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SUBJECT

Impact to the Coastal Processes due to the Construction of MRL's AIP Marine Infrastructure

Executive Summary

O2M have reviewed studies on oceanographic processes and littoral transport at the site, the ongoing coastline monitoring and management plans pertinent to Ministerial Statement 1131, and the associated compliance assessment reports to advise on the likelihood that the Ashburton Infrastructure Project will alter local coastal processes. As any foreseeable changes to littoral transport are minor, and the coastline is under legislated ongoing monitoring and management by PPA, the most likely outcome is a very minor change to the optimal nourishment location. As decisions of optimal nourishment location are to be reviewed biannually, no change to the existing management plan is likely to be required.

1. Background

1.1. Ashburton Infrastructure Project

The proposed Ashburton Infrastructure Project (AIP) involves the construction of a new port landside handling and storage facility at the Port of Ashburton (the Port). Export is proposed from port landside and marine export facilities within the Port, including a nearshore berth facility (Figure 1).

Figure 1 AIP dredge footprint, jetty and berths (white) relative to existing Wheatstone Jetty and Pilbara Port Authority Materials Offloading Facility

Construction of the dedicated nearshore berth facility will be undertaken from a temporary causeway that will be removed after construction of the jetty is complete (Figure 2).

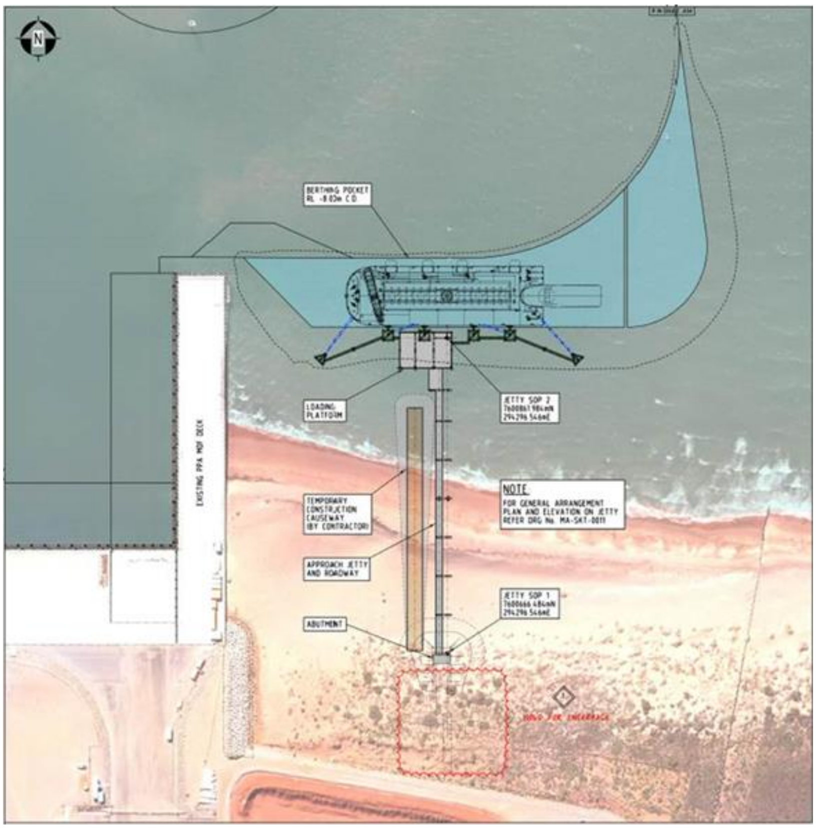


Figure 2: Extract from BG&E's <u>Preliminary</u> Port of Ashburton Transhipment Berth Port Plan [July 2021]

1.3. Existing Port Infrastructure

The Materials Offloading Facility (MOF) and tug pens were constructed as part of the Wheatstone project. Breakwaters were constructed around the MOF and tug pens which extend from the shoreline and encompass the MOF and tug pens with an opening on the eastern side of the MOF and tug pens as depicted in Figure 1. These breakwaters act to create a sheltered environment for marine operations during ambient conditions and vessel shelter during cyclonic conditions (PPA 2021).

1.2. Objective and Scope

The objective of this technical note is to undertake a desktop review and provide high level comments as to likely impacts that the AIP may have on the coastline.

This desktop assessment reviews the littoral transport process at the site, identifies the nearshore conditions that impact these littoral transport process and provides for recommendations as to whether the introduction of the AIP calls for a review of the existing coastline monitoring and management strategy, outlined in the PPA's Coastal Processes Monitoring and Management Plan (CPMMP; PPA, 2021).

As does the CPMMP, this study focusses on non-cyclonic conditions, often referred to as ‘ambient conditions’. Temporary impacts to the shoreline that may occur during the construction phase of the AIP are also excluded. This study of broad coastal processes also excludes highly-localised fluid-structure-sediment interactions (i.e. scour).

2. Local Coastal Processes at Ashburton

2.1 Coastline Evolution

The site is located within the western Ashburton sediment compartment. This compartment extends over 70 km from Tubridgi Point to Coolgra Point (PPA 2021), and includes a number of tidal creeks and the active delta of the Ashburton River (Figure 3).

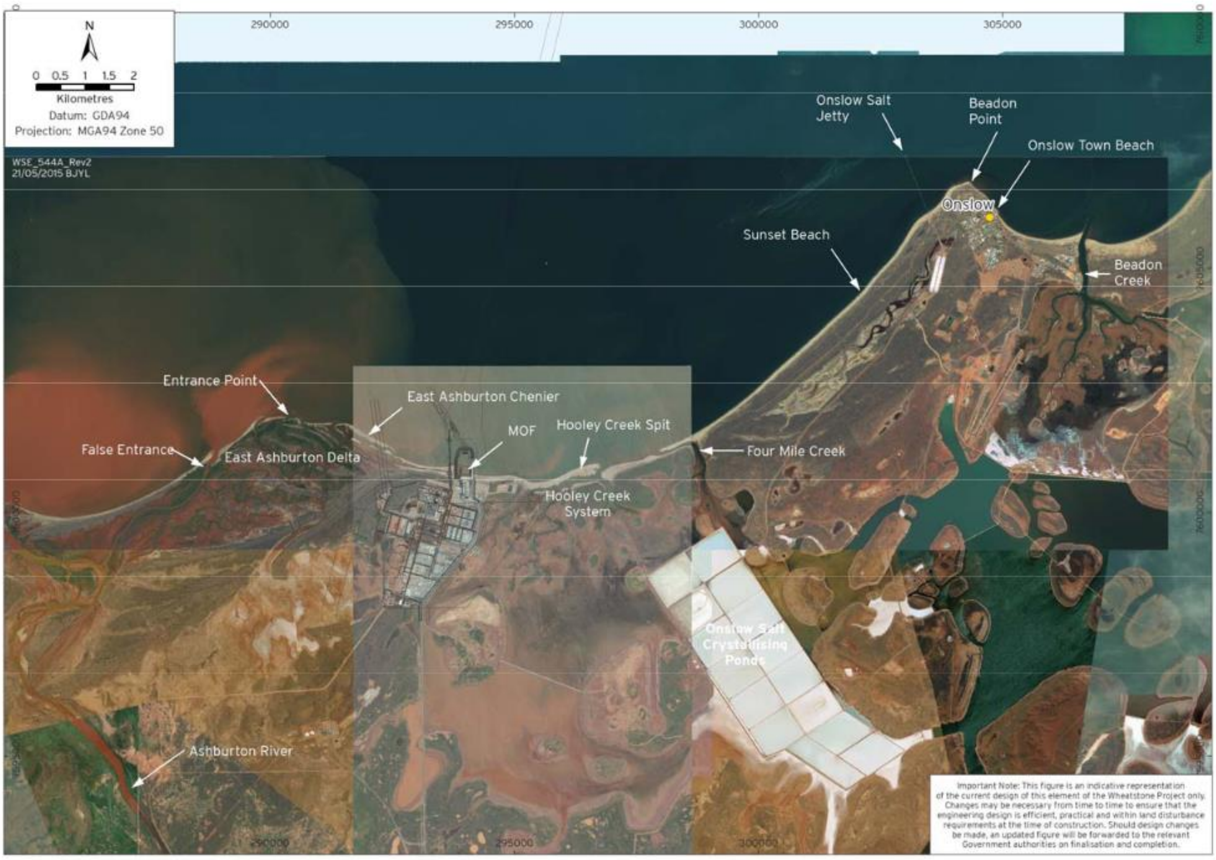


Figure 3 Key coastal features (PPA, 2021)

Historical coastline behaviour suggests that the coastline within the compartment is a dynamic coastal system with major transport acting eastward along the shore (PPA 2021), with the Ashburton River providing for a sediment source for littoral drift.

Estimates of historical littoral transport rates within isolated sediment cells between Ashburton Delta and Onslow Town Beach were derived by Damara (2010) and are presented below graphically in Figure 4. This study demonstrates the net littoral transport is in an easterly direction. These calculations were further supported by a modelling study conducted by DHI which estimated a net average eastward transport of 20,000 m^3 to 60,000 m^3 per year (DHI 2010).

Figure 4 Littoral Transport and Net Erosion/Accretion Rates (PPA, 2021)

2.2. Littoral Transport Process

The movement of sediments in the nearshore zone by waves and currents is referred to as littoral transport. Waves arriving at the shore are the primary cause of littoral transport, with the angle of approach of the waves arriving at the shore determine the direction of this transport (CERC, 1984). Longshore currents in the littoral zone are wave-induced and are sensitive to changes to wave breaking height and breaking angle (CERC 1984).

Since the contruction of the breakwaters surrounding the MOF and tug pens, the natural littoral transport (discussed previously in Section 2.1) was disrupted, with the breakwater capturing longshore transport on the western side of the MOF. Intervention by sand bypassing is expected to be required every 5-years to minimise the risk of erosion on the eastern side of the MOF and to minimise change to the natural littoral transport process at this site (PPA 2020). The monitoring and management of this intervention is discussed in the following section of this report (Section 3).

2.3 Existing Nearshore Wave Climate

Preliminary assessment of the inshore wave conditions in the vicinity of the AIP was previously conducted by Cardno (2020), which used offshore wave measurements to assess the translation of wave conditions into the nearshore site. This translation was conducted using swell waves as local seas were deemed unable to diffract around the breakwater.

Cardno's (2020) preliminary assessment concluded that the nearshore site immediately east of the breakwaters surrounding the MOF is sheltered from the large majority of the ambient incident waves. This sheltering was due to the breakwater. Prevailing swells diffract around the breakwater and approach the beach perpendicular to the coastline. Cardno (2020) concluded that the diffraction of the waves, which occurs in lee of the MOF, reduced the heights and energy of the waves as they approached the shore.

3. Existing Management: Wheatstone Project Coastal Processes Monitoring and Management Plan (CPMMP)

3.1. CPMMP Objective

A CPMMP was prepared by Chevron and amended by Pilbara Ports Authority (PPA) (PPA 2021) to monitor and manage compliance with section 5 of the WA Ministerial Statement 1131 (previously the WA Ministerial Statement 873). These requirements are (PPA 2021):

- Minimise change to littoral sediment transport,
- Minimise an erosion trend under non-cyclonic conditions in the position of the mean sea level shoreline and dune vegetation line between the nearshore marine facilities and Beadon Creek,
- Maintain the functionality of Hooley Creek,
- Maintain the functionality of the Ashburton Delta and avoid destabilisation of the chenier that impounds the coastal lagoon east of Entrance Point,
- Minimise the impacts on the recreational value of beaches between the nearshore marine facilities and Beadon Creek,
- Minimise the reduction in integrity and performance of the Onslow seawall, and
- Minimise the reduction in integrity and values of heritage sites between the Ashburton Delta and Beadon Creek.

3.2. Monitoring Plan

The monitoring plan implemented for the construction of port facilities for the Wheatstone project included both routine monitoring and triggered monitoring. The routine monitoring includes monthly, twice yearly, and annual scheduled survey activities as well as community consultation. The routine monitoring targets the following items (PPA 2021):

- Rate of littoral sediment transport interruption and associated accretion to the west of the MOF. This is then used to assist in determining the need and nature of bypass operations.
- To identify the occurrence of significant erosion/accretion events.

Triggered monitoring is then conducted on an as needed basis and is subject to outcomes of the routine monitoring. Other monitoring can also be conducted on an as needed basis subject to findings of the routine monitoring, triggered monitoring and sand bypassing operations.

3.3. Management Plan

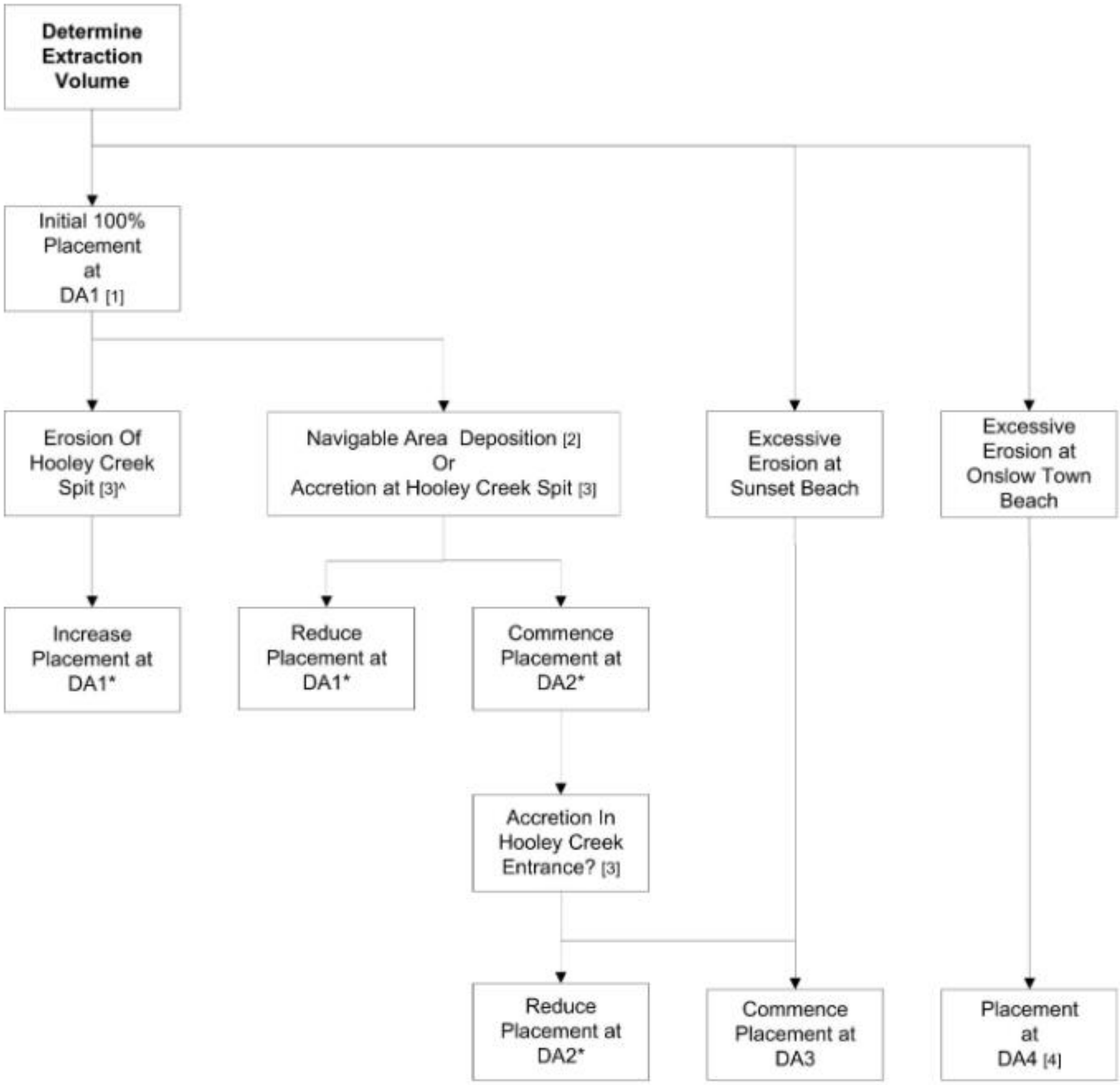
Periodic sand bypassing has been employed to transfer accumulated sediment from the western side of the MOF breakwater to the western side of the MOF breakwater. The main trigger for sand bypass operations occurs when the net accretion of sediment volume within the extraction area exceeds 200,000 m^3 (PPA 2021). Several placement locations for excavated sediment are identified to allow for flexibility in the management plan to resolve the littoral transport interruption. A decision tree was developed to provide assistance in determining placement locations and identifies the reasoning for placement at each location. Figure 5 presents the extraction area and possible nourishment locations identified in the CPMMP and Figure 6 presents the associated decision tree (PPA 2021). Note that the original primary disposal location (DA1) was amended in the latest revision of the CPMMP, splitting this location into two zones (DA1.1 and DA1), however it is unclear as to what this new zone (DA1.1) represents.

Figure 5 Sand extraction (blue) and disposal areas (PPA, 2021)

3.4 Knowledge gaps after CPMMP review

There are a few key knowledge gap areas that can be identified to support the conclusions made in this report as well as inform the continuing monitoring and management of the coastline including the following:

- Since the introduction of the CPMMP, there has been two occasions where the 200,000 m^3 trigger has been exceeded, leading to sand bypass actions being taken. These events are outlined in compliance reports by Chevron (2019, 2020). Whilst this information is publicly available, the location of the nourishment is not available in the compliance reports. This information could better inform whether the nearshore site for the AIP is an erosion risk.
- The amendment of the CPMMP in 2021 included the creation of a sub-zone titled DA1.1 within the existing DA1 nourishment location. This DA1.1 location covers the nearshore AIP site, however the amendment does not discuss the reasoning for the creation of this sub-zone. Information as to why the DA1 area was reduced in size by DA1.1 would be beneficial to understanding the ongoing monitoring and maintenance of this coastline relevant to the nearshore site for the AIP.



^ If Project-attributable erosion is observed at Hooley's Creek spit, following placement of sediment, extraction quantities to be assessed, and if necessary sediment from alternative sources may be required.

* Changes to placement volumes is to be implemented in the first extraction phase immediately following the observed change in accretion or erosion trend

[1] The initial distribution of sand between disposal areas DA1, DA2 and DA3 will be progressively refined, with each sand management exercise.

[2] Unacceptable deposition in the navigable area occurs where it affects berth use or provides a significant reduction of navigable depth of the channel.

[3] Change to the spit and lagoon entrance must be evaluated qualitatively relative to environmental conditions, as these areas are naturally dynamic.

[4] Subject to agreement with the Ashburton Shire Council, small volumes (no greater than 5000 m^3) of extracted material may be placed at DA4 (Onslow Town Beach) to assist in maintaining the recreational amenity of this beach and to provide a natural buffer to the Onslow Town Beach Sea Wall

Figure 6 CPMMP Beach Nourishment Decision Tree (Chevron 2021)

4. AIP Impact Discussion

The AIP could potentially alter the coastal processes (nature and extent of the littoral transport process) due to the introduction of the following:

> Project infrastructure (piled jetty and dolphin structures),
> The increased dredged area at the existing channel, and
> The presence of moored Transhipment Vessels (TSV) on an almost continuous basis.

Note that during the construction of the piled jetty and dolphin structures, a temporary impermeable causeway will also be constructed at the nearshore site as shown in Figure 2. As this structure will be temporary it is excluded from the scope of this study of long-term littoral transport processes (Section 1.2).

Likely impact of jetty and dolphins

The jetty and dolphins are to be piled structures that are known to have negligible effects the on the propagation of current and waves, with the exception of highly localised effects within a few diameters of the structure (i.e. tens of metres).

Likely impact of the modified dredge footprint

The modified dredge footprint for berthing is also a change that could alter the existing wave climate. Whilst this has not been studied in detail, foreseeable changes include:

- Very minor reduction in wave energy dissipation due to the increased depth;
- Very minor horizontal redistribution of energy through modified wave diffraction, and;
- Likely minor changes in non-linear interactions between the wave and seabed.

Each of these processes are foreseeable, but very minor changes to an already mild wave climate (Cardno, 2020), and thus any of negligible practical importance to littoral transport processes.

Likely impact of any berthed transhipment vessels (TSVs)

The third factor potentially affecting the wave and currents in the vicinity of the AIP is the presence of TSV. The TSV will result in a reflection of incident waves that attack the TSV hull, with the waves around the ends of the TSV likely diffracting around the bow and stern leading to a reduction in wave energy. The introduction of the TSV therefore could lead to a more sheltered area shoreside of the vessel.

Given that the outcome of the nearshore wave assessment by Cardno (2020) was that the wave climate at the nearshore site is sheltered by the MOF breakwaters, any likely exacerbation in the wave climate due to these discussed changes are likely to have a negligible impact on the littoral transport process as the location is already considered sheltered.

Comment on Appropriateness of Existing CPMMP in Accommodating the Changes Introduced by the AIP

The existing CPMMP sets out a plan for continuous monitoring and management of the coastline since the introduction of the breakwaters surrounding the MOF and tug pens.

In reviewing the CPMMP, there is a zone that is identified as a possible nourishment location that coincides with the nearshore site for the AIP. This zone is titled DA1 and was later amended to be split into two zones, DA1.1 and DA1. Under this amendment, the nearshore site no longer sits within DA1, but rather it sits within DA1.1. It is unclear whether the discussions in the CPMMP surrounding nourishment at DA1 is inclusive of DA1.1.

Under the assumption that it is inclusive of DA1.1, the decision tree introduced previously in Figure 6 lists the reasoning behind why nourishment at DA1 may be conducted, being that its purpose is to manage possible erosion at the Hooley Creek Split (further east of the AIP nearshore site). With Hooley Creek Split erosion being the risk associated with the nourishment area of DA1, this does not suggest that his nourishment location has any association with risk of beach erosion associated with the nearshore site for the AIP.

This conclusion is also consistent with the Cardno (2020) nearshore wave assessment which lists this area as being sheltered by the breakwaters surrounding the MOF and tug pens. Past estimates for littoral transport rates by Damara (2010) and DHI (2010) prior to the MOF breakwater construction also do not provide evidence of erosion at this nearshore site historically and conversely, they list possible accretion along this section of coastline.

Given that the changes introduced by the AIP project are likely to cause negligible impact on the existing littoral transport at the nearshore site and that the CPMMP suggests that the AIP site was not at risk of erosion in its existing state, the existing monitoring and management program outlined by PPA (2020) still appears appropriate for management of this section of coastline. The most likely outcome is a very minor change to the optimal nourishment location, but this is ongoingly reviewed biannually, and as such requires no change to the existing management plan.

5. Discussion and Recommendations

Maintaining the existing management strategy for sand bypassing as detailed in (PPA, 2021) is still the preferred (thus recommended) option, given that the proposed changes associated with the AIP are unlikely to induce any significant change in the AIP nearshore wave climate when compared to its existing state.

It is recommended that MRL liaise with PPA and/or Chevron regarding this ongoing monitoring and maintenance to address the knowledge gaps discussed in Section 3.4, allowing further understanding of the coastline erosion risks at the AIP nearshore site and provide clarity on the amendment of the CPMMP in 2021.

Whilst not a result of changes to littoral transport, and therefore not reviewed in this technical note, any project infrastructure (temporary or permanent) may impact upon the capacity to access the beach for nourishment, and may complicate the compliance with Ministerial Statement 1131. It is recommended that the Ministerial Statement 1131 is considered when planning construction and decommissioning of any temporary structures (such as the causeway).

Should discussions between MRL and PPA/Chevron still identify the need for monitoring and management of the nearshore site for the AIP under the CPMMP, appropriate coordination and arrangements between MRL and PPA/Chevron to allow for this to continue is recommended.

References

Cardno, 2021. *Port of Ashburton Preliminary Assessment of Inshore Wave Conditions to Inform Loading Options Assessment*, West Perth, Australia.

Chevron, 2019. Wheatstone Project Minsterial Statement 873 Compliance Assessment Report 2019, Document ID ABU190800885, Revision Date 21 November 2019.

Chevron, 2020. Wheatstone Project Minsterial Statement 873 Compliance Assessment Report 2020, Document ID ABU200700397, Revision Date 11 November 2020.

Coastal Engineering Research Centre (CERC), 1984. *Shore Protection Manual Volume 1 – Chapter 4: Littoral Processes*, Department of the Army, U.S Army Corps of Engineers, Washington.

Damara, 2010. *Coastal Geomorphology of the Ashburton River Delta and Adjacent Areas*. Report 82-01-01, May 2010. Appendix P1 of the Wheatstone Draft EIS/ERMP. Chevron Australia Pty Ltd.

DHI, 2010. *Wheatstone Project Coastal Impacts Modelling*. Appendix P2 of the Wheatstone Draft E IS/ERMP. Chevron Australia Pty, Ltd.

Mineral Resources Limited (MRL), 2021. *Ashburton Infrastructure Project Development Envelopes*, Drawing number P0011_D12_RevH, 30th of August 2021.

Pilbara Ports Authority, 2021. *Wheatstone Project Coastal Processes Monitoring and Management Plan*, Revision 3.1, April 2021.