

Memo

To: Dayna Claybourn, A/Compliance Delivery Manager, Wide Bay Burnett
From: Paul Prenzler, Principal Coastal Engineer, Coastal and Marine Assessment
Date: 4 February 2016
Re: Assessment of the Seawall at Toogoom, Hervey Bay

1. Background

An approved seawall was constructed in 2014 on the esplanade adjacent to 48 to 80 Kingfisher Parade, Toogoom. The seawall was constructed along an alignment approximately 10m seaward of the property boundaries to a design prepared by the engineering consultancy Aurecon. A development approval for operational works that is prescribed tidal works was issued in late 2013 for the construction of the seawall.

This report has been prepared in response to complaints received by the Department of Environment and Heritage Protection (EHP) s73 - irrelevant in relation to the seawall at Kingfisher Parade, Toogoom. I inspected the seawall on 10 November 2015 to assess compliance with the development approval conditions and the seawall condition in light of the concerns raised s73 - irrelevant

I am a coastal engineer with the following qualification; a Bachelor in Environmental Engineering, Masters in Coastal Engineering and I am a Registered Professional Engineer of Queensland (RPEQ).

2. Site Description

Toogoom is located on the southern coastline of Hervey Bay adjacent to the eastern bank of Beelbi Creek (Figure 1). The beach is exposed to waves from the north-west to north-east sectors due to its northerly aspect and the protection provided by Fraser Island to the east.

Tides in Hervey Bay are mixed, mainly semi-diurnal with a range of approximately 2.5 metres at spring tides. In addition to normal astronomical tides water levels within Hervey Bay can be influenced by large meteorological systems (e.g. tropical cyclones) which can elevate water levels above the predicted astronomical tide, a phenomenon known as a storm tide. Storm tide levels for Hervey Bay have previously been published by James Cook University (2004).

There has been a long-term coastal erosion problem along this section of coast and in the vicinity of the seawall the beach has receded over 30 metres in the last 25 years. Due to this long-term recession the properties from 48 (western end) to 80 (eastern end) Kingfisher Parade, Toogoom were at considerable risk of erosion associated with future storm events and this led to the construction of the subject seawall (Figure 2).

Toogoom Beach, like other beaches within Hervey Bay, exhibits features typical of tide modified beaches. Tide modified beaches typically consist of a wide zone of tidal flats backed by a narrow and steeper high tide beach. There are also typically sediment characteristics differences between the tidal flats and the high tide beach, with the sediment

on the tidal flats generally being much finer sand than the coarser sand found on the high tide beach. The wide tidal flat zone is generally around the level of Mean Sea Level.

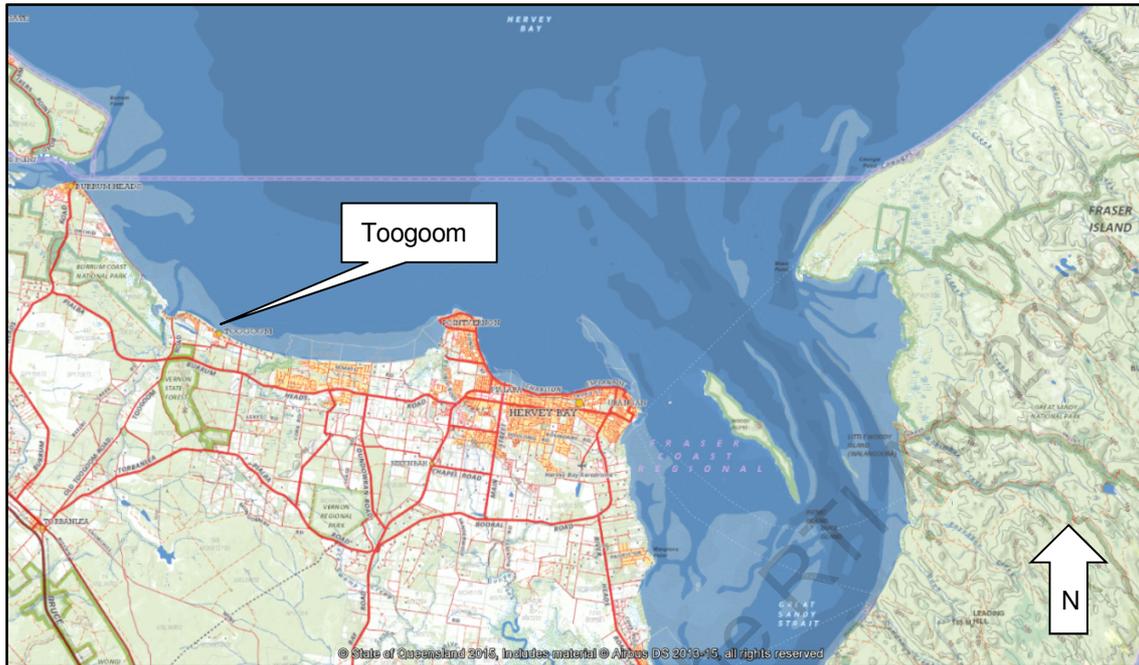


Figure 1: Location of Toogoom within Hervey Bay



Figure 2: Aerial photograph (May 2015) showing extent of Kingfisher Parade seawall

3. Seawall Design Criteria

As part of this investigation the design criteria for the Kingfisher Parade Seawall have been reviewed in relation to the requirements of the 'Prescribed Tidal Works Code' contained in the Coastal Protection and Management Regulation 2003 (PTW Code). The design criteria for

the Kingfisher Parade Seawall are detailed in the Aurecon (2013) report, 'Kingfisher Parade Seawall Detailed Design Report' included as attachment 1 to this report.

- Design water level – Aurecon has adopted a design water level for the Toogoom site of 2.85m above Australian Height Datum (AHD) which is based on a 50 year ARI storm tide level of 2.55m AHD and a sea level rise allowance of 0.3m by 2063. The storm tide level is based on published data by James Cook University (2004) and includes an allowance for the impact of climate change on cyclone intensity and frequency. The choice of a 50 year ARI event is consistent with the requirement of the PTW Code and normal engineering design practice for rock seawalls.
- Design waves – Aurecon has identified that wave heights will be limited by the depth of water over the tidal flats and this is considered a valid assumption. The consultant has calculated a depth limited wave height based on the 50 year ARI water level criteria of 2.5m with a wave period of 8 to 10 seconds. These calculations are consistent with the values I calculated using the empirical formula provided in the Coastal Engineering Manual (U.S. Army Corps of Engineers, 2002).
- Design life – Aurecon has undertaken design work based on an assumed design life of 50 years. This is consistent with the requirements of the PTW Code and the Australian Standard, 'Guideline for the design of maritime structures' (AS4997-2005). It should be noted that the actual life of a structure can be extended beyond its design life through regular maintenance to ensure its functionality is maintained.

The design criteria selected for the design of the Kingfisher Parade Seawall is consistent with engineering design practice for these types of coastal property protection structures. Aurecon also undertook physical modelling to refine the design of the seawall cross-section.

The alignment of the seawall is located on the esplanade approximately 10m from private property boundaries. This alignment is consistent with the longstanding Queensland Government position (currently contained in Module 10 of the State Development Assessment Provisions version 1.7) of allowing for structures (e.g. seawalls) to protect private property provided any protection structures are constructed as far landward as is practicable.

4. Site Inspection

I inspected the Toogoom Seawall at Kingfisher Parade on 10 November 2015 along with Denise Batten, Senior Environmental Officer, EHP (Maryborough). This inspection coincided with an inspection undertaken by Fraser Coast Regional Council (FCRC) officers with Mr Gildas Colleter (Coastal Engineer, Aurecon) and the construction contractors.

In general the seawall appeared consistent with the approved design. The following general observations were recorded:

- The alignment of the seawall was approximately 10m from the property boundaries;
- The slope of the seawall was approximately 1V:1.5H based on an estimate undertaken at the location of the stairs;
- The diameter of a sample of primary armour and crest armour units was measured and based on the rock density of 2.9t/m³ these armour units were either consistent or exceeded the design specifications of 3t and 6t for the primary and crest armour, respectively;
- Some rock fracturing was observed and this was estimated to affect less than 1% of the armour based on a count along a 5m sample of the wall (sample location at 62 Kingfisher Parade). This estimate is representative of the wall in general when also considered in relation to the condition of the armour stones marked for survey (see section 5 below);

- Revegetation of the area behind the crest had been undertaken with dune vine species; and
- Safety fencing had been installed along the crest of the wall.

As indicated above fracturing of some primary armour units (estimated at less than 1%) was observed during the inspection. In some instances the cause of fracturing could be clearly attributed to natural faults in the rock in other cases the fracturing did not appear to follow defined fault planes in the rock and may have been associated with placement or some movement of the individual armour units. The fracturing observed is within the design specifications as detailed by Aurecon (2013) and as such is not a significant issue. FCRC should undertake regular inspections (e.g. annually) to monitor the performance of the seawall and undertake maintenance as required.

It should be noted that the site inspection consisted of external features of the seawall only and there was no capacity to assess the underlying layers of the seawall or settlement of the structure. In this instance there did not appear to be development of voids behind the wall (other than voids in and around crest armour units) and as such it is assumed the underlying secondary armour and geotextile layers are satisfactory.

Settlement of the seawall could not be determined during the site inspection and FCRC were requested to undertake a follow-up survey of the seawall for comparison to the as-constructed survey completed following completion of the seawall construction. Marker plates had been installed on individual armour units along the seawall to allow for continued monitoring of the seawall over time.

5. Survey Data

FCRC supplied copies of the as-constructed survey (dated 17/5/14) and follow-up survey (dated 20/11/15) of the seawall using 60 markers (see Figure 3) attached to individual armour units (Attachment 2).

The follow-up survey located 50 markers (other markers were below sand level and excavation was not undertaken to locate these other markers) and a comparison of the data indicates minimal settlement and movement of the seawall since the as-constructed survey in May 2014. It should be noted that rock seawalls are structures that will move and settle over time as they are exposed to storm events.



Figure 3: Example of an armour unit ID plate on the Toogoom Seawall

6. Response to concerns raised s73 - irrelevant

s73 - irrelevant

s73 - irrelevant The following responses address the general and EHP issues raised s73 - irrelevant in relation to coastal management and engineering aspects of the seawall. The issues raised relating to financing of the wall, FCRC contractual arrangements and the Department of Infrastructure, Local Government and Planning are considered outside the scope of this report and therefore not addressed.

General Issues

- *Successive government knew erosion would occur in Toogoom*

Erosion trends at Toogoom have been monitored by Queensland Government agencies. The former Beach Protection Authority (BPA, 1989) prepared a detailed report 'Hervey Bay Beaches' which investigated in detail the coastal processes in Hervey Bay. The coastal management policies developed by the BPA in relation to coastal management and property protection have continued to be used to this day. In short the longstanding policies support maintaining coastal areas so that natural coastal processes can occur uninterrupted. However when private property or infrastructure is threatened by erosion, protection works can be installed provided they are located as far landward as practicable.

In this case a 10m offset from the property boundaries was considered reasonable due to the proximity of built infrastructure to the property boundaries.

- *Groundwater is shallow in this area and is having an effect on the stability of the wall. This is a matter for qualified engineers. My advice is that the continual flow of ground water through the sand on which the rock wall sits means that the stability of the wall is constantly eroded.*

The survey data has not indicated any substantial movement of the wall since May 2014. Seawalls are generally very robust structures exposed to a variety of wave and water level conditions over varying timeframes (e.g. tide cycles, cyclonic storm tide events). The fact that the seawall is naturally a porous structure means it is therefore less susceptible to hydrostatic forces associated with groundwater.

- *There used to be a northern facing scarp, which has been replaced with an eastern scarp that will erode all the way to Beelbi Creek. The north facing scarp has NOT been replaced. Because the wall alignment angled southward behind #52 an east facing scarp has been created, which lost approximately 20-25 meters of foreshore on the first 4.0M tides after construction. This erosion was exacerbated by the unauthorised removal of sand below HAT during construction.*

The seawall alignment was selected by EHP in conjunction with other agencies to ensure the structure was located as far landward as possible in order to minimise the longer term coastal processes impacts.

- *Wave run up testing was carried out by the University of New South Wales using concrete and timber not sand and therefore not relevant for Toogoom. The wave run up testing conducted by the University of NSW used a hard body flume which did not replicate the Toogoom beach site hence did not measure nor account for the constant movement of the base on which the rock wall was constructed, that is, a sand beach.*

Physical model testing is undertaken by skilled operators and is used to examine specific aspects of a design. A review of the design report indicates that the physical model testing

- Page 5

was undertaken to refine the sizing of the primary and crest armour the physical characteristics of the beach sand is not a factor in the sizing of the armour units and as such the model was based on an assumption relating to the bed profile. It should be noted that physical modelling is affected by scaling effects which need to be carefully considered when designing a physical model test.

- *A Rock wall should never have been built in this location as whenever a rock wall is built you can say goodbye to your beach. World leading experts in coastal erosion state that if you want to lose your beach, build a rock wall.*

The construction of a seawall will impact on the amenity of the beach and this is documented throughout coastal engineering literature. Seawalls, and other types of coastal protection structures, are not built to protect the beach they are built to protect property and infrastructure. It is for this reason that EHP requires seawalls to be located as close to the property or infrastructure being protected as is practicable.

- *Aurecon application claimed numbers 48 through to 86 were under immediate threat of erosion –* s73 - irrelevant #48
was further from the erosion scarp in 2013 than it was in 1910. This is demonstrated in government surveys. s73 - irrelevant
s73 - irrelevant

There has been a long-term trend of coastline recession observed at Toogoom. This recession is most likely related to erosion caused by storm events (e.g. cyclones). The beach is eroded during the storm event and recovers in following calmer period but does not recover fully. This process has seen the beach at this location recede by up to 30m over the last 25 years. As a result of this beach recession the properties along this section of Kingfisher Parade, Toogoom were considered to be within an area vulnerable to erosion during a large storm event (e.g. tropical cyclone) and this justified property protection works, such as a seawall.

Seawalls, like any structure placed on a beach, will have an impact on coastal processes and it is necessary to consider the impact of these structures when selecting the alignment and designing the structure. A seawall has the potential to cause additional localised erosion at the ends of the wall, referred to as end effects. It is for this reason that the seawall alignment is directed into the dunes to minimise the end effect impacts in the long-term.

In relation to meetings held prior to the approval of the wall Fraser Coast Regional Council undertook community consultation with property owners in the immediate vicinity of the proposed seawall to determine their desire to be involved. This process was independent of government agencies. As part of this process meetings were held with residents threatened by erosion and potential construction of the seawall. Officers from various government agencies attended some of these meeting to answer questions related to the approval processes and I recall attending two such meeting on behalf of EHP.

- *Why does the wall end prior to #82? THE WALL DOES NOT END AT #82. The wall extends approximately halfway across the rear boundary of this property as required in the design and is buried.* s73 - irrelevant
The entire width of #82 was cleared of large trees and thick undergrowth in preparation for the wall construction and yet that area has not been included in the revegetation. s73 - irrelevant

- Page 6

s73 - irrelevant

When designing a seawall it is best practice to include terminal ends to ensure the structural integrity of the wall by accommodating potential end effects should erosion continue to affect adjacent beaches. The work adjacent to 82 Kingfisher Parade is this terminal end of the wall a similar feature is built into the wall at the western end.

EHP Issues

s73 - irrelevant

This issue is outside the scope of this report which is aimed at reviewing the structural elements of the seawall.

s73 - irrelevant

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- *Revegetation Plan –The site contained intact coastal regional ecosystem 12.2.11 with mid strata and emergent canopy species, none of which have been replanted. DEHP should have required that FCRC ensure that replacement of all strata present occurs. The planting of groundcover species only, whilst not requiring replacement of canopy, emergent and mid strata species, appears to be a political fix based on allowing AURECON to dictate that no large tree species should be planted because of a perceived threat to the wall, which follows that all mature tree species from Zephyr Street Scarness to Elizabeth street Urangan must be removed, due to AURECONS conclusion in the RVMP (Revegetation Management Plan).*

s73 - irrelevant

This report focuses on the structural aspects of the seawall and issues associated with vegetation management are considered outside the scope. However, it should be noted that prior to construction of the seawall trees and other vegetation were essentially lost in front of the properties from 60 to 76 Kingfisher Parade. It is acknowledged that a small area of additional vegetation was lost to facilitate the construction of the eastern and western ends of the wall.

- *The current unacceptable loss of foreshore vegetation is a direct breach of FCRC coastal protection code.*

This issue is outside the scope of this report which is aimed at reviewing the structural elements of the seawall.

- *DEHP must now force FCRC to have the site replanted with all revegetation species (R) contained in Appendix A. Council did not follow revegetation plan. Revegetation does not include trees or shrubs and this is what was there prior to the wall being constructed.*

This issue is outside the scope of this report which is aimed at reviewing the structural elements of the seawall.

s73 - irrelevant

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- *Condition 12 for EHP requires sign off by an RPEQ within 3 months of the project being completed.*

s73 - irrelevant

It is understood that the certification issue has been effectively resolved.

- *Community perception is that there was a ministerial directive given to the Wide Bay office of EHP to "Get it done" which meant build the rock wall. This perception is confirmed by the Wide Bay Environmental Council report submitted to the minister.*

Fraser Coast Regional Council applied to build a rock wall as a response to an erosion threat to private property and this application was assessed against the relevant assessment provisions and accordingly approved.

- *Officers from EHP undertook an inspection, s73 - irrelevant and then advised that "all was good". This inspection was conducted by Andrew Connor and Tim Brain.*

- Page 8

Tim Brain told us that he had forewarned the contractor several days before hand that Andrew Connor and he would visit the site s73 - irrelevant

s73 - irrelevant

This issue is outside the scope of this report which is aimed at reviewing the structural elements of the seawall.

s73 - irrelevant

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- On raising the issue of Acid Sulfate Soils being disturbed, EHP advised s73 - irrelevant that no sediment had entered the water. s73 - irrelevant

s73 - irrelevant

This issue is outside the scope of this report which is aimed at reviewing the structural elements of the seawall.

s73 - irrelevant

s73 - irrelevant

The seawall inspected on the 10 November 2015 is a functional seawall which from the observations made on site has been built in accordance with the approved plans. Public safety risks have been addressed through the provision of stairs to allow access to the beach and fencing of the crest of the wall. There is no evidence that the seawall is exacerbating the erosion occurring on Toogoom Beach and survey has indicated that the structure is stable.

s73 - irrelevant

This issue is outside the scope of this report which is aimed at reviewing the structural elements of the seawall.

s73 - irrelevant

submitted documents showing construction irregularities accompanied by many photos taken during the construction of the rock wall.

A review of these documents does not indicate any aspects of the seawall construction that would raise concern about its structural integrity.

s73 - irrelevant

The seawall is a functioning structure which was designed to protect private property from erosion. There is no evidence that would suggest that the seawall is not achieving its intended purpose at this time. The seawall is designed to withstand a combination of a 50 year ARI wave and water level event and would therefore be expected to perform up to and

including that event. There is a small chance of more extreme events (e.g. 1000 year ARI events) occurring within the design life of the structure and this is a risk that must be considered and accepted with the design and construction of any structure. I am satisfied that the seawall meets conditions 2 through to 12 of SDA-0813-004113.

The design report prepared by Aurecon (2013) identified that the rock sourced for this seawall may be prone to fracturing and had considered this in the design and future maintenance requirements. The contingencies placed in the design to account for the quality and natural characteristics of the rock used for this seawall have made it suitable for construction in this instance.

It is understood that the complainant has raised issues associated with "sink holes" along the wall and related this to the stability of the wall. The nature of a rock seawall means there will be voids between the rocks and this assists in dissipating wave energy from incoming waves. These voids cannot be avoided and risks have been address by fencing the area and provision of stairs to minimise the potential risks posed to members of the public accessing the beach.

- *This 'minimised effect' of a 25m loss of foreshore vegetation and a guaranteed continuation , should in fact be viewed by DEHP as 'negligent destruction of coastal vegetation and foreshore littoral dune, by in the first instance, AURECON and the applicant/ proponent FCRC. DEHP should now order the FCRC to immediately mitigate the erosion issue, which is in clear breach of the SEMP.*

The seawall was assessed against the relevant assessment provisions and deemed to comply and I believe this was a sound decision based on the erosion threat faced by the properties protected by the seawall.

7. Conclusion

Following inspection of the seawall at Kingfisher Parade, Toogoom it is considered that the seawall is a functional structure which complies with the relevant design specifications as outlined above. The seawall was designed to protect private properties from beach erosion and in its current condition would be expected to achieve this for events up to and including the 50 year ARI wave and water level criteria selected for the design.

It is recommended that FCRC undertake regular inspections of the structure annually and also following storm events to determine any maintenance requirements. It is not considered that EHP should undertake any further compliance action in relation to the construction of the seawall at this time.

8. References

Aurecon, 27 August 2013: *'Kingfisher Parade Seawall Design Report'*

James Cook University, SEA, Bureau Of Meteorology for Queensland Department of Natural Resources and mines Department of Emergency Services and Environmental Protection Agency, 2004: *'Queensland climate change and community vulnerability to tropical cyclones'*

United States Army Corps of Engineers, 2002: *'Coastal Engineering Manual'*
schedule 4 - signature

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