					
4. Threatened species and ecosystems			8.27					
5. Priority species and ecosystems								
6. Special features								
7. Connectivity								
8. Representative-ness			8.27					

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

(No Records)

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, Herbrecs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the Environment Protection and Biodiversity Conservation Act 1999 or "Endangered", "Vulnerable" or "Near threatened" under the Nature Conservation Act 1992.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

Species	Common name	NCA status	EPBC status	Back on Track rank	Migratory species*	Wetland species**	Identified flora/fauna
Amytornis dorotheae	Carpentarian grasswren	E	E	High			FA
Dichanthium setosum		C	V				FL
Falco hypoleucos	grey falcon	V	V	Data Deficient			FA
Grantiella picta	painted honeyeater	V	V	High			FA
Petrogale purpureicollis	purple-necked rock-wallaby	V		Low			FA

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DES internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

*JAMBA - Japan-Australia Migratory Bird Agreement; CAMBA - China-Australia Migratory Bird Agreement; ROKAMBA - Republic of Korea-Australia Migratory Bird Agreement; CMS - Convention on the Conservation of Migratory Species.

**I - wetland indicator species; D - wetland dependent species.

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Back on Track rank	Identified flora/fauna
Amytornis ballarae	Kalkadoon grasswren	H	FA
Artamus cinereus	black-faced woodswallow	None	FA
Barnardius zonarius macgillivrayi	Cloncurry parrot	L	FA
Brachychiton collinus	None	L	FL
Corymbia bella	None	None	FL
Ctenotus decaneurus	ten-lined ctenotus	L	FA
Ctenotus striaticeps	stripe-headed finesnout ctenotus	L	FA
Cyperus cunninghamii subsp. cheradicus	None	None	FL
Diplodactylus barraganae	Gulf fat-tailed gecko	None	FA
Egernia hosmeri	Hosmer's skink	DD	FA
Eucalyptus leucophylla	None	None	FL
Gehyra robusta	robust dtella	L	FA
Heteromunia pectoralis	pictorella mannikin	L	FA
Livistona rigida	None	None	FL
Onychogalea unguifera	northern nailtail wallaby	L	FA
Planigale ingrami	long-tailed planigale	L	FA
Polygala barklyensis	None	None	FL
Tephrosia sp. (Barkly Downs S.L.Everist 3384)	None	None	FL
Tephrosia sp. (Mt Isa P.L.Harris 277)	None	None	FL
Triumfetta rupestris	None	None	FL
Varanus mertensi	Mertens' water monitor	L	FA

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

Species	Common name	Back on Track rank	Identified flora/fauna
Cyperus exaltatus	tall flatsedge	None	FL
Eucalyptus camaldulensis	None	None	FL
Ficus racemosa var. racemosa	None	None	FL
Hephaestus fuliginosus	sooty grunter	Low	FA
Lates calcarifer	barramundi	Low	FA
Leiopotherapon unicolor	spangled perch	Low	FA
Leiopotherapon unicolor	Spangled Perch	None	FA
Livistona rigida	None	None	FL

Species	Common name	Back on Track rank	Identified flora/fauna
Melaleuca bracteata	None	None	FL
Melaleuca fluviatilis	None	None	FL
Pseudoraphis spinescens	spiny mudgrass	None	FL
Scortum ogilbyi	Gulf grunter	Low	FA
Strongylura krefftii	freshwater longtom	Low	FA
Varanus mertensi	Mertens' Water Monitor	None	FA

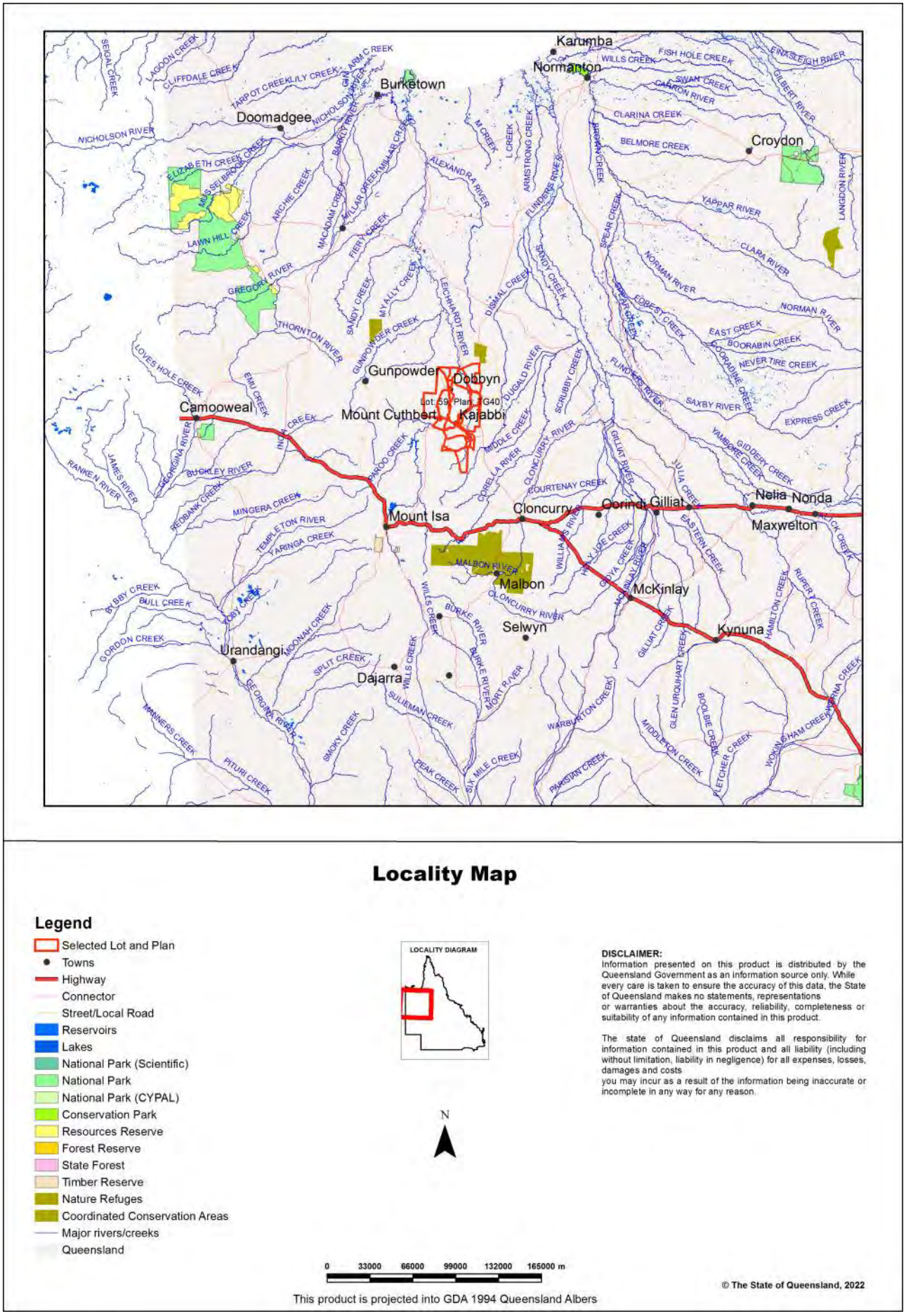
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

Species	Common name	Back on Track rank	Identified flora/fauna
Cyperus exaltatus	tall flatsedge	None	FL
Eucalyptus camaldulensis	None	None	FL
Hephaestus fuliginosus	sooty grunter	Low	FA
Lates calcarifer	barramundi	Low	FA
Leiopotherapon unicolor	spangled perch	Low	FA
Leiopotherapon unicolor	Spangled Perch	None	FA
Melaleuca bracteata	None	None	FL
Pseudoraphis spinescens	spiny mudgrass	None	FL
Scortum ogilbyi	Gulf grunter	Low	FA
Strongylura krefftii	freshwater longtom	Low	FA
Varanus mertensi	Mertens' Water Monitor	None	FA

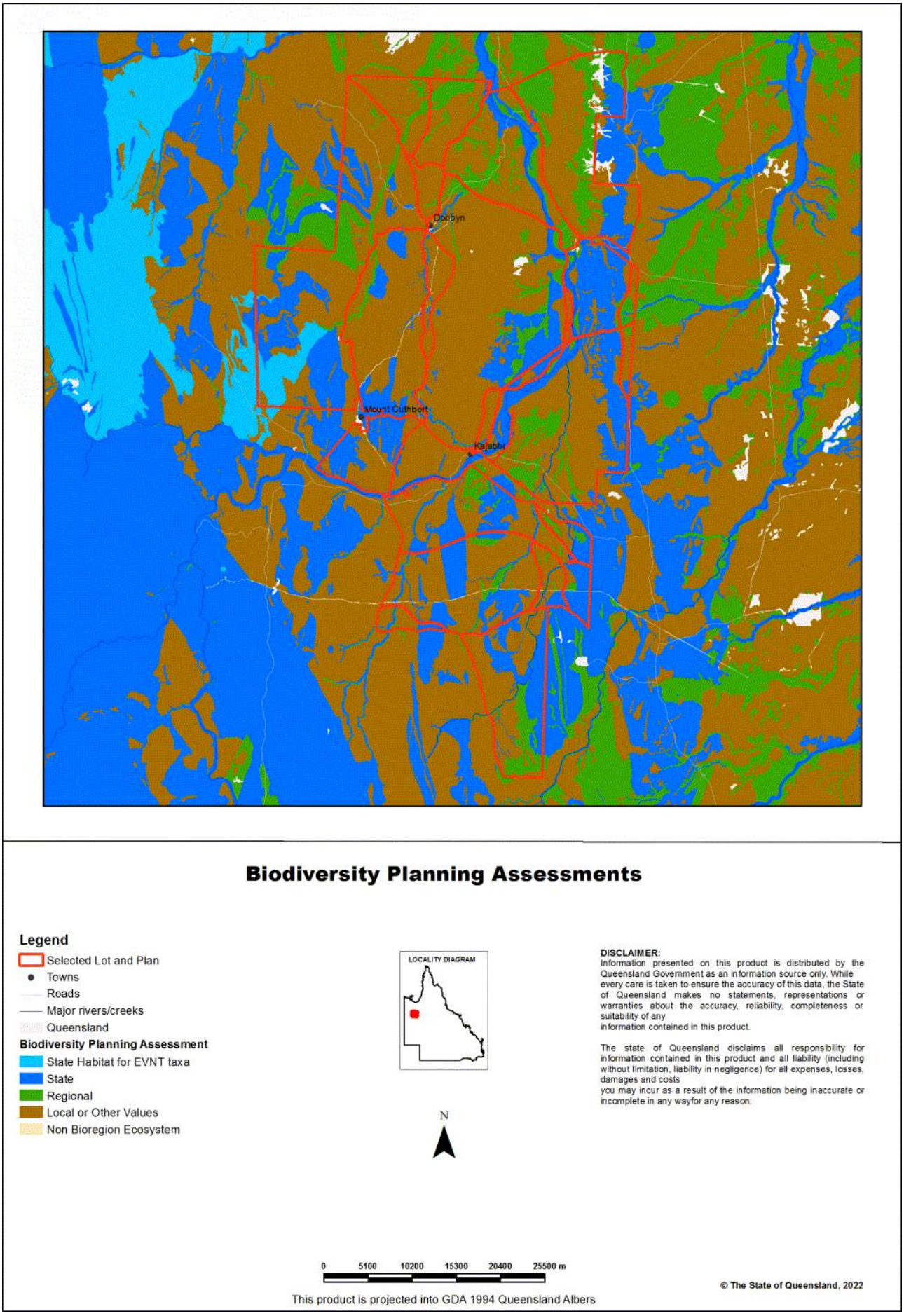
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

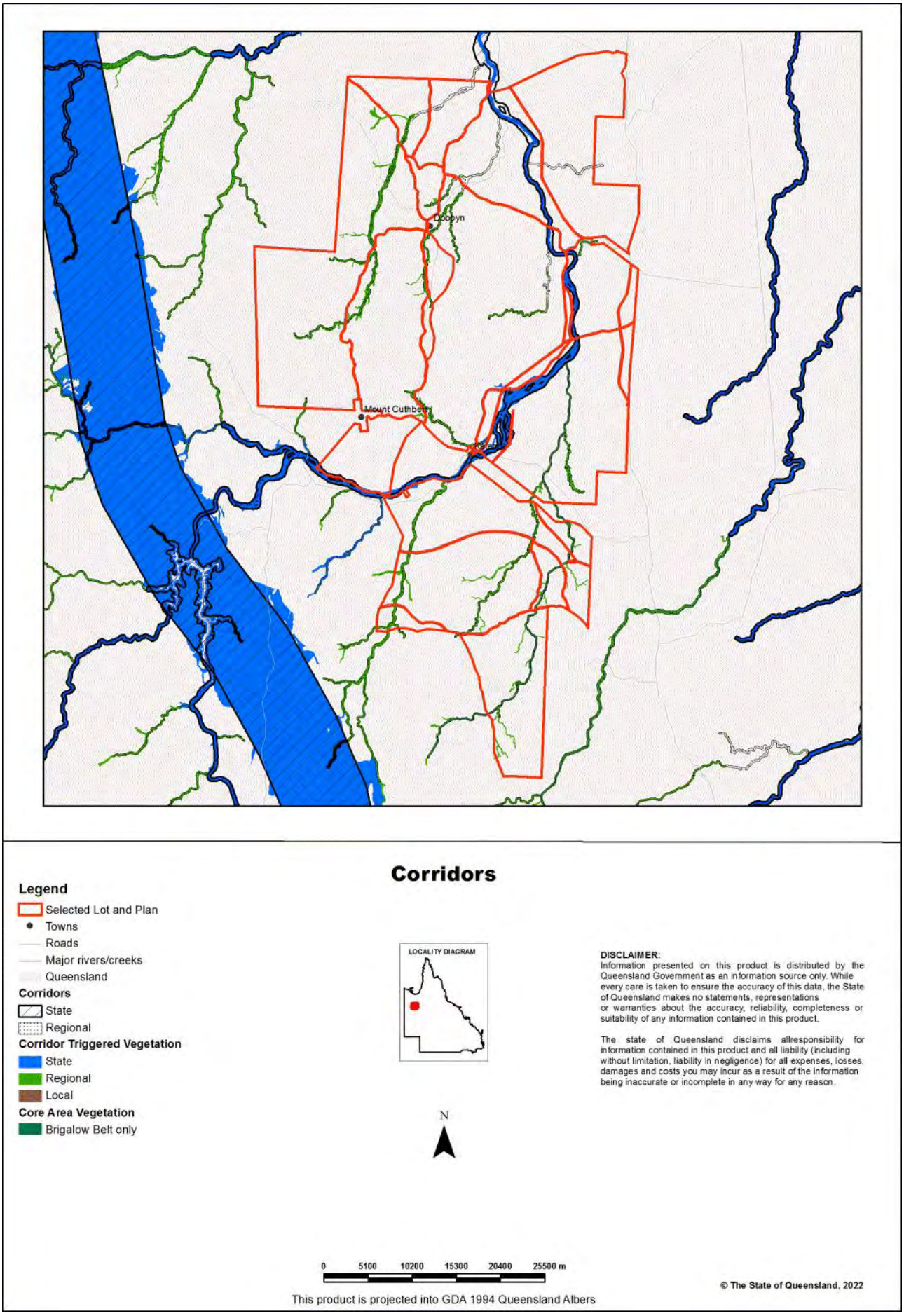
Map 1 - Locality Map



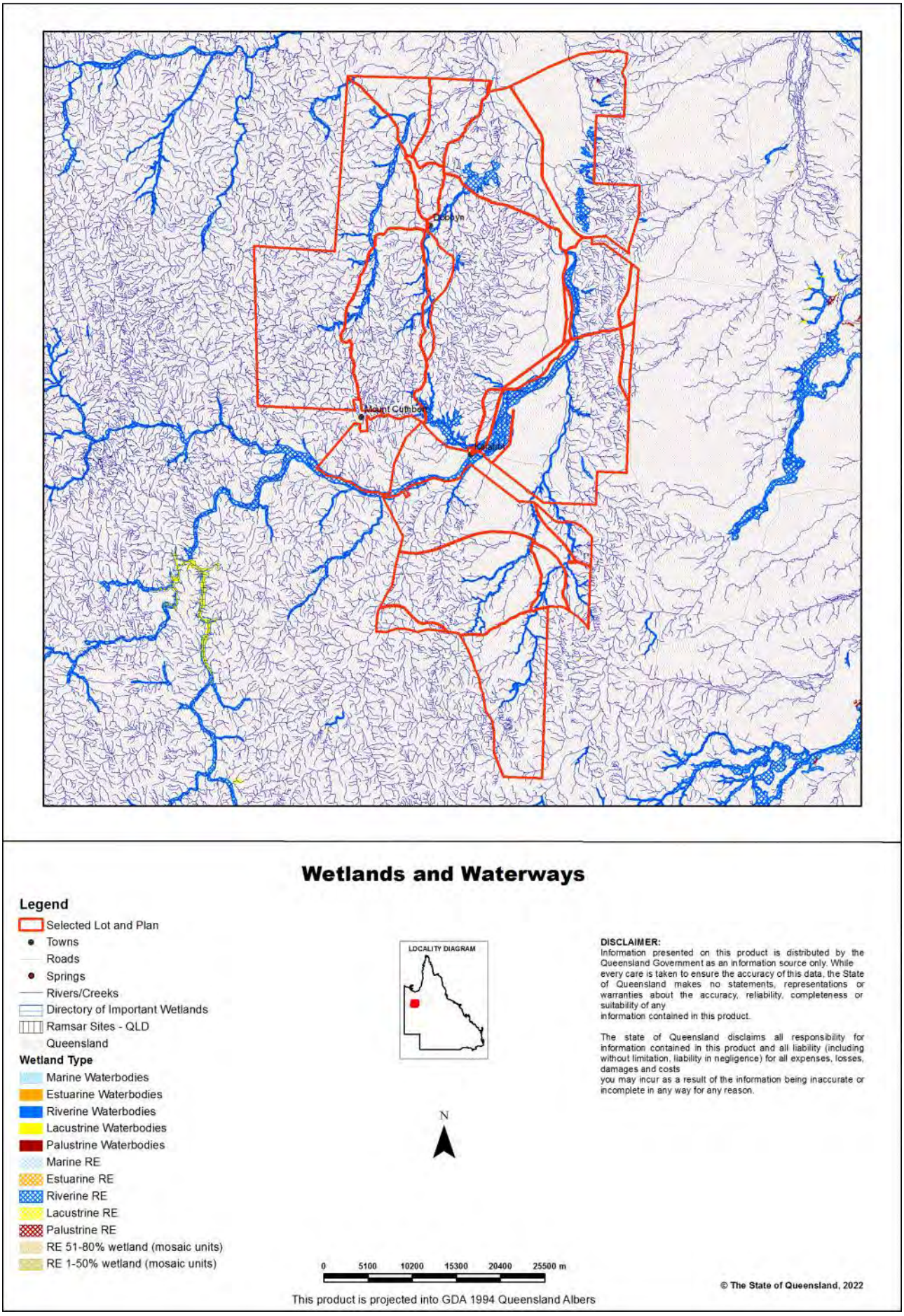
Map 2 - Biodiversity Planning Assessment (BPA)



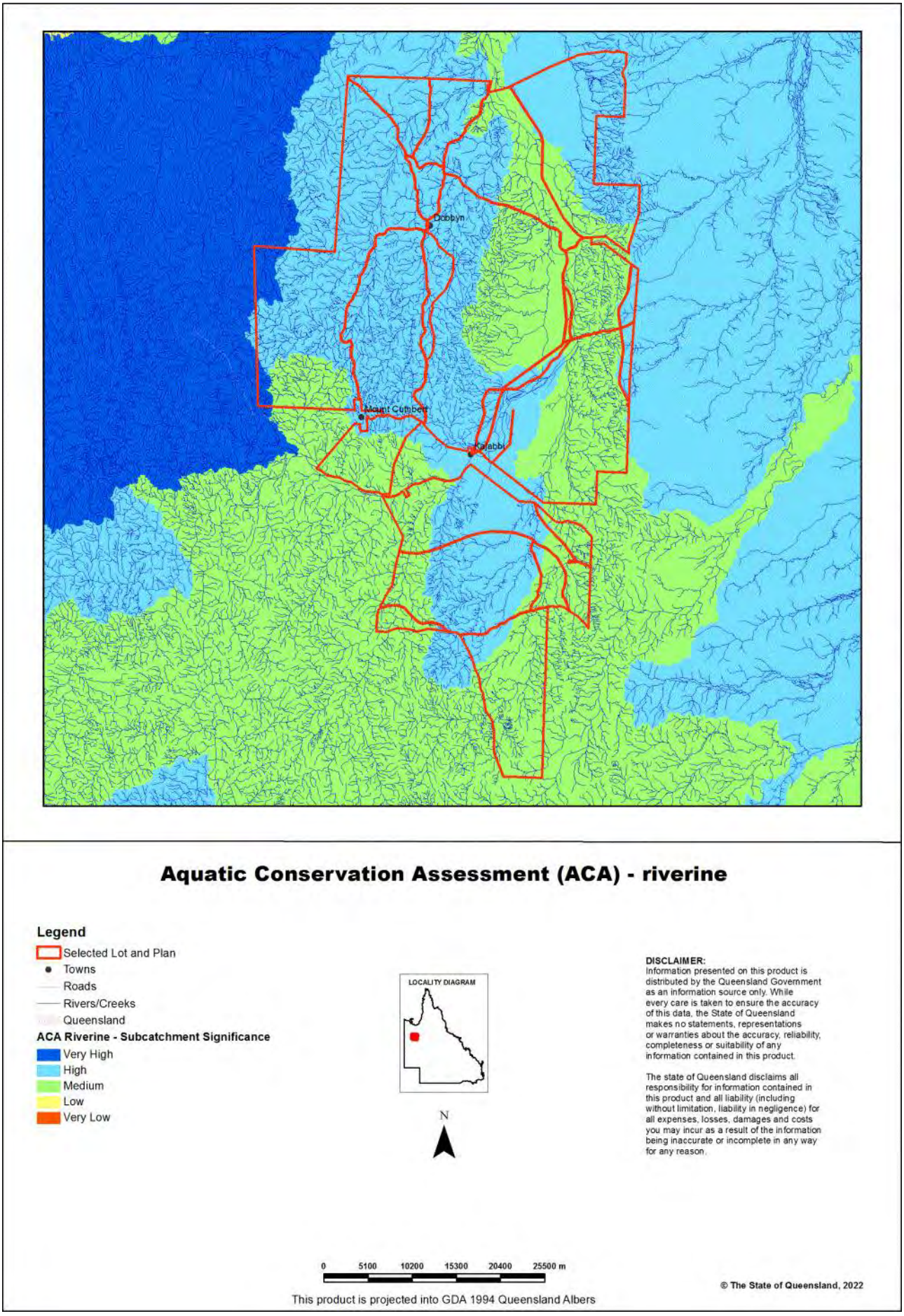
Map 3 - Corridors



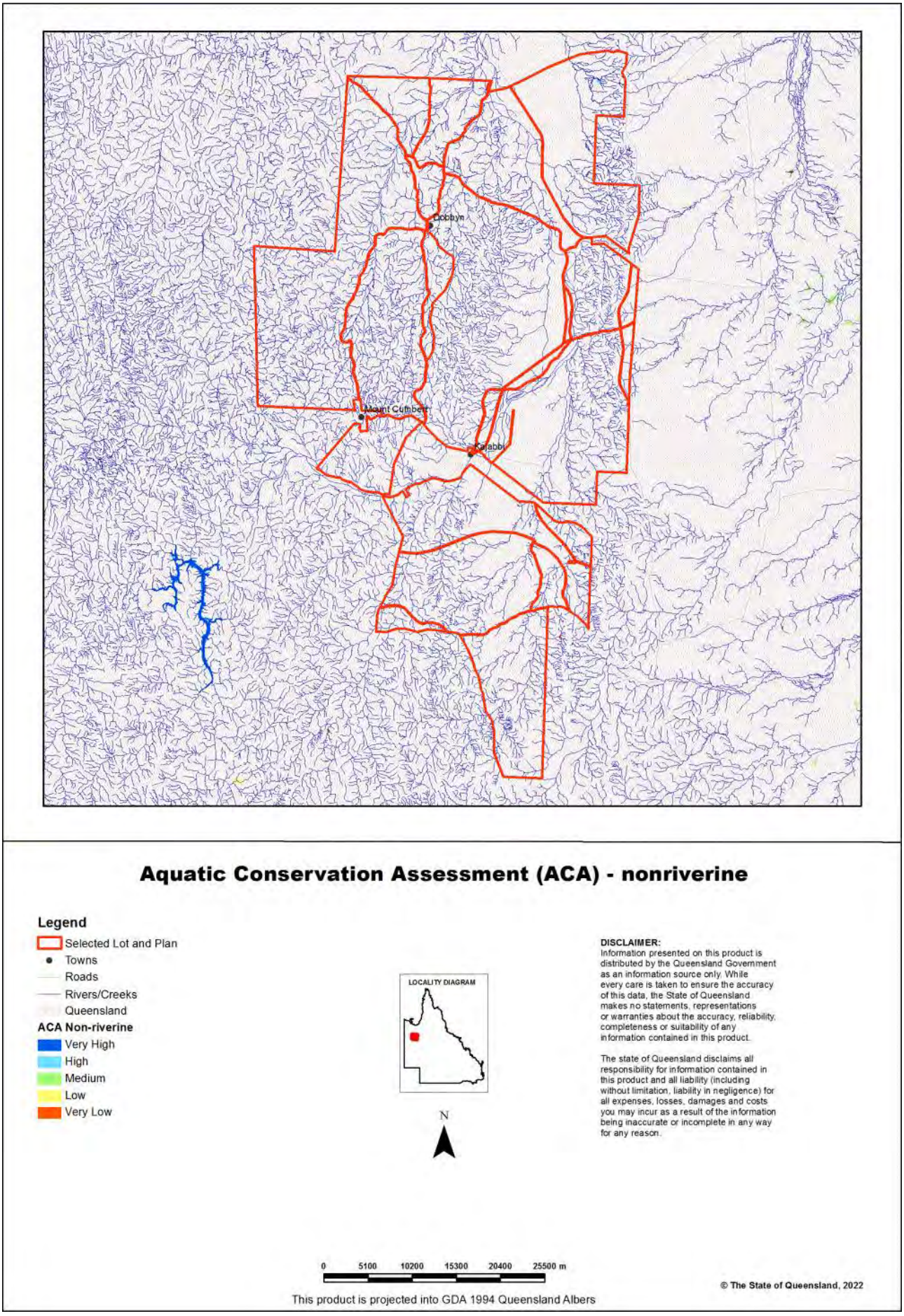
Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment. Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Environment and Heritage Protection 2014, Biodiversity Assessment and Mapping Methodology. Version 2.2. Department of Environment and Heritage Protection, Brisbane.

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series , Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). The Conservation Status of Queensland's Bioregional Ecosystems. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDB Non-riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDB Riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v2.3 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.6
Threatened Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.

***These datasets are available at:**

http://dds.information.qld.gov.au/DDS

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DES	- Department of Environment and Science
EPBC	- Environment Protection and Biodiversity Conservation Act 1999
EVNT	- Endangered, Vulnerable, Near Threatened
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

APPENDIX E – ENVIRONMENTAL REPORTS – REGIONAL ECOSYSTEMS – BIODIVERSITY STATUS

TAILINGS.WATER.WASTE.

Queensland Government

Department of Environment and Science

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
Lot: 59 Plan: TG40

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no matters of interest have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the Vegetation Management Act 1999 (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Resources website https://www.resources.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details: Lot: 59 Plan: TG40

Size (ha)	213,915.93
Local Government(s)	Cloncurry Shire
Bioregion(s)	Northwest Highlands, Gulf Plains
Subregion(s)	Armraynald Plains, Donors Plateau, Mount Isa Inlier
Catchment(s)	Flinders, Leichhardt

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	4,053.28	1.89
Of concern	13,681.21	6.4
No concern at present	195,826.07	91.54
Total remnant vegetation	213,560.56	99.83

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2020) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the Vegetation Management Act 1999 (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Resources website.

https://www.resources.qld.gov.au/

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

*Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.

**Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).

***Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.

****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
1.10.4a	Eucalyptus leucophloia low open woodland on sandstone plateaus	No concern at present	576.21	0.27
1.11.2a	Eucalyptus leucophloia low open woodland	No concern at present	52,820.66	24.69
1.11.3a	Corymbia terminalis and/or Eucalyptus leucophylla low open woodland on metamorphics	No concern at present	34,067.09	15.93
1.11.3b	Corymbia terminalis and/or Eucalyptus leucophylla low open woodland on metamorphics	No concern at present	4,562.79	2.13
1.11.7	Acacia cambagei low woodland on metamorphic hills	Of concern	72.96	0.03
1.11.8	Terminalia aridicola and/or Corymbia aspera low open woodland to low woodland, usually with vine-scrub species, on rock outcrops	No concern at present	1,525.20	0.71
1.12.1	Eucalyptus leucophloia low open woodland on granites	No concern at present	2,638.12	1.23
1.12.3a	Eucalyptus leucophylla and/or Corymbia terminalis +/- C. aparrerinja low open woodland on igneous rocks	No concern at present	2,834.63	1.33
1.12.7	Terminalia aridicola and Brachychiton collinus low open woodland on torfields	No concern at present	294.7	0.14
1.3.13a	Eucalyptus leucophylla woodland on levees and minor drainage lines	No concern at present	3,980.82	1.86
1.3.15	Eucalyptus pruinosa low woodland on recent alluvium	No concern at present	117.91	0.06
1.3.4a	Acacia cambagei low open woodland to woodland on alluvium, sometimes with Eucalyptus leucophylla	No concern at present	355.58	0.17
1.3.6a	Corymbia aparrerinja, Corymbia terminalis woodland on sandy levees	No concern at present	5,339.32	2.5
1.3.7a	Eucalyptus camaldulensis woodland on channels and levees	Endangered	2,863.81	1.34
1.3.7b	Eucalyptus camaldulensis woodland on channels and levees	Endangered	1,189.46	0.56
1.5.13	Eucalyptus pruinosa low open woodland on older alluvial and residual soils	No concern at present	19,115.62	8.94
1.5.15	Aristida contorta annual grasslands on hard setting red soils	No concern at present	23.78	0.01

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
1.5.16	Acacia cambagei low woodlands on red earths	No concern at present	4,861.36	2.27
1.5.3	Eucalyptus leucophloia low open woodland to woodland on sandy and gravelly red soils	No concern at present	2,936.81	1.37
1.5.4a	Eucalyptus leucophylla and/or Corymbia terminalis low open woodland on red earths	No concern at present	2,279.83	1.07
1.5.4d	Eucalyptus leucophylla and/or Corymbia terminalis low open woodland on red earths	No concern at present	17,295.73	8.09
1.7.1a	Eucalyptus leucophloia low open woodland on silcrete and lateritic surfaces	No concern at present	894.87	0.42
1.7.5a	Acacia shirleyi low woodland on lateritic scarps and hills	No concern at present	166.13	0.08
1.7.7a	Corymbia capricornia +/- Eucalyptus leucophloia or E. miniata low open woodland on silcrete	No concern at present	9,171.29	4.29
1.9.11c	Corymbia terminalis and/or Eucalyptus leucophylla and/or Lysiphyllum cunninghamii low open woodland on limestone	No concern at present	138.78	0.06
2.3.11	Eucalyptus microtheca +/- Excoecaria parvifolia, Atalaya hemiglauca, Grevillea striata low woodland on active Quaternary alluvial plains with cracking clay soils	No concern at present	437.15	0.2
2.3.17a	Eucalyptus microtheca +/- Excoecaria parvifolia, Lysiphyllum cunninghamii, Atalaya hemiglauca woodland fringing channels in fine-textured alluvial systems	Of concern	52.64	0.02
2.3.17b	Eucalyptus microtheca +/- Excoecaria parvifolia, Lysiphyllum cunninghamii, Atalaya hemiglauca woodland fringing channels in fine-textured alluvial systems	Of concern	4.33	less than 0.01
2.3.20a	Corymbia bella, Eucalyptus pruinosa, C. terminalis, Lysiphyllum cunninghamii in mixed woodlands on active levees and alluvial plains in the west	Of concern	473.6	0.22
2.3.20b	Corymbia bella, Eucalyptus pruinosa, C. terminalis, Lysiphyllum cunninghamii in mixed woodlands on active levees and alluvial plains in the west	Of concern	4,667.86	2.18
2.3.26d	Eucalyptus camaldulensis +/- Melaleuca spp. woodland fringing sandy, seasonal channels	Of concern	691.47	0.32
2.3.26f	Eucalyptus camaldulensis +/- Melaleuca spp. woodland fringing sandy, seasonal channels	Of concern	54.16	0.03
2.3.3	Astrebla squarrosa and/or A. elymoides and/or Iseilema spp. tussock grassland on active Quaternary alluvial plains	No concern at present	2,537.04	1.19
2.3.42c	Eucalyptus microtheca +/- Excoecaria parvifolia, Lysiphyllum cunninghamii, Melaleuca spp. open woodland on Quaternary alluvial plains with coarse-grained parent material	Of concern	140.78	0.07
2.3.46	Corymbia terminalis, C. aparrerinja +/- Lysiphyllum cunninghamii woodland on river levees in dry, southern parts of the bioregion	Of concern	1,275.35	0.6

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
2.3.49	Seasonal swamps. Mixed herblands and/or low shrublands with a fringe of Eucalyptus microtheca in closed depressions on silty, active Quaternary alluvial plains in the west of the bioregion	Of concern	8.27	less than 0.01
2.3.50a	Waterholes, bare sand and rock in the channels of major watercourses	Of concern	116.15	0.05
2.3.50b	Waterholes, bare sand and rock in the channels of major watercourses	Of concern	58.4	0.03
2.3.69b	Dichanthium spp., Iseilema spp., Aristida spp. and Brachyachne convergens in mixed tussock grasslands on active Quaternary alluvial deposits derived from coarse-grained parent material in the west	Of concern	148.64	0.07
2.3.7a	Acacia cambagei +/- Eucalyptus microtheca low woodland on fine-textured Quaternary alluvial plains	No concern at present	201.06	0.09
2.4.1a	Dichanthium spp., Eulalia aurea, Chrysopogon fallax and Themeda avenacea in mixed tussock grasslands on Tertiary clay plains	No concern at present	8,034.78	3.76
2.4.2a	Astrebla spp., Iseilema spp. +/- Aristida latifolia, Eulalia aurea tussock grassland on Tertiary clay deposits	No concern at present	697.42	0.33
2.4.2b	Astrebla spp., Iseilema spp. +/- Aristida latifolia, Eulalia aurea tussock grassland on Tertiary clay deposits	No concern at present	2,379.58	1.11
2.4.3a	Acacia cambagei low woodland on Tertiary clay deposits and shallow clay depressions on plateau surfaces	Of concern	2,971.72	1.39
2.4.5	Atalaya hemiglauca, Grevillea striata, Acacia victoriae and Vachellia sutherlandii in mixed low open woodlands on Tertiary clay plains	Of concern	2,763.75	1.29
2.5.11a	Eucalyptus leucophloia low open woodland on plains on lateritic podsolic soils	No concern at present	1,750.85	0.82
2.5.12a	Eucalyptus pruinosa subsp. pruinosa low woodland on plains and low rises on red and yellow earths	No concern at present	8,360.55	3.91
2.5.12b	Eucalyptus pruinosa subsp. pruinosa low woodland on plains and low rises on red and yellow earths	No concern at present	918.2	0.43
2.5.34a	Acacia cambagei low woodland on gravelly deposits and deeply weathered surfaces	No concern at present	697.16	0.33
2.7.14	Corymbia capricornia and/or Eucalyptus miniata low open woodland on margins of broad, Tertiary lateritic surfaces.	No concern at present	897.44	0.42
2.7.4	Eucalyptus leucophloia and/or Eucalyptus pruinosa subsp. pruinosa and/or Corymbia setosa low open woodland on surfaces, margins and residuals of Tertiary lateritic plateaus.	No concern at present	826.15	0.39
2.7.5a	Terminalia canescens and Corymbia setosa subsp. pedicellaris woodland on dissected plateau margins on skeletal soils	No concern at present	1,342.44	0.63
2.9.2a	Aristida spp., Eulalia aurea, Dichanthium spp. and Heteropogon contortus in mixed tussock grasslands on undulating plains on fine-grained Cretaceous sediments.	No concern at present	749.0	0.35

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
2.9.4	Acacia cambagei low woodland on undulating plains and hillslopes of Cretaceous mudstones.	Of concern	181.14	0.08
non-remnant	None	None	354.59	0.17
water	None	None	1.61	less than 0.01

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.10.4a	Pre-clearing 55000 ha; Remnant 2019 54000 ha	19a	Not a Wetland	High
1.11.2a	Pre-clearing 1245000 ha; Remnant 2019 1239000 ha	19a	Not a Wetland	Low
1.11.3a	Pre-clearing 662000 ha; Remnant 2019 658000 ha	19b	Not a Wetland	No representation
1.11.3b	Pre-clearing 662000 ha; Remnant 2019 658000 ha	19b	Not a Wetland	No representation
1.11.7	Pre-clearing 9000 ha; Remnant 2019 8000 ha	26a	Not a Wetland	No representation
1.11.8	Pre-clearing 30000 ha; Remnant 2019 30000 ha	27c	Not a Wetland	No representation
1.12.1	Pre-clearing 169000 ha; Remnant 2019 169000 ha	19a	Not a Wetland	No representation
1.12.3a	Pre-clearing 307000 ha; Remnant 2019 307000 ha	19b	Not a Wetland	Low
1.12.7	Pre-clearing 31000 ha; Remnant 2019 31000 ha	27c	Not a Wetland	No representation
1.3.13a	Pre-clearing 151000 ha; Remnant 2019 150000 ha	19b	Not a Wetland	Low
1.3.15	Pre-clearing 45000 ha; Remnant 2019 45000 ha	19c	Riverine	Low
1.3.4a	Pre-clearing 55000 ha; Remnant 2019 54000 ha	26a	Not a Wetland	No representation
1.3.6a	Pre-clearing 76000 ha; Remnant 2019 76000 ha	19b	Riverine	Low
1.3.7a	Pre-clearing 163000 ha; Remnant 2019 162000 ha	16a	Riverine	Medium
1.3.7b	Pre-clearing 163000 ha; Remnant 2019 162000 ha	16a	Riverine	Medium
1.5.13	Pre-clearing 320000 ha; Remnant 2019 319000 ha	19c	Not a Wetland	Low

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
1.5.15	Pre-clearing 14000 ha; Remnant 2019 14000 ha	31b	Not a Wetland	No representation
1.5.16	Pre-clearing 180000 ha; Remnant 2019 177000 ha	26a	Not a Wetland	No representation
1.5.3	Pre-clearing 290000 ha; Remnant 2019 289000 ha	19a	Not a Wetland	Low
1.5.4a	Pre-clearing 356000 ha; Remnant 2019 352000 ha	19b	Not a Wetland	Low
1.5.4d	Pre-clearing 356000 ha; Remnant 2019 352000 ha	19b	Not a Wetland	Low
1.7.1a	Pre-clearing 421000 ha; Remnant 2019 420000 ha	19a	Not a Wetland	High
1.7.5a	Pre-clearing 111000 ha; Remnant 2019 110000 ha	24a	Not a Wetland	Low
1.7.7a	Pre-clearing 575000 ha; Remnant 2019 575000 ha	19a	Not a Wetland	High
1.9.11c	Pre-clearing 81000 ha; Remnant 2019 80000 ha	19b	Not a Wetland	Low
2.3.11	Pre-clearing 661000 ha; Remnant 2019 658000 ha	16c	Not a Wetland	Low
2.3.17a	Pre-clearing 352000 ha; Remnant 2019 349000 ha	16a	Riverine	Low
2.3.17b	Pre-clearing 352000 ha; Remnant 2019 349000 ha	16a	Riverine	Low
2.3.20a	Pre-clearing 310000 ha; Remnant 2019 309000 ha	16b	Contains Riverine	Low
2.3.20b	Pre-clearing 310000 ha; Remnant 2019 309000 ha	16b	Contains Riverine	Low
2.3.26d	Pre-clearing 236000 ha; Remnant 2019 235000 ha	16a	Riverine	Low
2.3.26f	Pre-clearing 236000 ha; Remnant 2019 235000 ha	16a	Riverine	Low
2.3.3	Pre-clearing 791000 ha; Remnant 2019 786000 ha	30a	Not a Wetland	No representation
2.3.42c	Pre-clearing 498000 ha; Remnant 2019 497000 ha	16c	Not a Wetland	Low
2.3.46	Pre-clearing 49000 ha; Remnant 2019 48000 ha	16b	Riverine	No representation
2.3.49	Pre-clearing 9000 ha; Remnant 2019 9000 ha	34d	Palustrine	No representation
2.3.50a	Pre-clearing 81000 ha; Remnant 2019 81000 ha	16d	Riverine	Low
2.3.50b	Pre-clearing 81000 ha; Remnant 2019 81000 ha	16d	Riverine	Low
2.3.69b	Pre-clearing 145000 ha; Remnant 2019 144000 ha	31a	Not a Wetland	Low
2.3.7a	Pre-clearing 105000 ha; Remnant 2019 99000 ha	26a	Not a Wetland	No representation

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
2.4.1a	Pre-clearing 918000 ha; Remnant 2019 916000 ha	30b	Not a Wetland	Low
2.4.2a	Pre-clearing 1333000 ha; Remnant 2019 1317000 ha	30b	Not a Wetland	No representation
2.4.2b	Pre-clearing 1333000 ha; Remnant 2019 1317000 ha	30b	Not a Wetland	No representation
2.4.3a	Pre-clearing 139000 ha; Remnant 2019 113000 ha	26a	Not a Wetland	No representation
2.4.5	Pre-clearing 67000 ha; Remnant 2019 67000 ha	27a	Not a Wetland	No representation
2.5.11a	Pre-clearing 83000 ha; Remnant 2019 83000 ha	19b	Not a Wetland	No representation
2.5.12a	Pre-clearing 352000 ha; Remnant 2019 349000 ha	19b	Not a Wetland	Low
2.5.12b	Pre-clearing 352000 ha; Remnant 2019 349000 ha	19c	Not a Wetland	Low
2.5.34a	Pre-clearing 115000 ha; Remnant 2019 110000 ha	26a	Not a Wetland	No representation
2.7.14	Pre-clearing 15000 ha; Remnant 2019 15000 ha	19a	Not a Wetland	No representation
2.7.4	Pre-clearing 190000 ha; Remnant 2019 189000 ha	19a	Not a Wetland	No representation
2.7.5a	Pre-clearing 107000 ha; Remnant 2019 107000 ha	19c	Not a Wetland	No representation
2.9.2a	Pre-clearing 148000 ha; Remnant 2019 146000 ha	30b	Not a Wetland	No representation
2.9.4	Pre-clearing 39000 ha; Remnant 2019 31000 ha	26a	Not a Wetland	No representation
non-remnant	None	None	None	None
water	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
1.10.4a	Potential habitat for NCA listed species: Trachymene glandulosa
1.11.2a	Potential habitat for NCA listed species: Eucalyptus nudicaulis, Ipomoea antonschmidii, Solanum carduiforme, Trachymene glandulosa
1.11.3a	Potential habitat for NCA listed species: Eucalyptus nudicaulis
1.11.3b	Potential habitat for NCA listed species: Eucalyptus nudicaulis
1.11.7	None
1.11.8	Potential habitat for NCA listed species: Eucalyptus nudicaulis

Regional Ecosystem	Special Values
1.12.1	None
1.12.3a	None
1.12.7	None
1.3.13a	Potential habitat for NCA listed species: Ipomoea antonschmidii, Ptilotus maconochiei
1.3.15	None
1.3.4a	None
1.3.6a	Significant sub-regional fauna habitat due to the number and size of trees with hollows. 1.3.6b: Significant sub-regional fauna habitat due to the number and size of trees with hollows. 1.3.6e: Significant sub-regional fauna habitat due to the number and size of trees with hollows.
1.3.7a	Important seasonal water bird habitat; regional corridor for fauna.
1.3.7b	Important seasonal water bird habitat; regional corridor for fauna.
1.5.13	None
1.5.15	None
1.5.16	None
1.5.3	None
1.5.4a	Potential habitat for NCA listed species: Ipomoea antonschmidii
1.5.4d	Potential habitat for NCA listed species: Ipomoea antonschmidii
1.7.1a	Potential habitat for NCA listed species: Solanum carduiforme, Trachymene glandulosa
1.7.5a	None
1.7.7a	Potential habitat for NCA listed species: Ipomoea antonschmidii
1.9.11c	None
2.3.11	Seasonal wetland. Important feeding and moulting sites for water birds. 2.3.11x2a: Seasonal wetland. Important feeding and moulting sites for water birds. 2.3.11x2b: Seasonal wetland. Important feeding and moulting sites for water birds. 2.3.11x2c: Seasonal wetland. Important feeding and moulting sites for water birds. 2.3.11x2d: Seasonal wetland. Important feeding and moulting sites for water birds. 2.3.11x3: Seasonal wetland. Important feeding and moulting sites for water birds.
2.3.17a	Bioregional refuge for fauna, including macropods. 2.3.17a: Bioregional refuge for fauna, including macropods.
2.3.17b	Bioregional refuge for fauna, including macropods. 2.3.17a: Bioregional refuge for fauna, including macropods.
2.3.20a	Provincial refuge for some woodland flora and fauna. 2.3.20a: Provincial refuge for some woodland flora and fauna. 2.3.20b: Provincial refuge for some woodland flora and fauna. 2.3.20d: Provincial refuge for some woodland flora and fauna. 2.3.20f: Provincial refuge for some woodland flora and fauna. 2.3.20p: Provincial refuge for some woodland flora and fauna. 2.3.20x1d: Supports plant growth well into the dry season. Provincial refuge for flora and fauna. 2.3.20x4: Provincial refuge for some woodland flora and fauna. A restricted geomorphic surface.

Regional Ecosystem	Special Values
2.3.20b	Provincial refuge for some woodland flora and fauna. 2.3.20a: Provincial refuge for some woodland flora and fauna. 2.3.20b: Provincial refuge for some woodland flora and fauna. 2.3.20d: Provincial refuge for some woodland flora and fauna. 2.3.20f: Provincial refuge for some woodland flora and fauna. 2.3.20p: Provincial refuge for some woodland flora and fauna. 2.3.20x1d: Supports plant growth well into the dry season. Provincial refuge for flora and fauna. 2.3.20x4: Provincial refuge for some woodland flora and fauna. A restricted geomorphic surface.
2.3.26d	Significant provincial refuges for fauna. Includes areas of permanent water with high habitat values for aquatic and other species. 2.3.26a: Significant provincial refuges for fauna. Includes areas of permanent water with high habitat values for aquatic and other species. 2.3.26b: Provincial refuge for flora and fauna. 2.3.26d: Significant provincial refuges for fauna. Includes permanent, spring-fed water with high habitat values for aquatic and other species. 2.3.26e: Provincial refuge for flora and fauna. 2.3.26f: Provincial refuge for flora and fauna. 2.3.26x1a: Significant provincial refuges for fauna. Includes permanent, spring-fed water with high habitat values for aquatic and other species. 2.3.26x1b: Significant provincial refuges for fauna. Includes permanent, spring-fed water with high habitat values for aquatic and other species. 2.3.26x1c: Provincial refuge for flora and fauna. 2.3.26x1d: Provincial refuge for flora and fauna. 2.3.26x2: Supports plant growth well into the dry season. Provincial refuge for flora and fauna.
2.3.26f	Significant provincial refuges for fauna. Includes areas of permanent water with high habitat values for aquatic and other species. 2.3.26a: Significant provincial refuges for fauna. Includes areas of permanent water with high habitat values for aquatic and other species. 2.3.26b: Provincial refuge for flora and fauna. 2.3.26d: Significant provincial refuges for fauna. Includes permanent, spring-fed water with high habitat values for aquatic and other species. 2.3.26e: Provincial refuge for flora and fauna. 2.3.26f: Provincial refuge for flora and fauna. 2.3.26x1a: Significant provincial refuges for fauna. Includes permanent, spring-fed water with high habitat values for aquatic and other species. 2.3.26x1b: Significant provincial refuges for fauna. Includes permanent, spring-fed water with high habitat values for aquatic and other species. 2.3.26x1c: Provincial refuge for flora and fauna. 2.3.26x1d: Provincial refuge for flora and fauna. 2.3.26x2: Supports plant growth well into the dry season. Provincial refuge for flora and fauna.
2.3.3	Potential habitat for Sminthopsis douglasi (Julia Creek dunnart).
2.3.42c	None
2.3.46	None
2.3.49	Seasonal wetland. Important feeding and moulting sites for water birds.
2.3.50a	Important sites for feeding and movement of birds, fish and reptiles. Potential habitat for Pristis pristis (freshwater sawfish), Elseya lavarackorum (Gulf snapping turtle) and Malurus coronatus (purple-crowned fairy wren).
2.3.50b	Important sites for feeding and movement of birds, fish and reptiles. Potential habitat for Pristis pristis (freshwater sawfish), Elseya lavarackorum (Gulf snapping turtle) and Malurus coronatus (purple-crowned fairy wren).
2.3.69b	None
2.3.7a	None

Regional Ecosystem	Special Values
2.4.1a	A proven impact structure in Geology of Queensland, 2013. (Ed: Peter A. Jell)
2.4.2a	Potential habitat for Sminthopsis douglasi (Julia Creek dunnart).
2.4.2b	Potential habitat for Sminthopsis douglasi (Julia Creek dunnart).
2.4.3a	None
2.4.5	None
2.5.11a	None
2.5.12a	None
2.5.12b	None
2.5.34a	None
2.7.14	None
2.7.4	Provincial refuge for flora and fauna.
2.7.5a	Supports locally uncommon plant species in the bioregion, including Corymbia aspera.
2.9.2a	None
2.9.4	None
non-remnant	None
water	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at:

https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	356.2	0.17
16a	Open forest and woodlands dominated by Eucalyptus camaldulensis (river red gum) (or E. tereticornis (blue gum)) and/or E. coolabah (coolabah) (or E. microtheca (coolabah)) fringing drainage lines. Associated species may include Melaleuca spp., Corymbia tessellaris (carbeen), Angophora spp., Casuarina cunninghamiana (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded. (land zone 3) (MGD, BRB, GUP, CHC, MUL, DEU, EIU, NWH, SEQ, [NET, WET]) (All bioregions except CYP and CQC)	4,855.87	2.27
16b	Woodlands dominated by Eucalyptus leptophleba (Molloy red box), with Corymbia tessellaris (carbeen) or C. clarksoniana (grey bloodwood) or C. dallachiana. On sandy levees. (land zones 3, 5) (GUP, EIU, CYP)	6,416.81	3.0

BVG (1 Million)	Description	Area (Ha)	% of AOI
16c	Woodlands and open woodlands dominated by Eucalyptus coolabah (coolabah) or E. microtheca (coolabah) or E. largiflorens (black box) or E. tereticornis (blue gum) or E. chlorophylla on floodplains. Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded. (land zone 3) (All bioregions except WET, principally GUP, BRB, MUL).	577.94	0.27
16d	River beds, open water or sand, or rock, frequently unvegetated. (land zone 3) (GUP, EIU, BRB, CYP, DEU, [CQC, MUL])	174.55	0.08
19a	Low open woodlands dominated by Eucalyptus leucophloia (snappy gum) with Triodia spp. dominated ground layer, mainly on hills and ranges. (land zones 11, 7, 5, 12, 9, 10) (NWH, GUP, MGD)	70,761.56	33.08
19b	Low open woodlands dominated by Eucalyptus leucophylla (Cloncurry box) or less extensively Corymbia terminalis (long-fruited bloodwood) low open woodlands and related associations, mainly lower slopes and valleys. (land zones 5, 11, 9, 7, 12, 3) (NWH, MGD, GUP, CHC)	80,610.39	37.68
19c	Low open woodlands dominated by Eucalyptus pruinosa low open woodlands on sandplains and outwash areas. (land zones 5, 7, 9, 11) (GUP, NWH)	21,494.17	10.05
24a	Low woodlands to tall shrublands dominated by Acacia spp. on residuals. Species include A. shirleyi (lancewood), A. catenulata (bendee), A. microsperma (bowyakka), A. clivicola, A. sibirica, A. rhodoxylon (rosewood) and A. leptostachya (Townsville wattle). (land zones 7, 10, 5, 12, 11, [9, 3]) (MUL, CHC, BRB, GUP, EIU, MGD, DEU, NWH, [CYP])	166.13	0.08
26a	Open forests to tall shrublands dominated by Acacia cambagei (gidgee) or A. georginae (Georgina gidgee) or A. argyrodendron (blackwood). (land zones 9, 3, 4, 6, 5, 7, [8, 11]) (MGD, MUL, CHC, BRB, DEU, GUP, NWH, [EIU])	9,340.98	4.37
27a	Low open woodlands dominated by a variety of species including Acacia tephrina (boree), Atalaya hemiglauca (whitewood), Ventilago viminalis (supplejack) and Lysiphyllum spp. (land zones 9, 3, 4, [5]) (MGD, GUP, BRB, NWH, DEU, [CYP, EIU])	2,763.75	1.29
27c	Low open woodlands dominated by a variety of species including Grevillea striata (beefwood), Acacia spp., Terminalia spp. or Cochlospermum spp. (land zones 9, 12, 3, 11, 5) (NWH, EIU, DEU, GUP, [BRB])	1,819.90	0.85
30a	Tussock grasslands dominated by Astrebla spp. (mitchell grass) or Dichanthium spp. (bluegrass) often with Eulalia aurea (silky browntop) on alluvia. (land zones 3, 4) (MGD, GUP, BRB, MUL, [DEU])	2,537.04	1.19
30b	Tussock grasslands dominated by Astrebla spp. (mitchell grass) or Dichanthium spp. (bluegrass) often with Iseilema spp. on undulating downs or clay plains. (land zones 9, 3, 4, 8, [5]) (MGD, CHC, GUP, BRB, [EIU, DEU, NWH])	11,860.79	5.54
31a	Open forblands to open tussock grasslands which may be composed of Atriplex spp. (saltbush), Sclerolaena spp. (burr), Asteraceae spp. and/or short grasses on alluvial plains. (land zone 3) (CHC, MGD, MUL, GUP, [BRB, DEU])	148.64	0.07
31b	Short grass / forb associations on stony downs. (land zones 9, 7, [5]) (CHC, DEU, [NWH])	23.78	0.01

BVG (1 Million)	Description	Area (Ha)	% of AOI
34d	Palustrine wetlands. Freshwater swamps/springs/billabongs on floodplains ranging from permanent and semi-permanent to ephemeral. (land zone 3) (GUP, EIU, BRB, CYP, CHC, [MGD])	8.27	less than 0.01

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the Vegetation Management Act 1999. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2020 (PDF)* section 3.3 of:

https://publications.qld.gov.au/dataset/redd/resource/

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

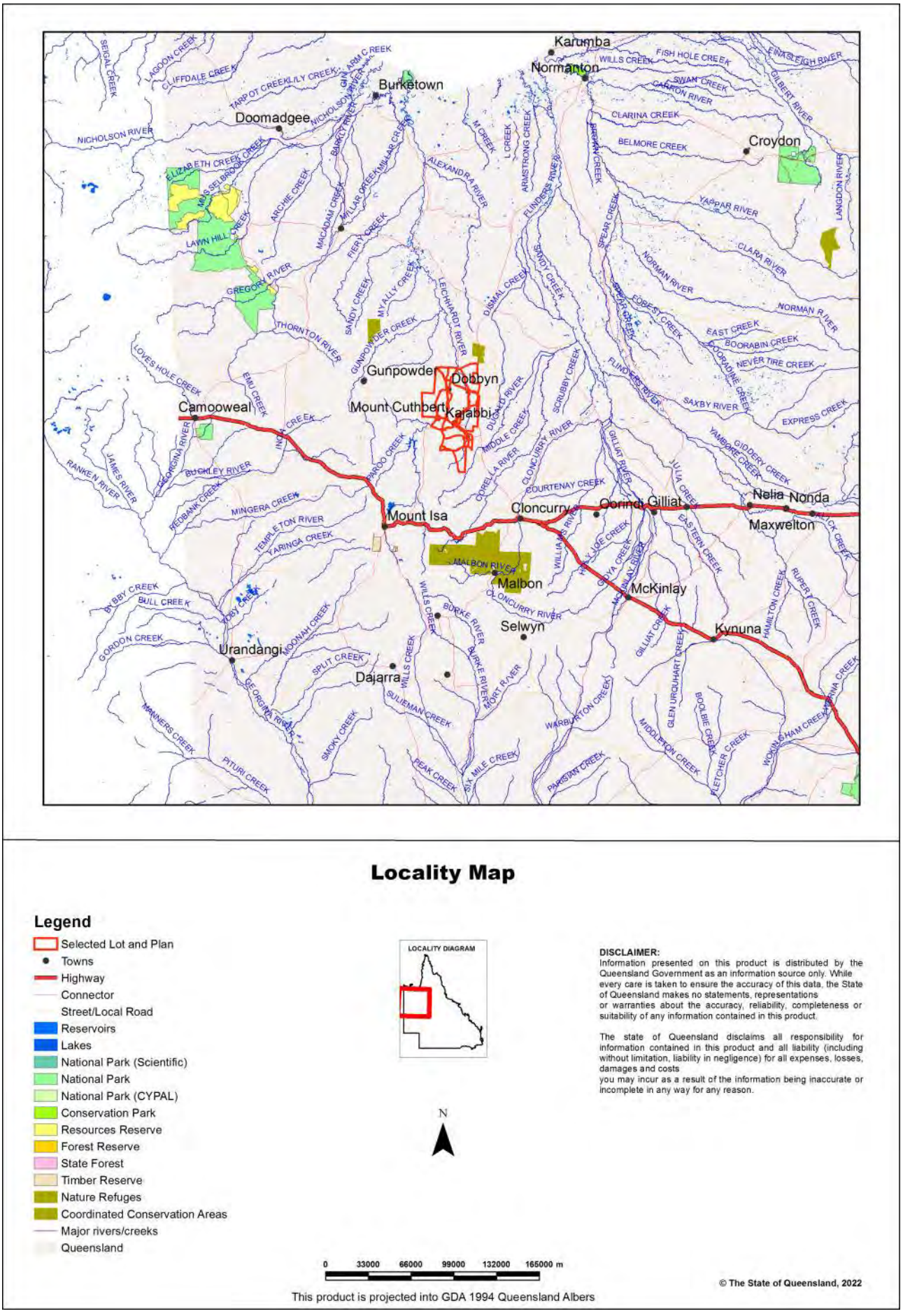
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
1.10.4a	Available	Not currently available
1.11.2a	Available	Not currently available
1.11.3a	Available	Not currently available
1.11.3b	Available	Not currently available
1.11.7	Available	Not currently available
1.11.8	Available	Not currently available
1.12.1	Available	Not currently available
1.12.3a	Available	Not currently available
1.12.7	Available	Not currently available
1.3.13a	Available	Not currently available
1.3.15	Available	Not currently available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
1.3.4a	Available	Not currently available
1.3.6a	Available	Not currently available
1.3.7a	Available	Not currently available
1.3.7b	Available	Not currently available
1.5.13	Available	Not currently available
1.5.15	Available	Not currently available
1.5.16	Available	Not currently available
1.5.3	Available	Not currently available
1.5.4a	Available	Not currently available
1.5.4d	Available	Not currently available
1.7.1a	Available	Not currently available
1.7.5a	Available	Not currently available
1.7.7a	Available	Not currently available
1.9.11c	Available	Not currently available
2.3.11	Not currently available	Not currently available
2.3.17a	Not currently available	Not currently available
2.3.17b	Not currently available	Not currently available
2.3.20a	Not currently available	Not currently available
2.3.20b	Not currently available	Not currently available
2.3.26d	Not currently available	Not currently available
2.3.26f	Not currently available	Not currently available
2.3.3	Not currently available	Available
2.3.42c	Not currently available	Not currently available
2.3.46	Not currently available	Not currently available
2.3.49	Not currently available	Not currently available
2.3.50a	Not currently available	Not currently available
2.3.50b	Not currently available	Not currently available
2.3.69b	Not currently available	Not currently available
2.3.7a	Not currently available	Available
2.4.1a	Not currently available	Not currently available
2.4.2a	Not currently available	Available
2.4.2b	Not currently available	Available
2.4.3a	Not currently available	Not currently available
2.4.5	Not currently available	Not currently available
2.5.11a	Not currently available	Not currently available
2.5.12a	Not currently available	Not currently available
2.5.12b	Not currently available	Not currently available
2.5.34a	Not currently available	Not currently available
2.7.14	Not currently available	Not currently available
2.7.4	Not currently available	Not currently available
2.7.5a	Not currently available	Not currently available

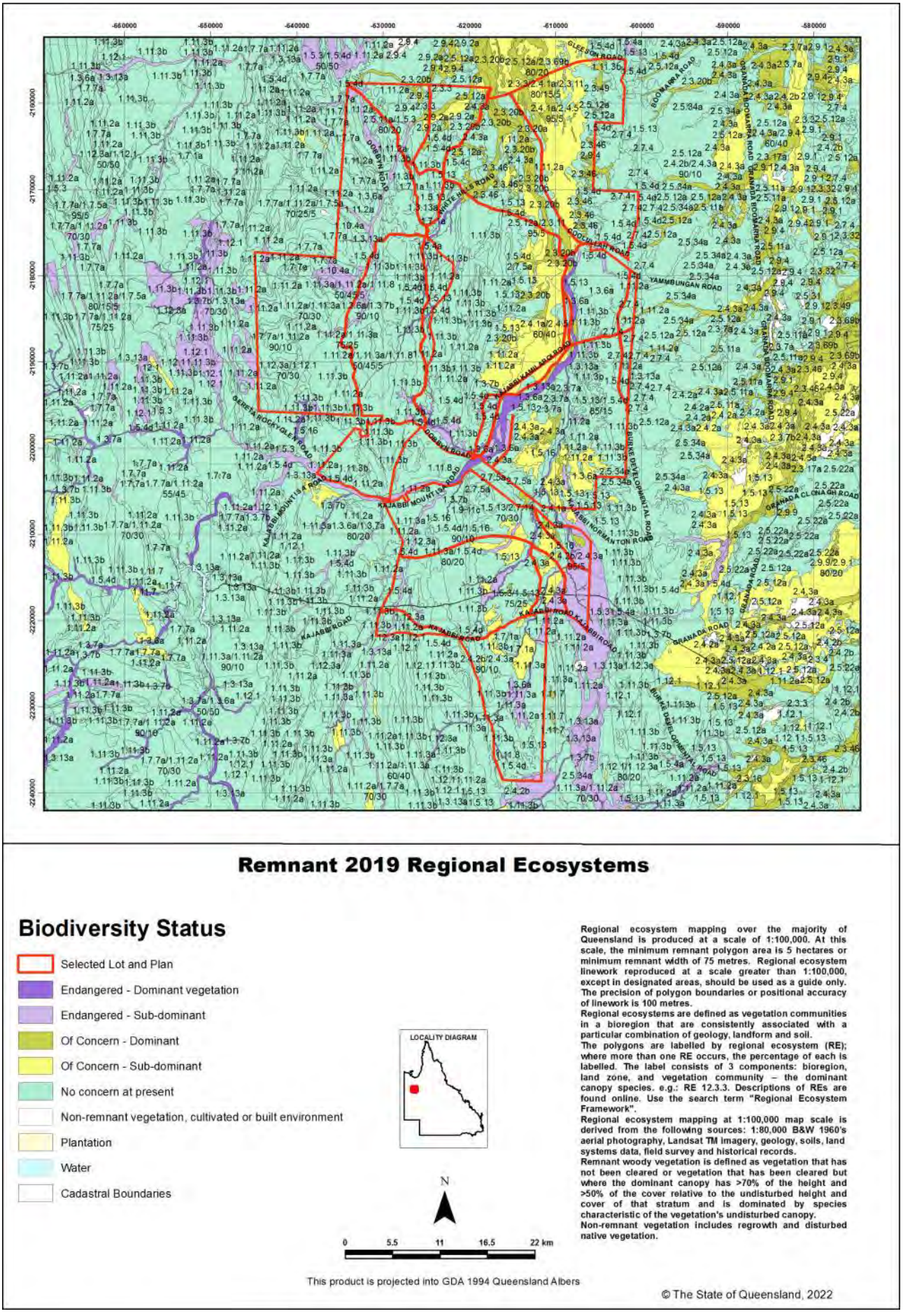
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
2.9.2a	Not currently available	Not currently available
2.9.4	Not currently available	Not currently available
non-remnant	Not currently available	Not currently available
water	Not currently available	Not currently available

Maps

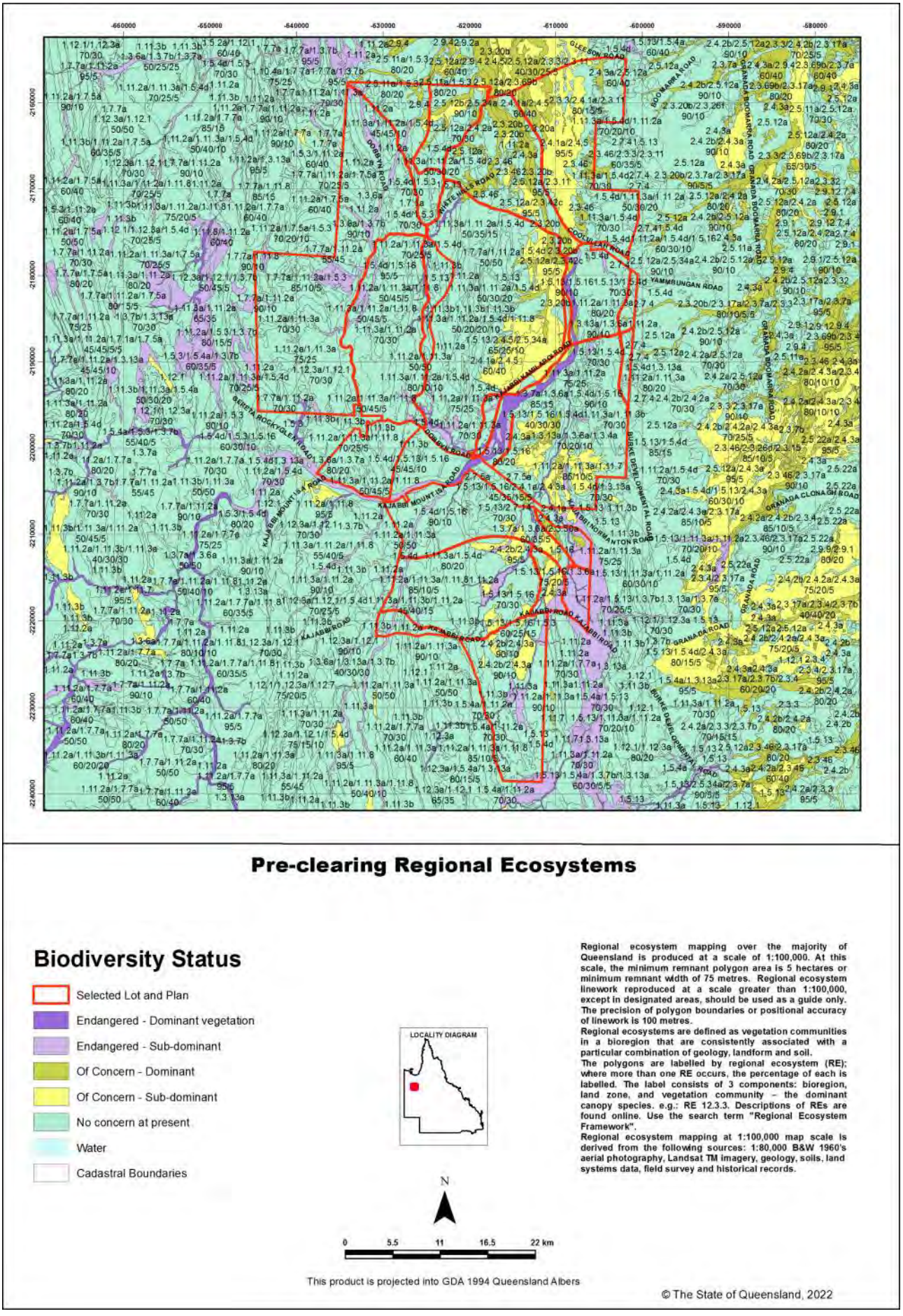
Map 1 - Location



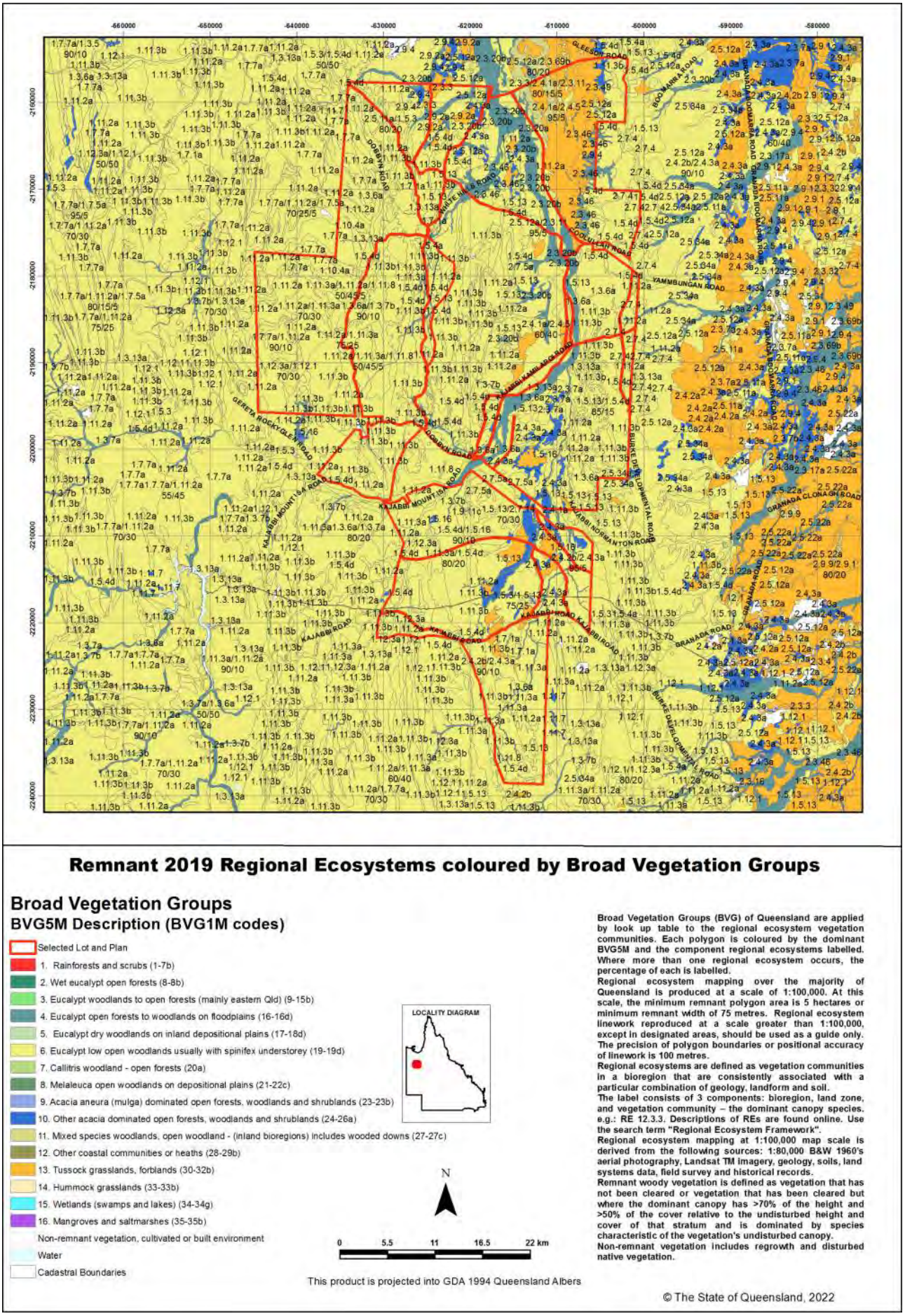
Map 2 - Remnant 2019 regional ecosystems



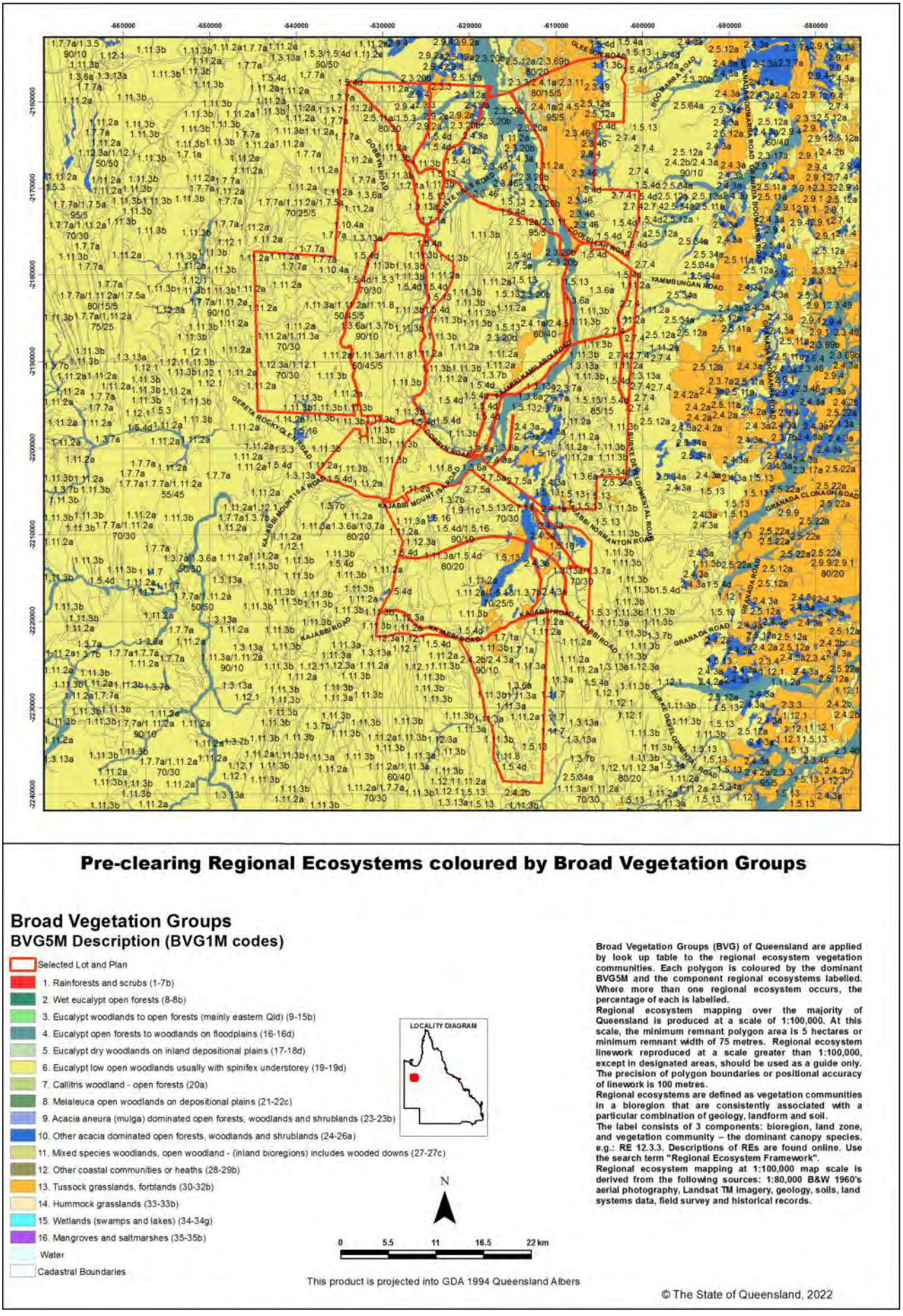
Map 3 - Pre-clearing regional ecosystems



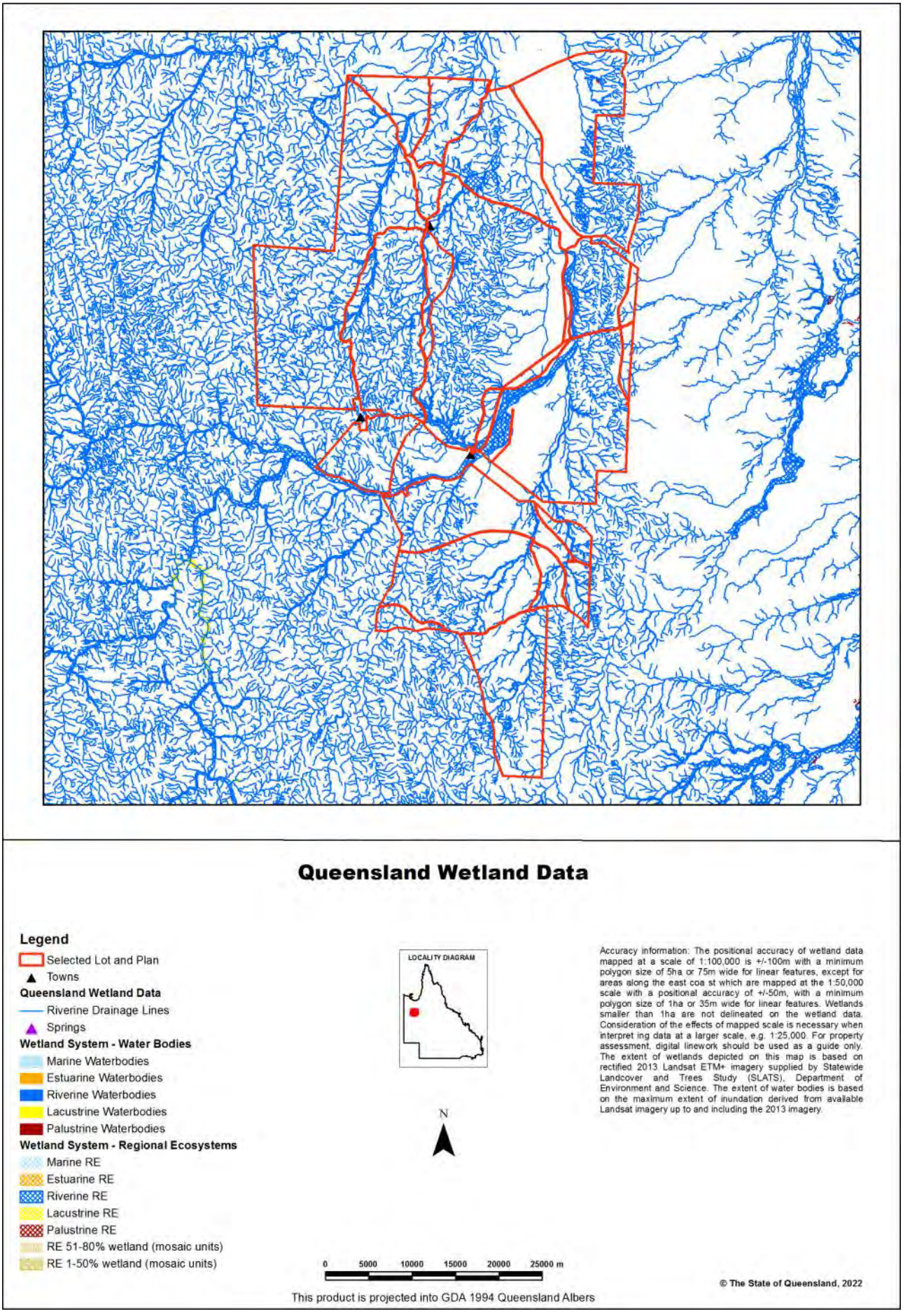
Map 4 - Remnant 2019 regional ecosystems by BVG (5M)



Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of Environment and Science's Website -

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

The methodology for mapping regional ecosystems can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

Technical descriptions for regional ecosystems can be obtained from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from:

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Government Information System portal,

http://dds.information.qld.gov.au/dds/

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

https://qldglobe.information.qld.gov.au/

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2019). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 4.0. Queensland Herbarium, Department of Environment and Science.

(https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Addicott, E.P. and Appelman, C.N. (2020). Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

(https://publications.qld.gov.au/dataset/redd/resource/6dee78ab-c12c-4692-9842-b7257c2511e4)

Sattler, P.S. and Williams, R.D. (eds) (1999). The Conservation Status of Queensland's Bioregional Ecosystems. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

http://dds.information.qld.gov.au/dds/

- Biodiversity status of pre-clearing and 2019 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

