walker

TOONDAH HARBOUR

CHAPTER 26
CUMULATIVE AND CONSEQUENTIAL IMPACTS

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26. Cumulative and Consequential Impacts

26.1. Definition and Scope

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. Consequential impacts are defined as those which result from further actions which are facilitated to a large extent by the Project (IFC 2013).

This section considers cumulative and consequential impacts of activities external to the Toondah Harbour Project that may combine to result in additional impacts to environmental values not considered by the technical studies contained in the EIS (Chapters 7 - 22), and in particular, any matters of national environmental significance (MNES).

The EPBC Act EIS guidelines further define the requirements of the cumulative and consequential impact assessment. They state:

The EIS must provide a detailed assessment of any likely impacts that the development may facilitate on MNES at the local, regional, state, national and international scale. Assessment of consequential and facilitated impacts must include consideration of:

- *a) the role of the upgraded harbour facilities in increasing general visitation to Moreton Bay, and the impacts of those visitors and their recreational activities;*
- *b) potential for increased activity (for example road traffic, boating and pets at the development site and more broadly in Moreton Bay);*
- *c) any other known development proposals which may be facilitated or impacted (either positively or negatively) by the development;*
- *d) the potential to disturb contaminated land;*
- *e) whether the development will result in an intensification of development or proposals in the region, or an increase in housing or workforce or in local and regional community changes; and*
- *f) any requirements for further proposals of major regional infrastructure to allow the development to go ahead.*

Cumulative impacts must be considered in terms of the potential overall consequence or magnitude of impacts on each of the MNES. The assessment of cumulative impacts must include:

- *a) review and analysis of residual impacts of the proposed development and of other known proposals where there may be a spatial or temporal overlap;*
- *b) consideration of the potential for cumulative impacts on the ecological character of the Moreton Bay Ramsar Wetland, resilience of any important populations of listed threatened or migratory species and ecological communities and on overall habitat quality and availability;*
- *c) consideration of the impact of climate change on MNES; and*
- *d) discussion of the potential for existing pressures and threats to be exacerbated by the proposed development.*

The discussion must include an evaluation of the likely short-term and long-term cumulative impacts on the general environment and ecosystem function where relevant to MNES. In this regard consideration must be given to the potential magnitude of effects and also the duration and reversibility of effects.

26.2. Cumulative and Consequential Impact Assessment Method

There is no specific method for cumulative and consequential impact assessment (CIA) that has gained wide acceptance nationally, or internationally. Any standardised methodology would need to have sufficient flexibility to be adapted to the location, scale and circumstances of a particular project. A tailored methodology which addresses criteria applicable to CIA is likely to be most successful.

While there is no widely accepted method for CIA, a number of guidelines have been published for specific industries or regions (e.g. *The Minerals Council of Australia Cumulative Environmental Impact Assessment Industry Guide* and A *framework for understanding cumulative impacts, supporting environmental decisions and informing resilience-based management of the Great Barrier Reef World Heritage Area*) that can be used as a basis for developing a method at the project level. The various guidelines generally utilise a number of common steps or tasks that form the core of the CIA process. These are:

a. Defining the key issues that need to be addressed by the CIA;
b. Identification of the environmental values with the potential to be impacted;
c. Definition of the spatial and temporal boundaries for considering cumulative and consequential impacts;
d. Identification of the types and sources of potential cumulative and consequential impacts; and
e. Assessment of the risk of impact and potential for significant impacts to MNES.

How these steps will be implemented for the Project CIA is outlined below. It is noted that there are a number of overlaps between the CIA method and the Ramsar impact assessment method. Where overlaps occur, cross reference will be made to the Ramsar impact assessment and, where possible, assessment methods are aligned for consistency in approach.

26.2.1 Key Issues to be Addressed by the CIA

The key issues to be addressed by the CIA are outlined in the EPBC Act EIS Guidelines (refer to Section 26.1). A number of issues specified by the guidelines, such as potential indirect impacts to MNES from increased pedestrian usage, boat and vehicle traffic, and impacts on the ecological character of the MBRS, are addressed in detail in other sections of the EIS. These assessments will not be repeated in the CIA; however, the outcomes will be cross-referenced, and the issues not already addressed will become the focus of the cumulative and consequential impact assessment.

26.2.2 Identifying Environmental Values

Sensitive environmental values are at the centre of CIA (or any impact assessment) as they are the ultimate receptors for any impacts that may occur. They integrate the cumulative effects of different pressures and activities (IFC 2013) and form the investigative focal point for a CIA with concerns typically expressed over a larger scale such as a regional population, catchment or aquifer (Hegmann *et al*. 1999).

Most environmental values to be addressed within the CIA have been addressed in the technical studies of the EIS for the Project (refer to other chapters within Volume 2). However, the broader focus of the CIA may result in the identification of a wider or slightly different range of concerns.

The Project CIA focuses on the cumulative and consequential impacts to which the Project may contribute. The method for identifying the environmental values includes:

- Literature review to identify established and historical threats to the existing environment of the Project footprint and its surrounds;
- Synthesis of consultation outcomes including feedback from community members, relevant experts and State and Federal Government agencies; and
- Review of potential impacts from the Toondah Harbour Project likely to result in significant impacts on environmental values, and MNES in particular.

26.2.3 Definition of Spatial and Temporal Boundaries

The concept of 'Zone of Influence' is utilised for the CIA. The 'Zone of Influence' varies depending on the development type, the actions being undertaken during both the construction and operational phases, and the environmental value being assessed. For example, actions that produce noise, dust or suspended sediment plumes may extend beyond the Project footprint. The spatial Zone of Influence should incorporate all areas with the potential to be impacted by any stage/activity of the Project. The temporal Zone of Influence will be based on the time period that impacts are likely to last. For ongoing or permanent impacts, the temporal boundary will be capped at 20 years as impacts beyond that period are difficult to predict.

The spatial extent will be used to identify actions external to the Project with impacts that may overlap those associated with the Toondah Harbour Project, however assessment of the extent of cumulative impacts may extend outside of this area. As an example, cumulative impacts to migratory bird species may be assessed at the international flyway level.

26.2.4 Identifying Types and Sources of Cumulative and Consequential Impacts

Actions that have caused or may cause effects and actions that may interact with effects caused by the Project need to be identified. Past actions that continue to have positive or negative influences will also need to be considered, such as ongoing maintenance dredging of existing harbours.

It is important that 'cumulative or consequential impact' is defined prior to commencing the CIA. While 'cumulative impact' is not defined in the EPBC Act, section 527E of the Act defines the meaning of 'impact', which includes events or circumstances that are:

- A direct consequence of the action;
- An indirect consequence of the action; and
- Facilitated to a major extent by the action.

In accordance with this definition, the impacts being considered in this CIA will be those that are direct, indirect or facilitated to a major extent by the Toondah Harbour Project. In this context, the definition of impact within the EPBC Act is considered to provide sufficient coverage of the generally accepted definition of CIA.

Hegmann *et al*. (1999) describe a set of criteria for categorising future actions into certain, reasonably foreseeable and hypothetical (refer to Figure 26-1). Pragmatism dictates that only those actions categorised as certain and some reasonably foreseeable actions that could have a significant cumulative impact with the Toondah Harbour Project will be considered. Speculative actions by definition lack detail and contain too many uncertainties to be considered by an impact assessment process.

Consideration must also be given to facilitated or ancillary actions (i.e., consequential actions) that are future activities that may occur if the project is approved (e.g., road works, Waste Water Treatment Plant upgrades, utility supply, etc.). These impacts are difficult to predict as they are generally speculative at the time an EIS is lodged. For the purposes of this assessment potential consequential actions will be identified and assessed based on their potential to impact on similar environmental values to the Toondah Harbour Project.

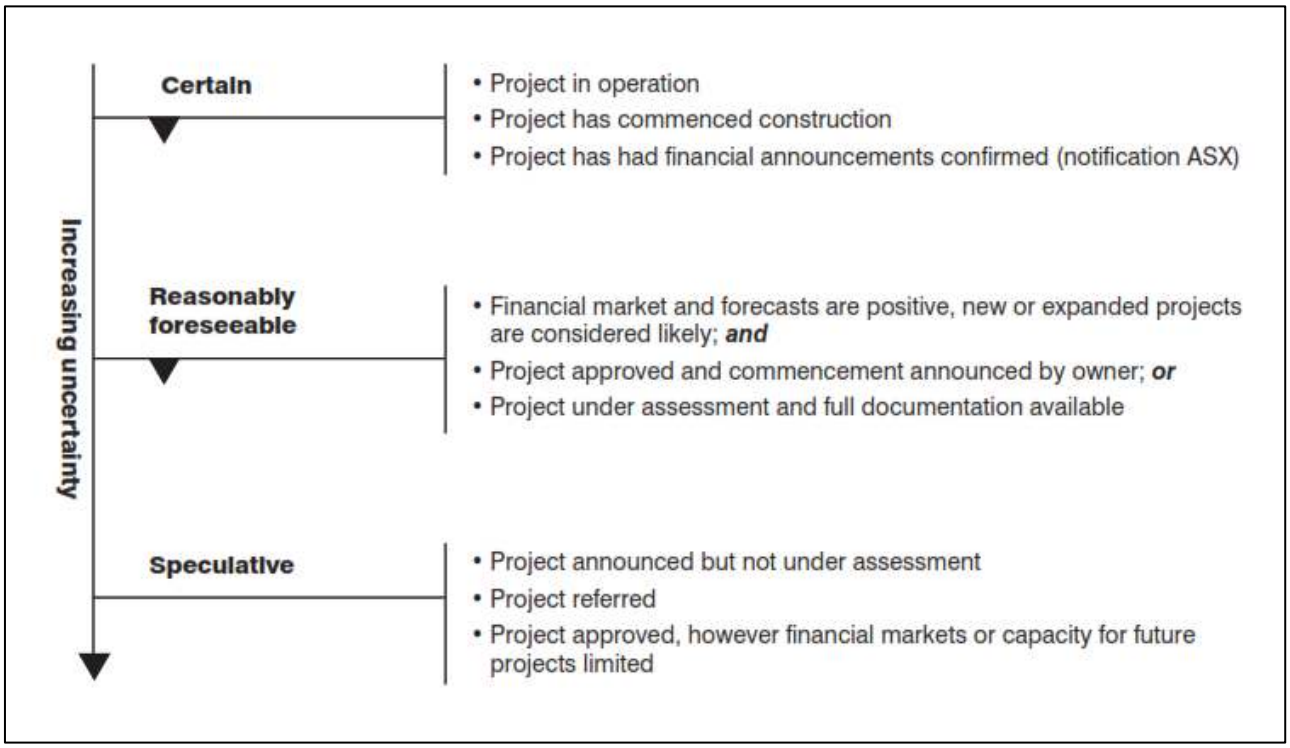


Figure 26-1: Decreasing Certainty of Project Forecasting (taken from Kaveney, Kerswell and Buick 2015).

26.2.5 Risk and Significant Impact Assessment Process

Risk and significant impact assessment can be done a number of ways. The EIS technical studies have utilised two separate approaches:

- A standardised risk assessment using likelihood, scale and duration; and
- Analysis against the relevant MNES significant impact criteria to outline the severity and nature of the impacts.

This dual approach provides both a risk and data informed qualitative assessment of impacts that can be used to support various approval and mitigation planning actions. The dual approach can also work to confirm findings and expose any gaps or differences between the two approaches. The risk assessment method is described in Chapter 6.

The CIA will include an assessment of potential risk to identified environmental values by cumulative and consequential actions including impacts associated with the Project. This will conclude with a risk assessment conducted as follows:

- A general risk assessment will be carried out for the Project and each relevant cumulative and consequential action using the method outlined in Chapter 6 and used throughout the technical chapters in Volume 2. Residual risk ratings for the 'other projects' will be obtained and/or interpreted from the respective Project's environmental assessment documentation and inputs from relevant experts involved in the impact assessment for the Toondah Harbour Project.
- A residual risk rating will be assigned against each cumulative and consequential action using the scoring method outlined in Table 26-1.
- The risk rating scores from the Toondah Harbour Project and 'other projects' will be weighted based on the potential for impacts on the environmental value being assessed. Weightings are assigned based on experience and knowledge of the area however to provide a conservative assessment larger weighting will be assigned to actions that have higher risk of impact.

- Weightings are assigned as a percentage so that an overall risk score can be calculated using rating scores outlined in Table 26-1. This method provides an overall score out of 4, with 1 being a very low risk of impact and 4 being a high risk.
- Where the environmental value being impacted is a MNES an cumulative impact assessment will be carried out against the relevant significant impact criteria.

Table 26-1: Scoring of Residual Risk.

Residual Risk Rating	Score
Very Low	1
Low	2
Medium	3
High	4

Finally, once the environmental risk of all external projects has been evaluated, the additional risk of exogenous factors, such as climate change and severe weather events will be considered. This assessment will be qualitative in nature and based on known sensitivities of the environmental value to external factors.

26.3. Cumulative and Consequential Impact Assessment

26.3.1 Key Issues to be Addressed

Key issues to be addressed by the CIA are outlined by the EPBC Act EIS Guidelines. Some of these issues are addressed in detail in other areas of the Draft EIS. Table 26-2 lists out the key issues, cross references the EIS section where they are addressed and provides a summary of the assessment outcomes. Through this process key issues that have not been addressed elsewhere are identified and will be the focus of the CIA.

Table 26-2: Key Issues to be Addressed by the CIA.

Key issue	EIS section cross reference	Summary of outcomes
Role of the upgraded harbour facilities in increasing general visitation to Moreton Bay, and the impacts of those visitors and their recreational activities. Potential for increased activity (for example road traffic, boating and pets) at the development site.	3.1 – Marine Vessel Traffic 3.3 – Vehicle Traffic 15.4.2 – Potential Impacts on Koalas 17.4 – Disturbance Impacts on Shorebirds 16.5.3 – Ongoing Use Impacts on Marine Ecology	An assessment of existing and predicted boat use at Toondah Harbour and surrounding areas found: ▪ Recreational boating use of Moreton Bay and the Redland City LGA is expected to grow. Registered vessels in the LGA are expected to increase from 23,559 to approximately 28,000 by 2031. Average weekend daily use is expected to increase from 1,410 to 1,668 vessels. ▪ The existing public boat ramp at Toondah Harbour will be decommissioned by the Project. Motorised recreational boat traffic generated by the new 200-berth marina is expected to be the same or less than traffic generated by the existing boat ramp. ▪ The Proponent will contribute to upgrades to the nearby William Street boat ramp at Cleveland to provide improved access for recreational vessels. Upgrades to the William Street boat ramp have been identified by a statewide Recreational Boating Facilities Demand Study as the top priority to increase capacity for recreational boating in the Redland City LGA, as it is already highly utilised with up to 200 vessels launched from the ramp during peak periods. ▪ The existing boat ramp will be replaced with a boat ramp for non-motorised vessels, such as kayaks and dinghies, and will provide water access over most, but not all, tidal phases. ▪ No data is available to make an informed prediction of the use of the boat ramp by non-motorised vessels, however the beach at GJ Walter Park is already a high tide kayak launch point. It is expected that the improved facilities and access provided by the Project could result in a moderate increase in non-motorised vessel use of the northern part of the PDA. A combination of natural morphology and educational signage will discourage traffic from non-motorised vessels travelling south towards Cassim Island. ▪ Additional demand for vehicle and passenger ferries is expected to be met through the use of larger vessels that cannot currently be used as the Fison Channel and turning basin are too narrow and shallow. To provide a conservative estimate, a small increase of six trips (12 vessel movements) per day is predicted. Middle Street is expected to see an increase in daily vehicle traffic movements of 2,561 trips after five years of development and a further 8,308 trips after 10 years with an ultimate increase of up to 15,827 trips. Shore Street East is expected to see an ultimate increase of up to 3,625 trips per day.

Key issue	EIS section cross reference	Summary of outcomes
		Potential for impacts to threated and migratory species from increased use are addressed in the relevant sections of the EIS: ▪ Noise and lighting are not expected to affect shorebird roost sites. Many studies have demonstrated the ability of many shorebird species to habituate to repetitive disturbance such as pedestrian activity. ▪ Dog attacks on koalas commonly occur when koalas enter suburban yards where dogs are housed. Cleveland is a highly urbanised area and GJ Walter Park includes a dog off leash area therefore this threat already exists at the site. The residential properties proposed for the Project are town houses and apartments where smaller, 'inside' dogs would be the norm. Educational materials will be supplied to all buyers and signage will be installed throughout open space areas. The Proponent will also contribute to RCC initiatives including the Koala Safe Neighbourhood Program. As a result, it is not expected that there will be an increased threat of dog attack on koalas because of the Project. ▪ While the Proponent cannot implement works outside of the PDA on its own, it is consulting with RCC to contribute to measures that improve koala movement through the Cleveland area including habitat tree planting and starting a Cleveland Koala Safe Neighbourhood program. ▪ Increased boat traffic may increase the chance of collisions between boats and marine vertebrates, particularly turtles and dugongs, both in the immediate vicinity of the Project footprint and in the broader environs of the Moreton Bay Marine Park. Boat movements are not expected to increase significantly as a result of the Project and a number of management measures will be put in place to reduce risk. **EIS technical assessments have considered both the broader context and impacts from other projects within the zone of influence. Accordingly, no further assessment is required by the CIA.**
Potential to disturb contaminated land	7.5.2 – Contaminated Land Assessment 7.6.3 – Contaminated Land Impacts 10.3.4 – Groundwater Quality	A preliminary site investigation (PSI) for contaminated land was carried out and identified the following potential sources of contamination: ▪ Diesel above-ground storage tanks (ASTs) are located at the passenger and vehicle ferry terminals, as fuel supply for ferries. One lot within the Trade College is also listed on the environmental management register (EMR) for fuel storage. Both ferry terminals also have waste oil ASTs, which are located adjacent to the diesel ASTs.

Key issue	EIS section cross reference	Summary of outcomes
	10.4.3 – Potential Impacts of Dewatering	▪ Stormwater from the site and surrounding urban area discharges to Moreton Bay at four locations at the site. A sewer discharge point is located at the north end of GJ Walter Park. ▪ Dredge material was previously disposed of at the disused maintenance dredge material disposal pond located south of the ferry terminals. ▪ Two ponds were previously located in the carpark area at the southern end of GJ Walter Park. It is not known what these ponds were used for. ▪ Intrusive investigations indicate that GJ Walter Park was historically used for waste disposal during the 1970s. ▪ The majority of the Toondah Harbour PDA site has been subject to filling to raise the ground level from the historical intertidal zone. Specific sources of fill are not known, except that waste material is present within the GJ Walter Park area. Potential impacts from existing contaminated areas are related to any excavation in areas identified as high risk by the PSI, including GJ Walter Park, the workshop area, the passenger ferry terminal (fuel storage and delivery infrastructure), vehicle ferry terminal (fuel storage and delivery infrastructure), disused dredge sediment pond, and the trade college (petroleum storage), and soils from the EMR listed lots. Any potential impacts will be managed on site through more detailed assessment prior to construction and identification of site and use-specific management and remediation requirements. Site-specific contaminated land assessment and management plans will be developed for these areas prior to construction to minimise and address risk. Groundwater sampling has shown no evidence of contamination from historical landfill under GJ Walter Park leaching into the groundwater system. Some localised and temporary groundwater drawdown will occur during construction of the northern reclamation area. Temporary sheet piling will be placed between the reclamation area and GJ Walter Park minimising the potential for any contaminants to be transported offsite form the landfill area in the event of leaching. Ongoing monitoring will also be carried out through the construction period and mitigation measures put in place if contaminants are detected. The sheet piling will be removed on completion of the northern reclamation returning groundwater levels to their preconstruction level.

Key issue	EIS section cross reference	Summary of outcomes
		The potential for further cumulative impacts is negligible as existing contaminated areas can be managed on site including detailed soils assessment prior to on ground works commencing therefore no further assessment required by the CIA.
Whether the development will result in an intensification of development or proposals in the region, or an increase in housing or workforce or in local and regional community changes	21.3 – Regional Economic Analysis 20.6 – Increased Local Employment Opportunities and Housing Diversity	The Economic Analysis of the Toondah Harbour Development estimated there will be a peak of 770 full time equivalent (FTE) construction jobs per annum created by the Project. When combined with the estimated employment on Minjerribah and harbour operations, peak employment is expected to be well in excess of 1,000 FTEs. The Redland City LGA will grow by 36,000 people between 2016 and 2041, with an additional 17,200 dwellings needed to accommodate this growth. The Project has the potential to have a high positive impact on housing diversity in Cleveland and the Redland City LGA. This includes the provision of dwellings of diverse sizes and configurations, as well as the incorporation of accessible and affordable housing. The Cleveland area is currently predominantly low density residential but is zoned for denser development (i.e., apartment buildings), which has been occurring over several years. While the Project may not facilitate further development in itself, cumulative impacts with future increases in density needs to be assessed. **Impacts from urban intensification to be addressed by CIA.**
Requirements for further proposals of major regional infrastructure to allow the development to go ahead	2.5 – Civil Infrastructure and Services	Electricity, telecommunications, water and sewage will all connect to existing infrastructure services and assets. The Project will not require any new major regional infrastructure however it is likely to result in some road upgrades and an upgrade to the Cleveland Wastewater Treatment Plant. **Impacts to infrastructure upgrades to be addressed by CIA.**
Review and analysis of residual impacts of the proposed development and of other known proposals where there may be a spatial or temporal overlap	N/A	**To be addressed by CIA.**

Key issue	EIS section cross reference	Summary of outcomes
Consideration of the potential for cumulative impacts on the ecological character of the MBRS, resilience of important populations of listed threatened or migratory species and ecological communities and on overall habitat quality and availability	Impacts to the MBRS, including cumulative impacts, are addressed in Chapter 27.	**Addressed in Chapter 27.**
Consideration of the impact of climate change on MNES	8.4.5 – Extreme Event Simulation with Climate Change	Two different levels of sea level rise (SLR) were superimposed to the modelled water level boundary conditions to represent possible future climate change scenarios: ▪ 0.4 m sea level rise (likely change over the next 50 years); and ▪ 1.5 m sea level rise (required by the EIS guidelines – worst case far-future scenario). In both scenarios modelling results indicate that the Project footprint effectively provides additional shielding to the coastline from Toondah Harbour to south of Oyster Point. This shielding produces a marked reduction in wave height within and around the Project. While the Project itself will not generate significant amounts of carbon and will not contribute to drivers of future climate change, additional stresses to MNES should be reviewed. **Additional Impacts to MNES from climate change to be addressed by CIA**
Discussion of the potential for existing pressures and threats to be exacerbated by the proposed development	N/A	**To be addressed by CIA**

26.3.2 Environmental Values that may be Impacted

Environmental values within and surrounding the Toondah Harbour Project footprint with the potential to be impacted by the Project have been assessed in detail in other chapters of the Draft EIS. Table 26-3 provides a summary of environmental values, potential impacts and whether further analysis is required by the CIA. Where EIS technical studies found impacts to an environmental value are unlikely to occur or will be localised to the Project footprint, those values will not be considered further in the CIA as the risk of any cumulative or consequential impacts is considered to be negligible (i.e., there will be no spatial or temporal crossover of impacts).

Impacts to the Ecological Character of the MBRS, including cumulative and consequential impacts, are addressed in Chapter 27.

Table 26-3: Environmental Values Considered in the CIA.

Value	Potential impact from Toondah Harbour Project	CIA requirement	EIS section cross reference
Coastal Processes	The Project will result in some changes to hydrodynamic processes such as current velocities, wave heights and erosions and accretion however these are all expected to be minor and localised to areas immediately surrounding the Project footprint.	As changes are localised and minor, further consideration by the CIA is **not required**.	Chapter 8 – Coastal Processes and Dredge Plume Modelling
Water Quality	The Project will result in increases in nutrients and suspended solids within the marina basin and internal channels however these will be short-term and localised. Dredging will result in increased turbidity outside the Project footprint (extending north to approximately Cleveland Point) while works are being carried out. A small amount of sedimentation outside of the Project footprint is also expected. It is noted that dredge plume modelling does not include the use of silt curtains. Silt curtains will be employed wherever practical resulting in significantly smaller sediment plumes than those predicted.	As impacts will occur outside of the Project footprint, further consideration by the CIA **is required**.	Chapter 9 – Water Quality
Groundwater	Modelling indicates that the Project will not impact on groundwater permeability or availability outside of the Project footprint, including at potential groundwater dependent ecosystems (GDEs). Some groundwater mounding behind sheet piling may occur, which has some potential to mobilise existing contaminants located under GJ Walter Park as a result of previous use as a landfill. However, groundwater sampling did not identify any contaminants at levels of concern. Modelling and impact analysis found that any mounding would be highly localised in areas adjacent to the sheet pile walls and can be dealt with quickly and simply through ongoing monitoring and immediate remediation. It also identified that drawdown would be localised and temporary on the landward side of the Project with conditions expected to return to pre-construction levels once temporary sheet piling is removed between the northern reclamation and GJ Walter Park. As the	As changes are localised and minor, further consideration by the CIA is **not required**.	Chapter 10 – Groundwater Quality and Quantity

Value	Potential impact from Toondah Harbour Project	CIA requirement	EIS section cross reference
	groundwater regime is highly influenced by tidal waters, no impacts are expected in areas seaward of the Project footprint.		
Ambient air quality	Air emissions generated by the Project were predicted to comply with human health and environmental criteria. Emissions will only occur during construction periods and therefore will be short term. The EIS assessment included background data from a site impacted by rail and road traffic, which effectively provides a cumulative assessment of impacts.	As changes are localised, minor and short term, further consideration by the CIA is **not required**.	Chapter 11 – Air Quality
Ambient noise	Noise modelling indicated that the Project is likely to cause periods of high noise in adjacent areas, including the Nandeebie Claypan and Cassim Island. However, these exceedances will be short lived and for most of the construction period is expected to readily comply with acoustic quality objectives. High noise generating activities such as sheet piling will be carried out from April to September to avoid potential indirect impacts on migratory shorebird species. Real time monitoring will also be carried out at Nandeebie Claypan and Cassim Island to ensure noise levels do not exceed limits that may result in disturbance.	As changes are localised, minor and short term, further consideration by the CIA is **not required**.	Chapter 12 – Terrestrial and underwater Noise and Vibration
Underwater Noise and Vibration	Underwater noise from sheet piling will occur for up to 3.25 hours either side of high tide when piling furthest from the shore. When sheet piling closer to the shore, the water is shallower and period in the water will be less. The impact piling in the marina will not generate underwater sound levels outside the marina basin since it is essentially a full enclosed body of water with only a narrow shallow connection to Moreton Bay at that stage of the project. Impact piling at the ferry terminal will result in underwater noise however this would be attenuated by mudflats either side of the dredge channel. The impacts of construction noise on marine fauna are addressed in Chapter 16. Levels fall below the US National Oceanic and Atmospheric Administration behavioural criteria of 160 dB re 1 µPa for impact pile	As changes are localised, minor and short term, further consideration by the CIA is **not required**.	Chapter 12 – Terrestrial and underwater Noise and Vibration

Value	Potential impact from Toondah Harbour Project	CIA requirement	EIS section cross reference
	driving and SPL 120 dB re 1 µPa for vibration pile driving within 1 km of the Project footprint.		
Terrestrial threatened species and communities	The PDA contains a small area of habitat for koalas it is not considered significant or important for any terrestrial species listed under the EPBC Act. However, it is recognised that it contributes to supporting the Cleveland urban koala population. Only a small number of koala habitat trees will be removed as a result of the Project and plantings within GJ Walter Park will more than compensate for any trees removed. Therefore. potential impacts to koalas are generally associated with increased traffic and barriers to dispersal that may occur outside of the Project footprint.	As impacts will occur outside of the Project footprint, further consideration by the CIA **is required**.	Chapter 15 – Terrestrial Ecology
Migratory and threatened shorebirds	Dredging and reclamation to accommodate the Project footprint will result in a permanent direct impact on feeding habitat for migratory shorebird species. The loss of 28.9 ha of tidal flat feeding habitat, which corresponds to 0.29 % of the approximately 10,000 ha of tidal flat habitat within Moreton Bay is likely to have a significant residual impact on: ▪ Migratory shorebirds, by reducing the capacity of the important habitat to support migratory shorebirds; ▪ Critically endangered eastern curlew, by adversely affecting feeding habitat and reducing the area of occupancy of the species in feeding habitat by 0.29% within Moreton Bay; and ▪ Vulnerable bar-tailed godwit (Western Alaskan), by adversely affecting feeding habitat and reducing the area of occupancy of an important population of the species by 0.29% within Moreton Bay.	As the Project will likely result in impacts to this environmental value further consideration by the CIA **is required**.	Chapter 17 – Migratory and Threatened Shorebirds
Marine threatened species and habitats	There will be a direct loss of habitat due to the construction of the Project, including: ▪ 3.4 ha of mangroves; ▪ Up to 37 ha of seagrass, including 11.8 ha in the Fison Channel some of which is likely to regrow; and	As the Project will likely result in impacts to this environmental value further consideration by the CIA **is required**.	Chapter 16 – Marine Ecology

Value	Potential impact from Toondah Harbour Project	CIA requirement	EIS section cross reference
	▪ 25 ha of sandbanks and mudflats, including 16.2 ha in the Fison Channel. Five species listed under the EPBC Act use the area likely to be impacted by the proposed works: loggerhead turtles, green turtles, hawksbill turtles, dugongs and Australian humpback dolphins. While dugong and marine turtles feed on seagrass, this is not a significant habitat for them. Australian humpback dolphins are found throughout the bay and the Project footprint is not part of their core habitat. Whale species such as the southern right whale also occasionally utilise Moreton Bay but are not known to frequent the Project footprint.		
Commercial and recreational fisheries	The Project will result in a minor loss of recreational fishing access which will be addressed by enhanced facilities and amenities and loss of habitat which does not represent a risk to the populations of fished species.	As changes are localised and minor further consideration by the CIA is **not required**.	Chapter 18 – Commercial and Recreational Fisheries
Moreton Bay Ramsar Site	Impacts to the MBRS, including cumulative impacts, are addressed in Chapter 27		Chapter 27 – MBRS Impact Assessment

26.3.3 Spatial and Temporal Boundaries for the CIA

Spatial and temporal boundaries for each of the environmental values addressed through the CIA will be based on the maximum potential 'Zone of Influence' of Project-related impacts. The assessment boundaries are summarised below and shown on Figure 26-2:

- **Water Quality** – modelling indicates dredge plumes will extend from Cleveland Point in the north to Goleby Esplanade Foreshore Park in the south. While the plume will not extend much further east than Fison Channel, the western shore of Peel Island will be used as the spatial boundary for impacts. Plumes will settle quickly once dredging is completed (within 24 hours). The first maintenance dredging event is likely to be required four to five years after the completion of the second capital dredging campaign. The temporal boundary for impact assessment will be up to the completion of the first maintenance dredging event (approximately 10 years after construction commencement).
- **Terrestrial Threatened Species and Communities** – potential cumulative and consequential impacts are restricted to increased traffic and barriers to movement for urban koala populations in the Cleveland area therefore the spatial boundary utilised will be the suburb of Cleveland. Traffic will be generated through the life of the Project and afterwards, therefore temporal impacts will be considered over 20 years.
- **Migratory and Threatened Shorebirds** – while impacts are not expected outside of the Project footprint, migratory birds are highly mobile and have the potential to utilise habitats throughout Moreton Bay. While migratory shorebirds often show high site fidelity to both roost sites and feeding habitat areas, satellite tracking of the movements of eastern curlew within Moreton Bay over several years (Lilleyman *et al*. 2020) has shown that they move through several locations within their home range locations within the bay and travel from 1 to 20 km between roosting and feeding areas. Therefore, cumulative impacts on foraging and roosting habitat will be addressed for Central Western Moreton Bay (Brisbane River to Logan River). Discussion will also be provided on potential impacts at the whole of Moreton Bay and Flyway level. As the loss of habitat will be permanent, ongoing impacts will be considered over 20 years.
- **Marine Threatened Species and Habitats** – the Project is considered unlikely to directly impact any threatened marine species therefore the CIA will focus on potential impacts to marine habitats including mangroves, saltmarsh and seagrass for the South Western Moreton Bay area. As the loss of habitat will be permanent, ongoing impacts will be considered over 20 years.

Some cumulative and consequential impacts associated with the Project may occur outside of these boundaries. If so, those impacts will be addressed individually.

26.3.4 Actions that may Result in Cumulative and Consequential Impacts

Projects that may result in cumulative and consequential impacts are listed in Table 26-4 and shown relative to the Project on Figure 26-2. No consequential projects were identified through this process, as the Project will result in the full development of the Toondah Harbour PDA. It is expected some tourism ventures on the mainland and Minjerribah (North Stradbroke Island) are likely to occur as a result of the Project, but these are anticipated to utilise existing infrastructure or infrastructure proposed by the current or planned projects identified as cumulative impacts.

Table 26-4: Actions with Potential for Cumulative and Consequential Impacts.

Project	Status	Brief Description	Action Type	Outcome for CIA
Cumulative Actions				
Southern Redland Bay Wastewater Treatment Plant (WWTP)	Referred under the EPBC Act on 6 January 2021 (EPBC 2020/8849)	Construction and operation of a permanent wastewater treatment plant and ancillary infrastructure (i.e., storage lagoon, mains connection and access roads) to service up to 5,000 dwellings on cleared and degraded land. Includes creation of a 9.85 ha mangrove wetland as a natural filtration system and nutrient offset for treated wastewater.	Reasonably foreseeable	**Include Project**
Weinam Creek PDA Master Plan	Ongoing	The project will be developed in stages and will include more open space; new pedestrian and cycle ways; rejuvenation of existing parkland; more car parks; improved drop off and storage facilities for island residents and visitors; a new boat ramp to separate emergency and public access; a mix of residential and retail spaces including cafes restaurants and potential for a medical precinct. Construction for Stage 1 has been completed including a new car park and foot bridge.	Reasonably foreseeable	**Exclude Project** – Stage 1 has been completed and no details have been released or applications lodged for future stages
Port of Brisbane Expansion	Approved in 2001 (EPBC 2000/25) - Reclamation near completion	Approximately 230 ha expansion of the Port of Brisbane through reclamation 1.8 km seaward of the previous port area. Reclamation fill has been sourced from dredged material from maintenance activities and the creation of new berth pockets. The southeastern extent of the reclamation is currently utilised as roosting habitat by a large number of migratory shorebirds.	Certain	**Include Project** – reclamation ponds completed however landform and development ongoing
Maintenance dredging of nearby harbours and marinas	Occurs periodically. Most harbours have long term approvals.	Maintenance dredging of nearby harbours and marinas within the assessment area, including: Weinam Creek, Raby Bay, Aquatic Paradise and Manly Boat Harbour. Dredged material is generally disposed of at the Mud Island unconfined ocean disposal site, which is outside of the CIA spatial boundary and unlikely to result in cumulative impacts with the Project.	Certain	**Include Projects**
Cleveland apartment developments and intensification	Approved in 2020. Other applications likely in the future.	A number of lots along Middle Street and Shore Street East are zoned medium density. A number of apartment development have occurred or been approved in this area. Recent approvals include development of 53 units at 152 Middle Street and another for 47 units at 196 Middle Street. These developments are located in predominantly cleared areas however will result in increased traffic generation in the Cleveland area.	Reasonably foreseeable	**Include Projects**

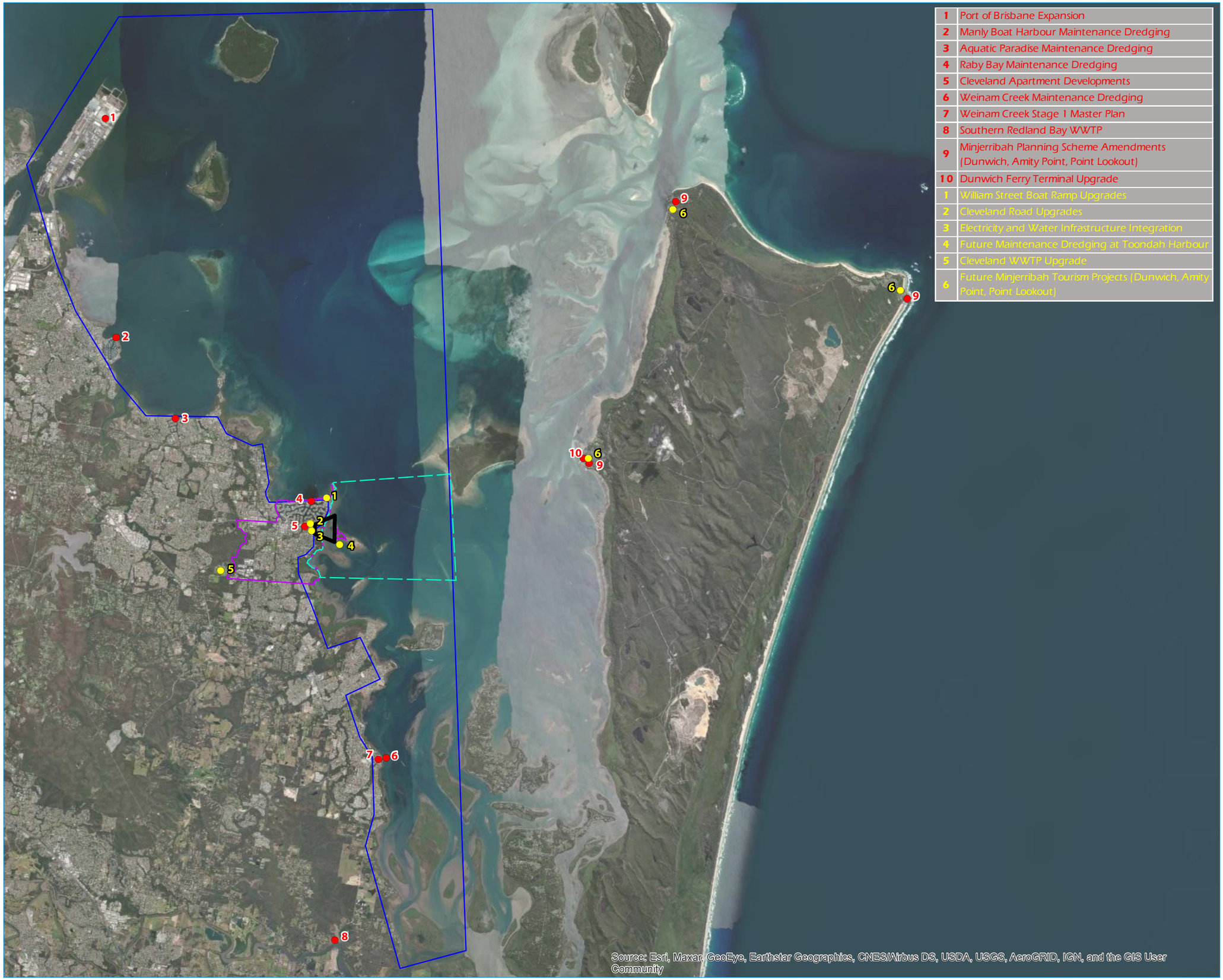
Project	Status	Brief Description	Action Type	Outcome for CIA
North Harbour	Two referrals were lodged in 2021 for a marina extension (EPBC 2021/9007) and waterways and waterfront residential (2021/9090). The referral decision is currently suspended for the marina extension and the residential action is currently being assessed by Public Environment Report	While outside of the CIA spatial boundary, the proposed North Harbour Marina Development and associated urban uses has the potential to impact on similar environmental values as the Toondah Harbour Project. The project is located approximately 55 km northwest of Toondah Harbour adjacent to the Caboolture River. The site is not within Moreton Bay or the MBRS, however it is adjacent to the Ramsar site boundary. Information provided with the referral documentation indicates while some species impacted by the Toondah Harbour Project also have the potential to be impacted by works at North Harbour (e.g., eastern curlew and bar-tailed godwit), habitats being impacted are different. North Harbour is generally situated within grass and sedge lands on the Caboolture River and not on tidal habitats. The distance between the sites is also greater than the home range of these species which is up to 20 km for the eastern curlew.	Reasonably foreseeable	**Exclude Project -** Given its distance from the Toondah Harbour PDA and different impact types, North Harbour is not included in the CIA.
Dunwich Ferry Terminal Upgrade*	Upgrade of the Dunwich Ferry Terminal announced in March 2022	The Federal and State governments along with the Council of Mayors (SEQ) announced a $1.8 billion SEQ city deal in March 2022, including $42 million for upgrade of the Dunwich Ferry Terminal. No other details have been provided however information included with the release indicates works will focus on removing the existing dilapidated One Mile and Junner Street ferry terminals and replacing them with new terminals and bus and taxi hubs in time for the Brisbane 2032 Olympic and Paralympic Games. This level of works aligns with the Queensland Government's Gumpi (Dunwich) Draft Masterplan (July 2021). Neither the Draft Masterplan nor the city deal announcement indicate that any capital dredging will be carried out as part of the upgrade.	Reasonably foreseeable	**Exclude Project –** no project details exist, and works will replace existing dilapidated infrastructure, most of which is on land.
Minjerribah Planning Scheme Amendments*	Public submissions on amendments open from 31 May to 11 July 2022	The proposed planning scheme amendments seek to rezone approximately 25 lots, covering approximately 249 ha of land at Dunwich (Gumpi), Amity (Pulan Pulan) and Point Lookout (Mulumba) on Minjerribah (North Stradbroke Island) from primarily environment and conservation zoning to a mixture of new urban zones. The proposed future uses could include low-density residential, tourist accommodation, community facilities, emerging community, local and neighbourhood centres, low and medium impact industry, waterfront and marine industry, recreation and open space.	Reasonably foreseeable	**Exclude Project –** planning scheme amendments are not finalised therefore no specific project details exist. Any impacts will occur in terrestrial habitats. Much of the area nominated for rezoning is remnant or regrowth Corymbia intermedia (Pink Bloodwood) open forest

Project	Status	Brief Description	Action Type	Outcome for CIA
		In accordance with the proposed amendment, most types of future development on the rezoned land parcels will require development applications to be assessed and decided by all levels of government.		which is not present within or adjacent to the Project footprint.
Consequential Actions				
Cleveland WWTP upgrade	Studies indicate WWTP upgrade is likely	Sewage treatment at the site will integrate with RCC's existing network with ultimate release to the Cleveland WWTP. Preliminary investigations indicate an upgrade to the plant is likely although the extent of the upgrade is unknown.	Reasonably foreseeable	**Include Project** – unlikely to result in additional impacts on environmental values (EVs) affected by the Project but may have impacts in other areas.
Road upgrades in the Cleveland area	Unknown	Some roads and intersections outside of the Project footprint may require upgrades to accommodate increased traffic generation. Upgrades will be in existing urban area therefore impacts on environmental values would be minimal.	Speculative	**Exclude Project** – requirements would be subject to future studies by RCC.
Upgrades to William Street Boat Ramp	Unknown	As part of the agreement for the Project, the Proponent will contribute funds for the planned upgrade of the William Street Boat Ramp. Upgrades to this ramp were identified as a key priority by the Queensland Recreational Boating Facilities Demand Study (GHD 2017) and would be implemented regardless of the Toondah Harbour Project. The closure of the Emmett Drive public boat ramp in the Toondah Harbour PDA as a result of the project will give the upgrades impetus.	Reasonably foreseeable	**Include Project** – While upgrades to William Street Boat Haven would occur regardless of the Toondah Harbour Project, they have the potential to result in cumulative impacts.
Future maintenance dredging of Toondah Harbour entrance channel and marina	Occurs every 4–5 years	Maintenance dredging is carried out regularly for the existing Fison Channel and will continue after the extension of the Channel and turning basin.	Certain	**Include Project** – likely to occur and included in impact assessment for the Project.
Electricity and water infrastructure requirements	Operational works applications will be lodged prior to construction	Preliminary investigations show the development will be able to integrate with existing electricity and water infrastructure. Some upgrades may be required however they would be minor and in urban areas, therefore unlikely to impact on environmental values.	Certain	**Exclude** – impacts to EVs unlikely.
Future tourism related development on	Unknown	While no projects have been announced, the Toondah Harbour Project may result in new culture and nature-based tourism Projects on Minjerribah. Any assessment	Speculative	**Exclude** – Impacts to EVs unlikely

Project	Status	Brief Description	Action Type	Outcome for CIA
Minjerribah (North Stradbroke Island)*		of impacts is impossible as no projects are announced and therefore no details available. Any future projects are likely to occur at either Dunwich, Amity or Point Lookout. Outside of these hubs almost the entire island is zoned as conservation under the Redland City Plan. A significant portion of the island is also national park with other areas mapped as MNES for protected vegetation or habitat. They would also require detailed assessment against relevant local, state and federal requirements, including the EPBC Act. In addition, new ventures would be targeted at cultural and nature-based tourism therefore by their nature are unlikely to have significant ecological impacts. In the event land on Minjerribah was impacted, EVs would not overlap with those at Toondah Harbour (i.e., tidal habitats are unlikely be impacted).		

* Proposed projects on Minjerribah are at the early stages of planning and do not have a temporal or spatial overlap with the Toondah Harbour Project. However, as Toondah Harbour is the primary mainland link to the island any potential future development has been considered in this assessment.

Figure 26-2: CIA Spatial Boundary and Actions that may Contribute to Cumulative Impacts



1	Port of Brisbane Expansion
2	Manly Boat Harbour Maintenance Dredging
3	Aquatic Paradise Maintenance Dredging
4	Raby Bay Maintenance Dredging
5	Cleveland Apartment Developments
6	Weinam Creek Maintenance Dredging
7	Weinam Creek Stage 1 Master Plan
8	Southern Redland Bay WWTP
9	Minjerribah Planning Scheme Amendments (Dunwich, Amity Point, Point Lookout)
10	Dunwich Ferry Terminal Upgrade
1	William Street Boat Ramp Upgrades
2	Cleveland Road Upgrades
3	Electricity and Water Infrastructure Integration
4	Future Maintenance Dredging at Toondah Harbour
5	Cleveland WWTP Upgrade
6	Future Minjerribah Tourism Projects (Dunwich, Amity Point, Point Lookout)

Legend

- Toondah Harbour PDA (Project Area)
- Qld DCDB
- Terrestrial Threatened Species CIA boundary
- Water Quality and Marine Habitats CIA Boundary
- Migratory and Threatened Shorebirds CIA Boundary
- Cumulative Impact Actions
- Consequential Impact Actions

Layer Source: © State of Queensland Datasets (Department of Natural Resources, Mines and Energy 2020), Aerial Imagery (Nearmap.com 2020)

Toondah Harbour EIS

TOONDAH HARBOUR

walker

0 1 2 3 4 Kilometers

GDA 1994 MGA zone 56

Scale (A3): 1:160,000

N

DATE: 20/07/2022

FILE REF. 9858 E Figure 26 2 CIA Boundary and Actions B

26.3.4.1 *Potential Sources of Impacts*

Based on the EVs identified in Table 26-3 and actions that may result in cumulative and consequential impacts identified in Table 26-5, a number of sources for impacts on EVs can be determined. To establish a consistent and simplified framework for the risk analysis, a suite of potential mechanisms of impact was established and are summarised in Table 26-5. These sources will be reviewed for their potential to impact on the identified EVs. The specific MNES that have the potential to be impacted are also identified. As addressed in Table 26-2 potential impacts, including cumulative impacts on the MBRS are addressed in Chapter 27, therefore are not included in the current assessment.

Table 26-5: Potential Sources for Impact Utilised for the CIA.

Potential source of impact included in CIA	Types of potential impacts included in the CIA	MNES potentially impacted
Direct removal of habitat	▪ Loss of seagrass habitat from smothering or being cut off from the marine environment. ▪ Loss of fisheries habitat through clearing of mangroves or saltmarsh. ▪ Loss of foraging or roosting habitat for shorebirds associated with the loss of mudflats in intertidal environments. ▪ Loss of koala habitat through clearing of food trees.	▪ Listed threatened species ▪ Listed migratory species
Secondary and indirect impacts on habitat	▪ Impacts to water quality through sediment plumes or release of nutrients. ▪ Reduced water quality impacting on the health of benthic communities (i.e., seagrass or coral). ▪ Disturbance of shorebird habitat (foraging or roosting sites) through increased noise, human presence or light. ▪ Increased stress on the Cleveland urban koala population through increased noise, human presence or light.	▪ Listed threatened species ▪ Listed migratory species
Turbidity and sedimentation	▪ Increased light attenuation reducing photosynthesis and growth rates of seagrass. ▪ Burial of benthic organisms through deposition of sediment suspended through the dredging process.	▪ Listed threatened species
Injury and mortality	▪ Injury and death caused by contact with increased levels of waste and marine debris. ▪ Injury and death caused by entrapment and direct contact with construction machinery and/or vessel strike. ▪ Injury and death to koala cause by vehicle strike or dog attack.	▪ Listed threatened species ▪ Listed migratory species

26.3.5 Cumulative Impact Assessment

26.3.5.1 *Water Quality*

Cumulative and consequential actions with the potential to impact on water quality include:

- Southern Redland Bay WWTP;
- Cleveland WWTP upgrade;
- Maintenance dredging of nearby harbours and marinas; and
- Future maintenance dredging of Toondah Harbour entrance channel and marina.

Potential cumulative impacts from these actions may include:

- Increased nutrients and suspended solids from the release of treated effluent from the WWTPs;
- Overlap of sediment plumes spatially or temporally from maintenance dredging at other sites reducing water quality in Western Moreton Bay;
- Burial of benthic organisms through deposition of sediment suspended from maintenance dredging at other sites and future maintenance dredging at Toondah Harbour.

Regional Water Quality

Healthy Land and Water (HLW) is an independent organisation that works in partnership with Traditional Owners, government, private industry, utilities and the community to protecting and enhance the environment in SEQ. HLW has released report cards for SEQ catchments since 2001 providing an overview of key indicators of waterway health. The report cards include assessment of water quality within Moreton Bay, splitting the bay into western, central and eastern sections for reporting purposes.

Water quality in Moreton Bay has shown a trend of steady improvement in recent years, with the 2020 results revealing this trend is continuing. This has been driven by the flushing of mud out of the bay through oceanic circulation, and the recovery of seagrass. The report noted that lower than average rainfall in 2020 limited river inputs which also provided some respite for Moreton Bay. The Toondah Harbour Project is located in Western Moreton Bay, which received an overall score of 'A-'. Water quality was considered excellent despite slight increases in nutrient and algae and a decrease in water clarity, while seagrass condition slightly improved.

The report goes on to say that during the recent dry weather conditions a key source of pollutants is discharge from point sources such as WWTPs. Nutrients accumulate adjacent to the release points of these facilities, due to less water to dilute the discharge, and are flushed into Moreton Bay with other rural and urban catchment contaminants when rainfall driven flow increases. Considerable improvements in the management of water pollution sources, particularly through advances in wastewater treatment, have occurred over the past 20 years. This has resulted in considerable reductions in nitrogen pollution.

The HLW report card identified sediment runoff from development and construction sites as well as continued investment in minimising wastewater treatment plant and other industrial discharges as key priorities for future management.

Increased Nutrients

The assessment of potential for increased nutrients from the Project found while there will be slightly elevated phosphorus and nitrogen levels in the Project's internal waterways, the increases are very small compared to background concentrations and relevant WQO. During storm events, nutrients and suspended solids are likely to be reduced compared to the existing situation, due to the increased stormwater treatment as a result of the Project.

Both the Southern Redland Bay (SRB) WWTP and upgrades to the Cleveland WWTP have the potential to increase nutrient levels in the central Moreton Bay area, however both would be subject to various environmental approval processes before any additional releases occur. The SRB WWTP was referred on 6 January 2021 (EPBC 2020/8849) and, at the time of writing, no decision had been made on whether it would be a controlled action or not a controlled action. No matter the outcome, DCCEEW will assess the potential impacts to MNES from the action. Any upgrade to the Cleveland WWTP would similarly require assessment against potential impacts to MNES.

It is notable that the SRP WWTP includes the creation of a mangrove wetland as a natural filtration system and nutrient offset for treated wastewater. Recycled water will be stored in an on-site freshwater lagoon for use in the irrigation of open space at the Shoreline Urban Village development. Excess recycled water will be discharged into the established mangrove wetland where it will mix with tidal flows regulated by ebb flows through inlet and outlet gates, prior to entering the Logan River. Documentation included in the referral for the SRB WWTP states that recycled water will be treated to "*Class A quality under the Australian and Queensland Recycled Water Quality Guidelines, and including contingency measures (wet-weather bypass) prior to release into the mangrove wetland"*. It will also require State level approvals before it can operate including an environmental authority (EA). The EA will specify stringent water release limits, including maximum nutrient levels, and require an ongoing water quality monitoring program. Treated water would eventually be released into the Logan River, more than 20 km from Toondah Harbour. Any increased nutrients are expected to be ameliorated by tidal currents in Moreton Bay before they reach Toondah Harbour.

The Cleveland WWTP is an existing, operational plant that is currently approved to treat effluent for up to 50,000 equivalent persons (EP). Upgrades to the plant will be required however it is likely to be minor compared to the existing capacity, given Toondah Harbour will require treatment for up to 6,000 EP. The WWTP does not discharge into a treatment wetland, however effluent from the plant is used to irrigate surrounding fields with excess treated water released into the adjacent Hilliards Creek, approximately 5 km from its ultimate release to Moreton Bay. Effluent would eventually be released into Moreton Bay near Thorneside, a further 5 km north of Toondah Harbour. Coastal processes modelling carried out for the Project shows that intertidal dynamics result in a net northern current movement dominating the nearshore environment in this part of Moreton Bay. Given the distance from the Project footprint and dominant tidal movements there is minimal risk in nutrient releases from the Cleveland WWTP mixing with the small releases associated with the Toondah Harbour Project.

The Cleveland WWTP is subject to an EA specifying stringent water release limits, including maximum nutrient levels, and require an ongoing water quality monitoring program. Any future upgrades will be required to comply with the conditions of the EA, meaning additional nutrient release would be minimal. As described by the recent HLW report cards the treatment of wastewater has improved significantly over the last 20 years which has resulted in a steady improvement in water quality in Moreton Bay. This trend will continue into the future with more innovative techniques such as the mangrove wetland proposed for the SRP WWTP.

As a result of the high level of treatment, ongoing regulation requirements and large distance between the sites, the risk of cumulative impacts from the release of nutrients from the WWTPs and the incremental increases associated with Toondah Harbour Project is expected to be minimal.

Sediment Plumes

Potential impacts as a result of sediment plumes from works for the Toondah Harbour Project can be summarised as:

- During the first and second dredging campaign there will be some increases in turbidity to the north of the channel, over seagrass and unvegetated sand/mud, in mangroves to the south of the ferry terminal. Sediment plumes extend approximately 3.5 km to Cleveland Point in the north and south approximately 1 km to Goleby

Esplanade Park. Turbidity plumes are at very low concentrations anywhere outside of the Project footprint and immediate surrounds.

- Increases in sediment deposition are largely confined to the channel and slightly to the north of the channel, over seagrass and unvegetated sand/mud and under the footprint of the southern reclamation area.
- A small increase in the deposition rates is expected leading to a 2 - 3 mm build-up of sediment in an area to the north-east of the project, over unvegetated sand/mud, seagrass, macro-algae and hard coral.
- Increases in deposition rates are lower in the second dredging campaign than in first dredging campaign, including brief increases in deposition rates over the seagrass and algae on sand close to the dredge area.

It is of note that dredge plume and sedimentation modelling assumed no use of silt curtains to provide an indication of the 'worst case' impacts. Silt curtains will be used whenever conditions and dredge location allow, therefore on ground impacts are expected to be significantly less than shown in the modelling.

In the context of existing regularly high turbidity in the vicinity of the proposed works, changes to the concentration of turbidity and sedimentation due to dredging are likely to be brief (in the order of days), short term (in that they are predicted to only increase during the dredging activity), and will not result in increases significantly greater than existing conditions.

The closest sites requiring regular maintenance dredging are the Raby Bay Canal Estate and William Street Boat Ramp (more than 3 km to the north of Toondah Harbour) and Weinam Creek (more than 8 km to the south). Based on historical trends both sites require maintenance dredging approximately every five years, with Raby Bay requiring approximately 21,000 m^3 of material removed and Weinam Creek approximately 4,000 m^3. Any other sites requiring regular maintenance dredging are too distant from the Project footprint for impacts to overlap.

Given the large time gap in dredging events it is highly unlikely that capital dredging or future maintenance dredging at Toondah Harbour will temporally overlap maintenance dredging at either of the other sites. As RCC is responsible for ongoing maintenance dredging of the three sites there may be instances where tenders are issued covering dredging at multiple sites. In the event of this occurrence a single contractor would likely use a single item of dredge plant (i.e., a cutter suction dredge) that would be shifted between sites, therefore active dredging would only be carried out at a single site.

Turbidity plume modelling is not generally undertaken for small maintenance dredging projects; however, plume dispersal would be expected to follow a similar pattern to Toondah Harbour where the dominant northern currents push suspended sediment to the east and north of the dredge site, making spatial overlap of plumes unlikely. Turbidity plumes from dredging at Raby Bay would travel away from the Toondah Harbour site while those from Weinam Creek would be too small to reach Toondah Harbour. Turbidity plumes for maintenance dredging would also be spatially and temporally smaller than those predicted for the Toondah Harbour Project given maintenance dredging involves considerably less material than capital dredging for the Toondah Harbour Project (approximately 20,000 m^3 compared to 530,000 m^3 respectively).

Any maintenance dredging events are subject to state approval requirements including sediment analysis and baseline water quality monitoring prior to dredging. Standard approval conditions for dredging projects include a compliance water quality monitoring program including sensitive receptor and up and down current monitoring locations.

Considering the above and detailed impact assessment carried out for the Toondah Harbour Project, potential cumulative impacts from sediment plumes can be summarised as:

- Impacts from sediment suspension (plumes) and settlement (sedimentation) from the Toondah Harbour Project are expected to be minor outside of the immediate Project footprint.

- Impacts from sediment suspension and settlement from nearby sites that undergo regular maintenance dredging (Raby Bay and Weinam Creek) would be smaller than those predicted for Toondah Harbour as the amount of material dredged is significantly lower than the Project.
- Sediment plumes from capital dredging associated with the Toondah Harbour Project or future maintenance dredging events are unlikely to overlap with sediment plumes from maintenance dredging at nearby sites spatially or temporally.
- Maintenance dredging at these sites (and many others in Moreton Bay) have been carried out for decades. Habitats within Western Moreton Bay have adapted to short term, intermittent increases in turbidity and sedimentation as it is a regular occurrence either from dredging, strong tidal currents and storm events.
- Future maintenance dredging at Toondah Harbour would be expected to result in similar impacts to existing maintenance dredging events therefore impacts would not be additional to what is already occurring.

The risk score for cumulative impacts on water quality are included in Table 26-6. Release of nutrients from the WWTPs are considered to provide a larger risk to water quality than temporary suspension of sediment associated with dredging therefore the two WWTP are given a higher impact weighting than dredging projects. Maintenance dredging is also considered to have a lower risk of impacting water quality than the larger capital works associated with the Toondah Harbour Project, therefore will be given a lower weighting. No additional cumulative or consequential impacts to any MNES are anticipated as a result of the Project.

Table 26-6: Water Quality Cumulative Risk Scores from Other Projects.

Projects	Risk Score	Impact weighting	Cumulative Risk
Toondah Harbour Project	1 / 4	20%	0.2
Southern Redland Bay WWTP	1 / 4	30%	0.3
Cleveland WWTP Plant upgrade	1 / 4	30%	0.3
Maintenance dredging of nearby harbours and marinas	1 / 4	10%	0.1
Future Maintenance Dredging of Toondah Harbour Entrance Channel and Marina	1 / 4	10%	0.1
CIA Risk	**-**	100%	**1 / 4 Very low**

26.3.5.2 *Terrestrial Threatened Species and Communities*

Cumulative and consequential actions with the potential to impact on terrestrial threatened species include the Cleveland apartment developments external to the Toondah Harbour PDA. As detailed in Section 15.4 of the EIS, impacts to terrestrial threatened species resulting from the Toondah Harbour Project are limited to the urban koala population in Cleveland. Potential cumulative impacts to terrestrial threatened species would also be limited to the koala population with sources for impacts including increased stress through increased noise, human presence or light and injury or death by vehicle strike or dog attack.

While the apartment developments specified in Table 26-4 will not add significant additional vehicle traffic or disturbance to koalas themselves (up to 200 vehicle movements per day if all residents have one vehicle that leaves and returns oncer per day), the Cleveland area is highly urbanised and infill development continues to occur, increasing pressure on the urban koala population. Increased pressure will mostly be related to more vehicle traffic and barriers to dispersal created by higher density residential.

An increase in higher density developments in the area will place greater significance on the habitat present in riparian and coastal parkland for maintaining the Cleveland urban koala population. It is important to maintain, supplement and ensure succession of koala trees in parkland as well as in residential areas currently providing connections between habitats. Without ensuring habitat connections, the coastal koalas may become isolated, and if this occurs there is a risk of inbreeding and associated population decline as described by Schultz *et al*. (2020). The implementation of the fauna underpass at Middle Street adjacent to GJ Walter Park will provide safer movement for koalas to highly utilised coastal parks to the south of the Project footprint, such as Nandeebie Park.

While the Proponent can only carry out physical works such as tree planting on land covered by the development agreement, they have and will continue to consult with RCC on management measures that could be employed in the broader Cleveland area to facilitate safe koala movement. Measures being investigated include:

- Planting of koala food trees prior to project works commencing on the public land outside of the south-western boundary of the PDA to strengthen the link from the PDA to Nandeebie Park. Planting these trees as early as possible will improve safe koala movement opportunities and increase resource availability for resident and transient koalas in the local area;
- Identify additional planting actions that can be undertaken to supplement and improve the safety of koala movement corridors within the suburb of Cleveland; and
- Put in place measures to discourage traffic moving west from Toondah Harbour from turning north into Wharf Street or Passage Street or south along Passage Street or Channel Street to avoid the creation of 'rat runs' that may increase risk of vehicle strikes on koalas.

The contribution of residents and visitors will be vital to achieving the maintenance of a healthy koala population within the Project footprint. A number of community initiatives will also be put in place as part of the Toondah Harbour Project, including:

- Implementation of a Koala Safe Neighbourhood program in the Cleveland area;
- Resident and visitor participation in social media monitoring of koala sightings in the area;
- Providing new residents with educational materials on koala behaviour, threats to koala and living harmoniously with koalas in a way that allows the urban koala to thrive; and
- Installing educational signage in open space and public areas.

Whisson *et al.* (2020) studied a group of 20 koalas moving through an urbanised area on the Mornington Peninsula in Victoria. They found that despite navigating risks of vehicle strikes and domestic dogs, none of the koalas died from these causes during the course of the study and concluded the low mortality rate may be due to movement occurring at night when risks may be lower, and from high awareness of the community about koalas. The authors suggest that effective conservation of urban populations of koalas requires a landscape-scale approach with participation by the community and public land managers to maintain and establish koala habitat and connectivity, and to encourage koala-friendly driving behaviour.

The Toondah Harbour Project is considered unlikely to have a significant impact on an important koala population as:

- The Project footprint does not support habitat critical to the survival of the vulnerable koala when measured against the relevant EPBC Act criteria and guidelines.
- Notwithstanding, habitat area and resources for the koalas present within the Project footprint will be doubled as a result of the impact mitigation measures proposed for the development.
- Construction activities will create noise and other disturbance that may impact individual koalas, with potential implications for the health of breeding females if unmitigated, however a number of management and monitoring measures will be put in place to mitigate against these impacts.

- There will be no significant barriers to koala movement created by the development through or within the Project footprint as a result of the retention of the koala habitat tree corridor within the PDA and implementation of koala-friendly design measures.

With the recommended measures for safe koala movement and habitat tree planting within the Project footprint, and the Proponent's commitment to work with RCC to implement measures to increase koala habitat and improve safe movement for koalas through the wider Cleveland area, the Project is unlikely to have a significant long-term impact on the local urban koala population.

While the increased urbanisation of Cleveland will result in amplification of some threats for the koala population, it is expected the implementation of the proposed management measures and educational programs in the broader Cleveland area could successfully mitigate against cumulative or consequential impacts to koala. Management and mitigation measures have a greater chance of success within the Project footprint as the Proponent has greater control over the planning and delivery of these measures therefore a higher impact weighting has been given to the apartment developments. The cumulative risk assessment is outlined in Table 26-7.

Table 26-7: Koala Cumulative Risk Scores from Other Projects.

Projects	Risk Score	Impact weighting	Cumulative Risk
Toondah Harbour Project	2 / 4	30%	0.6
Cleveland apartment developments (and associated traffic increases)	3 / 4	70%	2.1
CIA Risk	**-**	100%	**2.7 / 4 Medium**

An assessment of potential cumulative impacts to the koala has also been carried out against the relevant MNES Significant Impact criteria (vulnerable species) included in Table 26-8. If appropriate management measures are implemented, no significant impacts are expected to occur to any terrestrial MNES as a result of cumulative and consequential impacts.

Table 26-8: Koala Cumulative Significant Impact Assessment.

Significant Impact Criteria	Assessment
Will the action lead to a long-term decrease in the size of an important population of a species?	An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are: ▪ key source populations either for breeding or dispersal; ▪ populations that are necessary for maintaining genetic diversity; and/or ▪ populations that are near the limit of the species range. While important in the local context, koalas within the Project footprint are not identified in recovery plans published by the State or National government, are not identified as a key source population, are not known to be genetically distinct from the Koala Coast population and are not at the limit of the species range; therefore,

Significant Impact Criteria	Assessment
	they do not meet the criteria for a nationally important population as outlined in the MNES Significant Impact Guidelines 1.1.
Will the action reduce the area of occupancy of an important population?	The koala population at the Project footprint is not considered an important population at the national level when assessed against the criteria outlined in the MNES Significant Impact Guidelines 1.1. Habitat area and resources for the koalas present within the Project footprint will be doubled as a result of the impact mitigation measures proposed for the Project. Actions outside the PDA will likely result in the removal of some habitat trees however this will be minor as development will be an intensification of existing uses rather than greenfield projects which may require significant clearing.
Will the action fragment an existing important population into two or more populations	There will be no significant barriers to koala movement created through or within the Project footprint. Increased vehicle movement will occur as a result of the Toondah Harbour Project and other cumulative actions, however management and design measures identified will mitigate against risk of vehicle strike.
Will the action adversely affect habitat critical to the survival of a species?	The Toondah Harbour Project will not result in the clearing of habitat critical to the survival of the vulnerable koala (refer to section 15.4.2 of the draft EIS). Residential areas of Cleveland are highly urbanised and do not support critical habitat for the koala.
Will the action disrupt the breeding cycle of an important population?	While not considered an important population at the national level, construction activities will create noise and other disturbance that may impact individual koalas, with potential implications for the health of breeding females if not mitigated. Increased human presence for the operational phase of the development may also disturb and cause stress to breeding koalas. Measures will be put in place for the Toondah Harbour Project to reduce these stresses during construction and ongoing operation.
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Habitat area and resources for the koalas present within the Project footprint will be doubled as a result of the impact mitigation measures proposed for the Project. Cumulative actions will not result in the clearing of critical habitat for the koala but may result in the removal of isolated habitat trees, which will be offset.
Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	The Project as well as other cumulative actions are urban in nature with the koala habitat present occurring within landscaped gardens and parkland that is regularly maintained. Therefore, there will be no opportunity for invasive species to establish in these environments.
Will the action introduce disease that may cause the species to decline?	The cumulative actions will not introduce disease, although stress may lead to disease in koalas. Through the Toondah Harbour Project a koala monitoring program will be implemented for the PDA and surrounds to document health and breeding activity during construction and operation.

Significant Impact Criteria	Assessment
Will the action interfere substantially with the recovery of the species?	The Project itself will not interfere substantially with the recovery of the species as safe koala movement opportunities will be maintained and koala habitat increased within the Project footprint. The long-term presence of a healthy urban koala population in Cleveland, which may have a role in supporting the bushland koala population, is likely to depend on the implementation of treatments to allow safe koala passage across dangerous roads, bolstering suitable urban habitat, and community participation in koala conservation. The Proponent is consulting with RCC on measures that could be implemented outside of the PDA, including planting of habitat trees to strengthen movement corridors and contributions to fauna underpasses, which would benefit the broader Cleveland urban koala population.
Conclusion	With the recommended measures for safe koala movement through the Project footprint, koala tree planting within the Project footprint and the Proponent's commitment to advance measures to increase koala habitat and improve safe movement for koalas outside of the Project footprint, the Project is unlikely to have a significant long-term impact on the local urban koala population.

26.3.5.3 *Migratory and Threatened Shorebirds*

The only other action identified as having the potential for cumulative or consequential impacts on migratory and threatened shorebirds is the Port of Brisbane expansion. Potential cumulative impacts from these actions may include:

- Loss of foraging or roosting habitat for shorebirds associated with the loss of mudflats in intertidal environments; and
- Disturbance of shorebird habitat (foraging or roosting sites) through increased noise, human presence or light.

The reclamation ponds for the Port of Brisbane Expansion were completed several years ago, however not all land has been converted to operational port land which will occur over the next 20 years. The south eastern extent of the port reclamation area is currently utilised as roosting habitat by a large number of migratory shorebirds, with approximately one third of Moreton Bay's shorebirds dependent on the temporary habitat created by the reclamation (Fuller et al. 2021). While the Port of Brisbane Corporation has created an artificial roost site, it is already utilised by a number of migratory species and will not be large enough to accommodate the approximately 8,000 birds that will be displaced from the port land (Fuller et al. 2021). The reclamation ponds also provide non-tidal feeding habitat for the smaller migratory shorebirds such as curlew sandpiper and red-necked stint. During the early stages of reclamation, sediment from dredging of the main shipping channel is pumped into the ponds. These sediments contain small invertebrates, including bivalves and crustaceans, which are prey of small shorebirds. Threatened species identified within the reclamation area that have also been observed at Toondah Harbour include the critically endangered eastern curlew and vulnerable bar-tailed godwit (Milton 2017).

A multitude of threats face migratory shorebirds globally. Pressures are particularly intense in the EAAF, with the key driver of shorebird population declines being the loss of two thirds of the intertidal habitat in the Yellow Sea over the past 50 years (Fuller et al. 2021). These losses have substantially reduced the availability and quality of foraging and resting habitat for the birds on their long journeys between their breeding grounds and Australia (Amano *et al*. 2010; Murray *et al*. 2014; Piersma *et al*. 2016; Studds *et al*. 2017). There is evidence to suggest that species that generally do not utilise the Yellow Sea during migration are not declining, and some are even increasing (Studds *et al*. 2017), suggesting the loss of habitat in the Yellow Sea is playing a significant role in declines of Australia's migratory shorebirds (Clemens *et al*. 2016), and the declines observed within Moreton Bay specifically (Wilson *et al*. 2011; Dhanjal-Adams *et al*. 2019).

Changes in shorebird numbers at various sites across Moreton Bay are not uniform, suggesting that threats are operating within Moreton Bay, as well as external sources. A recent analysis showed that factors local to Moreton Bay as well as factors operating more broadly around the EAAF interact to explain why migratory shorebirds are declining in Moreton Bay (Dhanjal-Adams *et al*. 2019). For example, mangroves are increasing in spatial extent in the lower estuaries and Moreton Bay. While there are a number of benefits from increasing mangrove habitat, it may be leading to reductions in some high tide roosting sites and feeding grounds used by migratory shorebirds, critical to their survival (Healthy Land and Water 2020). This demonstrates a clear need for robust management of the birds and their habitats within Moreton Bay.

A report prepared by the University of Queensland (UQ) for HLW (Fuller *et al.* 2021 - Managing Threats to Migratory Shorebirds in Moreton Bay) has assessed the key threats to migratory shorebirds in Moreton Bay and prioritised a set of recommended management actions to address these threats.

A key threat identified by this report is the number, distribution and management of roost sites in the roost site network in Moreton Bay, with 15 roost sites having been lost and 95% of roost sites impacted by one or more threats, particularly disturbance, development and mangrove encroachment. The report prioritised the following as the most urgent and important management actions to mitigate threats to migratory shorebirds and their habitats in Moreton Bay:

1. Conduct a major strategic planning process to establish how to ensure there will be sufficient roosting site capacity for the birds currently using the Port of Brisbane reclamation ponds (currently used by up to one third of migratory shorebirds in Moreton Bay), as works to fill in the reclamation ponds take place. The strategic plan should include options to enhance management of existing roost sites and identify locations for the construction of additional artificial sites. Suggested locations for new artificial roost sites include Dynah Island at Cabbage Tree Creek and the western side of Minjerribah (North Stradbroke Island), both being close to important feeding areas and with the Dynah Island location potentially providing an alternative site for many birds currently using the Port of Brisbane.
2. Implement threat management at roost sites, including threats from disturbance and mangrove encroachment.
3. Design and implement strategies to reduce disturbance to migratory shorebirds foraging at low tide, particularly from dogs being walked off leash on tidal flats.

The Toondah Harbour Project will result in the loss of foraging habitat, increased human use of foreshore parks and coastline around Toondah Harbour and small increases in marine craft usage, including non-motorised vessels such as sea kayaks. These impacts and proposed management measures are addressed in detail in Section 8.2.7 of the EIS. No long-term residual impacts are predicted to the adjacent Cassim Island and Nandeebie Claypan roost sites. It is of note that the UQ study does not specifically address foraging habitat at Toondah Harbour or in Southern Moreton Bay, however relevant findings include:

- There are over 100 km^2 of intertidal habitat in Moreton Bay, constituting substantial potential foraging habitat for migratory shorebirds.
- The overall extent of intertidal flats has not substantially changed since the 1980s, but an increasing human population has increased disturbance to feeding birds, in particular dog off leash areas between Deception Bay and Lota.
- Foraging habitat at Toondah Harbour is not discussed. However, the study stresses that any development at Toondah Harbour should be planned in such a way as to ensure minimal or no impact on roosting sites.

While significant residual impacts to roosting habitat are not predicted at Toondah Harbour, independent scientific studies and evidence has shown loss of this habitat is the key risk to shorebirds within Moreton Bay. As a result, to provide the best conservation outcome for the species in Moreton Bay, the offsets strategy for the project will focus on providing

additional or improved roosting habitat in areas immediately surrounding Toondah Harbour. The Toondah Harbour Project's Offset Strategy is outlined in Chapter 29.

No other known or speculative projects are likely to directly impact on the foraging or roosting habitat on migratory and threatened shorebirds in Moreton Bay as state and local legislation and planning implements generally discourage development within or immediately adjacent to tidal areas. The Toondah Harbour Project is unique in the SEQ region and focused around the existing ferry terminal and harbour uses as well as the PDA, which was established by the state and local governments in recognition that Toondah Harbour is the optimum location for an urban and maritime hub in southern Moreton Bay. Cumulative risk assessment is outlined in Table 26-9. While cumulative risk is identified as medium - high this is mostly a result of the loss of temporary roosting habitat and foraging resources at the Port of Brisbane. This area is not located in the MBRS.

Table 26-9: Migratory and Threatened Shorebirds Cumulative Risk Scores from Other Projects.

Projects	Risk Score	Impact weighting	Cumulative Risk
Toondah Harbour Project	2 / 4	20%	0.4
Port of Brisbane Expansion	4 / 4	80%	3.2
CIA Risk	**-**	1	**3.6 / 4 Medium - High**

An assessment of potential cumulative impacts to threatened and migratory shorebirds has been carried out against the relevant MNES Significant Impact criteria (migratory species) in Table 26-10. To minimise repetition, threatened species that may be cumulatively impacted are also addressed using the migratory bird criteria. It is noted that the Toondah Harbour Project is expected to impact on these species through a loss of foraging habitat, while the Port of Brisbane expansion will impact on roosting habitat. Recent studies have identified loss of roosting habitat at the Port of Brisbane as a key threat to migratory shorebirds in Moreton Bay therefore the proposed offset strategy for the Toondah Harbour Project will address the improvement of existing roost sites and creation of new roost sites.

Table 26-10: Threatened and Migratory Shorebird Species Cumulative Significant Impact Assessment.

Significant impact criteria	Assessment
Result in invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.	No pathways have been identified for an invasive species that are harmful to the migratory species becoming established. A significant residual impact under this criterion is unlikely.
Direct mortality of birds leading to a *substantial reduction* in migratory shorebirds using important habitat	No pathways for direct mortality to migratory shorebirds have been identified. A significant residual impact under this criterion is unlikely.
Increased disturbance leading to a *substantial reduction* in migratory shorebirds using important habitat	The external revetments around the perimeter of the Project footprint have been designed as a rock armour pitched wall, and the only constructed access to the tidal flats is via the boat ramp for non-motorised vessels. Consequently, the Project does not promote public access to the adjacent tidal flats at low tide. The ongoing Port of Brisbane expansion will not result in the loss of foraging habitat for migratory shorebirds.

Significant impact criteria	Assessment
	A significant residual impact under this criterion is unlikely.
Loss of important habitat leading to a reduction in the capacity of the habitat to support migratory shorebirds	The Toondah Harbour Project will not have a direct impact on the Cassim Island or Nandeebie Claypan roost sites. Dredging and reclamation at Toondah Harbour will result in the loss of 28.9 ha of feeding habitat, which corresponds to 0.29 % of the approximately 10,000 ha of tidal flat habitat within Moreton Bay. The foraging areas are used by a small number of eastern curlews and bar-tailed godwits. While the Port of Brisbane expansion will result in the loss of some foraging habitat for migratory shorebirds the key issues will be the loss of a major roosting site. The loss of high tide roosting areas at the Port of Brisbane as a result of ongoing reclamation works will displace approximately 8,000 migratory birds including eastern curlews and bar-tailed godwits. As the works at Port of Brisbane are ongoing in accordance with an historical approval, there is no requirement for the impact to be offset. A significant residual impact under this criterion is likely.
Disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	Tidal flat feeding habitat at Toondah Harbour does not support an ecologically significant proportion (i.e., more than 0.1% of the flyway population) of any migratory shorebird species. Short-term disruption of roosting behaviour from noise and activity is possible during the dredging and reclamation - particularly the revetment wall construction. However, the risk of disruption will be minimised by scheduling revetment wall construction and activities that generate noise levels exceeding 60 dB(A) in the receiving environment to the winter months, when fewer migratory shorebirds are present. Long-term disruption during operation is unlikely if the recommended mitigation measures are implemented. The loss of high tide roosting areas and foraging habitat at the Port of Brisbane as a result of ongoing reclamation works will displace approximately 8,000 migratory birds including eastern curlews and bar-tailed godwit. It is difficult to predict where these birds will displace to, but it is likely to impact on their lifecycle—at least in the short term. A significant residual impact under this criterion is likely as a result of the ongoing works at Port of Brisbane.
Degradation of important habitat leading to a *substantial reduction* in migratory shorebirds using the site	There is unlikely to be a significant increase in turbidity or sedimentation at Toondah Harbour therefore no significant impact on benthic invertebrate communities (shorebird food) in tidal flats adjacent to the Project footprint is predicted and no roost sites are expected to be impacted therefore, a significant residual impact under this criterion is unlikely. The Port of Brisbane expansion will result in the loss of some foraging habitat for migratory shorebirds which will likely impact on some migratory species however the loss of high tide roost habitat has the potential to impact on a large number of migratory shorebirds and may lead to an overall reduction of shorebirds in Moreton Bay. Fuller *et al.* (2021) identified the need to provide alternate roosting habitat for these birds as a key management requirement for the migratory shorebird population in Moreton Bay. A significant residual impact under this criterion is likely as a result of the ongoing works at Port of Brisbane.

Significant impact criteria	Assessment
	While this impact is not a direct result of the Toondah Harbour Project, offsets will include high tide roosting habitat (refer to Chapter 29 of the draft EIS).
Increased disturbance leading to a *substantial reduction* in migratory shorebirds using important habitat	While short-term disturbance to high tide roosting habitat adjacent to Toondah Harbour from noise and activity is possible during dredging and reclamation, the risk of disturbance will be minimised by scheduling revetment wall construction and activities that generate noise levels exceeding 60 dB(A) to the winter months (mid-April to August) when fewer migratory shorebirds are present. Long-term disturbance during operation is unlikely if the recommended mitigation measures are implemented to ensure no increase in disturbance to the roost from non-motorised watercraft occurs. Removal of the existing boat ramp will also result in minimal increase in traffic from motorised vessels as traffic created by the marina will be similar to current usage of the boat ramp. The external revetments around the perimeter of the Toondah Harbour Project footprint have been designed to be a rock armour pitched wall, and the only constructed access to the tidal flats is the boat ramp for non-motorised vessels. Consequently, the Project does not promote public access to the adjacent tidal flats at low tide. The loss of high tide roost habitat at the Port of Brisbane has the potential to impact on a large number of migratory shorebirds and may lead to an overall reduction of shorebirds in Moreton Bay. Fuller *et al.* (2021) identified the need to provide alternate roosting habitat for these birds as a key management requirement for the shorebird population in Moreton Bay. A significant residual impact under this criterion is likely as a result of the ongoing works at Port of Brisbane.
Conclusion	Dredging and reclamation at Toondah Harbour will result in the loss of 28.9 ha of important feeding habitat, which corresponds to 0.29 % of the approximately 10,000 ha of important tidal flat habitat within Moreton Bay. The foraging areas are used by a small number of eastern curlews and bar-tailed godwits. Eastern curlews are observed regularly on the mudflat feeding areas in low numbers (average of 3.5 and maximum of 5 birds) in the Project footprint. This is approx. 0.3% of the average number seen in Moreton Bay between 1978 and 2006 (1,299) and 0.02% of the estimated flyway population of 35,000. Bar-tailed godwits have also been observed consistently but in low numbers on the mudflat feeding areas (average of 10 and maximum of 19 birds) in the Project footprint. This is approximately 0.15% of the average number seen in Moreton Bay between 1978 and 2006 (6,018) and 0.005% of the estimated flyway population of 325,000. While short-term disturbance to high tide roosting habitat adjacent to Toondah Harbour from noise and activity is possible during dredging and reclamation, the risk of disturbance will be minimised by limiting high noise activities to the winter months (mid-April to August) when fewer migratory shorebirds are present. Long-term disturbance during operation is unlikely if the recommended mitigation measures are implemented. The loss of high tide roost habitat at the Port of Brisbane has the potential to impact on many shorebirds and may lead to an overall reduction of shorebirds in Moreton Bay. Fuller *et al.* (2021) identified the need to provide alternate roosting habitat for these birds as a key

Significant impact criteria	Assessment
	management requirement for the shorebird population in Moreton Bay. The Port of Brisbane expansion will not result in the loss of some foraging habitat that may be important for a number of migratory shorebird species. While this impact is not a direct result of the Toondah Harbour Project offsets will include high tide roosting habitat (refer to Chapter 29 of the draft EIS) as this will provide the best outcome for the MNES.

26.3.5.4 *Marine Threatened Species and Habitats*

Cumulative and consequential actions with the potential to impact on marine threatened species and habitats include:

- Maintenance dredging of nearby harbours and marinas; and
- Future maintenance dredging of the Fison Channel, internal waterways and marina.

Potential cumulative impacts from these actions may include:

- Loss of seagrass habitat from smothering or being cut off from the marine environment;
- Increased light attenuation reducing photosynthesis and growth rates of seagrass; and
- Burial of benthic organisms through deposition of sediment suspended through the dredging process.

No other known projects within the CIA's spatial and temporal boundaries will result in the direct loss of seagrass habitat from smothering or being cut off from the marine environment.

As outlined in the cumulative and consequential impacts to water quality, sources of impact for these actions are highly unlikely to overlap spatially or temporally, as dredging is unlikely to be carried out at the same time in multiple locations. Even if they were, distance between sites and dominant northerly tidal forces make it unlikely that there would be any spatial interaction between plumes.

The volume of material dredged during maintenance dredging differs between sites and events, however tends to be in the tens of thousands of cubic metres compared to the approximately 530,000 m^3 of dredging required at Toondah Harbour. Recent maintenance dredging events at Toondah Harbour have ranged between 40,000 m^3 and 85,000 m^3. Dredging at Raby Bay is generally in the order of 20,000 m^3, although a recent event in 2017 required dredging of approximately 42,000 m^3.

The smaller volumes of dredging would result in plumes being present for a smaller period of time and resulting in less sediment deposition than predicted for the capital dredging associated with the Toondah Harbour Project. Outside of the loss of habitat within the Project footprint, potential impacts to marine threatened species and habitats resulting from the Project are expected to be insignificant. Indirect impacts can be summarised as:

- Increases in turbidity and sedimentation during dredging were predicted to be mostly within the dredge area, with some increases over nearby seagrass, coral, mangrove and rubble communities.
- Changes to turbidity and sedimentation due to dredging are likely to be limited to the dredge campaigns, with turbidity returning to ambient levels once dredging ceases.
- Turbidity in the vicinity of the Project footprint is already high, regularly exceeding water quality objectives.
- Predicted increases in turbidity in the dredge campaigns are short lived, and usually less than ambient maximums. Consequently, the changes to turbidity and sedimentation are unlikely to negatively impact the

seagrass, rubble, coral and mangrove areas in the vicinity of the proposed works, as these communities are already adapted to high and variable turbidity.

- The relatively small increases in sediment deposition are unlikely to negatively impact the long-term distribution and growth of seagrass in the area.
- Similarly, the soft sediment benthic fauna, macroalgae and coral communities growing in the areas that may be impacted by increased sedimentation rates, are adapted to current conditions, including the deposition of sediment.

The resilience of seagrass in western Moreton Bay in general was demonstrated during and following the floods in January 2011. Water quality in the central and western bay was severely impacted by this flood, with significantly poorer water quality in the three months following the flood than in the same three months every year since 2002, with significantly higher nitrogen availability, and lower salinity and Secchi depth (i.e. decrease in light availability) in *Z. muelleri* meadows impacted by the flood compared to previous years (Maxwell *et al*. 2014). Secchi depth in the meadow most impacted by the flood was approximately half the average of previous years. While there were some changes to physiology and morphology of the seagrass following the flood, there was no mortality, indicating *Z. muelleri* in the central and western bay is highly resilient to changes in water quality (Maxwell *et al*. 2014).

Detailed benthic surveys have not been carried out in offshore areas at Weinam Creek or Raby Bay, however broad scale mapping (refer to Section 16.3) indicates benthic habitats would be similar to those at Toondah Harbour dominated by unvegetated sand/mud, seagrass and macroalgae. The assessment for Toondah Harbour could be applied to maintenance dredging at both of those sites, with any impacts expected to be minor and temporary.

While dugong and marine turtles feed on seagrass, Western Moreton Bay generally is not significant habitat for them, with population densities far higher on the Eastern Banks. Australian humpback dolphin is found throughout the bay, however no areas that may be impacted by these actions would be considered core habitat. Consequently, the direct loss of seagrass habitat in Western Moreton Bay is unlikely to have a significant impact on marine MNES species.

According to an assessment using the IUCN framework, saltmarshes in Moreton Bay were assessed as endangered, while mangroves and seagrass were assessed as least concern (Sievers *et al.* 2020). This was in large part due to 'coastal squeeze' from sea level rise, with mangroves colonising landward into saltmarsh areas, but the landward progression of saltmarsh constrained by development and landform.

The risk score for cumulative impacts on marine threatened species and habitats are included in Table 26-11. As works associated with the Toondah Harbour Project will be more extensive than maintenance dredging ant any of the sites it is given a higher impact weighting. No additional cumulative or consequential impacts to MNES are anticipated as a result of the Toondah Harbour Project.

Table 26-11: Marine Threatened Species and Habitats Cumulative Risk Scores from Other Projects.

Projects	Risk Score	Impact weighting	Cumulative Risk
Toondah Harbour Project	2 / 4	60%	1.2
Maintenance dredging of nearby harbours and marinas	2 / 4	20%	0.4
Future maintenance dredging at Toondah Harbour	2 / 4	20%	0.4
CIA Risk	**-**	100%	**2 / 4 Low**

26.4. Other Consequential Impacts

26.4.1 Increased Boat and Recreational Vessel Usage

Boat strikes are responsible for the largest proportion of all human-related turtle strandings or mortalities (Greenland *et al*. 2004). In general, the shallower the area and the larger the boat, the greater the risk of a boat strike to turtles. Turtles feed on intertidal flats at high and mid tides and drop into deeper waters (which can include the waters of navigation channels) at low tide, where they can be struck by passing traffic. This habit of moving into navigation channels increases the risk of boat strike.

Dolphins are likely to be able to avoid approaching boats. While at least nine dolphins were killed in Queensland by boat strike in a period of eight years (Greenland and Limpus 2007b), no deaths by boat strike were recorded more recently than 2014 and 2015 (Meager 2016a). Dugong will also avoid approaching boats; however, they are slower than dolphins and more vulnerable to vessel strike, with up to seven dugongs killed each year in Queensland due to boat strike (Greenland and Limpus 2007a, Meager 2016). The majority of these boat strikes occurred in Moreton Bay due to the high amount of boat traffic.

Moreton Bay is a high usage area for recreational boating craft, predominantly due to its location in densely populated SEQ. A Recreational Boating Facilities Demand Forecasting Study carried out by Economic Associates (2017) for the Department of Transport and Main Roads (DTMR) projected the Redland City LGA would see a significant increase in the size of the recreational boating fleet using the area, with anticipated growth from 21,801 vessels in 2016 to 29,984 vessels in 2036. This projected growth will occur with or without the Toondah Harbour Project, with more than 90% of vessels small enough (less than 8 m) to be kept on a trailer and launched from one of the many boat ramps in the region, including from the existing public boat ramp at Toondah Harbour if the Project does not proceed.

The Project is not expected to result in the generation of significant additional boat traffic in the vicinity of Toondah Harbour. The removal of the existing Emmett Drive boat ramp is expected to offset boat movements associated with the new marina (refer to Section 3.1 of the EIS). While the Project will provide marina berths and supporting infrastructure, it is small (maximum of 200 wet berths) and will not include facilities that may draw vessels from outside the marina such as repairs or a chandlery. Those types of facilities are available at Manly Boat Harbour, approximately 15 km north of the Project footprint. In addition, Toondah Harbour currently holds little value for recreational fishing and the Project has been designed to provide future land-based opportunities for fishers. Any recreational vessels coming into the harbour would also have to contend with vehicle and passenger ferry traffic within Fison Channel and the turning basin. Given the above, it is likely that few recreational boats would be attracted to the area outside of those occupying a wet berth.

To compensate for the removal of the Emmett Drive Boat Ramp the Project will contribute to the upgrade of an existing boat ramp at William Street, located approximately 1.5 km north of the existing harbour, adjacent to the Raby Bay Canal Estate. While the upgrade will result in additional use of this boat ramp, it is already highly utilised. TMR's recreational boating demand forecasting study (2017) identifies William Street as a ramp that is subject to overcrowding and not utilised to its full potential due to a lack of parking and ramp capacity. The study proposes to increase parking areas into adjacent open space and increase the current two-lane ramp to four lanes.

TMR's demand forecasting study (2017) also identified upgrade of the William Street boat ramp as the highest priority for meeting recreation boating demand in the Redland City LGA, therefore, upgrades are likely to occur regardless of the Toondah Harbour Project.

The new ramp for non-motorised vessels at Toondah Harbour will likely result in increased usage of the area by kayaks and other small craft. It is difficult to predict usage of this ramp; however, these vessels are unlikely to have any impact on marine fauna such as dugongs and turtles. There is some potential for these craft to impact on roosting shorebirds at

Cassim Island, however several management measures will be put in place to minimise impacts. Educational signage, fencing to stop people accessing Cassim Island from the rock breakwater and the implementation of an exclusion zone around Cassim Island will be discussed with the Queensland Government and RCC.

Based on the assessment above, the Toondah Harbour Project is expected to **low risk** of increasing the risk of impact to marine fauna or shorebirds by increasing boat and recreational watercraft usage in the area.

26.4.2 Climate Change

The Project itself will not generate significant amounts of carbon and will not contribute to drivers of future climate change.

Coastal processes modelling has reviewed potential wave and water level impacts of the completed project under various sea level rise scenarios and an extreme weather event (refer to Section 8.4).

Two different levels of sea level rise (SLR) were superimposed to the modelled water level boundary conditions to represent possible future climate change scenarios, specifically:

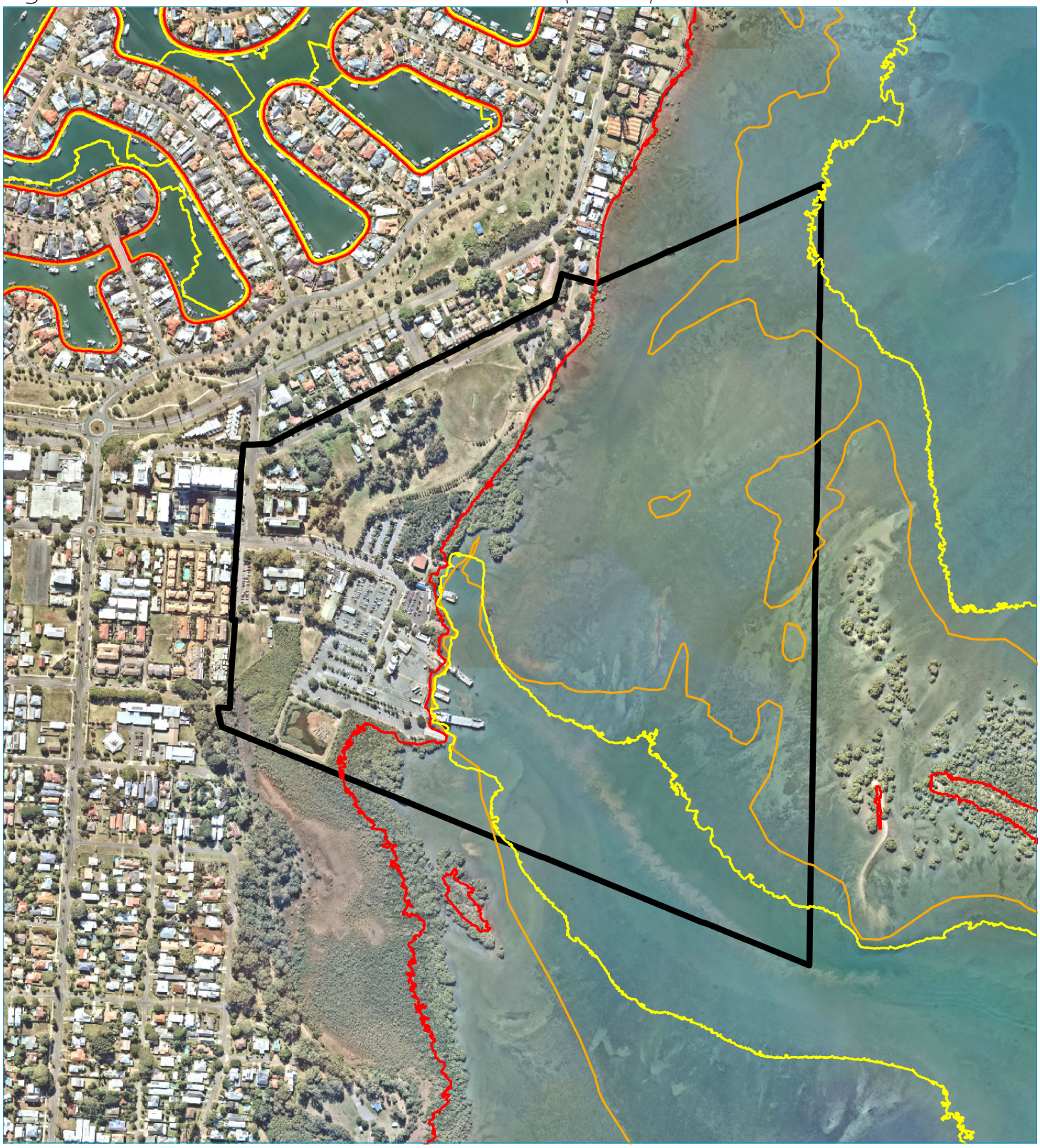
- 0.4 m sea level rise (likely change over the next 50 years given prediction of 0.8 m sea level rise by 2100); and
- 1.5 m sea level rise (required by the EIS guidelines – worst case far-future scenario).

Present-day bathymetry was used for the simulations and the bathymetry will adjust over time in unknown ways. However, even with some change in bathymetry, it is likely that in the without-Project case, a significant portion of the mudflats at Toondah Harbour will be inundated under most tides (any tide higher than Mean Low Water Springs (MLWS)) in the event of a 0.4 m sea level rise and the entire mudflat would be inundated as a result of a 1.5 m sea level rise (Figure 26-3). Cassim Island would also be impacted under both scenarios but completely inundated in a 1.5 m sea level rise. In the broader region it is likely mangroves would continue to encroach inland impacting on various habitats including shorebird roost sites such as Nandeebie Claypan. It is difficult to predict the movement of intertidal areas however mudflat and seagrass habitats are likely to shift with erosion and sedimentation processes being altered across Moreton Bay. As outlined in the study by Sievers *et al*. (2020) this change is likely to result in 'coastal squeeze', with mangroves and seagrass colonising landward into saltmarsh areas, but the landward progression of saltmarsh constrained by development and landform.

Outputs from modelled maximum water levels during storm events are included in Section 8.4 and are not repeated here, however the results indicate under both extreme event scenarios that the Project footprint effectively provides additional shielding from Toondah Harbour to south of Oyster Point. This shielding produces a marked reduction in modelled wave height within and around the Project.

Overall, the model results indicate that the proposed development provides additional protection for the adjacent shorelines in extreme event scenarios therefore there is **a very low risk** that it will impact on climate change.

Figure 26-3: : Toondah Harbour Mudflat Extent (MLWS) under Predicted Sea Level Rise



Toondah Harbour EIS

Legend

- Toondah Harbour PDA
- Current shorebird foraging habitat (MLWS (AHD -0.87))
- Shorebird foraging habitat with 0.4 m sea level rise (MLWS + 0.4 m (-0.47 mAHD))
- Shorebird foraging habitat with 1.5 m sea level rise (MLWS + 1.5 m a (+0.63 mAHD))

TOONDAH HARBOUR

walker

N

0 100 200 300 400 m

GDA 1994 MGA zone 56 Scale (A4): 1:8,000

Layer Source: State of Queensland Datasets (© State of Queensland 2020), Aerial (© Nearmap 2020), Fauna records (© State of Queensland 2020)

DATE: 20/11/2020 E Figure 10 3 Toondah Harbour Mudflat Extent SLR A

26.5. Summary

A CIA has been carried out addressing likely cumulative and consequential impacts associated with the Toondah Harbour Project. Environmental values present within and surrounding the Toondah Harbour Project footprint with the potential to be impacted by the Project have been assessed in detail in this volume of the EIS. Where EIS studies found impacts to an environmental value are unlikely to occur or will be localised to the Project footprint, those values have not been considered further in the CIA. Environmental values with the potential to be impacted include:

- Water Quality – modelling indicates dredge plumes will extend from Cleveland Point in the north to Goleby Esplanade Foreshore Park in the south;
- Terrestrial threatened species and communities – potential cumulative and consequential impacts include increased traffic and barrier to movement for urban koala populations in the Cleveland area;
- Migratory and threatened shorebirds – While impacts are not expected outside of the Project footprint, migratory birds are highly mobile and have the potential to utilise habitats throughout Moreton Bay; and
- Marine threatened species and habitats – the Project is considered unlikely to impact on any threatened marine species therefore the CIA addresses potential impacts to marine habitats including mangroves, saltmarsh and seagrass.

Impacts to the Ecological Character of the MBRS are addressed in Chapter 27.

The Zone of Influence for each of the environmental values was used to determine the spatial and temporal boundaries for the CIA. A number of existing or potential future actions that may have spatial or temporal overlap with the Project were then identified. Actions with the potential to result in cumulative or consequential impacts included:

- Southern Redland Bay Wastewater Treatment Plant (WWTP);
- The ongoing Port of Brisbane expansion'
- Maintenance dredging of nearby harbours and marinas;
- Cleveland apartment developments;
- Cleveland WWTP upgrade; and
- Future maintenance dredging of Toondah Harbour.

Potential cumulative and consequential impacts for each environmental value are summarised below.

Water Quality

The risk of potential cumulative impacts to water quality is considered to be very low for the following reasons:

- As a result of the high level of treatment, ongoing regulation requirements and large distance between the sites, the risk of cumulative impacts from the release of nutrients from the WWTPs and the incremental increases associated with Toondah Harbour Project is expected to be minimal.
- Impacts from sediment suspension (plumes) and settlement (sedimentation) from the Toondah Harbour Project are expected to be minor outside of the immediate Project footprint.
- Impacts from sediment suspension and settlement from nearby sites that undergo regular maintenance dredging (Raby Bay and Weinam Creek) would be smaller than those predicted for Toondah Harbour as the amount of material dredged is significantly lower than the Project.
- Sediment plumes from capital dredging associated with the Toondah Harbour Project or future maintenance dredging events are unlikely to overlap with sediment plumes from maintenance dredging at nearby sites spatially or temporally.

- Maintenance dredging at these sites (and many others in Moreton Bay) have been carried out for decades. Habitats within western Moreton Bay have adapted to intermittent increases in turbidity as it is a regular occurrence either from dredging, strong tidal currents and storm events.
- Future maintenance dredging at Toondah Harbour would be expected to result in similar impacts to existing maintenance dredging events therefore future impacts would not be additional to what is already occurring.

Terrestrial Threatened Species (Koalas)

The risk of cumulative and consequential impacts to koalas is considered low to medium. Several management measures will be put in place within the Toondah Harbour PDA to improve existing habitat and allow the small number of koalas that utilise the area to move through the site. While increased urbanisation of Cleveland will result in increased threats for the local koala population, the population is not considered to meet national criteria to be considered an MNES and it is expected the implementation of a number of management measures and educational programs in the broader suburb could successfully mitigate against cumulative or consequential impacts to koala.

Migratory and Threatened Shorebirds

A recent report prepared by the University of Queensland for HLW (Fuller *et al*. 2021 - Managing Threats to Migratory Shorebirds in Moreton Bay) identified distribution and management of roost sites as the key threat to migratory shorebirds in Moreton Bay. A key concern is the imminent loss of a temporary roost site on the Port of Brisbane reclamation area which currently provides roosting habitat for approximately one third of Moreton Bay's shorebirds.

While the Toondah Harbour Project will result in the loss of foraging habitat for shorebirds, there are over 100 km^2 of intertidal habitat in Moreton Bay, constituting substantial potential foraging habitat for migratory shorebirds. Significant residual impacts to roosting habitat is not predicted as a result of the Toondah Harbour Project.

To provide the best conservation outcome for migratory shorebird species in Moreton Bay, the offsets strategy for the Project will address additional or improved roosting habitat in areas immediately surrounding Toondah Harbour and other important areas in Moreton Bay.

No other known or speculative projects are likely to directly impact on the foraging or roosting habitat on migratory and threatened shorebirds in Moreton Bay as state and local legislation and planning implements generally discourage development within or immediately adjacent to tidal areas. The Toondah Harbour Project is unique in the SEQ region and focused around the existing ferry terminal and harbour uses as well as the PDA, which was established by the state and local governments in recognition that Toondah Harbour is the optimum location to provide an urban and maritime hub in Moreton Bay. While cumulative risk is identified as medium to high, this is mostly a result of the loss of significant temporary roosting habitat at the Port of Brisbane.

Marine Threatened Species and Habitat

The risk of cumulative impacts to marine threatened species and habitat is considered low. Impacts would be related to other dredging projects in Western Moreton Bay, however risk of impact at each location is considered low as:

- Increases in turbidity and sedimentation during dredging were predicted to be mostly within the dredge area, with some increases over nearby seagrass, coral, mangrove and rubble communities.
- Changes to turbidity and sedimentation due to dredging are likely to be limited to the dredge campaigns, with turbidity returning to ambient levels once dredging ceases.
- Turbidity in Western Moreton Bay is already high, regularly exceeding WQO.
- Predicted increases in turbidity in the dredge campaigns are short lived, and usually less than ambient maximums. Consequently, the changes to turbidity and sedimentation are unlikely to negatively impact the

seagrass, rubble, coral and mangrove areas in the vicinity of the proposed works as these communities are already adapted to high and variable turbidity.

- The relatively small increases in sediment deposition are unlikely to negatively impact the long-term distribution and growth of seagrass in the area.
- Similarly, the soft sediment benthic fauna, macroalgae and coral communities growing in the areas that may be impacted by increased sedimentation rates, are adapted to current conditions, including the deposition of sediment.

While dugong and marine turtles feed on seagrass, Western Moreton Bay generally is not significant habitat for them, with population densities far higher on the Eastern Banks. Australian humpback dolphin is found throughout the bay; however, no areas that would be impacted by these actions would be considered core habitat. Consequently, the direct loss of seagrass habitat in Western Moreton Bay is unlikely to have a significant impact on marine MNES species.

Other Consequential Impacts

Other consequential impacts assessed include increased boat and recreational vessel usage and climate change impacts resulting from the Toondah Harbour Project. The Project is not expected to result in an overall increase in boat traffic as the removal of the existing boat ramp is expected to offset additional trips generated by development of the marina. There is some potential for non-motorised watercraft utilising the new boat ramp to impact on roosting shorebirds at Cassim Island, however a number of management measures will be put in place to minimise impacts. Educational signage, fencing to stop people accessing Cassim Island from the rock breakwater and the implementation of an exclusion zone around Cassim Island will also be discussed with the Queensland Government and RCC.

The Project itself will not generate significant amounts of carbon and will not contribute to drivers of future climate change. Coastal processes modelling reviewed potential wave and water level impacts of the completed project under various sea level rise scenarios and an extreme weather event. Two different levels of sea level rise were assessed, 0.4 m (likely to occur over the next 50 years based on current predictions) and 1.5 m (specified by the EIS guidelines). Under both scenarios, the extent of existing mudflats at Toondah Harbour will be significantly reduced. Modelled maximum water levels during storm events indicate under both extreme event scenarios that the Project footprint effectively provides additional shielding from Toondah Harbour to south of Oyster Point.