Noise and Vibration

5. NOISE AND VIBRATION

5.1. Introduction

This Chapter is concerned with understanding the existing acoustic environment and then assessing any likely noise and vibration impacts to identified noise sensitive receptors from the construction and operation of the proposed Port Bonython Bulk Commodities Export Facility (BCEF). This includes both terrestrial and marine environments.

The acoustic environment around the Port Bonython area is currently characterised by industrial, vehicular traffic and natural oceanic noise sources. Noise and vibration from the operation and construction of the BCEF has the potential to adversely affect the following noise sensitive receptors:

- Residential properties at False Bay
- Residential properties at Point Lowly
- Terrestrial life
- Marine life.
- This Chapter presents the following information:
- Details of the relevant acoustic regulations with which noise and vibration from the BCEF site is to comply
- Details of the existing noise and vibration sources
- The results of baseline noise measurements conducted at Point Lowly and False Bay
- Prediction of construction noise and vibration levels
- Prediction of operational noise associated with:
  - Port operations and ship movements
  - Road traffic generated by the Project
  - Rail
- Assessment of predicted noise and vibration levels with respect to the acoustic criteria and guidelines to determine the impact
- Recommendations for mitigation measures ,where required, to meet the acoustic criteria
- Identification of residual impacts.

The underwater noise and vibration impacts on the marine environment are addressed in **Chapter 15, Underwater Noise**.

A glossary of acoustic terminology used in this Chapter is included following **Chapter 20, Conclusions and Recommendations** of this report.

5.2. Methodology and Assumptions

Full details of the methodology and assumptions used in the Marine impact assessment are included in **Chapter 15, Underwater Noise**.

5.2.1. Baseline

Unattended noise measurements have been conducted using environmental noise loggers at the nearest noise sensitive receptors associated with the construction and operation of the proposed BCEF. This is in accordance with the noise assessment approach agreed following consultation with the SA Environment Protection Agency (EPA), which for some noise sources (such as construction traffic on local roads) requires a comparison of the existing noise levels against the future predicted noise levels.

5.2.2. Noise and Vibration Sensitive Receptors - Terrestrial

The nearest affected noise sensitive receptors (NSRs) are the residential receivers located in the False Bay and Point Lowly areas. These NSRs and the proposed development are identified in **Figure 5.2a**.

5.2.3. Noise Measurement Methodology

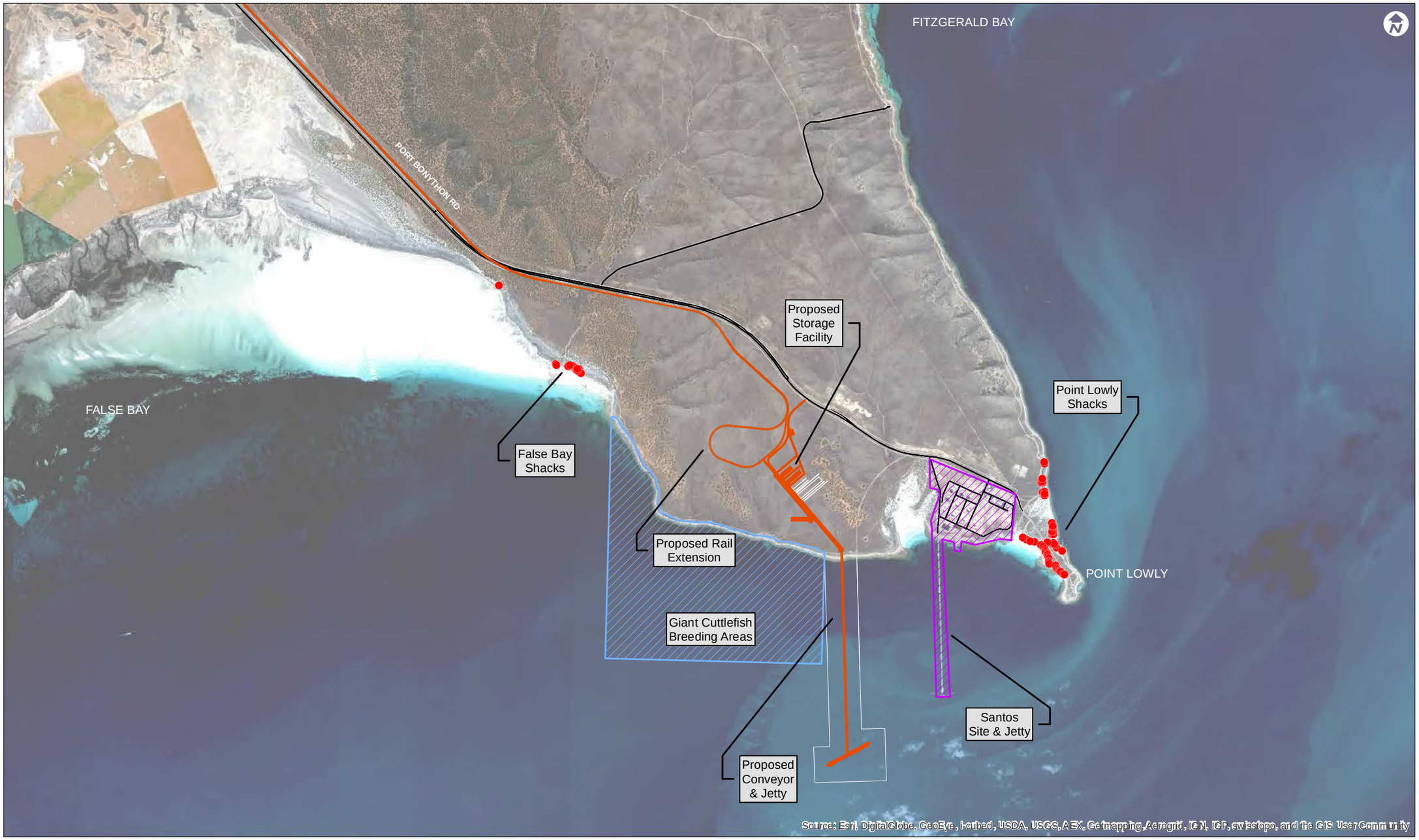
Attended noise measurements (i.e. short-term, human-operated measurements) have been undertaken to identify the major features of the acoustic environment in the vicinity of the BCEF and to supplement and verify unattended (automated noise logger) measurements, which provide longer-duration information about the variation in the ambient noise environment throughout the day/night cycle. A mobile weather station was used to monitor the weather, including wind speed and precipitation over the week-long period at one of the local measurement locations.

Noise measurements have been conducted generally in accordance with the following legislation, regulations and Australian standards:

- Australian Standard AS 1055.1:1997 *Acoustics – Description and measurement of environmental noise, Part 1: General procedures*
- SA Environment Protection *(Noise) Policy 2007 (SA EPA Policy 2007)*
- Australian Standard AS 2702:1984 Acoustics – *Method for the measurement of road traffic noise*.

Figure 5.2a: Noise sensitive receptors

Figure 5.2a: Noise sensitive receptors



Port Bonython EIS
Spencer Gulf Port Link

Figure 5.2a -
Noise Sensitive Receptors

Legend

- Roads
- Shacks
- Upper spencer gulf marine park (Santuary zone)

ARUP

Spencer Gulf Port Link

1:50,000 (at A3)

0 0.5 1 2

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

All noise measurements were measured under free-field conditions (i.e. sufficiently far away from reflecting surfaces (except the ground) that no significant increase in the measured noise level occurs). Industrial noise levels from the BCEF port operations are required to be assessed under free-field conditions (at the property boundary) and hence the noise measurement location meets the requirements of the SA EPA Policy.

The noise survey measured the LAeq, 15minute (energy-average noise level) and LA90, 15minute statistical noise parameter at all sites. The LAeq parameter is characteristic of the average noise level at a site, while the LA90 parameter is characteristic of the quasi-steady-state "background" noise level.

Since ambient noise levels vary over the course of a day, it is necessary to obtain a single-number representative noise level to characterise the "typical" ambient noise levels experienced on site over the course of the noise survey.

For the LAeq parameter, the energy-average of the LAeq, 15minute noise levels over the course of each time period over the survey was calculated. This level is denoted LAeq, 15min, ave.

For the LA90 parameter, the Rating Background Level (RBL) parameter (defined in the NSW Industrial Noise Policy) was used to provide a representative single-number "typical" background noise level for each noise logger, as required by the SA EPA Policy.

Noise measurements have been conducted at the locations described in **Table 5.2a** to establish the existing baseline noise levels:

Table 5.2a: Noise measurement locations

Location	Description	Type of measurement (attended/unattended)	Date of Measurement(s)	Duration
1	Representative location of the only residential property on Gilja Retreat	Unattended and attended	29/4/2013 (attended) 29/4/2013-6/5/2013 (unattended)	15 minutes (attended) 1 week (unattended)
2	Representative location of residential properties on Yorrel View	Unattended and attended	29/4/2013 (attended) 29/4/2013-6/5/2013 (unattended)	15 minutes (attended) 1 week (unattended)
3	Opposite residential property at 14 Sida Cove.	Attended and weather station	29/4/2013 (attended) 29/4/2013-6/5/2013 (weather)	15 minutes (attended) 1 week (weather)
4	Representative location of residential properties on Lighthouse Drive	Attended	29/4/2013	4 x 15 minutes
5	Representative location of residential properties on Wilsonia Drive	Attended	29/4/2013	3x15 minutes
6	Representative location of residential properties on Boobilla Retreat	Attended	29/4/2013	2x15 minutes

These locations are also identified in **Figure 5.2b**.

Figure 5.2b: Noise measurement locations

Figure 5.2b: Noise measurement locations

Port Bonython EIS
Flinders Ports Holdings

Figure 5.2b -
Proposed Noise
Monitoring Locations

Legend

- ▲ Shacks
- ×1 Proposed Noise Receiver Location
- A Attended Measurements (Hand held sound level meter)

ARUP

Spencer Gulf Port Link

1:40,000

0 0.5 1 2

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

5.2.4. Construction Noise and Vibration Assessment

5.2.4.1. Airborne

Full details of the input and equipment sources used in the construction noise and vibration assessment are included in **Appendix F.1**.

The construction noise and vibration assessment has been conducted in accordance with the following standards and guidelines:

- Australian Standard AS 2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*
- British Standard BS 5228.1:2009 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*
- British Standard BS 5228.2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*
- NSW EPA A*ssessing Vibration: A Technical Guideline, 2006*
- Australian Standard AS2670.2:1990 *Evaluation of human exposure to whole-body vibration, Part 2: Continuous and shock-induced vibration in buildings.*

5.2.5. Operational Noise and Vibration Assessment

Full details of the inputs into the noise modelling and calculations are included in **Appendix F.2**.

5.2.5.1. Industry

Operational noise from industrial components of the operation of the Project has been assessed using the CONCAWE methodology as implemented in SoundPlan V7.1 environmental noise modelling software.

5.2.5.2. Rail

Rail noise from the operation of the 17.5km line with 6.1km rail loop extension to the BCEF has been modelled using the Nordic Prediction Methodology Kilde 1996, as implemented in SoundPlan V7.1 environmental noise modelling software. Source noise levels of railway freight locomotives and the train consist have been sourced from Rail Noise Database: Stage II Noise Measurements and Analysis, Wilkinson Murray Pty Ltd, 2000.

5.2.5.3. Road

Road noise will be assessed against the change in road traffic noise levels as a result of the Project. Calculation of the 'Basic Noise Level' (BNL) has been conducted in accordance with the Calculation of Road Traffic Noise (CRTN) method. The BNL provides an indication of the noise emission from a road by providing a calculated noise level at 10m from the edge of the carriageway.

This enables a simple comparison to be made of noise emissions for individual roads and the effect of changes in traffic flows attributable to the development. As the criteria for road traffic noise is typically rated against a daytime (7am-10pm) 15hour Leq and a night-time (10pm to 7am) 9hour Leq, these noise levels have been calculated from the CRTN BNL using the methodology detailed in **Appendix F.3**.

5.2.6. Assumptions and Technical Limitations

5.2.6.1. Baseline

Point Lowly and False Bay are areas that are subject to high wind conditions, due to their coastal locations. Data that has been affected by wind conditions (wind velocity greater than 5m/s) has been discarded and not included in the noise data presented in **Section 5.3.1.2** and in **Appendix F.5**.

Noise loggers were located at representative locations of the nearest noise sensitive receptors.

5.2.6.2. Construction

Source noise levels of construction equipment have been taken from BS 5228.1 used in preference to AS 2436 as the British Standard has a more-extensive database with octave-band construction source levels.

Construction equipment methodology, plant numbers and percentage on-times have been based on the construction methodology outlined in **Chapter 2, Project Description**.

All assumptions regarding plant are included in Appendix F.1.

5.2.6.3. Operation

Operational methodology, plant numbers and percentage on-times have been based on the operational plant and equipment as defined in the Project description and design for the BCEF outlined in **Chapter 2, Project Description**.

Source noise levels of equipment have been taken from a range of sources including:

- Arup internal noise database
- Publicly available data from similar noise impact assessments.

All assumptions regarding plant details and source noise levels are included in **Appendix F.2**.

5.3. Existing Conditions

A description of the existing conditions of the marine environment around the BCEF is included in **Chapter 15, Underwater Noise**.

5.3.1. Existing Noise Environment

5.3.1.1. Airborne

The subject site is in a rural coastal location with some existing industrial activities at the Santos facility Point Lowly. Investigation of the Project area showed that the following noise sources characterise the area:

- Industrial noise from the Santos site – Point Lowly receptors only
- Wave noise from the coast
- Wind noise due to the coastal location of the site
- Occasional road traffic from local roads
- Bird noise.

5.3.1.2. Noise Survey

A noise survey was conducted in the area from 29 April to 6 May 2013 as described in **Section 5.2.3**. A summary of the results is presented below in **Tables 5.3a and 5.3b**. For measurement locations refer to **Figures 5.2b and 5.2c**. Graphs of results of the unattended measurements and all attended noise measurement data are included in **Appendix F.5**.

In summary, False Bay has a relatively-constant ambient noise environment characterised by low ambient noise levels. The noise environment is typically dominated by natural noise sources, such as ocean wave sound and wind causing vegetation to rustle. Very little man-made noise was observed at these locations, with the exception of the occasional car accessing Yorrel View at measurement Location Two (2).

Point Lowly has a higher level of daytime ambient noise as the sound of waves is noticeably louder than at False Bay and there is significantly more traffic (particularly tourist traffic) accessing this area, with the camping grounds being in close proximity to the measurement locations. Noise from the Santos site was generally inaudible during the day time period.

Night-time noise was typically constant and lower than daytime noise levels. Noise levels at night were due to the sound of waves and industrial noise from the Santos site, which was only audible at night.

Table 5.3a: False Bay unattended noise logger measurements summary, 29 April to 6 May 2013

			Measured noise levels, dB(A)	
Location	Average Weekday/Weekend	Time period*	Leq,15min,ave	RBL**
1	Weekday	Day	40	25
	Weekday	Night	31	26
	Weekend	Day	38	25
	Weekend	Night	36	25
2	Weekday	Day	38	23
	Weekday	Night	34	23
	Weekend	Day	39	26
	Weekend	Night	38	24

*Daytime 0700 to 2200 hours; Night-time 2200 to 0700 hours

** Rating background level

Table 5.3b: Point Lowly attended noise measurements summary, 29 April 2013

		Measured noise levels, dB(A)	
Location	Time period*	Leq,15min	L90,15min
3	Day	45	42
4	Day	47	44
	Night	41	40
5	Day	44	42
	Night	38	36
6	Day	45	41
	Night	38	36

*Daytime 0700 to 2200 hours; Night-time 2200 to 0700 hours

5.4. Impact Criteria

Impact criteria for construction and operational noise and vibration impacts from the BCEF development are governed by applicable SA Legislation and EPA policies. In some cases, no specific SA policy or guidelines exist (e.g. for vibration impacts) and guidance from other states (particularly NSW) has been used to set impact criteria.

5.4.1. Construction Noise

5.4.1.1. Airborne Noise

Construction noise associated with the BCEF development is to meet the requirements of the SA EPA Policy 2007, *Part 6 – Special noise control provisions, Division 1 – Construction noise. These provisions are summarised below*:

Construction noise is considered to have an adverse impact on amenity at noise sensitive receivers when:

- The continuous noise source level exceeds 45dB(A) or the ambient continuous noise level, whichever is higher
- The maximum noise source level exceeds 60dB(A) or the ambient maximum noise level (that is reached consistently), whichever is higher.

Noise that is considered to have an adverse impact on amenity should:

- Not occur on a Sunday or public holiday
- Not occur during the night-time or evening period (7pm to 7am).

Unless construction must occur to:

- Avoid unreasonable interruption of vehicle or pedestrian traffic movement
- If other grounds exist that the administering agency determines to be sufficient.

Where construction noise is considered to have an adverse impact on amenity all reasonable and practicable measures must be taken to minimise construction noise and its impact.

5.4.2. Operational Noise

5.4.2.1. Airborne Noise

Industrial

The regulation in which limits are prescribed for industrial noise in South Australia is The Environment Protection (Noise) Policy 2007 (SA EPA Policy, 2007).

A summary of the industrial noise criteria for noise sensitive receivers in the vicinity of the Port Bonython operation site have been determined and are presented below in **Table 5.4a**.

Table 5.4a: Industrial noise criteria

Receiver Location	External Noise Limit at Noise Sensitive Receiver	
	Day (7am to 10pm)	Night (10pm to 7am)
Point Lowly	51 dBL_{Aeq}	43dBL_{Aeq} 60dBL_{Amax}
False Bay	51 dBL_{Aeq}	43dBL_{Aeq} 60dBL_{Amax}

Full details of the derivation of these criteria are included in **Appendix F.2.1**.

Road

Legislation for road traffic noise limits do not exist in South Australia. SA EPA has advised (by email from Phil Hazell on 15 February 2013) that the predicted road traffic noise levels from new roads in outdoor recreational areas on residential allotments should not exceed 52dBLAeq15hr (7am – 10pm). This applies to land divisions near major arterial roads.

There will be no major arterial roads constructed for this development, but there will be a change in road traffic volume on the existing road network as a result of the development. No recommendations for changes in road traffic noise and the subsequent effects exist in South Australia. The changes in road traffic noise as a result of the development will be assessed against the significance criteria outlined in **Section 5.6**.

Rail

Legislative requirements or policies in South Australia with respect to rail noise do not currently exist, although the SA EPA has released Draft Guidelines for the assessment of noise from rail operations (2010), which sets the following noise limits for noise sensitive receivers located within 180m proximity to the rail corridor:

- 7am to 10pm: 60 dBLAeq(15hr) and 80dBL_{Amax}
- 10pm to 7am: 55 dBLAeq(9hr) and 80dBL_{Amax} .

All reasonable and practicable measures should be taken (e.g. separation) to avoid residents from receiving this level of noise.

These guidelines are similar to other states guidance (e.g. the NSW *Interim Guideline for Assessment of Noise from Rail Infrastructure Projects)* and hence it is likely that the final guidelines when released will not impose significantly different noise criteria.

The development will also increase the number of freight trains using the existing rail network. Because there are no upgrade works for the existing rail network beyond the new spur, noise on the existing rail network does not fall under the *Draft guidelines*. The SA EPA (by email from Phil Hazell on 15 February 2013) has advised that noise on the existing rail network will be the responsibility of the existing rail operators, and that there are no applicable noise criteria for this to be assessed against within this EIS.

5.5. Vibration

Legislative requirements with respect to vibration do not exist in South Australia, however, guidance for vibration limits for human comfort is provided in the NSW EPA Assessing vibration: A Technical Guideline 2006 document, which is referenced in AS2436:2010 as providing standard guidance for vibration from construction activities.

Vibration generating equipment from BCEF construction (such as compactors and piling) is best characterised as being intermittent vibration sources. Vibration from train movements and operation of the BCEF equipment (e.g. conveyers, unloading etc.) is best characterised as intermittent vibration.

The *Assessing Vibration* guideline (2006) recommends impact threshold levels to manage vibration impacts from intermittent vibration, using the Vibration Dose Value (VDV) parameter, which is a complicated parameter taking into account both the level of vibration and its duration. BS 5228.2 also provides guidelines for human comfort, but using a simplified metric (the Peak Particle Velocity), which only takes into account the maximum level of vibration. The VDV parameter is more robust, but requires more information and is more difficult to measure, while the PPV parameter is relatively straightforward to apply. Hence, the VDV criteria should be assessed wherever possible, but for some equipment or vibration sources there may not be enough information to calculate VDV at this stage of assessment and a simplified assessment using PPV may be necessary. Hence, criteria for both parameters are presented, but the VDV criteria should take precedence wherever it is practicable to assess VDV. Vibration impact criteria are given in **Table 5.5a**.

For intermittent vibration, the following impact threshold values are recommended based on BS 5228.2 and the *Assessing Vibration guideline* (NSW EPA, 2006).). Subjectively, complaints are likely to occur if vibration impacts are “moderate” or higher, with “major” vibration impacts likely to be intolerable for more than extremely brief exposure.

5.6. Description of Significance Criteria

Full details of the significance criteria for the marine environment are included in **Chapter 15, Underwater Noise.**

5.6.1. Significance of Impact

5.6.1.1. Construction Noise

This section should be read in conjunction with the noise impact criteria detailed in **Section 5.4**. An assessment of the significance of the noise impact has been conducted using the significance criteria outlined in **Table 5.6a**.

5.6.1.2. Operational Noise

Industrial and Rail Noise

An assessment of the significance of the impact has been conducted using the significance criteria detailed in **Table 5.6b**.

Table 5.5a: Vibration impact criteria for construction vibration

Impact Category	PPV (mm/s)	VDV ($m/s^{1.75}$)	
		Day (0700-2200)	Night (2200-0700)
Negligible	PPV ≤ 0.3	VDV ≤ 0.2	VDV ≤ 0.13
Minor	0.3 < PPV ≤ 1.0	0.2 < VDV ≤ 0.4	0.13 < VDV ≤ 0.26
Moderate	1.0 < PPV ≤ 10	0.4 < VDV ≤ 0.8	0.26 < VDV ≤ 0.52
Major	PPV > 10	VDV > 0.8	VDV > 0.52

Table 5.6a: Construction significance of impact

Significance of Impact	Exceedance of Noise Impact Criteria
	Long-term impact (>1 month) (e.g. main site construction)
Very High	Construction noise levels are predicted to regularly exceed the noise impact criteria by more than 15 dB(A) at the majority of noise-sensitive receptors.
High	Construction noise levels are predicted to regularly exceed the noise impact criteria by up to 15 dB(A) at the majority of noise-sensitive receptors, or occasionally by up to 20 dB(A) at individual noise-sensitive receptors.
Moderate	Construction noise levels are predicted to regularly exceed the noise impact criteria by up to 10dB(A) at the majority of noise-sensitive receptors, or occasionally by up to 15 dB(A) at individual noise-sensitive receptors.
Minor	Construction noise levels are predicted to regularly exceed the noise impact criteria by up to 5dB(A) at the majority of noise-sensitive receptors, or occasionally by up to 10dB(A) at individual noise-sensitive receptors.
Negligible	Construction noise levels are predicted to exceed the established noise impact criteria by less than 3dB(A) at the majority of noise-sensitive receptors
Beneficial	Construction contributes to the reduction of noise. For example, construction or operation shuts down an existing source of noise such as a road and the resulting noise impact is less than the previous noise impact

Table 5.6b: Industrial and rail significance of impact

Significance of Impact	Exceedance of Noise Impact Criteria
Very High	Operational noise levels are predicted to regularly exceed the established criteria by more than 15dB(A) at noise sensitive receptors.
High	Operational noise levels are predicted to exceed the established criteria by between 10 to 15dB(A) or occasionally by more than 15dB(A) at noise sensitive receptors.
Moderate	Operational noise levels are predicted to exceed the established criteria by between 5 to 10dB(A) or occasionally by more than 10dB(A) at noise sensitive receptors.
Minor	Operational noise levels are predicted to exceed the established criteria by up to 5dB(A) or rarely by more than 10dB(A) at noise sensitive receptors.
Negligible	Operational noise levels are not predicted to exceed the established criteria.
Beneficial	Operation contributes to the reduction of noise. For example, operation shuts down an existing source of noise such as a road and the resulting noise impact is less than the previous noise impact

Road

No major arterial roads will be constructed as a part of the development; however here will be an increase in road traffic volumes on Port Bonython road. As there are no absolute criteria which apply to this situation, based on Arup's previous project experience and advice provided in the Design Manual for Roads and Bridges (UK), Volume 11, Section 3 Part 7 (2011) the significance of the noise impact as a result of the change in road traffic volume will be assessed against the criteria in **Table 5.6c**.

Table 5.6c: Significance of road traffic noise effects

Predicted Noise Change	Impact of Scale	Rating of Likely Effect
Increase of more than 10dB	Major increase	Potentially significant adverse effect (Major/ Moderate)
Increase of 6-10dB	Moderate increase	
Increase of 3-5dB	Minor increase	Potentially significant (Minor)
Increase of less than 3dB	Negligible change	Not significant (Negligible)
Decrease of more than 3dB	Slight decrease	Potentially beneficial effect, not significant

5.6.1.3. Construction and Operational Vibration

This section should be read in conjunction with the impact criteria and the qualitative levels of impact detailed in **Section 5.4.** An assessment of the significance of vibration impacts has been conducted using the significance criteria outlined in **Table 5.6d**.

5.7. Noise and Vibration Assessment of Effects

Terrestrial noise and vibration impacts from the BCEF development are anticipated to occur from the following major sources:

- Construction of the BCEF main site (including marine construction works)
- Construction of the connecting rail line
- Operational noise from operation of BCEF, including noise from unloading of rail vehicles, operation of conveyers and loading of bulk carrier vessels
- Operational noise from the connecting rail line
- Increased traffic noise levels on roads serving BCEF

The terrestrial Noise and Vibration assessment has been conducted in accordance with relevant SA policies, Australian and international guidelines and standards as summarised in **Table 5.7a**.

All references with regards to the underwater noise assessment are included in **Chapter 15, Underwater Noise**.

Table 5.6d: Construction significance of impact

	Vibration Impact Level	
Significance of impact	Short-term impact (up to one month) (e.g. rail construction)	Long-term impact (>1 month) (e.g. main site construction, operational vibration)
Very High	Major impact at all receivers	Major impact at majority of receivers
High	Major impact at majority of receivers	Major impact at isolated receivers Moderate impact at majority of receivers
Moderate	Major impact at isolated receivers Moderate impact at majority of receivers	Moderate impact at isolated receivers Minor impact at majority of receivers
Minor	Moderate impact at isolated receivers Minor impact at majority of receivers	Minor impact at isolated receivers Negligible impact at majority of receivers
Negligible	Negligible or minor impact at all receivers	Negligible impact at all receivers
Beneficial	Construction contributes to the reduction of vibration. For example, construction or operation shuts down an existing source of vibration	Construction contributes to the reduction of vibration. For example, construction or operation shuts down an existing source of vibration

5.7.1. Construction

5.7.1.1. Airborne Noise

Airborne noise levels from the construction activities listed below have been predicted at the nearest affected noise sensitive receptors, assuming that no noise mitigation measures have been applied. Full details of construction plant that have been used in the assessment are included in Appendix F.1.

A summary of the predicted noise levels at each of the nearest noise sensitive receptors is included below in **Table 5.7b**. Where noise levels are predicted to exceed the noise criteria, this has been bolded. Due to the large distances involved and changing wind conditions in the coastal area, it is possible that meteorological effects may impact noise levels at receptors. As such, noise levels have been calculated for neutral weather conditions and adverse weather conditions.

During adverse weather conditions, noise levels from piling activities offshore will cause a marginal exceedance of the noise criteria at Point Lowly; however this impact is considered to have negligible significance since the level of exceedance is only 1dB(A) and the exceedance will only occur under specific adverse weather conditions.

Construction of the rail line as it passes the coastal homes at False Bay is predicted to cause exceedances of the noise criteria at Site One (1) (Gilja Retreat) at False Bay. No exceedances are predicted for Point Lowly or for the Yorrel View (residence) receivers at False Bay.

Noise from trucks using the construction haul route has been assessed separately within the Road traffic noise assessment in **Section 5.7.2**. As detailed in **Chapter 8**, Transport, during peak times, there will be two trucks using the haul route per hour (assuming the trucks entering the site will also be leaving the site within the same hour, the assessment has been conducted for four pass-bys per hour). Using the calculation methodology provided in BS5228.1 for noise from haul routes (detailed in **Appendix F.3**), at the nearest noise sensitive receptor, which is Gilja Retreat in False Bay, the predicted noise level from the trucks using the haul route is 41 dB LAeq,15min. As this is below the criterion, the significance of the impact is negligible.

Table 5.7a: Policy, guidelines and legislation

Document	Relevance
CONCAWE, The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities, C.J. Manning, 1981	Prediction methodology used for the prediction of industrial noise from the operation of the BEF.
Australian Standard AS 2436:2010 Guide to noise and vibration control on construction, demolition and maintenance sites	Construction noise and vibration predictions, assessment and mitigation have been conducted in accordance with AS 2436.
British Standard BS 5228.1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise	In accordance with AS 2436, source noise levels of construction plant has been obtained from BS 5228.1.
British Standard BS 5228.2:2009 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration	Methodology of construction vibration prediction and assessment has been based on recommended calculations and criteria from BS5228.2.
Calculation of Road Traffic Noise, Department of Transport, Welsh Office 1988	Noise levels from road traffic noise have been predicted using Calculation of Road Traffic Noise (CoRTN), which is commonly used for road traffic noise prediction in Australia.
Nordic Council of Ministers (1996) Railway Traffic Noise – The Nordic Prediction Method, TemaNord 1996:524	Noise levels from rail noise have been predicted using the Nordic rail prediction method. Kilde has been used in this assessment as it is capable of predicting both L_{Aeq} and L_{Amax} rail noise levels, which is in accordance with the required assessment.

Table 5.7b: Predicted construction noise levels, dB re 20µPa

Receptor	Activity	Expected Duration of Impact	Noise Criteria	Predicted noise level, dB(A) Neutral weather conditions (Pasquil stability category D)
Site 1: False Bay (Gilja Retreat)	Marine plant – offshore	Long-term	45	34
	Marine plant – loading platform	Long-term	45	14
	Marine plant – canti-traveller	Long-term	45	29
	Marine – loading yard	Long-term	45	26
	Marine – on jetty	Long-term	45	14
	Marine – piling	Long-term	45	33
	Civil plant – bulk earthworks	Short-term (rail site) Long-term (main storage shed)	45	**65 (rail site)** 31 (main storage shed site)
	Civil plant – site works for buildings, sheds, rail and access road	Short-term (rail site) Long-term (main storage shed)	45	**64 (rail site)** 30 (main storage shed site)
	Rail plant	Short-term	45	60
	General site support plant	Long-term	45	**53 (rail site)** 19 (main storage shed site)
Site 2:False Bay (Yorrel View)	Marine plant – offshore	Long-term	45	32
	Marine plant – loading platform	Long-term	45	12
	Marine plant – canti-traveller	Long-term	45	27
	Marine – loading yard	Long-term	45	24
	Marine – on jetty	Long-term	45	12
	Marine – piling	Long-term	45	36
	Civil plant – bulk earthworks	Short-term (rail site) Long-term (main storage shed)	45	**47 (rail site)** 36 (main storage shed site)
	Civil plant – site works for buildings, sheds, rail and access road	Short-term (rail site) Long-term (main storage shed)	45	**46 (rail site)** 35 (main storage shed site)
	Rail plant	Short-term	45	43
	General site support plant	Long-term	45	35
Point Lowly	Marine plant – offshore	Long-term	45	42
	Marine plant – loading platform	Long-term	45	22
	Marine plant – canti-traveller	Long-term	45	37
	Marine – loading yard	Long-term	45	34
	Marine – on jetty	Long-term	45	22
	Marine – piling	Long-term	45	40
	Civil plant – bulk earthworks	Long-term	45	33
	Civil plant – site works for buildings, sheds, rail and access road	Long-term	45	32
	Rail plant	Long-term	45	28
	General site support plant	Long-term	45	21

Adverse weather conditions (Pasquil stability category B)	Significance of Impact	Risk Rating
40	Negligible	Low
20	Negligible	Low
35	Negligible	Low
32	Negligible	Low
20	Negligible	Low
39	Negligible	Low
69 (rail site) 35 (main storage shed site)	**High (rail site)** Negligible (main storage shed site)	**High (rail site)** Low (main storage shed site)
68 (rail site) 34 (main storage shed site)	**High (rail site)** Negligible (main storage shed site)	**High (rail site)** Low (main storage shed site)
64	Moderate	Medium
57 (rail site) 23 (main storage shed site)	**Minor (rail site)** Negligible (main storage shed site)	**Medium (Rail site)** Low (main storage shed)
38	Negligible	Low
18	Negligible	Low
33	Negligible	Low
30	Negligible	Low
18	Negligible	Low
42	Negligible	Low
53 (rail site) 42 (main storage shed site)	Negligible (rail site) Negligible (main storage shed site)	Low
52 (rail site) 41 (main storage shed site)	Negligible (rail site) Negligible (main storage shed site)	Low
49	Negligible	Low
41	Negligible	Low
48	Negligible	Low
28	Negligible	Low
43	Negligible	Low
40	Negligible	Low
28	Negligible	Low
46	Negligible	Low
39	Negligible	Low
38	Negligible	Low
34	Negligible	Low
27	Negligible	Low

5.7.1.2. Vibration

Vibration levels from vibration inducing equipment have been predicted at the nearest sensitive receptors. Due to the distances involved to nearest affected receptors (more than 1km) vibration from piling activities are not expected to generate levels high enough to exceed the significance criteria.

The closest receptor for vibration effects from construction activities is the most western coastal home at False Bay, Location One (1). As the main activities conducted will be earthworks, civil and rail construction, the highest vibration inducing plant used will be:

- Compactors (vibratory compaction) (approximate source level approximately 15mm/s at 10m).

Following guidance in BS5228.2, calculation of vibration levels from this equipment is only valid for distances less than 110m. As the distance to the nearest receptor is 235m, and other receptors are more than 1km away from the works, a maximum distance of 110m has been assumed for prediction, at which point vibration levels are expected to be approximately 0.08mm/s and hence it is expected that levels of construction vibration will be negligible at all receptors.

5.7.2. Operation

5.7.2.1. Airborne Noise

Industrial

Full details of the types of plant, location and sound power levels that have been used in the assessment are included in **Appendix F.2**.

Airborne operational noise levels from all activities have been predicted at the nearest affected noise sensitive receptors for the weather conditions described in **Table 5.7c.**

As it is expected that the Project will be potentially in operation 24 hours a day, the predicted daytime and night-time levels are the same, as all plant has been assumed to be in operation during a train unloading/ship-loading activity, which may potentially occur at any time throughout the 24 hour period. Noise levels will comply with the daytime criterion at all receptors. Under adverse meteorological conditions, the receivers at Point Lowly are predicted to experience a marginal exceedance of 1dB(A) at night; however this impact is assessed to have negligible significance because of the magnitude of the predicted exceedance and it only being predicted to occur under certain meteorological conditions. The significance of the impact is low adverse.

Noise contours have been produced and are included on the following pages as **Figures 5.7a to 5.7d**.

Table 5.7c: Assessed weather conditions

Meteorological Condition	Wind Speed (m/s)	Temperature (°C)	Humidity (%)	Pasquil Stability Category
Neutral	0	20	50	Neutral (D)
Adverse	8	7	77	Unstable (B)

The results of the assessment are summarised below in **Table 5.7d**.

Table 5.7d Predicted operational noise levels at nearest noise sensitive receptors

	Sound pressure level, dB(A) re 20µPa LAeq					
	Noise Impact Criteria		Meteorological conditions			
Location	Day	Night	Neutral	Adverse	Significance of Impact	Risk Rating
False Bay	51 dBL_{Aeq}	43dBL_{Aeq}	27	34	Negligible	Low
Point Lowly	51 dBL_{Aeq}	43dBL_{Aeq}	36	44	Negligible	Low

Figure 5.7a: Noise contour plot for industrial noise

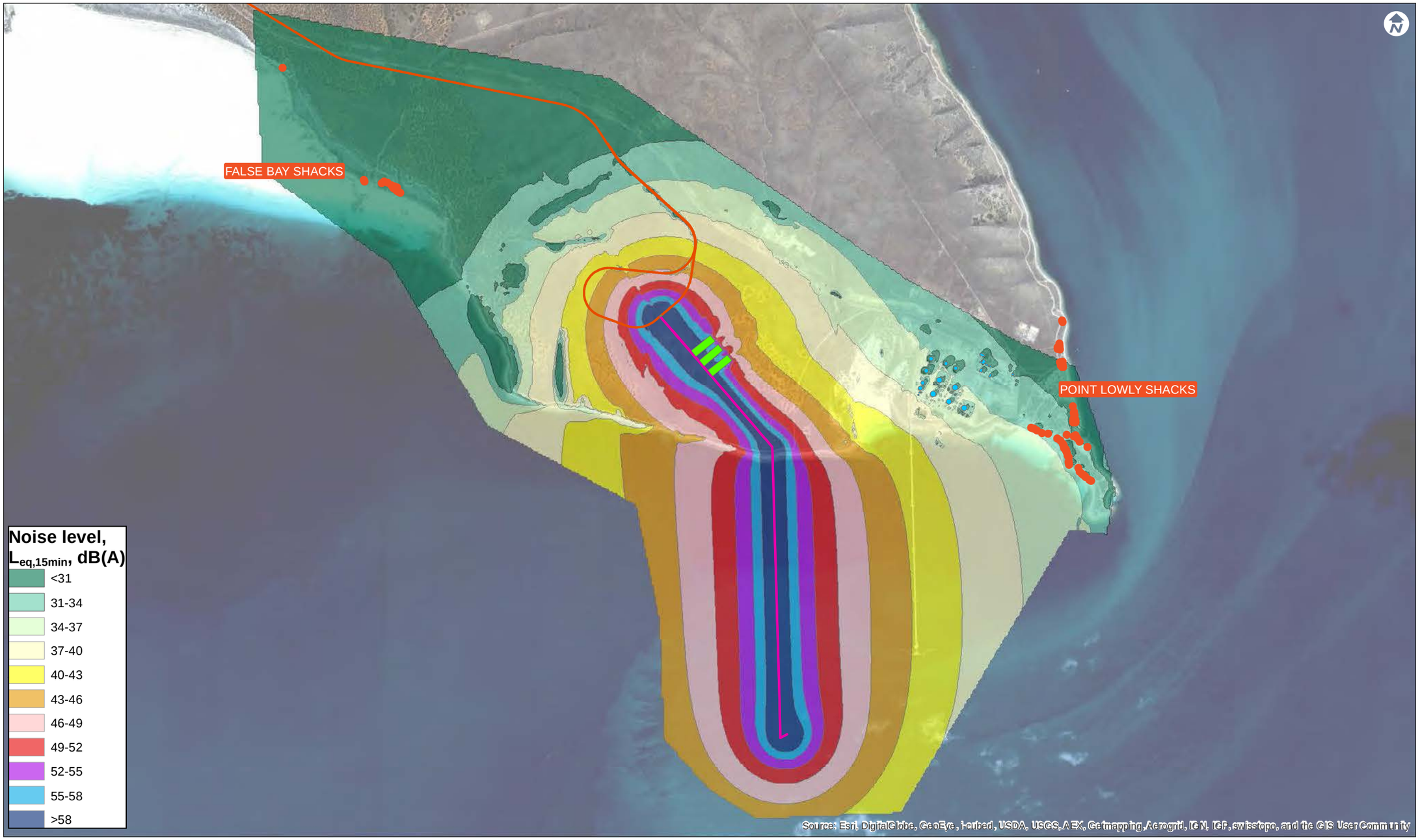


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Figure 5.7a -
Industrial noise contours - Neutral weather
$L_{Aeq,15min}$ 1.5m above ground level
Contours represent daytime and night-time operation

Legend
- Shacks
- Railway alignment
- Conveyer
- Storage sheds

ARUP
Spencer Gulf Port Link

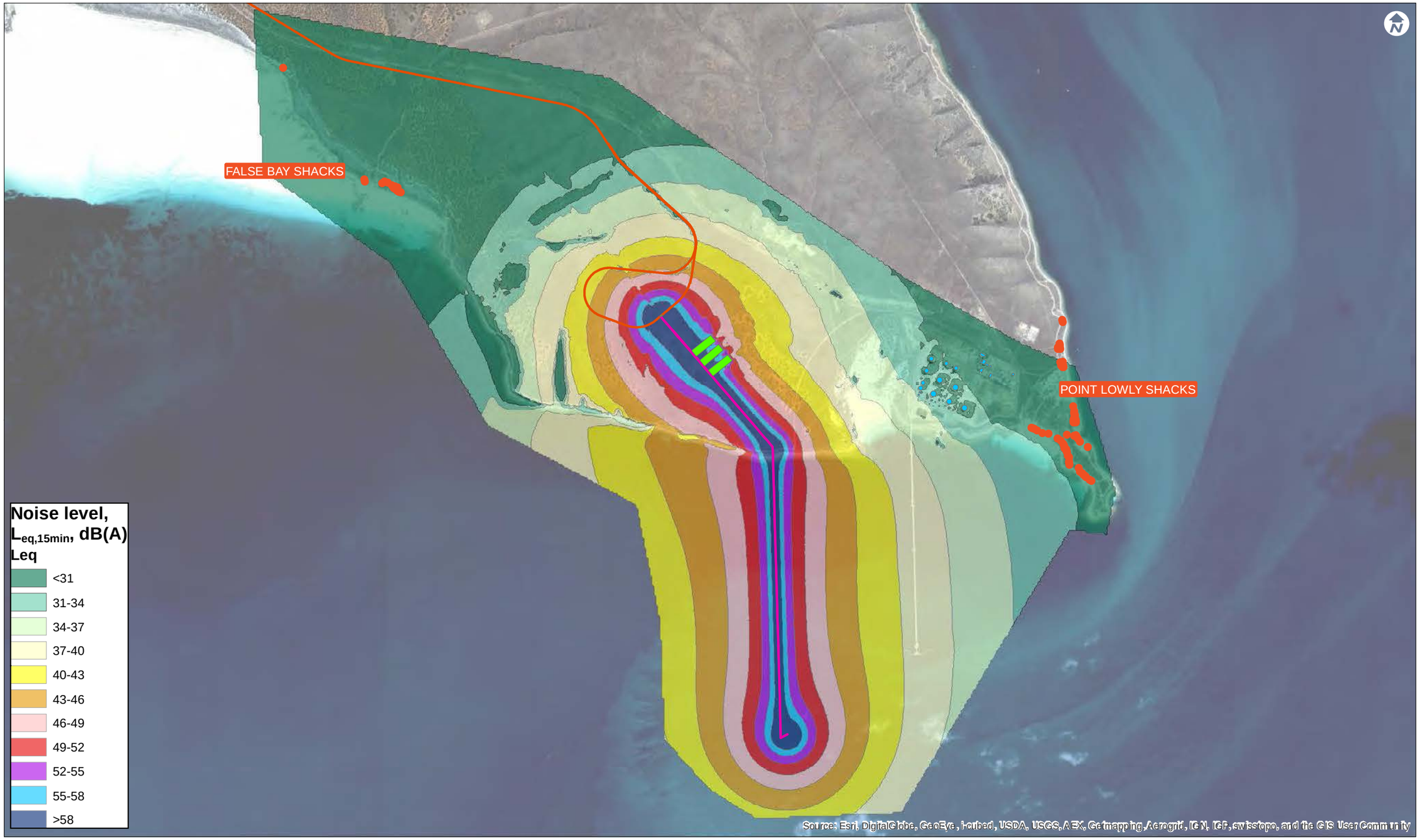
1:35,000 (at A3)

0 0.5 1 2
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 5.7a: Noise contour plot for industrial noise

Figure 5.7b: Noise contour plot for industrial noise



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Flinders Ports Holdings
Figure 5.7b -
Industrial noise contours - mitigated
Neutral weather
$L_{Aeq,15min}$ 1.5m above ground level
Contours represent daytime and night-time operation

Legend
- Shacks
- Railway alignment
- Conveyer
- Storage sheds

ARUP
Spencer Gulf Port Link

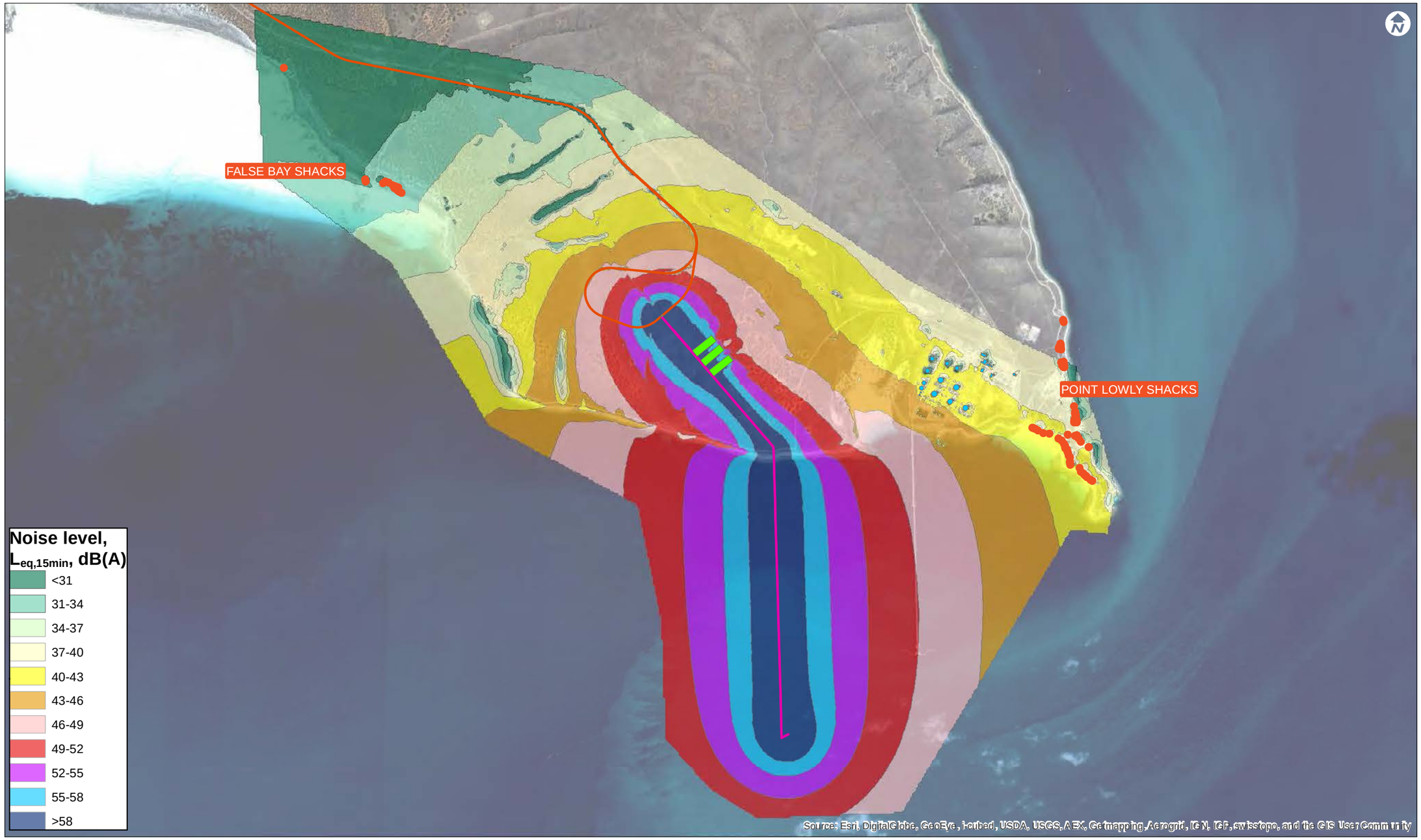
1:35,000 (at A3)

0 0.5 1 2
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 5.7b: Noise contour plot for industrial noise

Figure 5.7c: Noise contour plot for industrial noise



Port Bonython EIS
Flinders Ports Holdings

Figure 5.7c -
Industrial noise contours - Unstable weather
$L_{Aeq,15min}$ 1.5m above ground level
Contours represent daytime and night-time operation

Legend
- Shacks
- Railway alignment
- Conveyer
- Storage sheds

ARUP
Spencer Gulf Port Link

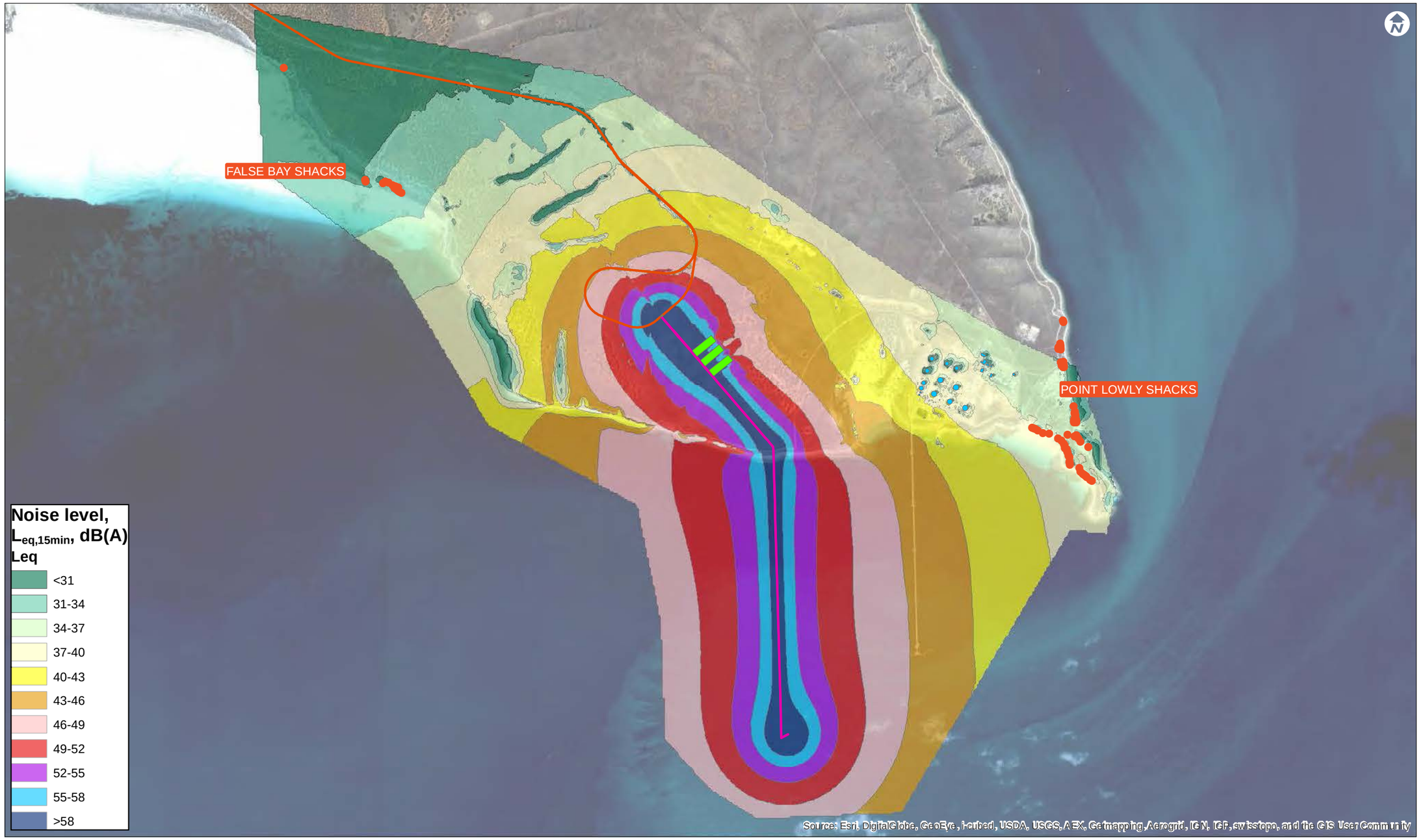
1:35,000 (at A3)

0 0.5 1 2
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 5.7c: Noise contour plot for industrial noise

Figure 5.7d: Noise contour plot for industrial noise



Port Bonython EIS
Flinders Ports Holdings
Figure 5.7d -
Industrial noise contours - mitigated
Unstable weather
$L_{Aeq,15min}$ 1.5m above ground level
Contours represent daytime and night-time operation

Legend
- Shacks
- Railway alignment
- Conveyer
- Storage sheds

ARUP
Spencer Gulf Port Link

1:35,000 (at A3)

0 0.5 1 2
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 5.7d: Noise contour plot for industrial noise

Road Traffic Noise (Construction and Operation)

Road traffic volumes for 15 hour (7am to 10pm) and nine hour (10pm to 7am) operational times and percent heavy goods vehicles (hgv) have been provided in **Chapter 8, Transport** for the following roads:

- Port Bonython Road
- Lincoln Highway
- Norrie Avenue Extension.

Norrie Avenue Extension will have a less than 20 percent increase in road traffic volumes (compared to the "future existing" 2017 volumes) due to construction and operation of the Project. A 20 percent increase in road traffic volume is a less than 1dB increase in road traffic noise levels, which is subjectively not noticeable. As such, the impact to noise sensitive receptors affected by road traffic noise from Norrie Avenue Extension will be negligible.

For all situations, Lincoln Highway will experience a less than 1dB increase in road traffic noise levels. As such, the impact to noise sensitive receptors affected by road traffic noise from Lincoln Highway will be negligible.

Port Bonython Road will experience an increase in road traffic volumes of 18 percent/37 percent (day/night) (due to additional operational traffic once BCEF is operational) and a temporary increase of 65 percent/122 percent (day/night) over the baseline case due to construction traffic.

The nearest noise-sensitive receiver to Port Bonython Road is Location One (1) (Gilja Retreat), which is expected to be the most-affected receiver for traffic noise increases associated with the BCEF.

The increase in road traffic noise levels are summarised in **Table 5.7e**, along with the predicted significance of impact.

Rail

Full details of the type and number of locomotive and wagons that have been used in the assessment are included in **Appendix F.4**.

Airborne noise levels from the operation of the railway line have been predicted for the day 15 hour (7am to 10pm) and night nine hour (10pm to 7am) periods, the results are summarised in **Table 5.7f**

Noise levels from trains using the rail line during operation of the Project are expected to comply with EPA criteria. The significance of rail noise impacts is assessed as negligible. Noise contours have been produced and are included on the following pages as **Figures 5.7e to 5.7g**.

5.7.3. Vibration

Given the significant distances to the nearest sensitive receptors, none of the equipment used in the operation of the Projects or the operational rail movements are expected to create vibration levels high enough to create adverse vibration levels at the nearest noise sensitive receptors. Hence operational vibration impacts from Port Bonython BCEF are assessed as being negligible.

Table 5.7e: Port Bonython Road traffic noise impact assessment

	Port Bonython Road basic noise level, dB(A)		Change in Port Bonython Road basic noise level, compared to Future Existing 2017, dB			
	Future Existing 2017		Construction 2017		Operation 2017	
Impact	15 hour Day	9 hour Night	15 hour Day	9 hour Night	15 hour Day	9 hour Night
Predicted impact	56	49	+1.8	+2.2	+0.5	+1.0
Significance of impact	N/A	N/A	Negligible	Negligible	Negligible	Negligible
Risk Rating	N/A	N/A	Low	Low	Low	Low

Table 5.7f: Predicted rail noise levels at nearest noise sensitive receptors

		Sound pressure level, dB(A) re 20µPa				
Location	Criteria	$L_{eq,15hr}$	$L_{eq,9hr}$	L_{max}	Significance of Impact	Risk Rating
False Bay	60 $dBL_{Aeq(15hr)}$ and 80dBL_{Amax}	49	48	65	Negligible	Low
Point Lowly	55 $dBL_{Aeq(9hr)}$ and 80dBL_{Amax}	28	27	44	Negligible	Low

Figure 5.7e: Noise contour plot for rail noise

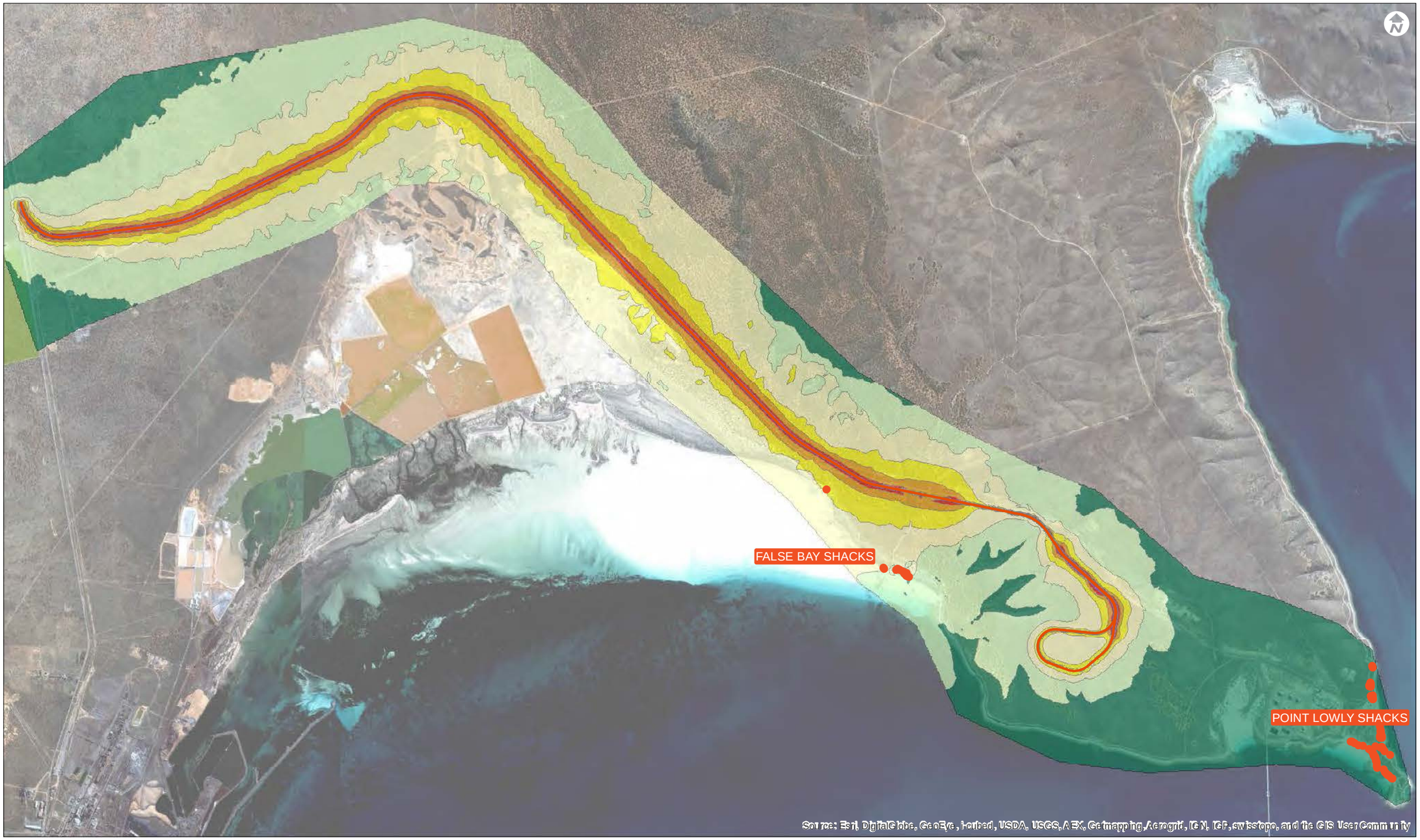


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Figure 5.7e -
Night-time rail noise contours
$L_{Aeq,9hour}$ 1.5m above ground level

Legend

- Shacks
- Railway alignment

Noise level, $L_{eq,9hour}$, dB(A)

- <35
- 35-40
- 40-45
- 45-50
- 50-55
- 55-60
- 60-65
- >65

ARUP

Spencer Gulf Port Link

1:50,000 (at A3)

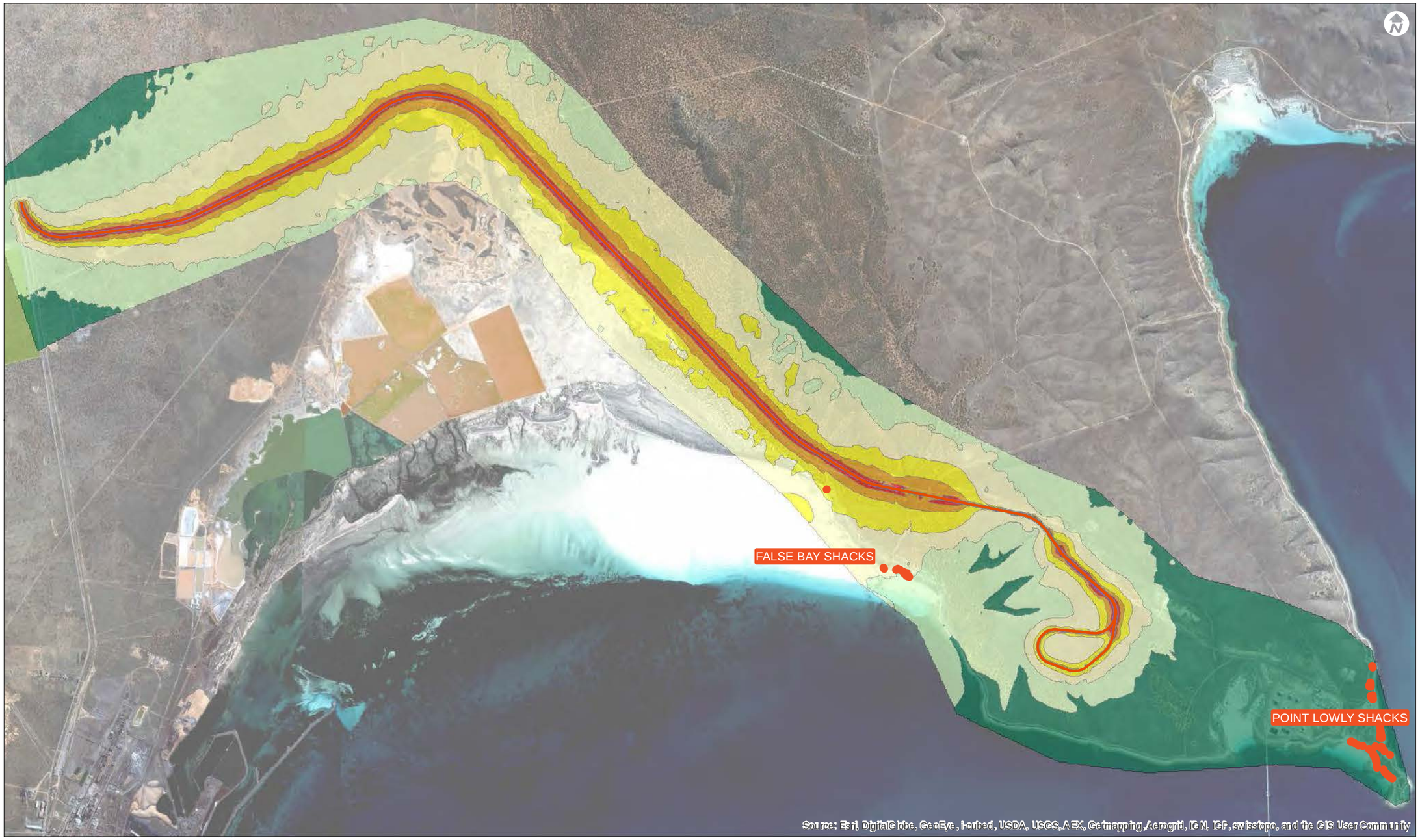
0 0.75 1.5 3

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 5.7e: Noise contour plot for rail noise

Figure 5.7f: Noise contour plot for industrial noise



Port Bonython EIS
Flinders Ports Holdings

Figure 5.7f -
Daytime rail noise contours
$L_{Aeq,15hour}$ 1.5m above ground level

Legend

- Shacks
- Railway alignment

Noise level, $L_{eq,15hour}$, dB(A)

- <35
- 35-40
- 40-45
- 45-50
- 50-55
- 55-60
- 60-65
- >65

ARUP

Spencer Gulf Port Link

1:50,000 (at A3)

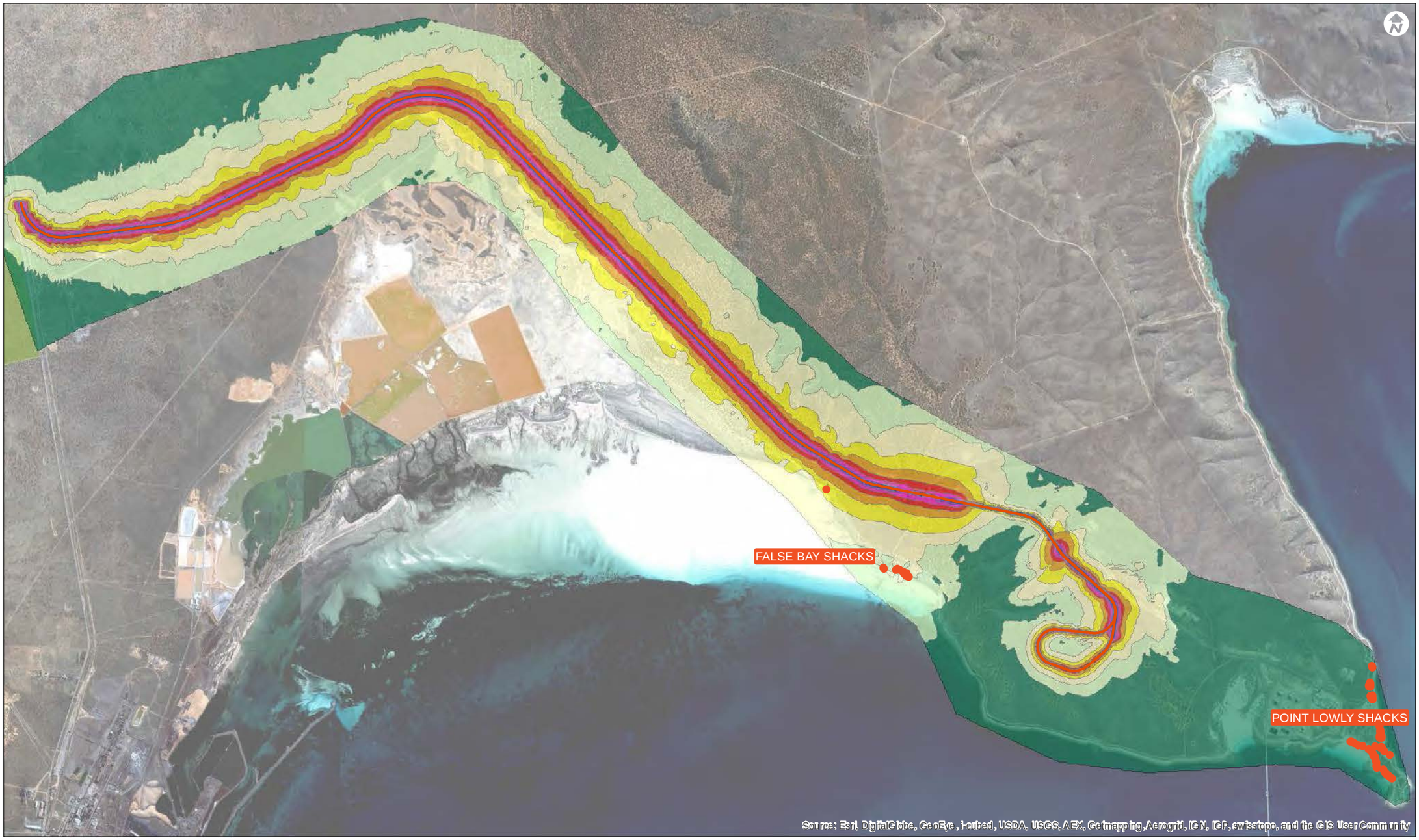
0 0.75 1.5 3

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 5.7f: Noise contour plot for industrial noise

Figure 5.7g: Noise contour plot for industrial noise



Port Bonython EIS
Flinders Ports Holdings

Figure 5.7g -
Maximum rail noise contours
L_{max} 1.5m above ground level

Legend

- Shacks
- Railway alignment

Noise level, L_{max} dB(A)

- <50
- 50-55
- 55-60
- 60-65
- 65-70
- 70-75
- 75-80
- 80-85
- >85

ARUP

Spencer Gulf Port Link

1:50,000 (at A3)

0 0.75 1.5 3

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 5.7g: Noise contour plot for industrial noise

5.8. Mitigation

5.8.1. Construction

Specific mitigation measures for each of the construction activities that cause exceedances at noise sensitive receptors are included in **Table 5.8**.

In addition to the above measures for specific activities, all general activities relating to the construction works will be carried out in line with and engage the principles of Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) during the construction period to manage the noise impacts:

- The Contractor will use modern and well serviced equipment to undertake the works
- Limiting operation of the construction works to 6 am to 6 pm Monday to Saturday except for specific identified activities for which approval from the EPA/local authority is obtained.
- Notifying potentially-affected residents of any out-of-hours construction works (preferably at least one weeks' notice, minimum of two days' notice except for emergency works)
- Establish a communications register for recording incoming complaints

5.8.2. Operational Noise

Enclosure of the conveyer(s) on the jetty is required for dust suppression purposes. This also provides an acoustic benefit. No further mitigation will be required to achieve the noise emission targets.

5.9. Residual Effects

Full details of the residual effects from marine are included in **Chapter 15, Underwater Noise**

5.9.1. Construction

5.9.1.1. Airborne Noise

The residual impact of construction noise with all mitigation measures is assessed to be negligible in general, and minor adverse for Location One (1) (Gilja Retreat).

5.9.1.2. Vibration

The residual impact of construction vibration will be negligible for all receivers.

5.9.2. Operation

5.9.2.1. Airborne noise

The residual impact of operational noise will be negligible for all receivers.

5.9.2.2. Vibration

The residual impact of operational vibration will be negligible for all receivers.

5.10. Summary of Effects

A summary of the impacts, mitigation measures and residual impacts is given in **Table 5.10**.

Table 5.8: Construction mitigation measures

Construction activity	Recommended mitigation
Civil plant – bulk earthworks (rail site) Civil plant – site works for rail and access road Rail plant General site support plant (rail site)	Around the False Bay area, construction activity should not be conducted during the night-time period, unless approval is obtained from EPA/local authority based on "sufficient grounds" to justify night time construction. Additional noise mitigation measures will likely apply to night works. All works to be undertaken with regard to AS 2436-2010 - Guide to noise and vibration control on construction, maintenance and demolition sites. Community consultation with local residents (particularly Gilja Retreat) will include discussion of the following mitigation measures as potential options: » Respite periods (i.e. agreed periods during the day and night when construction activity will not be audible at the receiver) » Reprogramming works to avoid times when residents will be present » Avoiding works during windy conditions when noise is more likely to impact on residents » Provision of alternative accommodation for the period (if night-works will be conducted along the rail section adjacent to the properties for an extended period).
Marine - piling	At Point Lowly, impact piling may be audible and noticeable during the day adverse weather conditions (i.e. wind direction from the works to Point Lowly). Piling activities are proposed to be limited to the daytime period to minimise impacts on marine fauna. Or if night time works are required, for example due to tide constraints, community consultation with residents should occur to explore the following options: » Noise monitoring of piling works » Respite periods » Temporary alternative accommodation if night works occur over an extended period

Table 5.10: Summary of impacts, mitigation measures and residual effects

Effect	Assessment of Impact	Mitigation	Residual Risk
Construction noise	Rail construction (including civil works) – moderate adverse at Gilja Retreat, False Bay and negligible at Yorrel View, False Bay and at Point Lowly. All other construction activities assessed as having negligible impact.	Around the False Bay area, construction activity will not be conducted during the night-time period, unless "sufficient grounds" exist to obtain approval for out-of-hours' work from the EPA/local authority. All works to be undertaken with regard to AS 2436-2010 - Guide to noise and vibration control on construction, maintenance and demolition sites. General site activities to follow the principles of Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) Community consultation with local residents (particularly Gilja Retreat) should seek agreed mitigation measures	Medium
Construction vibration	Negligible	N/A	Low
Operational vibration	Negligible	N/A	Low
Operational noise – industrial	Negligible	Enclosures for conveyers on the jetty (for dust purposes) will also provide some noise reduction benefits.	Low
Operational noise – road traffic	Negligible	N/A	Low
Operational noise – rail traffic	Negligible	N/A	Low