Round Hill Creek Channel Options

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Synopsis: **This report reviews the coastal processes causing channel shoaling at the Round Hill Creek entrance and identifies potential options to improve navigability.**

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Executive Summary

Changes to the shoaling patterns at the entrance to Round Hill Creek over recent years has resulted in increased shoaling in the lower reaches causing navigational constraints for recreational and commercial vessels at low tide with associated safety and operational issues. A new survey was completed in September 2018 and shows that this trend is continuing.

A proposal to sweep sand from shallow sections of the channel into deeper sections was proposed in early 2018 and Council obtained advice on the likely success, environmental approvals and associated permitting requirements and costs. These investigations and Council's own reviews indicated significant risks associated with the proposed sand sweeping and a likely indefinite but short time of benefit to navigation.

After consideration at a Council meeting on 19 June 2018 it was resolved to further investigate the broad benefits and risks for a range of options to establish and maintain a deeper navigation channel.

The investigations to date have concluded that the sand movements and shoals west of the Round Hill headland are continually changing while conforming to broadly consistent patterns over time. Currently it appears that sand accumulation in the entrance and the shoal restricting access between the deeper channels seaward of Monument Point is continuing. It is possible that at some time in the future when weather patterns change, the entrance will return to another of the historically common configurations with less interruption to navigation. However, the timing of this cannot be predicted.

If Council were to consider intervention to improve the navigation, then the options would fall into two broad categories:

- Hard structural options such as training walls with or without a sand bypassing system; and
- Soft options such as dredging (noting that sand sweeping has been largely discounted by reviewers).

It should be noted that most works will be in or adjacent to the boundaries of a Fish Habitat area and the Great Barrier Reef Marine Park and that no detailed ecological surveys or assessment of potential impacts have been undertaken to date. Therefore, significant work will be required to gain approvals and permits.

Hard structural options such as training walls have the potential to stabilise the entrance and maintain a deeper channel most of the time by constraining its width. However, shoaling may eventually occur necessitating maintenance dredging or the instillation of an artificial sand bypassing system in the extreme. There are significant technical difficulties associated with designing and assessing such works. These include:

- Any training wall structure will need to be isolated on the western side of the entrance channel i.e. it cannot economically be connected to the shoreline which is many kilometres to the south. Therefore, the structure will need to be designed so that any major changes in channel location over time will not threaten or undermine the structure. It is also noted that the structure will be fully exposed to cyclonic conditions. This will likely add significantly to costs e.g. increased foundation depths and rock size. Also, construction would likely require resources e.g. rock to be sourced from distant locations and transported to site by barge.
- Any sand bypassing plant would need to be constructed on the headland so that sand can be captured to the east of the channel (possibly to the east of the headland) and deposited to the west of the channel and / or training wall. Generally, this is done using a pipeline buried under the channel and a sand slurry pumping system.

It is impossible to estimate the full range of design requirements at this time however the technical difficulties and expected environmental investigations to gain approvals will likely mean this is a very expensive option. A first pass estimate would indicate about $180M for the training wall and $70M for a bypassing plant if needed. The bypassing plant option would be conditional upon construction of the training wall. The 50 year lifecycle costs will be $630M for the training wall and $1,530M including full bypassing. Another significant cost will be about $2,000,000 for the environmental approvals and permits which will require substantial negotiation.

Since the experimental sand sweeping suggestion has been largely discounted as not providing value for money or in fact a practical solution, the remaining option would be to dredge a channel to provide the required navigable access. However, the highly mobile nature of the sediments in the entrance is such that shoaling will occur necessitating regular repeat dredging to maintain navigable access. The frequency, extent and cost of the maintenance dredging will be dependent on the location and the extent of the initial dredging as well as the prevailing processes. Rapid shoaling could occur during major storm or cyclone events effectively filling any dredged channel.

Environmental significance overlays in the area are such that substantial impact assessment and negotiation will be required to secure environmental approvals for any dredging works including placement of the dredged material. In particular, dredging within the FHA would only be permissible in the area of a channel marked by aids to navigation which would require clarification.

Three potential channel alignments have been considered with varying technical and environmental opportunities and constraints as follows:

- A channel close to the western shore of the headland where a shallow channel has appeared most consistently over time along most of its length (refer Option A in the figure below). However, it is understood that rock may exist in the bed of this channel. Subject to confirmation, this would prevent dredging by conventional means and as such may rule this option out completely. While this option has the largest footprint, it is also likely to have lowest infill rate and therefore require the least maintenance dredging. In addition, it does not have the constraints of the FHA.
- A channel continuing the existing central channel which has been developing directly out to sea in recent years (refer Option B in the figure below). There appears to be no constraints e.g. rocks, to dredging this channel and it is likely that wave conditions will be favourable much of the time exclusive of cyclones. However, historical aerial photography for the last 60 years does not indicate that this is one of the broadly consistent alignments over time and it is expected that significant annual maintenance will be required to maintain this channel. It also has navigation constraints associated with breaking waves across the outer shoal and the uncertainty surrounding dredging in the FHA which would need to be confirmed.
- A cross-over from the central channel to the northern extension of the western channel which has been the dominant location of historical channels (refer Option C in the figure below). As previously indicated it is considered that this option will have limited success based on the current sand movements. In particular, the shoal constraining navigation is continuing to grow by sand moving to the north (downstream) and this will infill the proposed dredged cross-over channel quickly necessitating regular maintenance dredging. It also has the uncertainty surrounding dredging in the FHA which would need to be confirmed.

A first pass estimate of the dredging costs is about $450,000 including dredge mobilisation and demobilisation to establish the channel with some over-capacity i.e. increased size and depth to reduce the time between maintenance dredging exercises. Lower costs may be possible if locally based equipment can be used. It is expected that the formed channel will have a limited life expectancy due to its limited size and the dynamic nature of the shoals. In qualitative terms this might be expressed as “until the next major storm”. An estimate would be 12 months maximum e.g. over the winter months to one week e.g. before a storm or cyclone. Therefore a 50 year lifecycle cost for this dredging will be $22.95M. Environmental approvals and permits may cost around $1,000,000.

Based on the above findings of this initial study it can be concluded that:

- Major structural works to provide a permanent channel deepening solution are not considered viable due to substantial costs, inherent risks and significant negotiations that would be required to obtain approval.
- While dredging a channel would provide the desired navigable access initially, it would be subject to ongoing shoaling which is likely to be quite rapid necessitating repeat dredging on a regular basis to maintain that navigable access. As such, there will be an initial cost and ongoing costs unless natural conditions return to more favourable configurations, the timing of which cannot be predicted.
- Dredging will also be subject to technical considerations and environmental approvals which may constrain or preclude some options. Further investigations and negotiations will be required to confirm those constraints and the preferred alignment if dredging is to be pursued.

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1 Introduction

1.1 Background

Changes to the shoaling patterns at the entrance to Round Hill Creek over recent years has resulted in navigation constraints for recreational and commercial vessels at low tide with associated safety and operational issues. In response, the Gladstone Regional Council is seeking the most appropriate strategy to address the constraints and manage the associated risks.

A proposal to sweep sand from shallow sections of the channel into deeper sections was proposed in early 2018 and Council obtained advice on the likely environmental approvals and associated permitting requirements and costs. BMT also reviewed the proposed works giving consideration to the prevailing coastal processes and provided Council with advice on the likelihood of success.

The above investigations and Council's own reviews indicated significant risks associated with the proposed sand sweeping including:

- Significant costs and time to obtain environmental approvals;
- Likely rapid infill of the deepened section with limited time frame of improved navigation;
- Uncertainty as to whether sand sweeping will effectively achieve the intended channel design;
- Potential and perceived environmental concerns; and
- Other limiting infrastructure restricting the potential economic benefits from being realised.

After consideration at a meeting on 19 June 2018, Council resolved to undertake a preliminary concept design of a permanent channel deepening solution for Round Hill Creek. Council subsequently engaged the services of BMT Eastern Australia Pty Ltd to undertake this initial study which includes the identification and preliminary assessment of options to establish and maintain a deeper navigation channel.

1.2 Scope

The scope of this initial study is focussed on the identification and preliminary assessment of the broad benefits and risks for a range of options to establish and maintain a deeper navigation channel for Round Hill Creek. In particular, Council is seeking advice on a concept design for a navigation channel that achieves:

- A depth of 1.2 to 1.5m at LAT; and
- A width of 25m.

The consideration of options is based on a review of coastal processes including historical sand movements in the area and the prevailing wind/wave climate. The scope does not include any data collection or detailed modelling of the processes nor any socio-economic assessment related to the need for works. Environmental considerations and approval requirements are considered in a broad sense as they may influence options. However, detailed data collection and assessment of environmental factors is not included in the scope of this preliminary study. Initial estimates of capital and ongoing costs of any works are also required to help inform consideration of options.

2 Site Visit and Stakeholder Consultation

An initial site visit was undertaken by a senior coastal engineer together with Council representatives on 10 December 2018. The opportunity was taken to meet with a selection of representative local stakeholders to understand user requirements as well as to gather information on existing conditions and the local history of changes to the channel. Follow-up telephone conversations were also had with some other stakeholders. The intent and scope were not to undertake a full consultation exercise at this preliminary investigation stage.

Key information that came out of this initial consultation relating to the coastal processes included:

- The channel has been gradually changing and is continuing to become shallower to the extent that it is not navigable at low tide.
- Substantial changes can occur during major cyclone or flood events.
- Reports of an old main channel out to sea near the mainland on the north western side.
- Reports of vegetation extending on the western shoals many years ago with this being washed away during a major cyclone event and never returning.
- The possibility of more flow out to the west through the shoals reducing flow to the north and thereby contributing to shoaling.

Key comments related to channel options included:

- Justification of the need for works including safety and economics was raised by certain stakeholders while others would prefer no disturbance to the natural environment (no specific works) citing the importance to not disturb key habitats including those for humpback dolphins, soft corals and seagrass. (This does not form part of the scope of this study).
- No specific preference was raised for a channel alignment.
- The potential for rock close to the shoreline may constrain an alignment along the eastern side.
- Navigation out close to the headland provides some shelter from waves.
- Waves breaking across the outer shoal would be a constraint to smaller vessels for a channel heading straight out.

Observations from the site inspection included:

- Navigation constraint at low tide is very evident.
- Fast currents and plumes of suspended sediment in the main channel as well as extensive bed forms confirm the high mobility of sand in the area.
- Waves breaking across the outer shoal confirm the associated sediment mobility and navigation constraint in that area.

3 Review of Coastal Processes

The behaviour of a natural creek entrance on an open sandy coastline is a complex interaction of the prevailing coastal processes. These include:

- Wave driven longshore transport of sand along the coast and into the entrance area;
- Wave and flood tide driven currents transporting sand into the entrance and upstream; and
- Ebb tide and fluvial (flood) currents moving sand downstream and offshore.

Such processes typically occur gradually and are continually changing on a day to day basis in response to the prevailing driving forces which are subject to natural variability. In addition, rapid changes can occur during extreme events such as cyclones and storms which can generate:

- Large waves with rapid movement of large volumes of sand into the entrance region over a short period of time; and
- Flood flows with large currents scouring sand from some areas and depositing it further downstream or offshore also over a short time period.

As such, natural creek entrances are subject to continually varying and sometimes rapid changes in the channels and shoals as is the case at Round Hill Creek.

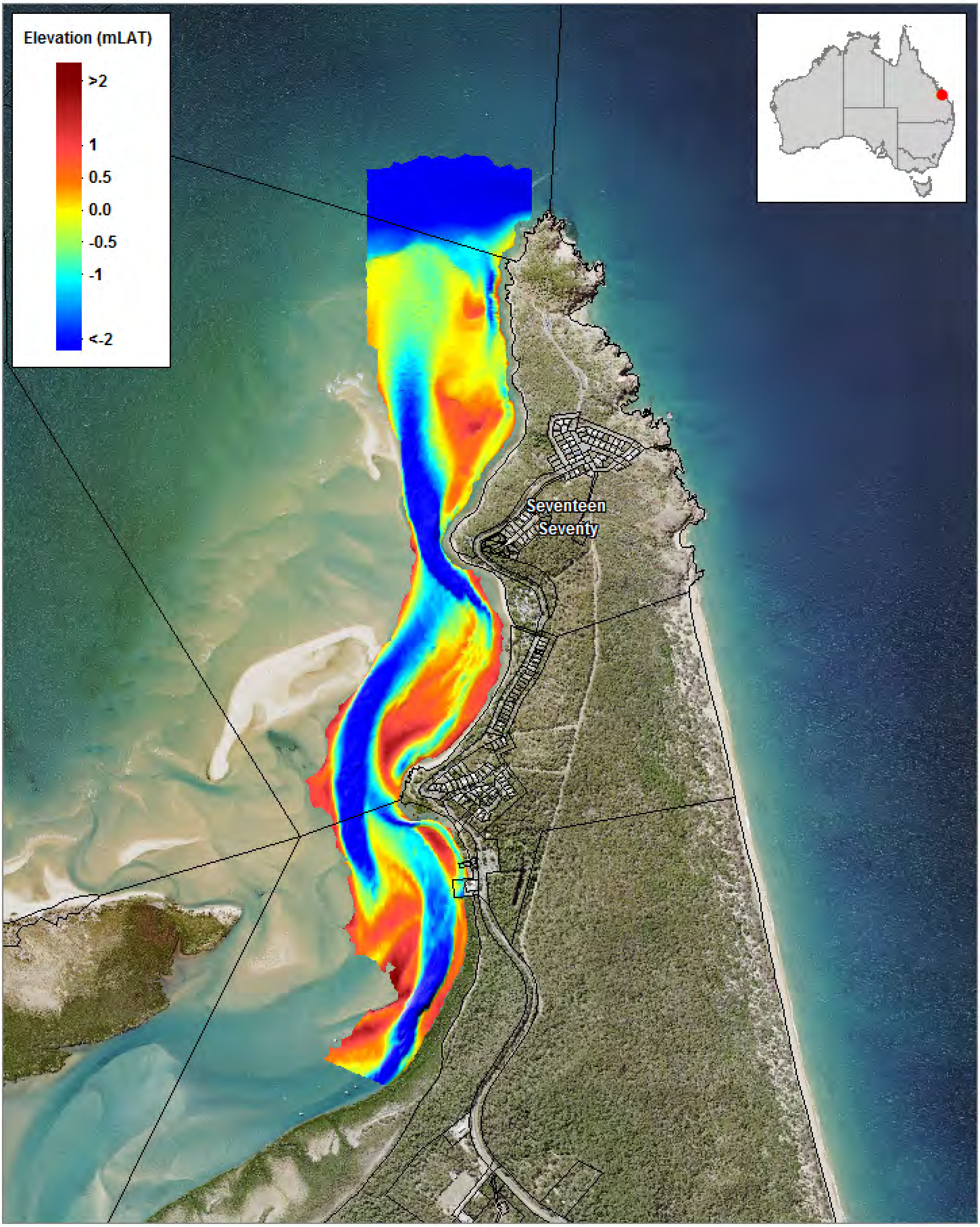
As part of the previous May 2018 BMT report related to the sand sweeping proposal at that time, some preliminary analyses were carried out, using existing data, of several factors which may influence sand accumulation at the lower part of the Round Hill Creek estuary. These included:

- A review of historical aerial photography back to 1959;
- A review of entrance bathymetric surveys 2012 to 2016/7;
- Preliminary assessment of wave induced sand transport past Round Hill Head and into the lower estuary.

The conclusion was that the bathymetric surveys supported the anecdotal evidence that sand shoal growth was increasing resulting in a loss of navigable depth in channels in recent times. A calculation of the potential sand transport past Round Hill Head for the past 8 years indicated a relatively consistent sand supply with no recent peaks.

The historical aerial photography (1959 – 2001) presented previously provided a valuable visual record. This has now been supplemented with the addition of more recent aerial photography and through rectification of the photographs to the same orientation to allow direct comparison of changes. Notional outlines of the channels and shoals in the entrance region have also been interpreted from those photographs and overlain on different dates of photography to illustrate the changes as contained in Appendix A.

The previous report recommended that an up to date survey be obtained to ascertain the recent changes and this was captured by Maritime Safety Queensland (MSQ) on 18 September 2018. Figures showing the 2018, 2016 and 2014 surveys are presented in Figure 3-1 to Figure 3-3. The difference in bed elevation between the 2018 and previous 2016/17 survey is also plotted in Figure 3-4.



Title:

14 September 2018 Survey Data (2017 Aerial Image)

Figure: 3-1

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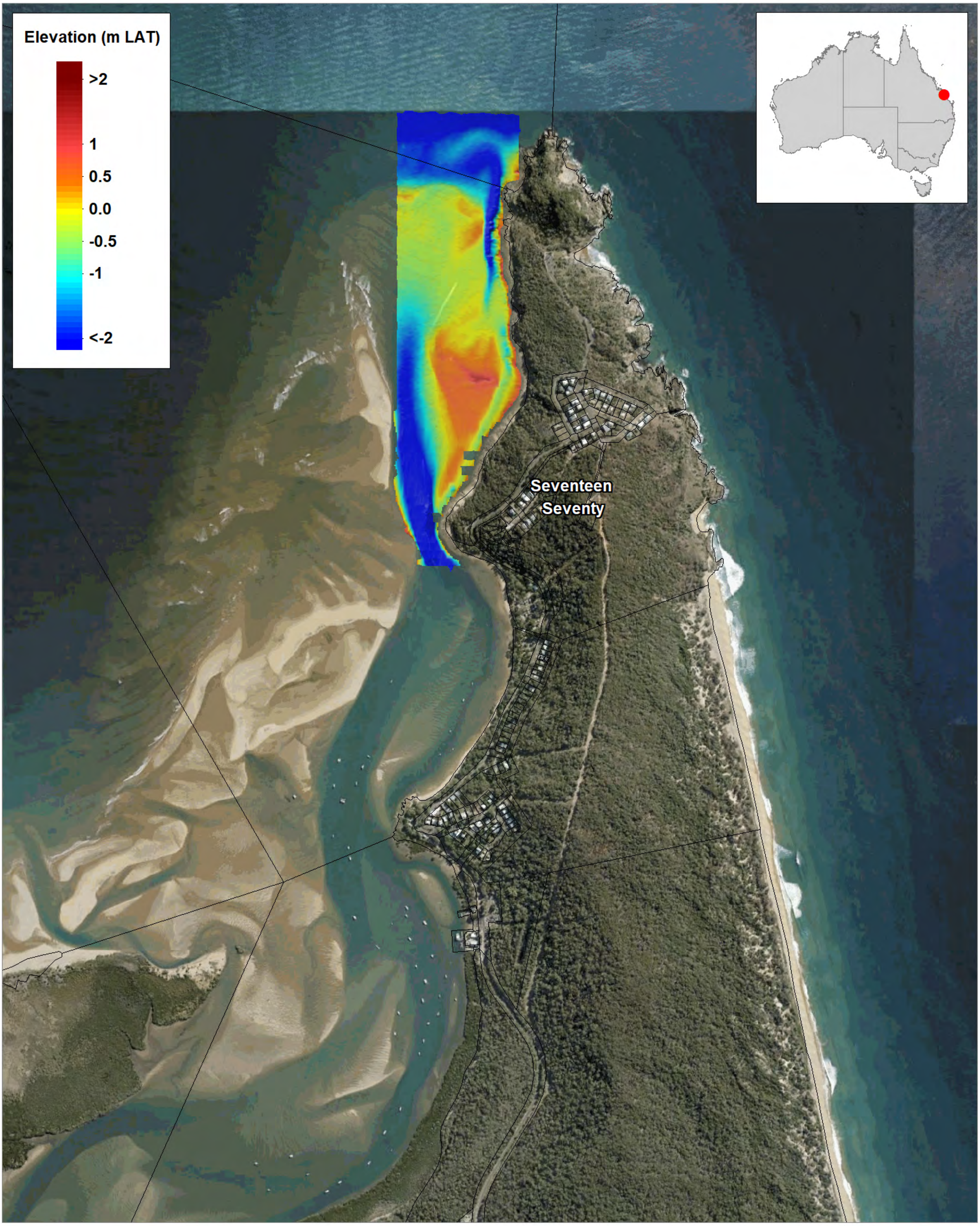

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7 December 2016 Survey Data

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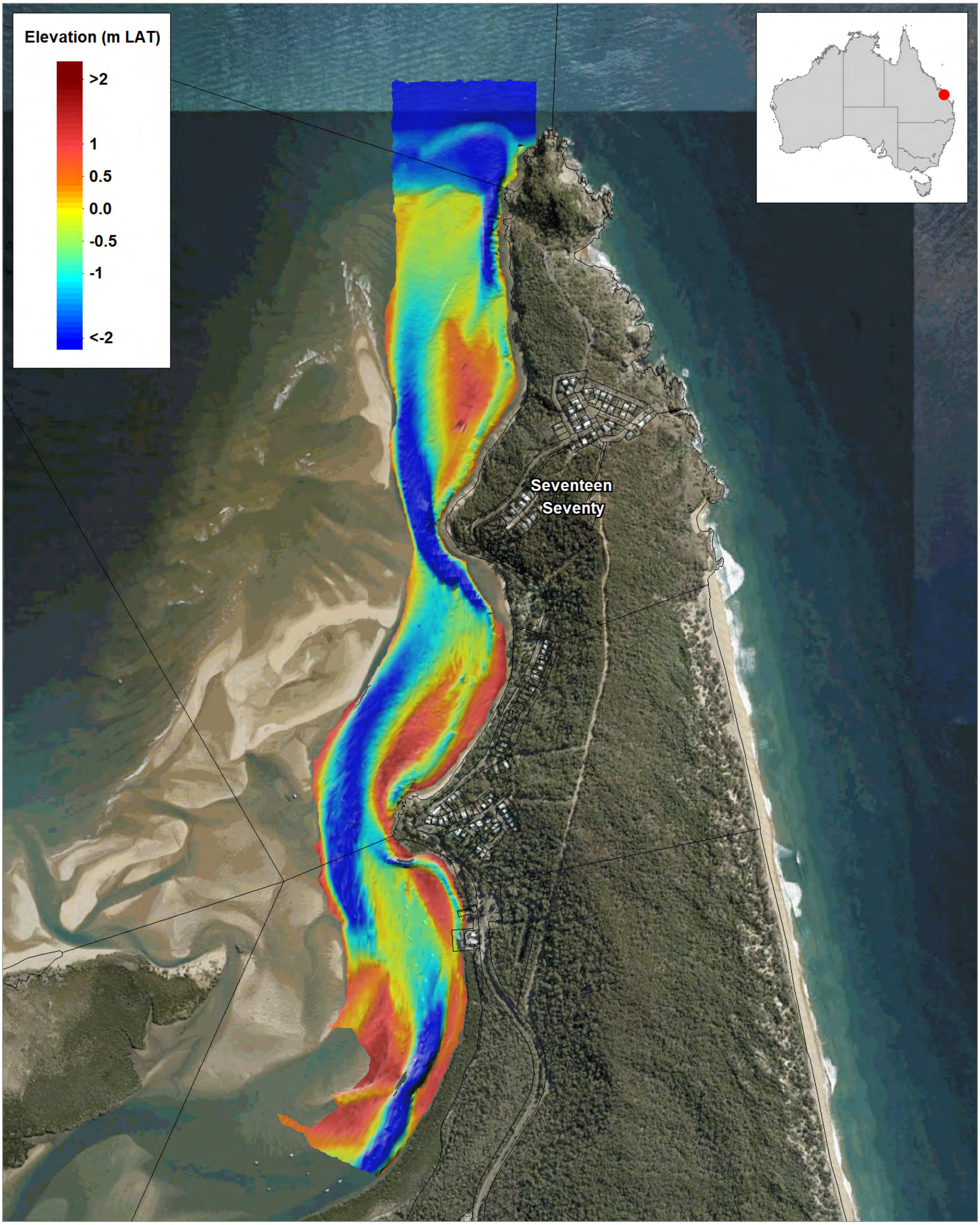

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17 November 2014 Survey Data

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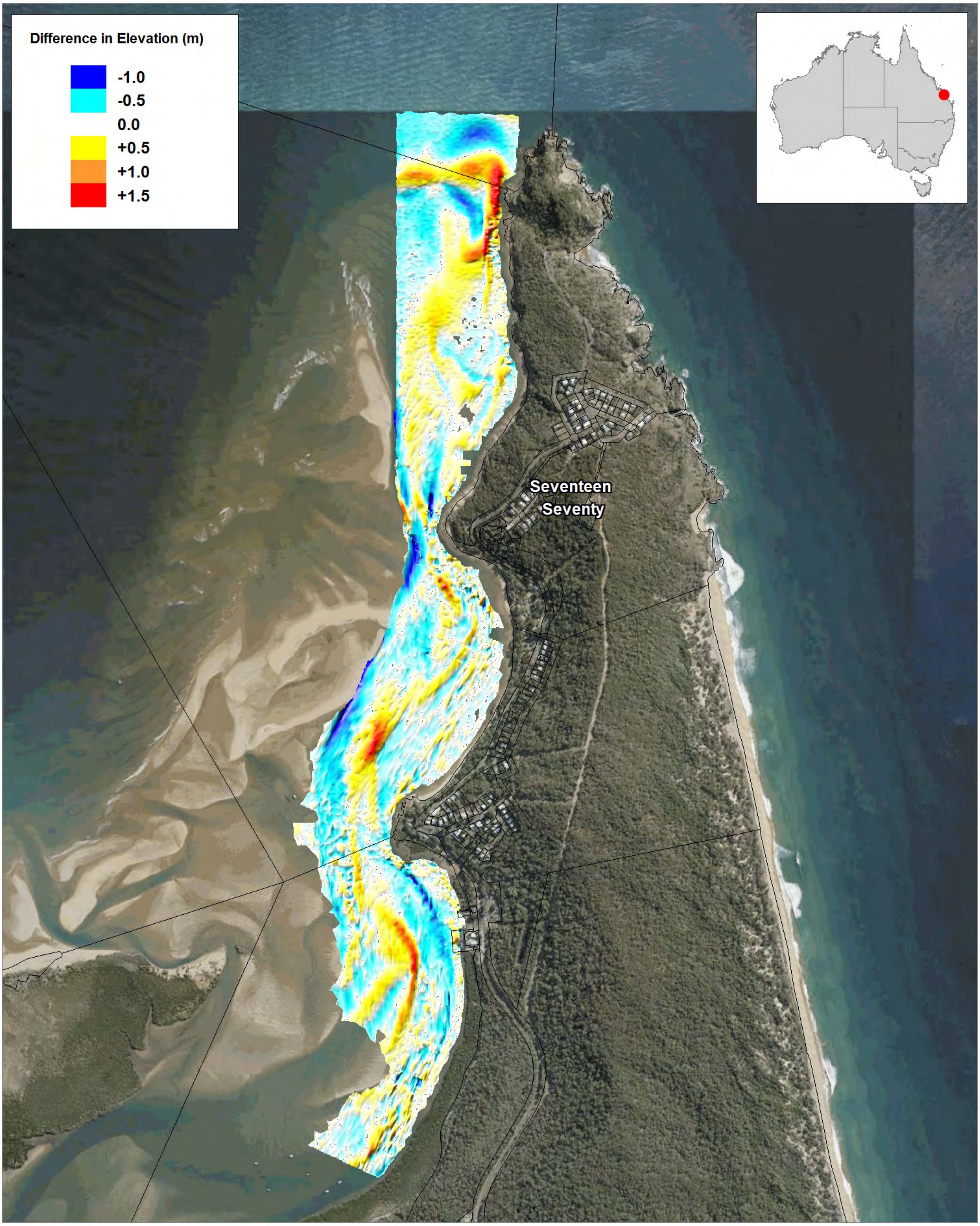

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Difference in Elevation between 2018 and 2016/2017

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These clearly show the continued growth of the sand shoal seaward of Monument Point and the resulting increased constraint on navigation across the entrance bar. The bed elevations in the vicinity of the previous cross-over channel between the red and green buoys are now above the level of the Lowest Astronomical Tide (LAT) which means it essentially dries completely on the very low spring tides. While the channel heading straight out has now deepened a little, it is still only 0.5m deep on the lowest low tides.

The dynamic nature of the channels at the entrance is captured in Figure 3-5 to Figure 3-7 which show the main navigation channel in 2017, 2010 and 1996 (channel outlines traced from the relevant aerial photograph). The significant changes which have occurred over this 11 year period give an indication of the challenges which will be encountered if interventions to stabilise the entrance channels are considered. The full set of aerial photographs is contained in Appendix A. Of particular note is that up until about 2010, a relatively narrow and therefore deeper channel tendered to persist and meander over towards the headland at the outer (northern) end, with the western side of the channel being constrained and defined by sandy shoals. Since that time, the western shoals at the entrance have tended to migrate further west with the entrance channel becoming broader and shallower. As discussed above, the previous cross-over channel to the deep channel near the headland has now essentially gone with the channel heading straight out now tending to become more dominant, albeit being broader and shallower. It is also relevant to note that waves break along the shallow outer edge of the ebb tide delta of that main channel as illustrated in Figure 3-8. This is a navigation constraint and also exemplifies the dynamic processes occurring.

Wave driven longshore transport of sand past Round Hill Head and into the entrance of Round Hill Creek is a key contributing factor. To gain further insight into the observed changes, wind records from Double Island Point since 1996 were analysed as a further indicator of potential changes in regional wave patterns and hence sediment movements. Annual wind roses from 1996 to 2006 are presented in Appendix B together with the dominant wind speed weighted direction for the southerly and northerly sector winds. The annual dominant wind directions are also plotted in Figure 3-9 which illustrate the annual variability. It also shows that while the dominant northerly winds have fluctuated around a fairly constant direction, a trend is evident in the southerly winds over the last 20 years with an apparent gradual shift in the dominant wind direction from SSE (157.5deg) to SE (135deg). Any such shift could be expected to be also reflected in the wave conditions and alter the patterns of sand transport across and into the entrance of Round Hill Creek with flow on affects for the channel and shoal behaviour of the entrance.

The conceptual sand movements in the lower estuary are represented in Figure 3-10 which has been updated to include the likely sand transport mechanisms which are continuing to move sand into the lower estuary sand shoals. The behaviour of the channels and shoals is a complex interaction of the prevailing processes as described above. These are subject to natural variability related primarily to meteorological conditions. The dynamic and highly mobile nature of sand movement in the entrance is also evidenced by large bed forms, strong currents and turbulent boils of suspended sediment observed in the water during the site inspection. Consideration of options to maintain a navigable entrance needs to recognise the highly mobile and variable nature of the processes as well as the fact that changes can occur rapidly (in a matter of hours or days) in extreme events as well as gradually through seasonal and longer-term trends. The nature, timing and extent of future behaviour cannot be readily predicted.

Figure 3-5 Recent Channel Locations shown on 2017 Photo

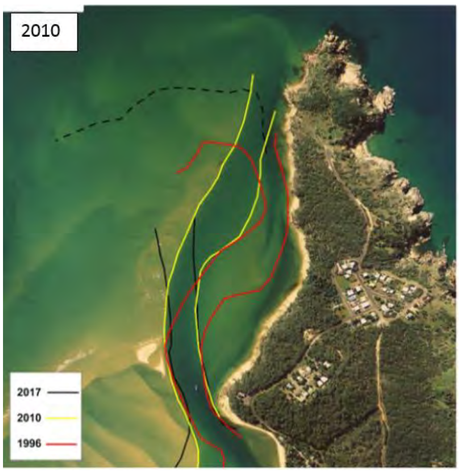


Figure 3-6 Recent Channel Locations shown on 2010 Photo

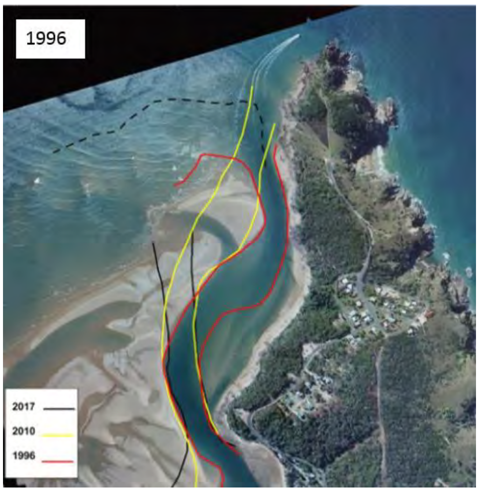


Figure 3-7 Recent Channel Locations shown on 1996 Photo

Figure 3-8 Waves Breaking Across Outer Shoal

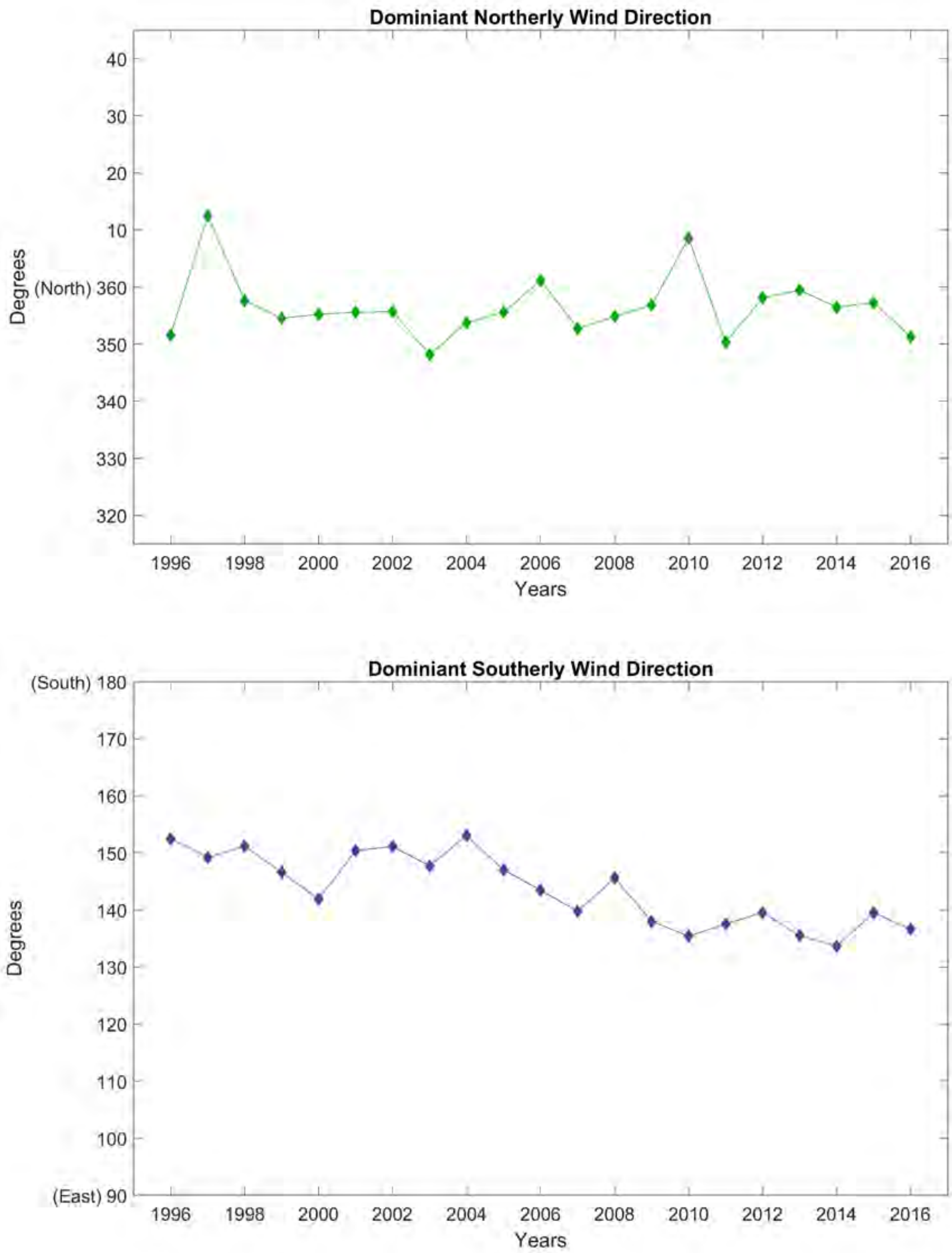
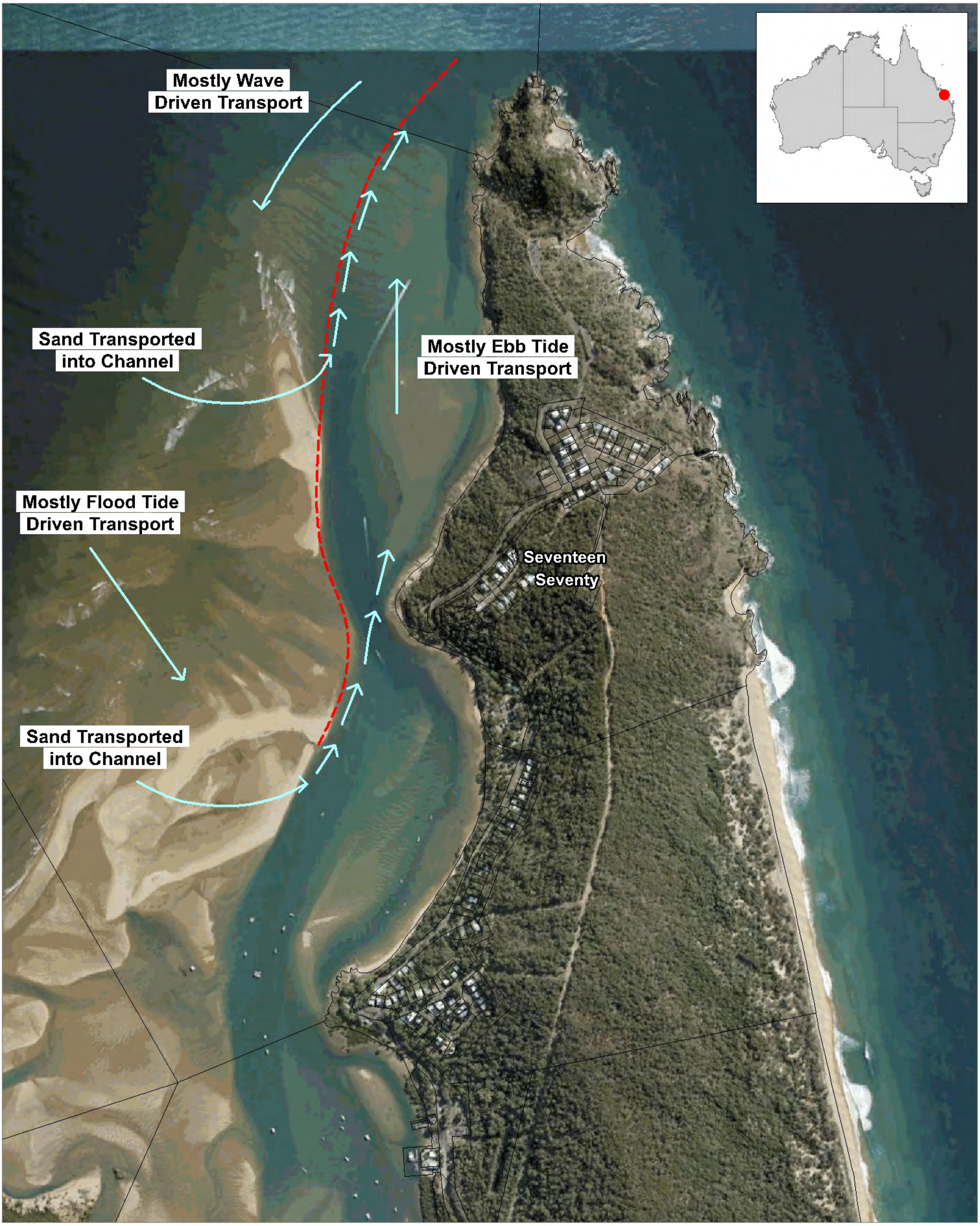


Figure 3-9 Annual Dominant Wind Directions



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General Sand Transport Pathways

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4 Option Identification

The investigations to date have concluded that the sand movements and shoals west of the Round Hill headland are continually changing while conforming to broadly consistent patterns over time. Currently it appears that sand accumulation in the entrance and the shoal restricting access between the deeper channels seaward of Monument Point is continuing. It is possible that at some time in the future when weather patterns change the entrance will return to another of the common configurations with less interruption to navigation. However, the timing of this cannot be predicted. Furthermore, it needs to be recognised that changes can also occur rapidly in response to extreme events such as cyclones and floods.

If Council were to consider intervention to maintain navigable access, then the options would fall into two broad categories:

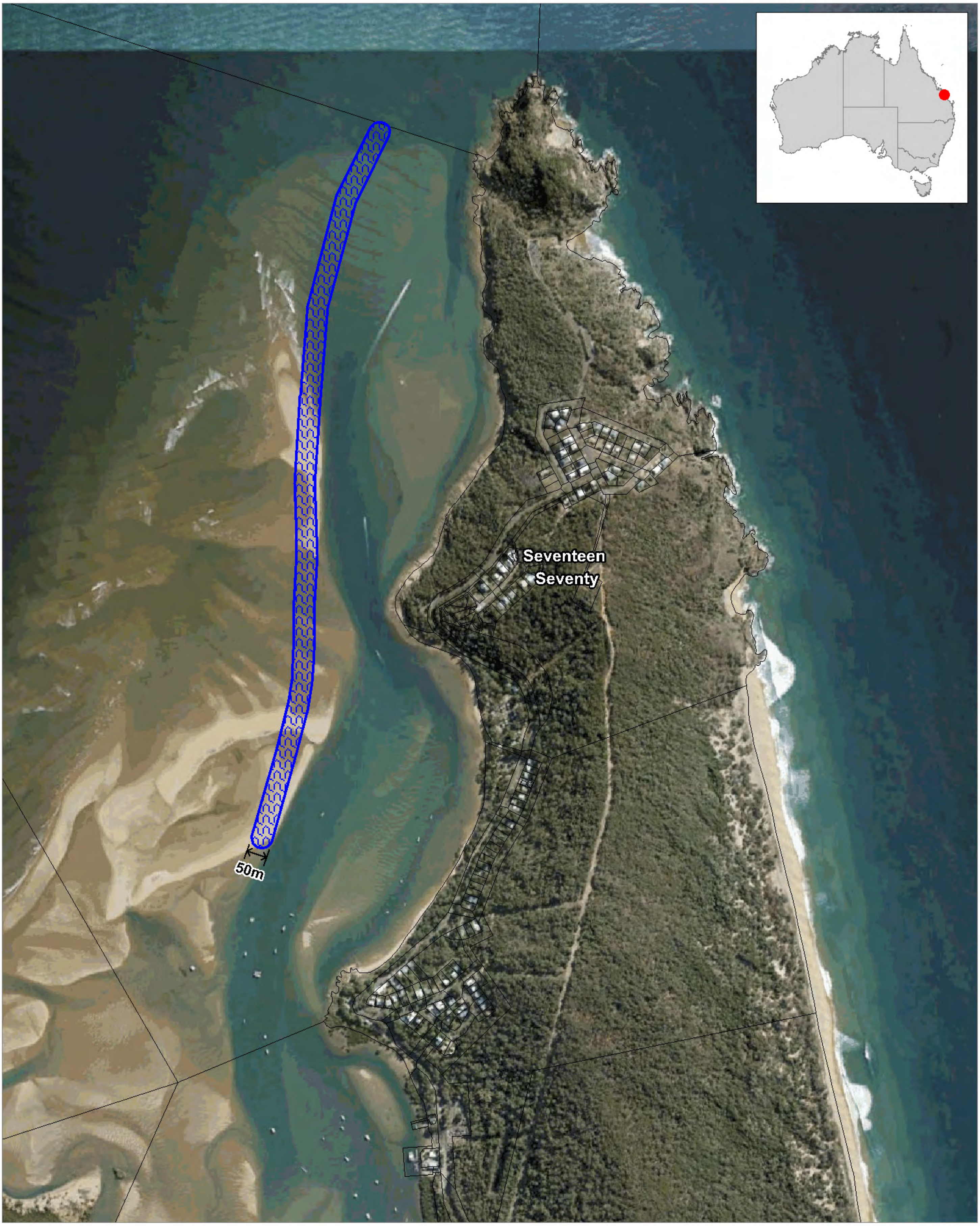
- Hard or permanent structural options such as training walls with or without a sand bypassing system; and
- Soft options such as dredging (noting that sand sweeping has been largely discounted by reviewers).

It should be noted that most works will be in or adjacent to the boundaries of the Fish Habitat area and the Marine Park and that no detailed ecological surveys or assessment of potential impacts have been undertaken to date. Therefore, significant work will be required to gain approvals and permits.

4.1 Hard Structural Options

Hard structural options such as training walls, with or without sand bypassing, are often considered as a means of maintaining a navigable entrance channel. The training walls typically stabilise the location of the entrance and confine the width of the channel with the intent of ensuring velocities are high enough to scour and maintain the desired depth. On coastlines with substantial longshore sand transport, training walls introduce other constraints through the interruption of that transport of sand leading to accretion on the updrift side and erosion on the downdrift side. Furthermore, sand will typically build up within the entrance channel and/or form a shallow offshore ebb tide delta. Maintenance dredging or in the extreme, an artificial or mechanical sand bypassing systems can then be introduced to offset those effects, albeit at a greater and ongoing cost.

There would be significant technical difficulties in assessing and designing such options for Round Hill Creek. Given the configuration with substantial shoals forming the western boundary, any training wall structure would need to be isolated on that western side of the entrance channel i.e. it cannot economically be connected to the shoreline which is many kilometres to the south (refer Figure 4-1 as an example). Therefore, the structure would need to be designed so that any major changes in channel location over time do not threaten or undermine the structure. It is also noted that the structure would be fully exposed to cyclonic conditions. This would likely add significantly to costs e.g. increased foundation depths and rock size. Also, construction would likely require resources e.g. rock to be sourced from distant locations and transported to site by barge.



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Possible Training Wall Location

Figure: 4-1

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While a training wall as indicated above may maintain a suitable navigable depth within the confines of the channel, sand being transported around Round Hill Head may still enter the channel and/or lead to the formation of a shallow ebb tide delta or shoal beyond the end of the channel with associated navigation constraints. A permanent sand bypassing system would be an option to prevent such build-up of sand or even in its own right to help maintain a navigable channel. Any sand bypassing system (pump and pipeline) would need to be constructed on the headland so that sand can be captured to the east of the channel (possibly to the east of the headland) and deposited to the west of the training wall. Generally, this is usually achieved by sand pumps which collect the sand and pump it under the entrance as a slurry using a pipeline buried under the channel. Figure 4-2 shows the jetty and pumps at the Tweed River required to capture the sand before bypassing.

It is impossible to estimate the full range of design requirements at this time however the technical difficulties and expected environmental investigations to gain approvals will likely mean this is a very expensive option.

Figure 4-2 Tweed River Sand Bypassing Jetty

4.2 Dredged Channel Options

Council has indicated the need for a navigation channel with a width of 25m and depth of 1.2m to 1.5m below Lowest Astronomical Tide (LAT). Experimental sand sweeping to provide a minimum channel has been largely discounted as not being practical and not providing value for money or in fact a reasonable result. The remaining option would therefore be to dredge and maintain a navigation channel. The major option locations for this would be:

- A channel close to the western shore of the headland up to Monument Point where a shallow channel has appeared most consistently over time along most of its length (refer Option A Figure 4-4). Due to its location away from the dominant waves and currents, this is likely to be the option with lowest infill rates and therefore best longevity. However, it is apparent that rock exists in the bed of this channel. It is likely that this would prevent dredging by conventional means and as such may rule this option out completely.

- A channel continuing the existing central channel which has been developing in recent years (refer Option B Figure 4-4). There appears to be no constraints e.g. rocks, to dredging this channel and it is likely that wave conditions will be favourable for dredging via conventional means much of the time exclusive of cyclones. While this alignment would be working with the present trend of the developing channel, historical aerial photography for the last 60 years does not indicate that this is one of the broadly consistent channel alignments over time. The highly mobile nature of the sediments in this area as evidenced by wave action along the outer edge of the delta and strong currents indicates that rapid infill is likely. It is therefore expected that significant annual maintenance will still be required to maintain a channel along this alignment. Waves breaking across the outer edge of the channel will also be a navigation constraint for smaller vessels.
- A cross-over from the central channel to the northern extension of the western channel which has been the dominant location of historical channels (refer Option C Figure 4-4). As previously indicated in the sand sweeping review, it is considered that this option will have limited success based on the current sand movement directions. In particular, the shoal constraining navigation is continuing to grow by sand moving to the north (downstream) and this will infill the proposed dredged cross-over channel quickly. As such dredging a channel along this alignment is working against the present trends although historically it has been the dominant location. It is expected that significant annual maintenance will be required to maintain a channel along this alignment as well.

The volumes of sand to be relocated as part of these options to provide the minimum channel required is relatively small and changing continually. For example, Option B with a channel width of 25m, average dredge depth of 1m and a length of around 400m the volume to be dredged is likely to be around 10,000 cum including batters. Options for dredging could include:

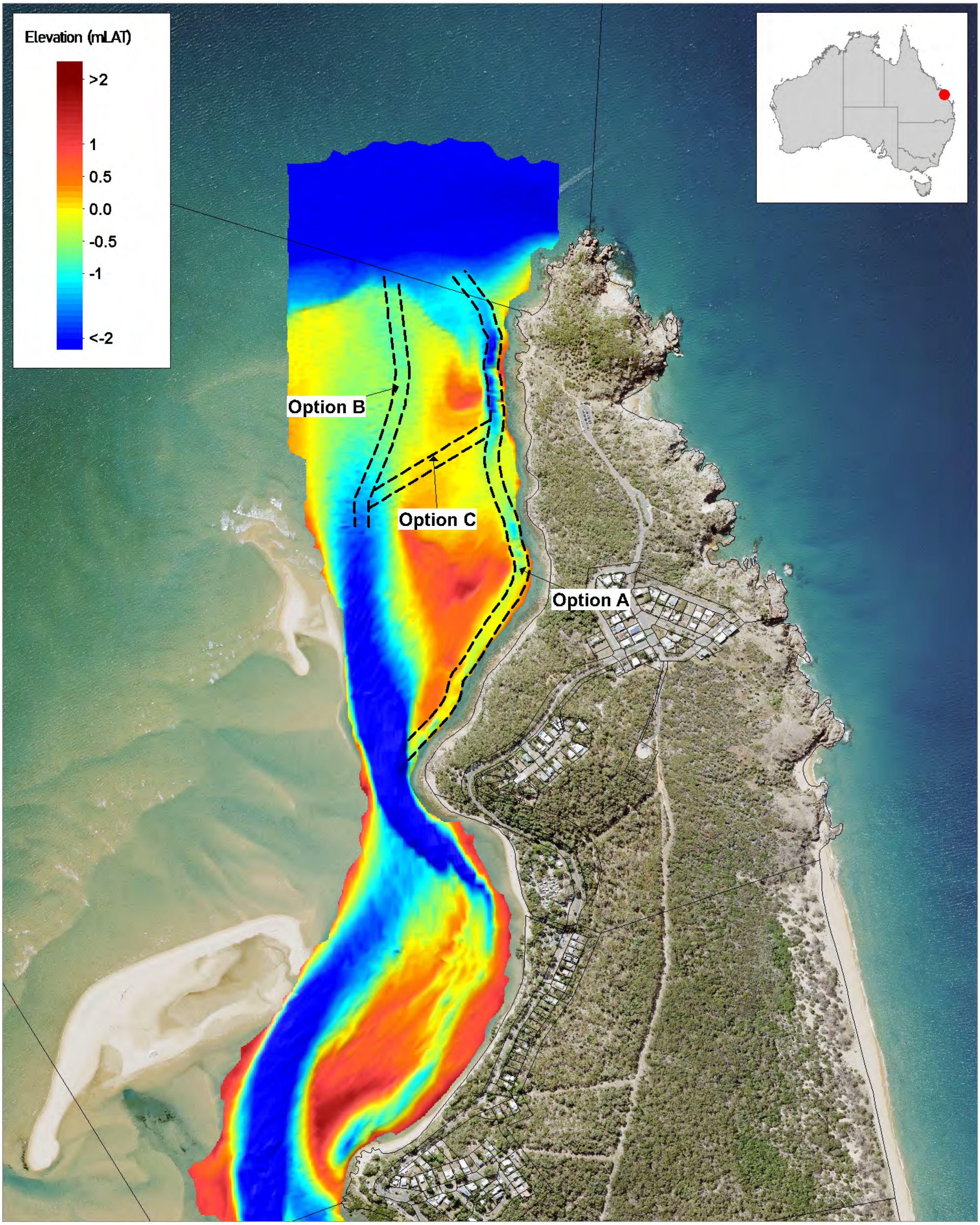
- A small 150mm diameter suction dredge as shown in Figure 4-3 with the sand pumped away via a pipeline. This will have a production rate of around 50 cum per hour and 500 cum per day. Therefore, the time to dredge the channel would be about 20 days.
- A small mechanical backhoe or grab dredge with the sand transported away via barges. While conceptually such a dredge could be used, draft constraints are likely to limit the size and therefore the production rate with the time to achieve the design channel constraining its viability.

Other methods such as fluidisation are not considered to be practical at this location.

While the quantities to be dredged to provide the required channel are only small, this also exemplifies that not a lot of sand movement is required to infill the dredged area necessitating regular ongoing maintenance dredging. Furthermore, in highly mobile zones, small equipment with low production rates may find it difficult to keep pace with ongoing infill limiting the viability. The dredging design would need to consider such factors as well as the value of over-dredging i.e. dredging deeper and/or wider initially, potentially with a larger dredge, to improve longevity and optimise the costs. Assessment will also be needed as to where and how the dredged material could be placed and the associated cost taking a range of factors into consideration including:

- Practicality in terms of distance and method (eg pumping or barging);
- Technical considerations i.e. will the sand migrate quickly back into the channel; and
- Environmental and coastal process impacts / approvals.

Figure 4-3 Typical Small Dredge



Title:

Dredge Options
(14 September 2018 Survey Data)

Figure: 4-4

Rev: B

N

0 200 400m

Approx. Scale

BMT

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5 Environmental Approval and Permitting

Environmental approvals for channel management can be split into two groups:

- Approvals required based on nature of works
- Approvals required based on environmental significance overlays – these include the Great Barrier Reef World Heritage Area (GBRWHA), the Great Barrier Reef Marine Park (GBRMP) and Great Barrier Reef Coast Marine Park (GBR Coast MP), and the Seventeen Seventy-Round Hill Fish Habitat Area (FHA) (refer Figure 5-1 for areas of environmental significance).

These establish the regulatory framework for whether different management options are permissible (i.e. legally able to be approved) and level of further assessments and/or management required before an approval can be granted.

Table 5-1 provides a generic summary of the types of approvals that could apply for the management areas. Further discussion for each management option are provided below.

Table 5-1 Generic Summary of Approvals

Approval	Works covered	Assessment requirements
Development Permit (Tidal Works)	Tidal Works, i.e. works on tidal land, including land below the low water mark (e.g. dredging, beach nourishment, breakwaters)	RPEQ design Assessment of impacts to coastal processes
Development Permit (State Coastal Land)	Works above the high-water mark within the Coastal Management District or that have potential disturb coastal processes	Assessment of impacts to coastal processes Contamination assessment (if works involved reclamation)
Environmental Authority	Environmentally Relevant Activities, e.g. dredging	Operational environmental management procedures Assessment of impacts to water quality
Allocation of Quarry Material	Movement of quarry material (sand) from below to above the high-water mark	Royalties Contamination assessment
Marine Parks Permit	Activities within marine park zones	Assessment of impacts to marine ecology Assessment of impacts to recreational use Operational environmental management procedures
Sea Dumping Permit	Placement of dredged material in Commonwealth waters	Contamination assessment

Note that approvals under the FHA are not included in Table 5-1. Under the *Fisheries Act 1994*, approval *cannot* be granted for dredging or infrastructure construction works in a FHA. However, the legislation also automatically excludes from the FHA the area of a channel marked by aids to navigation (Fisheries Regulation 2008, r617(1)(a)). The current aids to navigation at Round Hill Creek reflect the historical channel which has now silted up. It is at the discretion of Maritime Safety Queensland (MSQ) to now amend the location of these markers to reflect the new naturally-forming channel.

Recognising this, both dredging options B and C could be considered to formalise the naturally-occurring channel of Round Hill Creek. Therefore, in both instances, it is assumed that the formal navigation channel would be re-declared by MSQ, thereby making the works permissible. This would be subject to further discussion with MSQ. Where such an outcome cannot be achieved, neither of these options will be acceptable.

5.1 Hard Structural Options

Hard structural options would require the following approvals:

- Development Permit (Tidal Works)
- Development Permit (State Coastal Land)
- Marine Parks Permit.

This option will lead to significant changes in the coastal environment, including modification of natural coastal processes. Such changes are typically only accepted by regulatory agencies where there is an imminent threat to people or property from coastal hazards (e.g. coastal erosion, storm tide inundation), or where there is a need to maintain infrastructure (e.g. navigation channels) that have been previously approved and developed. As the project area consists of a naturally moving channel that has not been subject to any formalisation or training historically, it is considered highly unlikely that approval would be granted for this option.

If this option was to be pursued, it would require significant negotiation with State and Federal agencies and would likely trigger the need for an Environmental Impact Statement (EIS) due to the scale of impact and complexity of approvals environment.

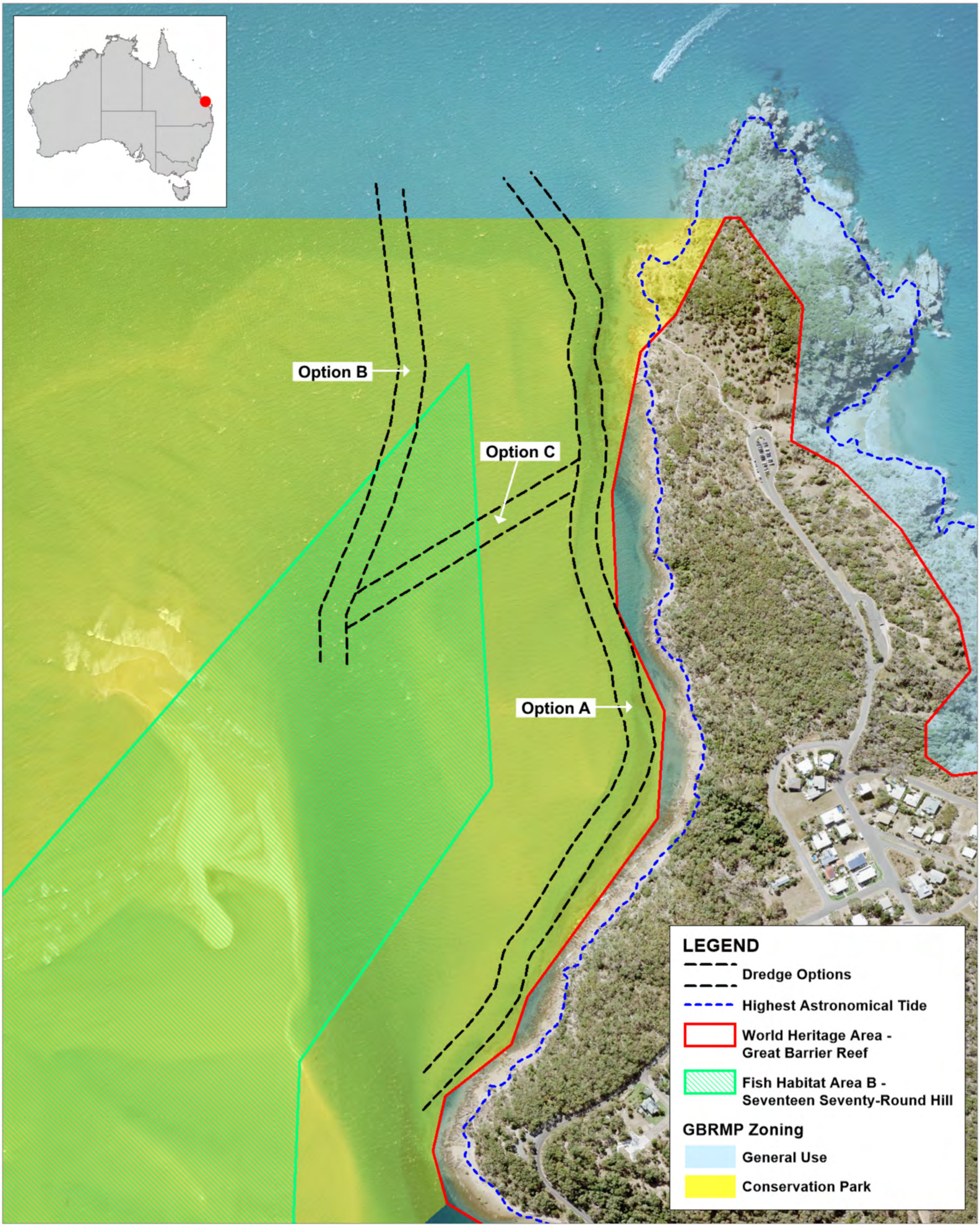
5.2 Dredged Channel Options

5.2.1 Capital and Maintenance Dredging

Dredging activities will require the following approvals:

- Development Permit (Tidal Works)
- Environmental Authority
- Marine Parks Permit.

Figure 5-1 shows the three potential dredging options comparative to the location of the GBRWHA, GBRMP, GBR Coast MP, and FHA.



Title:

Environmental Significance Overlays and Dredging Options

Figure: 5-1

Rev: A

N

0 100 200m
Approx. Scale

BMT
www.bmt.org

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All three dredging options involve capital dredging within the Conservation Park Zone of the GBRMP and GBR Coast MP. Under the zoning plan for the park, such works are permissible with approval but only where it can be shown that works are compatible with the objectives of the zone. As these objectives include the conservation of marine habitat, flora and fauna, it will be necessary to prepare a comprehensive environmental assessment and/or management plan for the dredging. Once-off dredging works are more likely to be approved than works requiring significant ongoing maintenance dredging. Additionally, works will require an environmental offset due to their impact on a higher-protected zone of the marine park.

All three dredging options are generally consistent with the requirements of other (non-marine park) State and Federal policy. However, further assessments would be required to support approvals, with a focus on potential impacts to coastal processes and environmental values, and the likely requirements for re-dredging of the channel in the future.

5.2.2 Placement

In addition to approvals to dredge material, approvals are also required for placement. These differ depending on the ultimate location for the placement:

Offshore

- Sea Dumping Permit – only if placed in Commonwealth waters (i.e. more than 3 nm offshore), otherwise offshore placement can be covered in the Environmental Authority and Marine Parks Permit for dredging.

Onshore

- Development Permit (State Coastal Land)
- Allocation of Quarry Material.

Note that material can also be used for reclamation purposes (i.e. placing dredged material to raise land above the high-water mark) but this is not permissible within the GBRMP. Therefore, if reclamation is to be undertaken, it must occur outside the boundaries of the marine park.

Where material is placed offshore, it needs to be assessed and certified as free from contaminants as per the *National Assessment Guidelines for Dredging 2009* (NAGD). Where this cannot be achieved, material will be required to be placed onshore. However, due to the lack of heavy industry near the dredging works, it is considered highly unlikely that material would be considered contaminated.

The above assumes that the total volume of material to be dredged for any one option will be <15,000 m^3. Under the Regulations for the GBRMP, material from capital dredging cannot be placed within the GBRMP except where it is below this threshold (measured in situ). If the dredging requires a total capital volume exceeding 15,000 m^3 (even if undertaken over multiple campaigns), no placement can occur in the marine park.

Materials to be placed onshore need to be assessed and certified under the National Environmental Protection Measure for Site Contamination (NEPM) and the Queensland Acid Sulfate Soils Technical Manual (QASSTM). Alternatively, if material is contaminated and/or contains acid sulfate soil (ASS), it can still be placed onshore but subject to treatment and/or management. As with NAGD, the material for dredging is unlikely to be contaminated as per NEPM screening levels but could contain ASS.

6 Preliminary Costs

6.1 Structural Options

Any structural options of training wall and bypassing system will require significant design input to make them fit for purpose in a complex littoral sand transport system including the need to be robust enough to survive full exposure to cyclones. As an initial estimate it is expected that the foundations would need to be at -6m AHD, the crest at +5m AHD giving a cross sectional area of 300 cum (600 tonne) of rock per metre of structure. Based on recent experience with rock seawalls it is expected that the cost per tonne of rock to build the training wall will be $200/tonne giving about $120,000 per metre. Therefore, for 1500m of training wall as shown in Figure 4-1 the estimated preliminary cost would be $180M. Maintenance costs are likely to be 5% per annum.

Regarding the cost of the sand bypassing system, reference is made to the Tweed River Sand Bypassing system which was completed in 2001 at a cost of $23.3M (2001 value). This system is larger than what would be required at Round Hill however it was constructed in the Gold Coast / Tweed area where many contractors had heavy construction experience. It could be expected that isolation and inflation would increase the cost by a factor of 3 bringing the present day estimated cost to $70M. Operational costs (electricity and maintenance) are likely to be 20% of capital cost per annum.

6.2 Dredging Options

As indicated above the volumes of sand to be relocated to achieve the desired channel as part of these options is relatively small. For Option B with around 10,000 cum of dredging, the major costs (excluding environmental approvals) are likely to be mobilising the plant to site and demobilising. This is estimated as $250,000 with the dredging rate estimated at $20 / cum. Therefore, the likely contract cost would be $450,000. Lower costs may be possible if locally based equipment can be used.

Maintenance is difficult to predict as channel meandering and shoaling will be dependent on weather conditions. As a preliminary estimate it is assumed that a dredging campaign may provide a suitable navigation channel for up to 1 year on average. This would result in a minimum average annual cost of $450,000 in perpetuity. It is quite likely that more frequent maintenance dredging will be required, particularly if a smaller initial channel is chosen and/or a major meteorological event results in rapid infill. Other factors which may increase costs are the relocation distance as booster pumps are generally needed every 1000m.

7 Options Assessment

Broad benefits and risks of the various options and components thereof are outlined below with respect to their viability of achieving the desired channel outcome from the point of view of coastal processes and environmental approval requirements. These are based on the broad understanding of the processes as outlined above. No detailed assessments of those processes, the potential environmental impacts or the specific design requirements have been undertaken at this stage and these would be necessary to support any applications for works. Furthermore, the scope of this study does not include consideration of the broad economic or social benefits and costs associated with the need for such works.

7.1 Hard Structural Options

Hard structural works such as a major training wall would have the potential benefit of stabilising the entrance location and constraining the channel in such a manner to maintain an adequate navigable depth for the majority of time. Sand transport around Round Hill Head could lead to ongoing shoaling which could be mitigated with the addition of maintenance dredging or an artificial sand bypassing system in the extreme. Major works such as this have been successfully implemented to varying extents at many river entrances to improve and maintain navigability.

Because of the geographical location of the headland and the Round Hill Creek entrance any structural works will also face a number of challenges. In particular, the alignment of Round Hill Creek along and adjacent to the headland is such that there is no practical location for a shore connected training wall. As such, any such structure would have the challenges of offshore construction and would need to be designed for full cyclonic exposure. Furthermore, it would need to be long enough and sited appropriately to minimise the potential of being outflanked which remains a risk. Initial dredging to establish a channel may also be required adding further to the costs. These aspects make structural options relatively expensive, although it is likely that a scheme with a service life of 50 years could be designed and built. Such options also would require significant negotiation with State and Federal agencies and would likely trigger the need for an Environmental Impact Statement (EIS) due to the scale of impact and complexity of the approvals environment.

7.2 Dredging Options

Dredging options offer the potential benefit of being on a much smaller scale and initial capital cost to achieve the desired navigation requirements. However, the highly dynamic nature of the processes and continually changing conditions are such that there are substantial risks associated with a dredged channel. Foremost, any dredged channel is likely to be subject to ongoing sedimentation on a day to day basis as well as potentially rapid infill during a major storm or cyclonic event. As such, regular maintenance dredging with associated ongoing costs will most likely be required to maintain a navigable channel. The need for such works will potentially be at short notice and may be at a high frequency depending on the design and the prevailing conditions.

Detailed assessment of the potential environmental impacts and management measures will be required in support of applications for environmental approvals of any such works. These assessments relate to the potential impacts of the actual dredging as well as placement or use of the dredged material. Environmental approvals are subject to a number of constraints and can't be guaranteed. The size of the dredging program and the likely need and frequency of ongoing maintenance will be important considerations with once-off dredging works being more likely to be approved than works requiring significant ongoing maintenance dredging.

In the context of the above, the relative considerations of the three potential dredging options put forward (refer Figure 4-4) are as follows.

Option A

- Has the largest footprint and outcropping rock is likely to constrain standard dredging techniques.
- Is likely to experience the slowest infill rate and require less frequent maintenance dredging.
- Does not extend into the Fish Habitat Area but is within the Marine Park.

Option B

- Is along the alignment of the presently developing channel and is likely to require the least amount of initial dredging although historically the channel has not followed this alignment.
- Is likely to be subject to rapid infill particularly on the outer edge of the sand shoal where waves regularly break necessitating regular maintenance dredging.
- The abovementioned wave breaking is an added constraint to navigation for smaller vessels.
- Dredging would extend into the Fish Habitat Area as well as the Marine Park and would need consideration and clarification of the status of the marked navigation channel for dredging to be permissible.

Option C

- Is along the historic channel alignment but has been subject to substantial shoaling in recent times as patterns have changed.
- Is likely to be subject to rapid infill, particularly related to the ongoing shoal development in this area necessitating regular maintenance dredging.
- Dredging would extend into the Fish Habitat Area as well as the Marine Park and would need consideration and clarification of the status of the marked navigation channel for dredging to be permissible.

All dredged channel options will require ongoing maintenance dredging from time to time. Of the 3 options considered, Option A is likely to require least maintenance dredging and does not have the Fish Habitat Area constraints. However, the potential presence of rock may reduce the viability to dredge and also introduce rocky shore habitats into the impact assessment. Both Options B and C extend into the Fish Habitat Area with associated constraints to be clarified and both will be subject to rapid infill necessitating regular maintenance dredging. Of those, Option B is following the alignment of the presently developing channel but is still likely to have a relatively short life due to the dynamic nature of the sand shoals within the estuary and therefore long-term maintenance costs will be significant. It also has the constraint of waves regularly breaking across the entrance channel.

7.3 Summary of Option Costs

The costs of any works are very dependent on the detailed design as well as the tendering process and the availability of local equipment. A brief summary of the broad costs likely for the types of options considered is given in Table 7-1 below for indicative purposes. This includes an allowance for environmental studies, approvals and permits including environmental offsets. While smaller dredging works using local equipment may be possible at lower costs, they are less likely to be viable in achieving the desired long-term outcome.

Table 7-1 Summary of Option Costs

Option	Capital Cost	Annual Cost	50 Year Life Cost (PDV)	Environmental Studies & Permits	Ranking
Dredged Channel	$0.45M	$0.45M	$22.95M	$1M	1
Training Wall	$180M	$9M	$630M	$2M	2
Training Wall + Sand Bypassing	$250M	$21M	$1,530M	$2M	3

8 Summary and Conclusions

The main findings of this preliminary investigation are as follows:

- The coastal processes at the entrance to Round Hill Creek are highly dynamic with the channels and shoals constantly changing. The changes occur gradually on a day to day basis but can also happen rapidly in a major storm or cyclone event.
- A shallow navigable channel has generally existed for many years with the channel being constrained by substantial shoals on the west and meandering across towards the headland on the east. In recent years the western shoals at the outer entrance have rotated to the west with a broader and shallower entrance heading straight out to the north becoming more dominant and the old cross-over channel being infilled.
- Options to improve the navigability of the entrance broadly fall into the categories of “hard” structural works and/or “soft” dredging works with varying constraints from technical and coastal process perspectives.
- Any works will be subject to detailed design as well as environmental impact assessment and regulatory approval requirements. Approvals required based on environmental significance overlays include the Great Barrier Reef World Heritage Area (GBRWHA), the Great Barrier Reef Marine Park (GBRMP) and Great Barrier Reef Coast Marine Park (GBR Coast MP), and the Seventeen Seventy-Round Hill Fish Habitat Area (FHA). Once-off schemes are more likely to gain approval than those requiring significant ongoing works. Additionally, environmental offsets may be required.
- Structural options such as a training wall have the potential to stabilise the entrance and constrain the channel to maintain a navigable depth for most of time. However, the configuration of Round Hill Creek is such that it is not viable to have a shore connected training wall which significantly increases the costs and risks. Structural options therefore come with a very high cost and will also require significant assessment and negotiation with regulators to obtain approval.
- While structural options such as a training wall may minimise the need for ongoing works, gradual shoaling may ultimately require maintenance dredging and in the extreme, a permanent sand bypassing system to maintain a navigable entrance and mitigate adverse coastal process impacts. There will be ongoing costs for maintenance of the wall and potentially irregular maintenance dredging and very high costs in the case of full bypassing. Given the above, structural options are not considered to be viable.
- Dredging options offer the potential to improve navigability through initial capital works at a much lower capital cost (~$0.45M). However, the dynamic nature of the processes is such that shoaling will occur necessitating regular repeat dredging to maintain navigable access. The frequency, extent and cost of the maintenance dredging will be dependent on the location and the extent of the initial dredging as well as the prevailing processes. Rapid shoaling could occur during major storm or cyclone events. Repeat annual dredging at a similar cost (~$0.45M) could therefore be expected.

- Environmental significance overlays in the area are such that substantial impact assessment and negotiation will be required to secure environmental approvals for both dredging and placement of the dredged material. In particular, dredging within the FHA would only be permissible in the area of a channel marked by aids to navigation which would require clarification.
- The 3 dredged channel alignments considered each have different opportunities and constraints and there is no clear preferred option. Each would require repeat maintenance dredging at some point in time but potentially to different extents and frequency. Environmental assessment and approval requirements may also vary.
- Option A (along the shoreline of the headland) is likely to require least maintenance dredging and does not have the Fish Habitat Area constraints. However, it has the largest footprint and outcropping rock may reduce the viability to dredge. Investigation of presence of rock would therefore be required to further consider this option.
- Option B (heading straight out) is along the alignment of the presently developing channel but would still be subject to rapid shoaling and the need for frequent maintenance dredging. It also has the navigation constraint of breaking waves across the outer shoal and the uncertainty surrounding dredging in the FHA which would need to be confirmed.
- Option C (following the historic cross-over channel) cuts across the area that has been subject to rapid shoaling in recent years and such ongoing processes would necessitate frequent maintenance dredging. It also has the uncertainty surrounding dredging in the FHA which would need to be confirmed.

Based on the above findings of this initial study it can be concluded that:

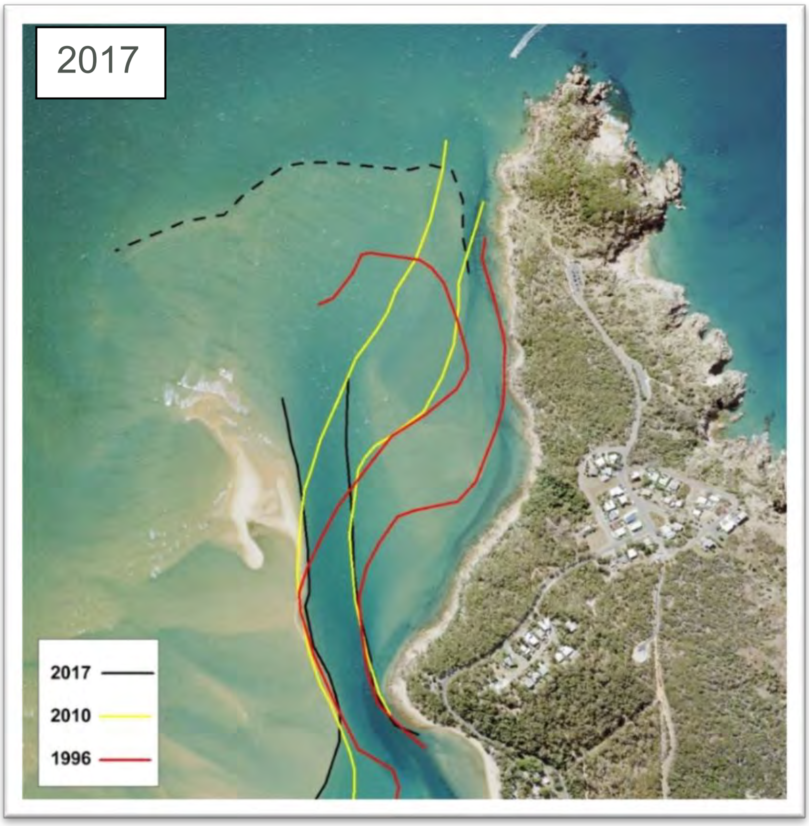
- Major structural works to provide a permanent channel deepening solution are not considered viable due to substantial costs, inherent risks and significant negotiations that would be required to obtain approval.
- While dredging a channel would provide the desired navigable access initially, it would be subject to ongoing shoaling which is likely to be quite rapid necessitating repeat dredging on a regular basis to maintain that navigable access. As such, there will be an initial cost and ongoing costs unless natural conditions return to more favourable configurations, the timing of which cannot be predicted.
- Dredging will also be subject to technical considerations and environmental approvals which may constrain or preclude some options. Further investigations and negotiations will be required to confirm those constraints and the preferred alignment if dredging is to be pursued.

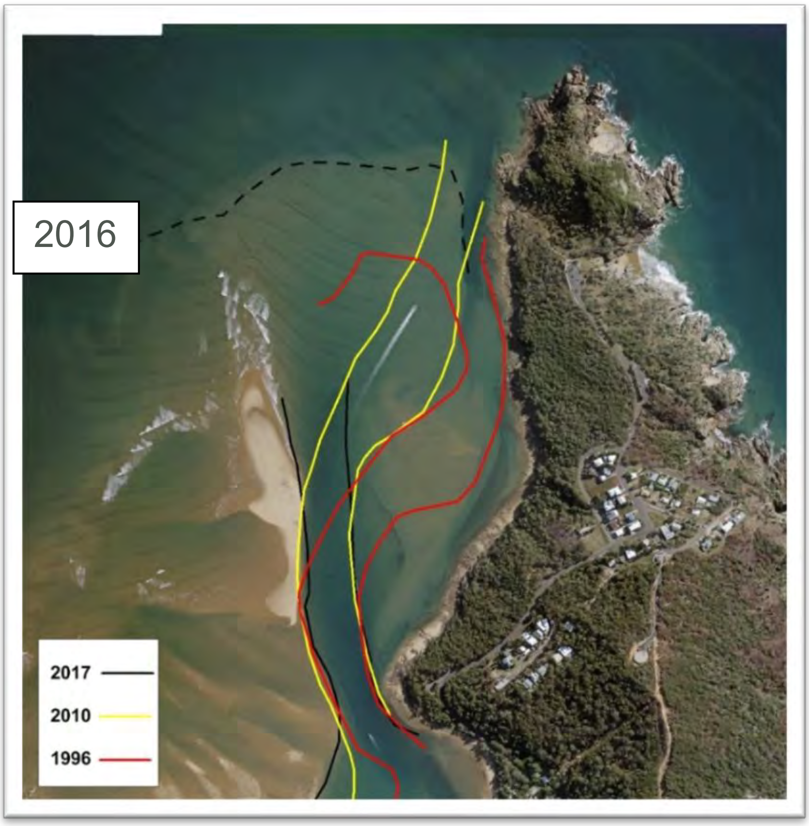
9 References

BMT (2018), Round Hill Creek Entrance Sweeping. Report prepared for Gladstone Regional Council.

CQG Consulting (2018), Round Hill Creek Sand Sweep. Report prepared for Gladstone Regional Council.

Appendix A Aerial Photos showing historic channel locations

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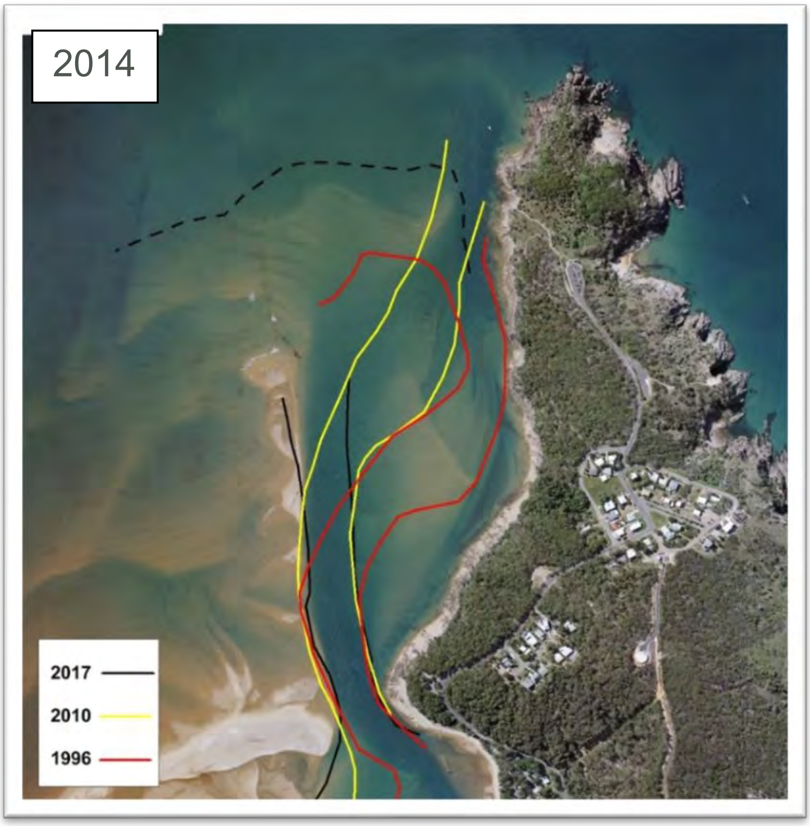
2017
2010
1996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2017
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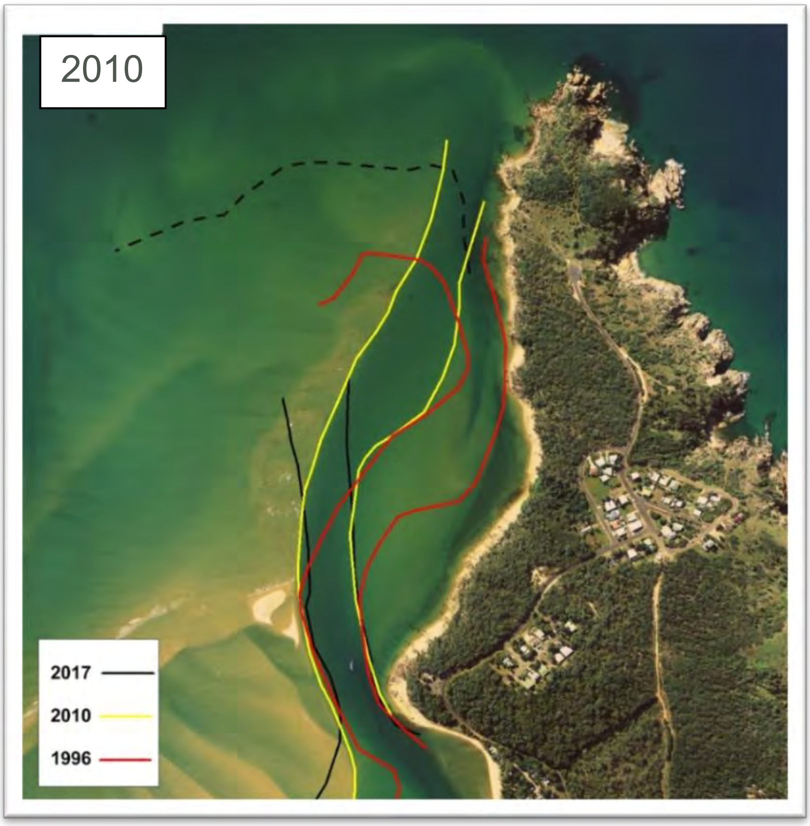
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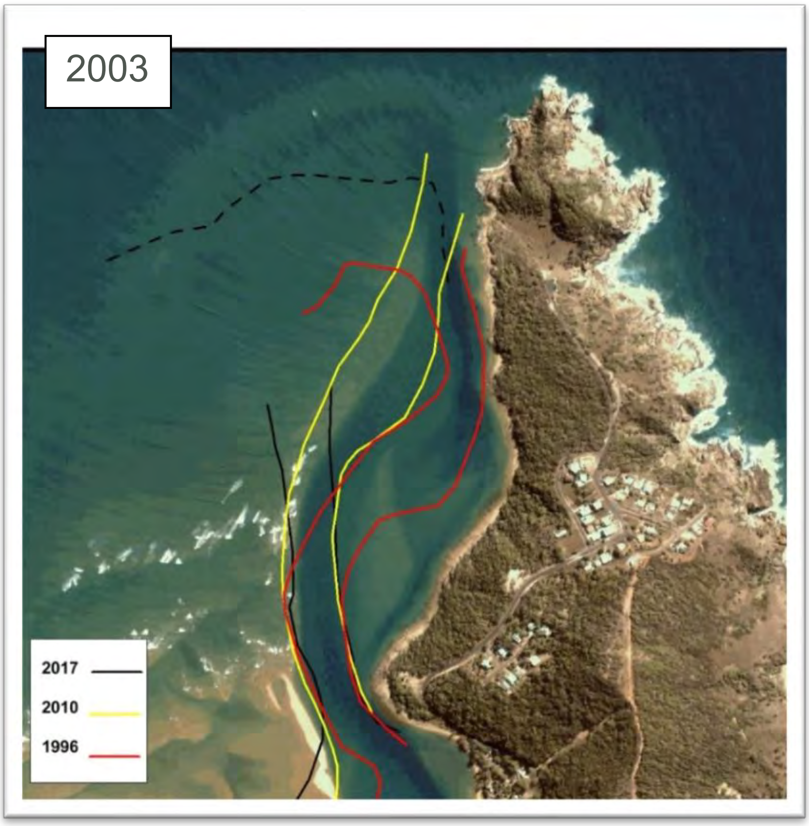
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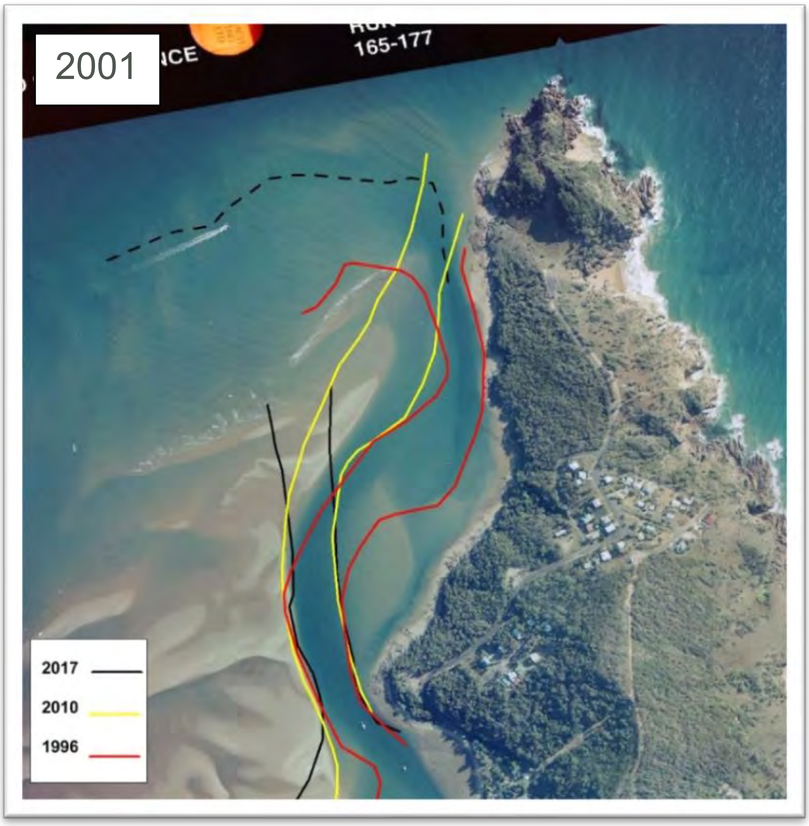
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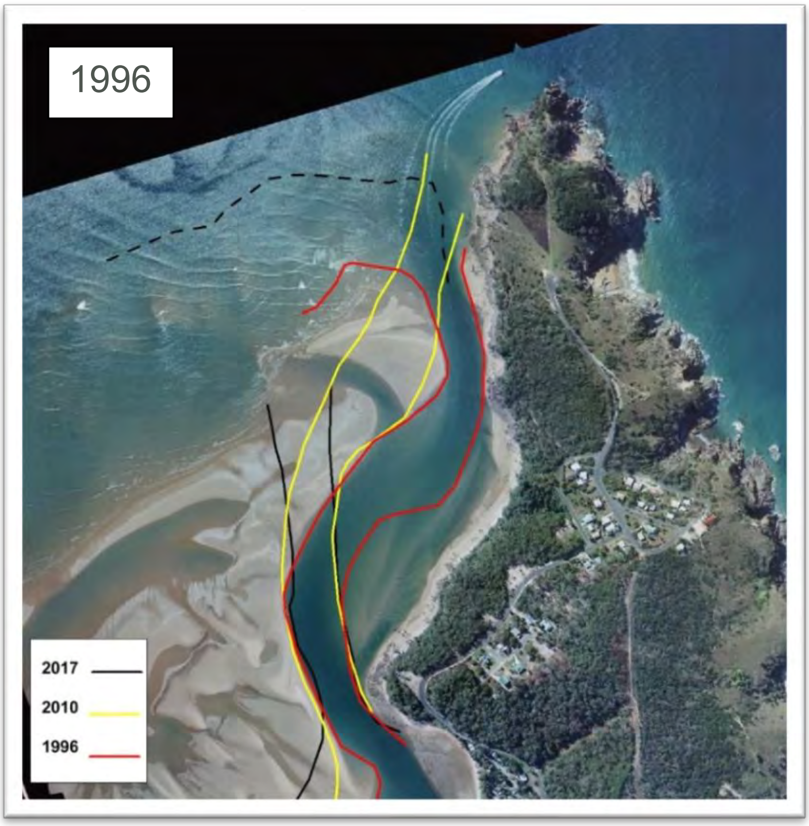
1996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2017
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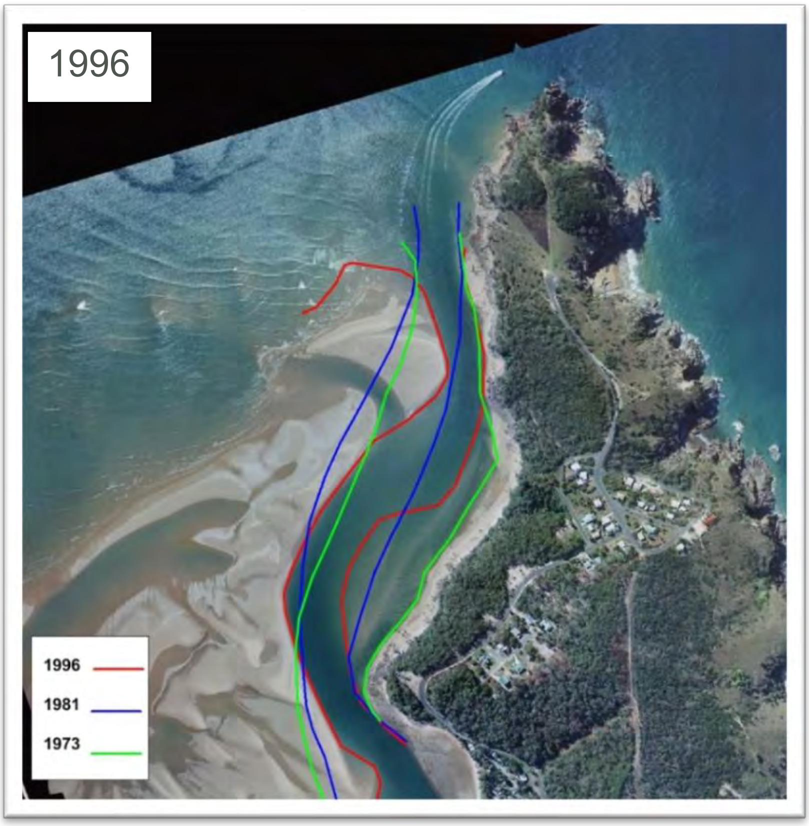
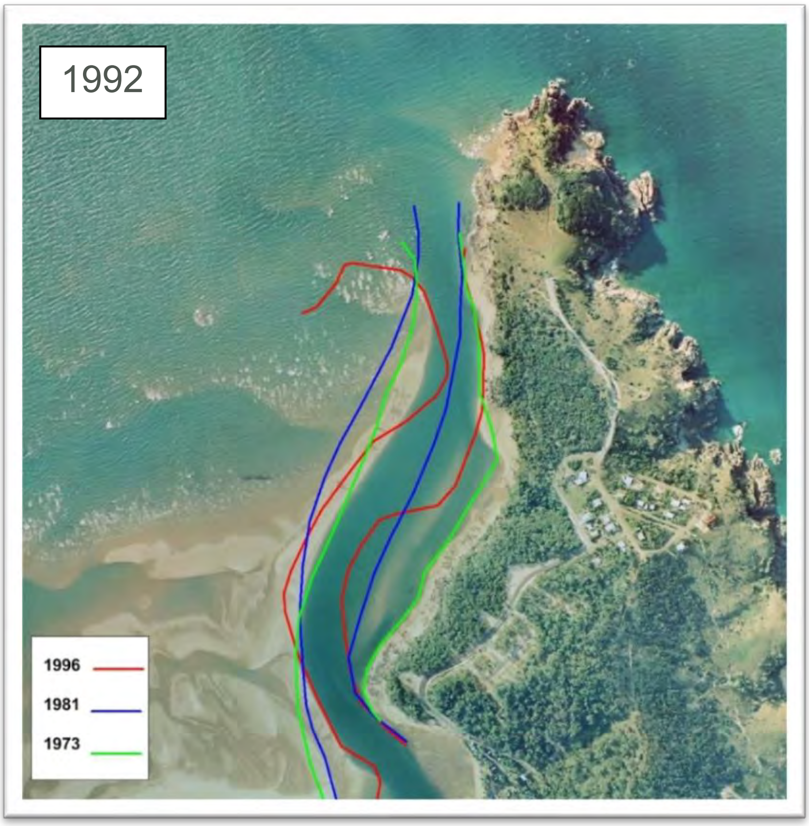
Aerial Photos showing historic channel locations





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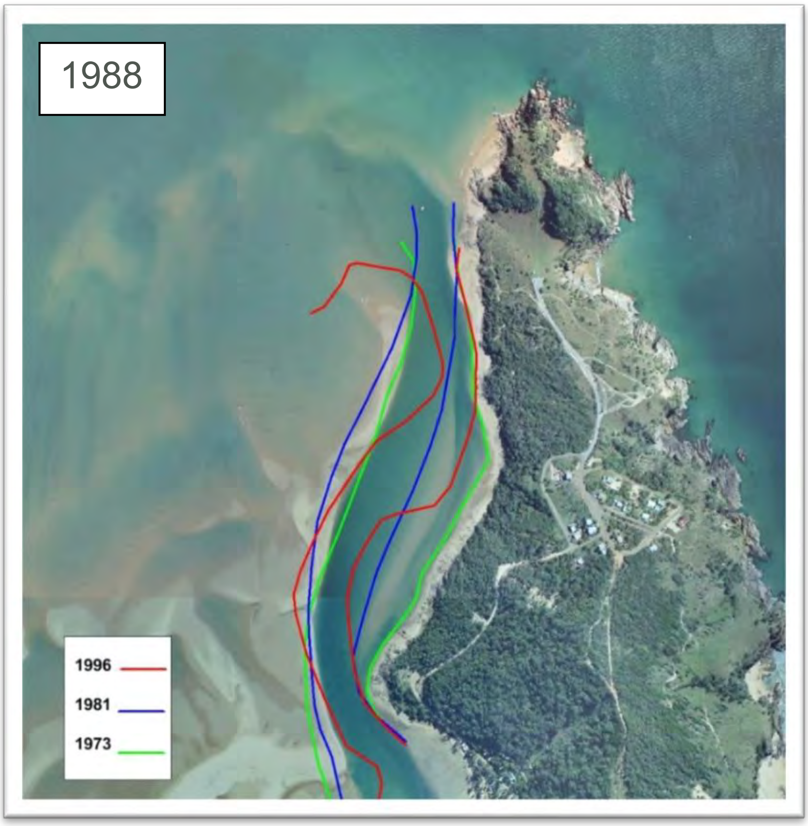

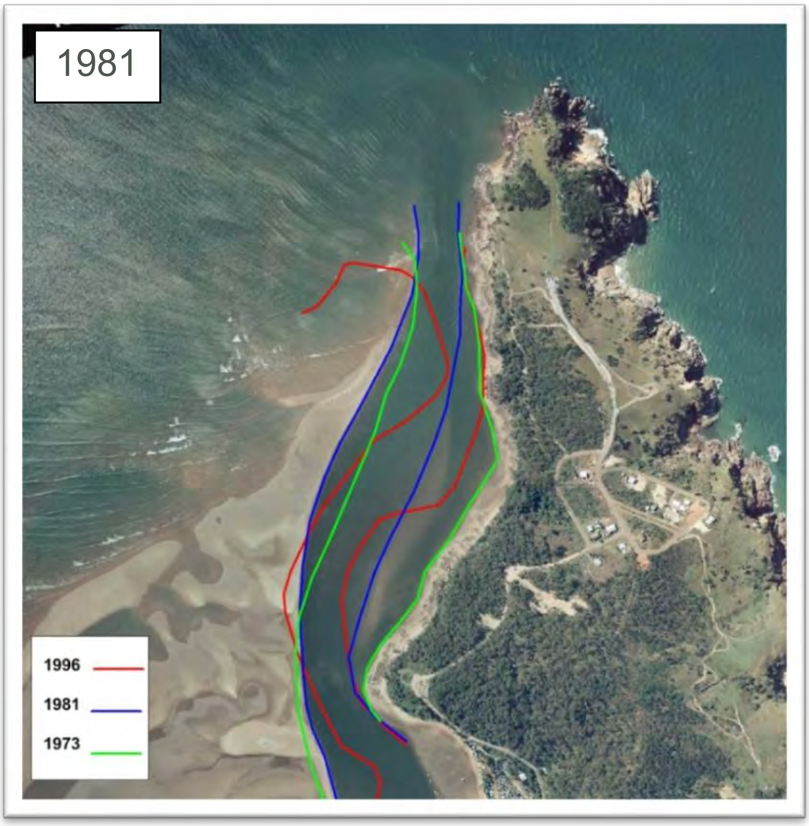

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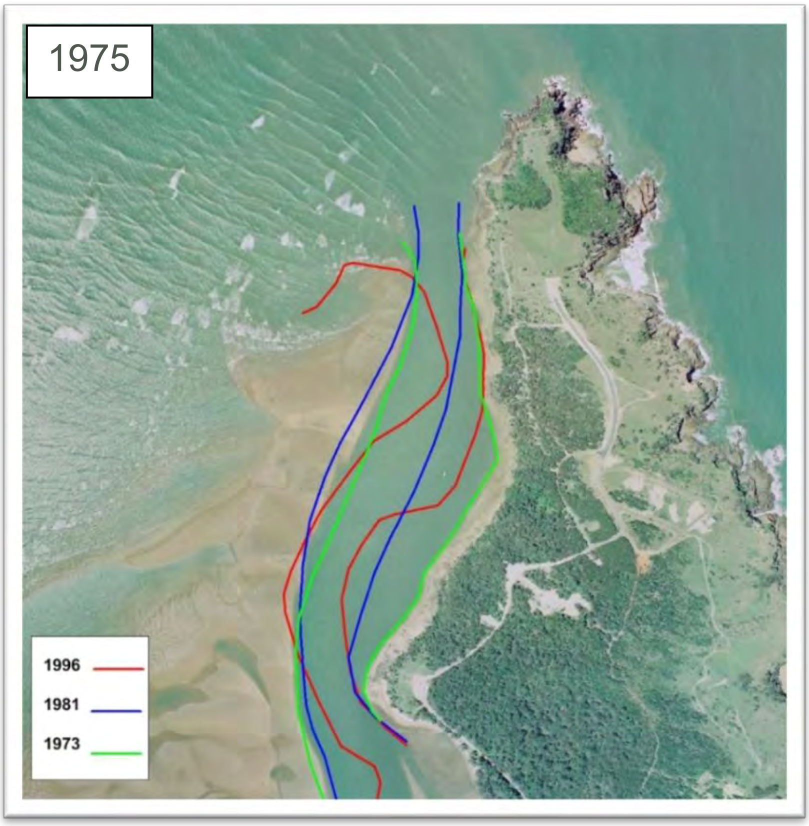

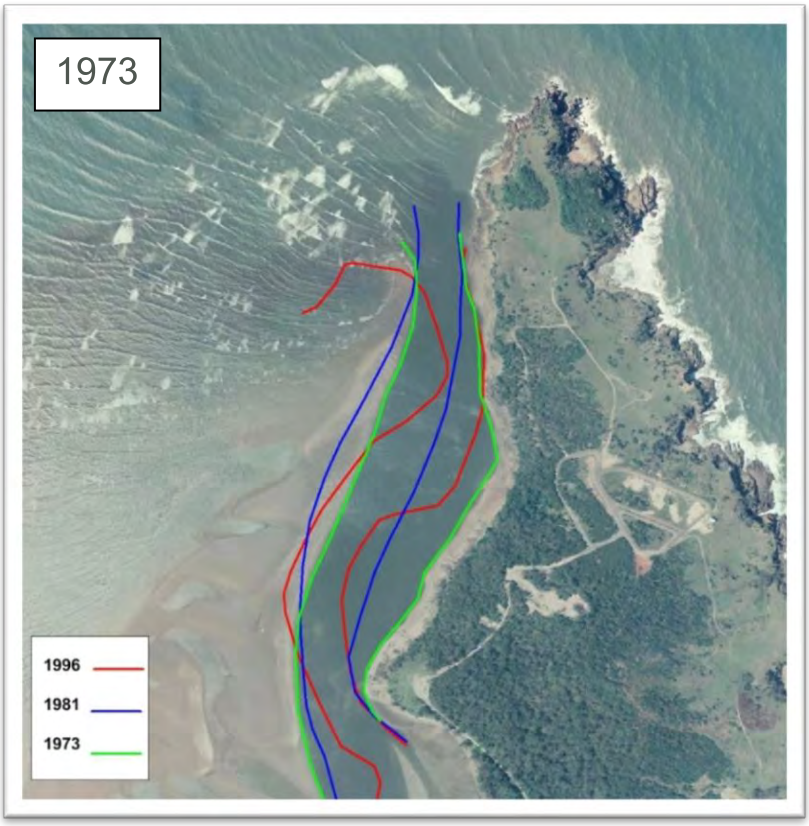

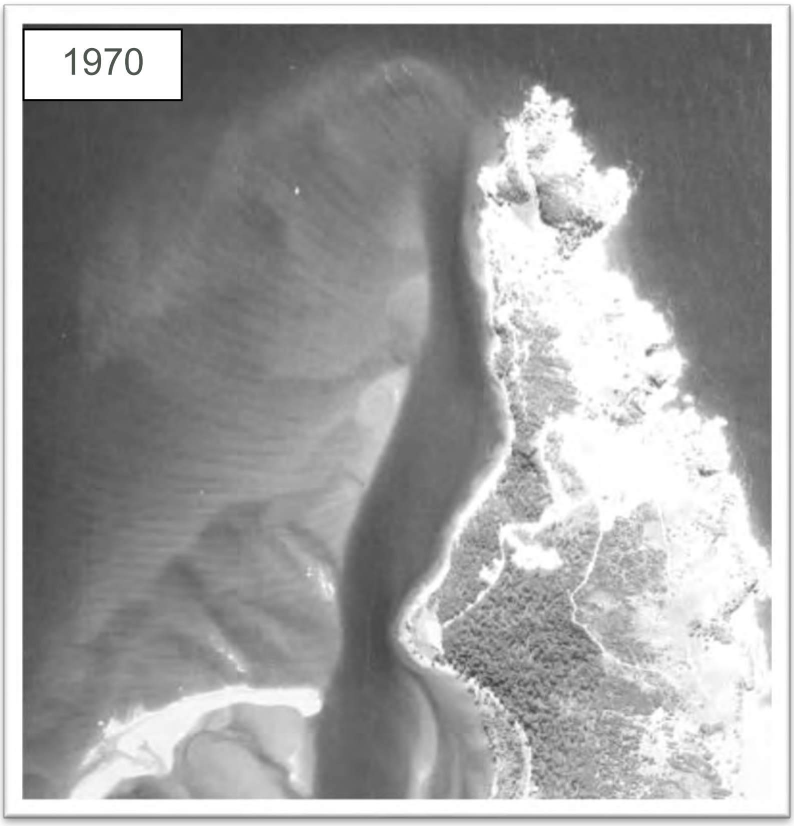
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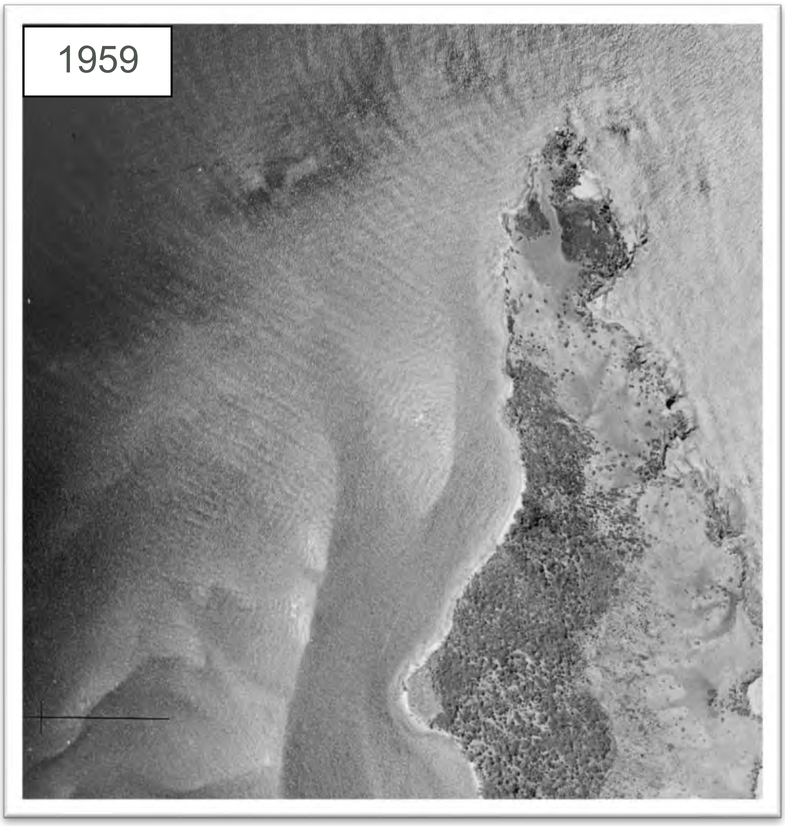
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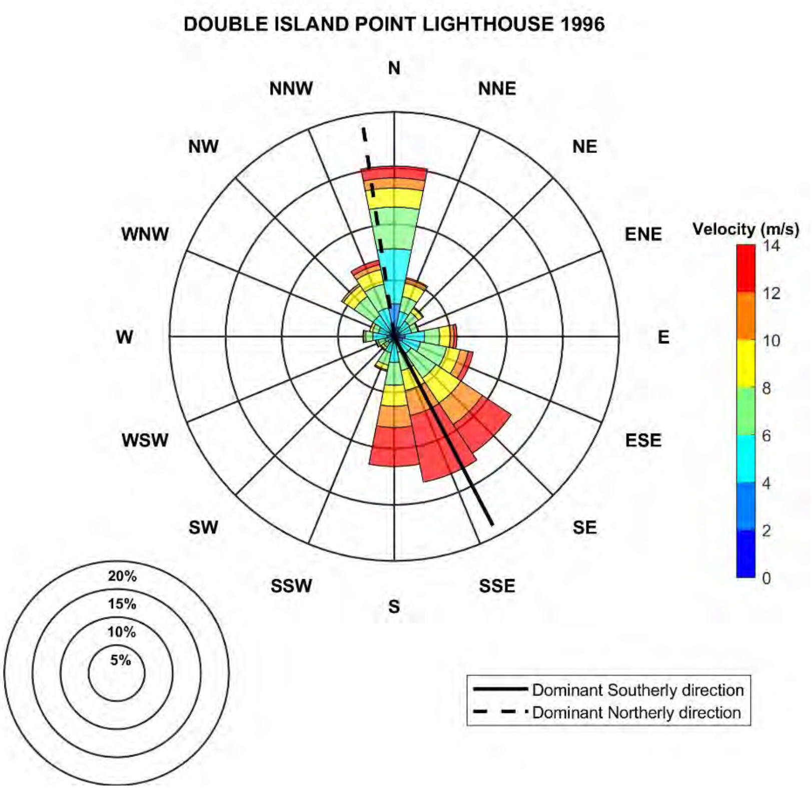
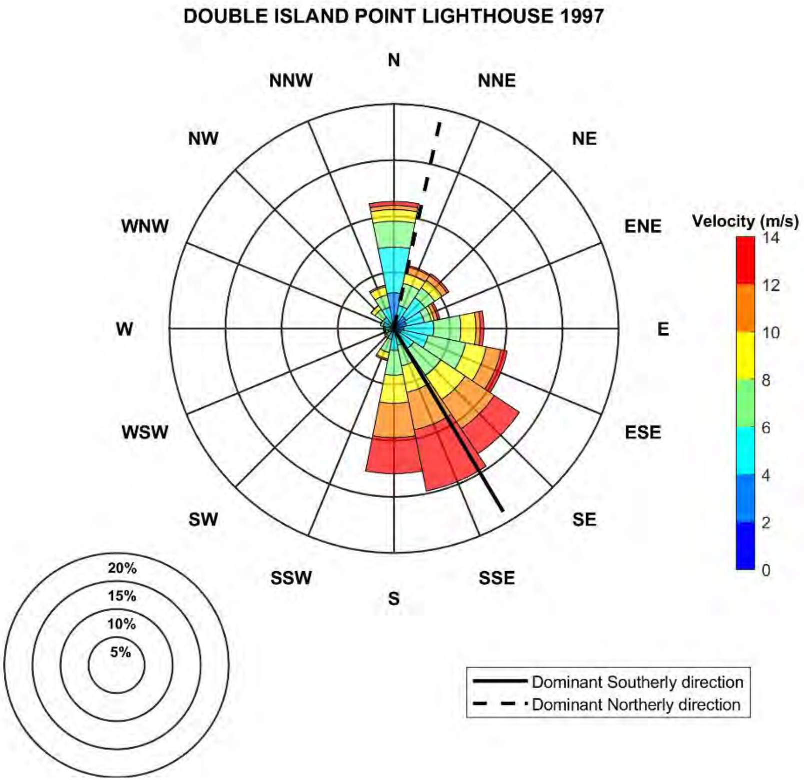
Appendix B Wind Roses Double Island Point




DOUBLE ISLAND POINT LIGHTHOUSE 1997
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NNE
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W
WNW
NW
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Velocity (m/s)
14
12
10
8
6
4
2
0
20%
15%
10%
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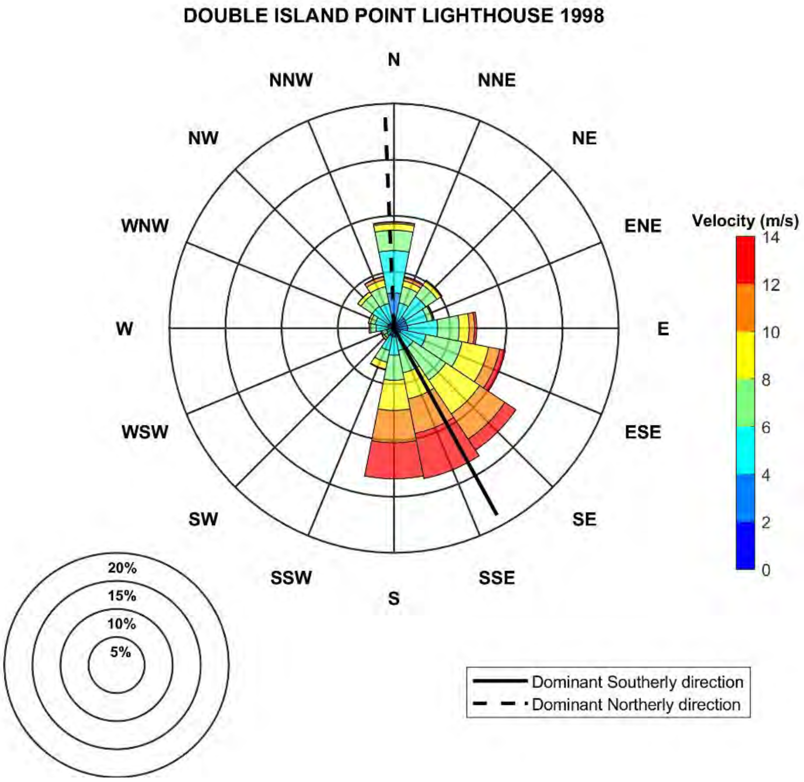
Dominant Southerly direction
Dominant Northerly direction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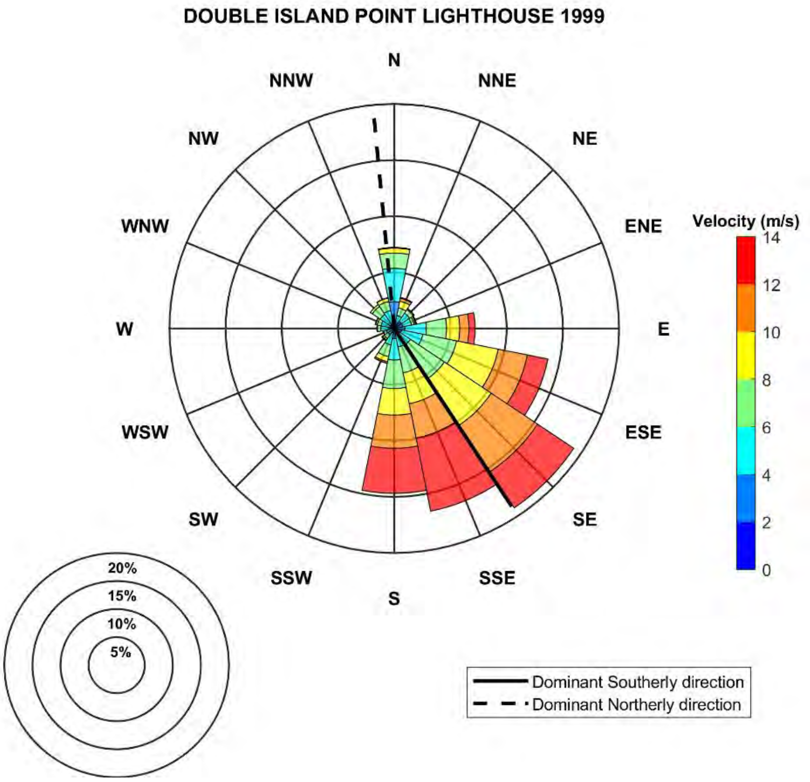
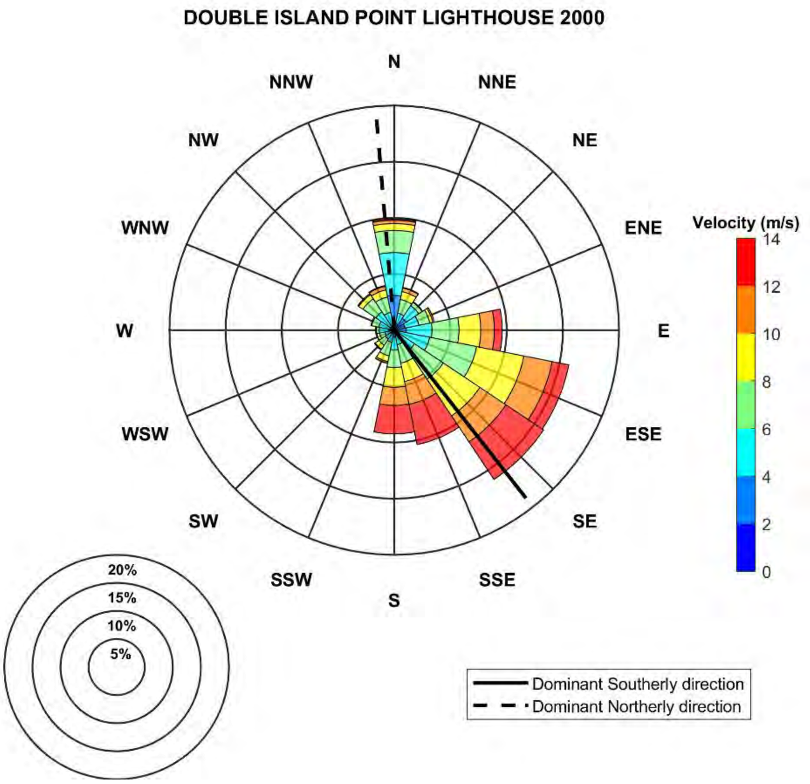
WNW
NW
NNW
Velocity (m/s)
14
12
10
8
6
4
2
0
20%
15%
10%
5%
Dominant Southerly direction
Dominant Northerly direction

Wind Roses Double Island Point





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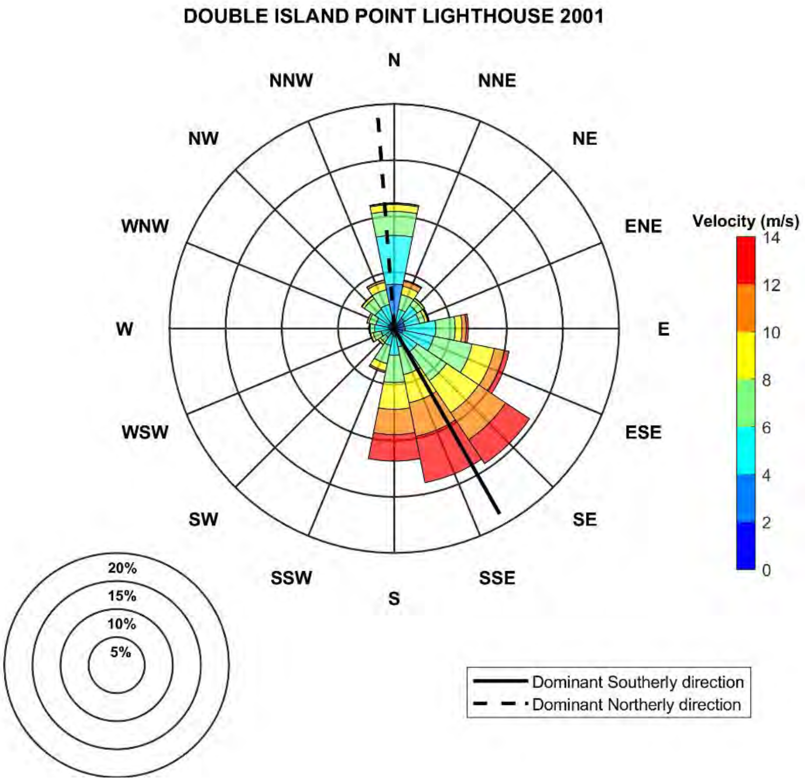

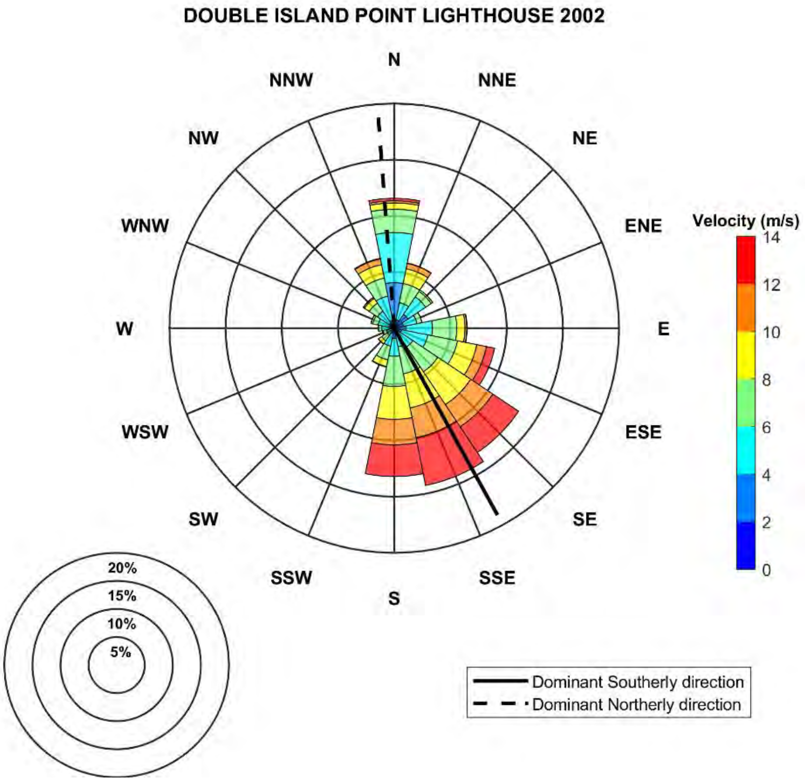

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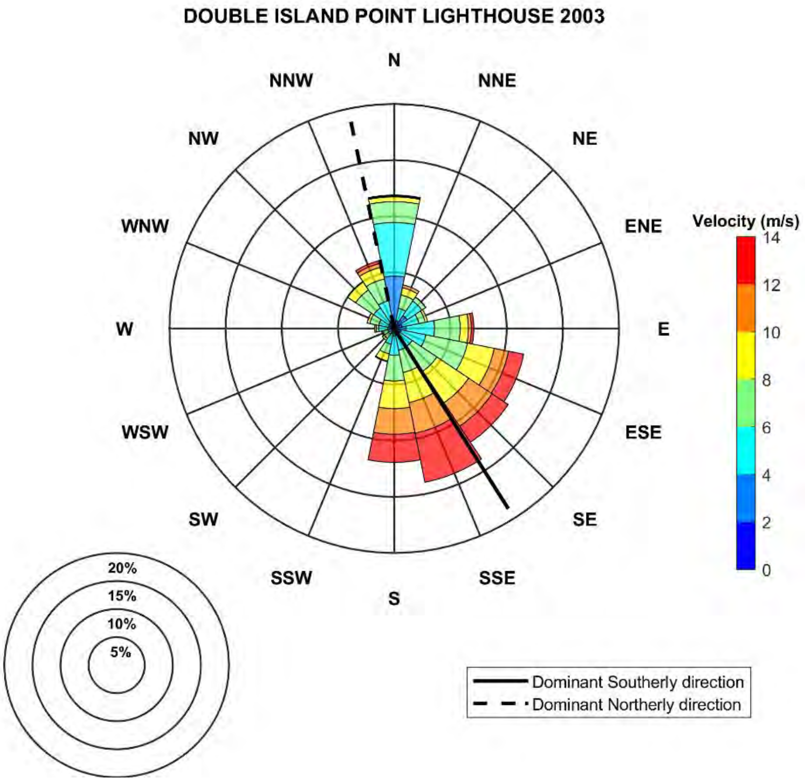
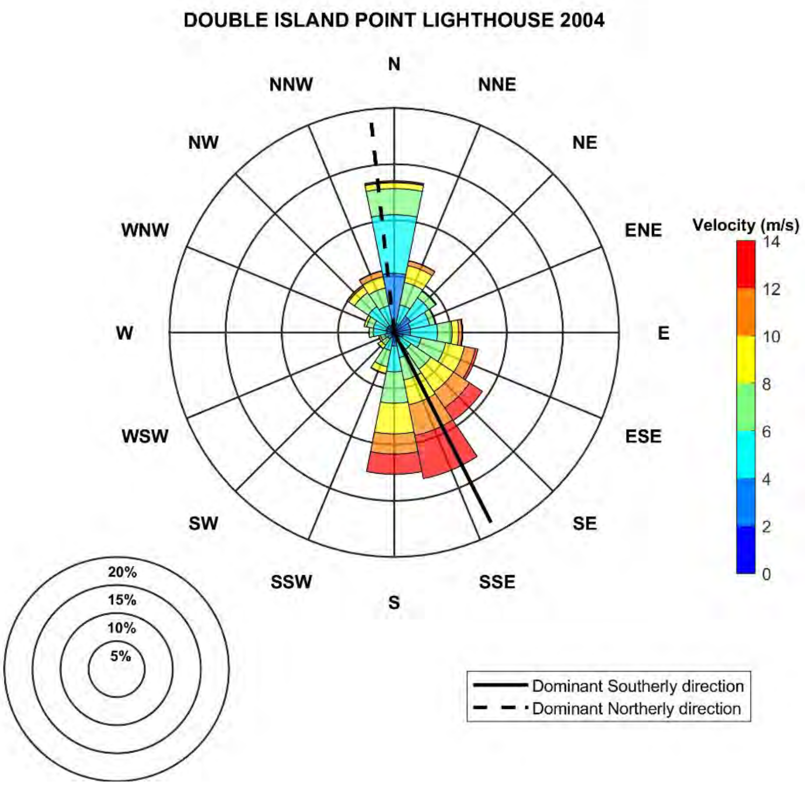
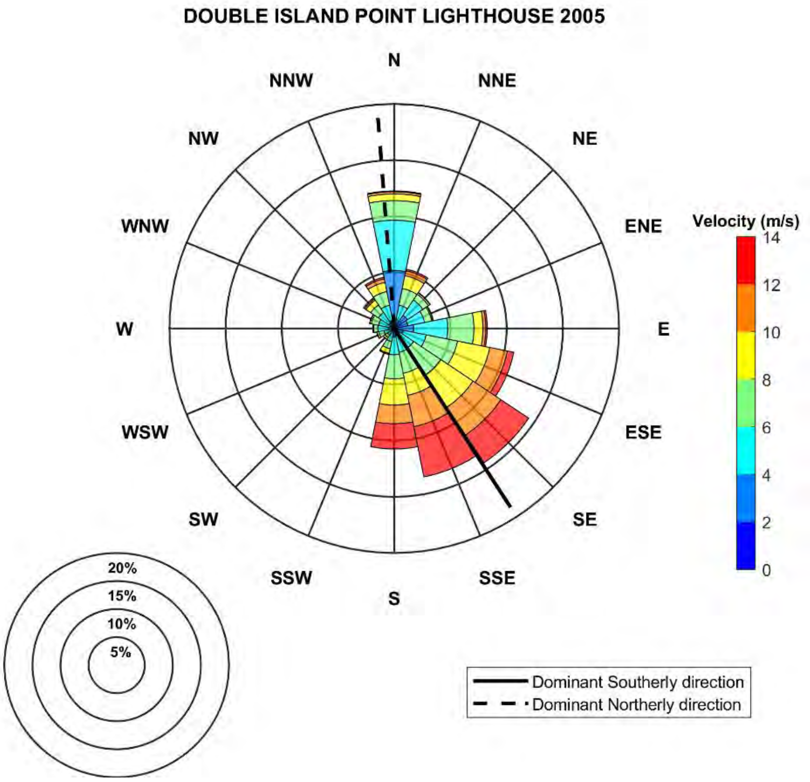
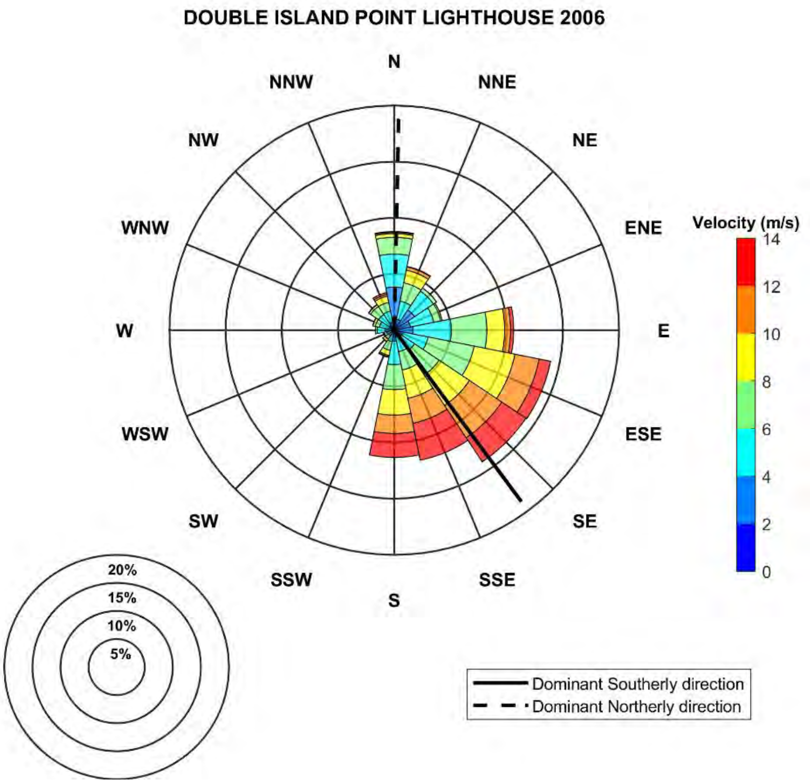
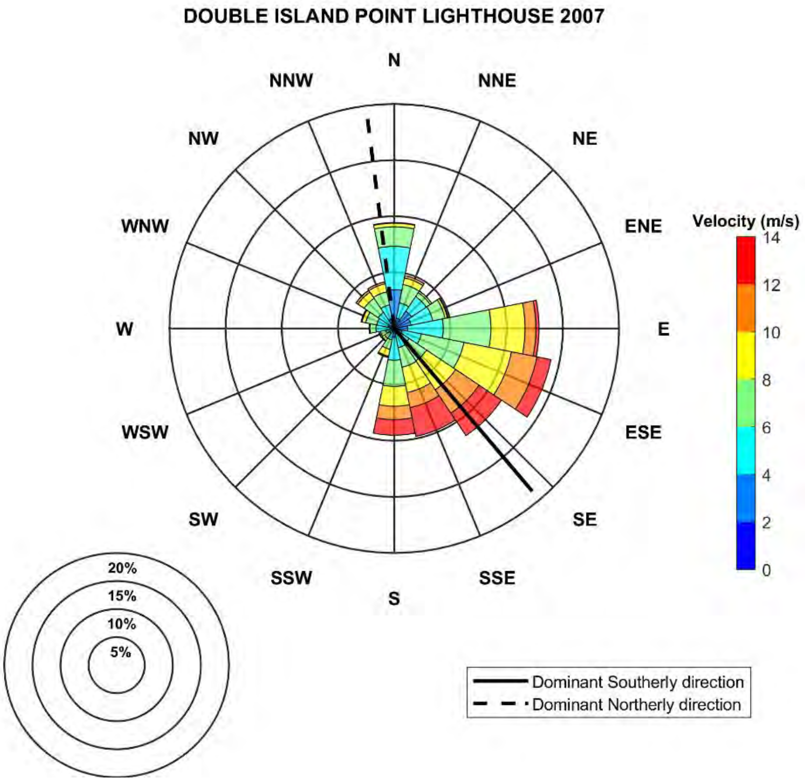


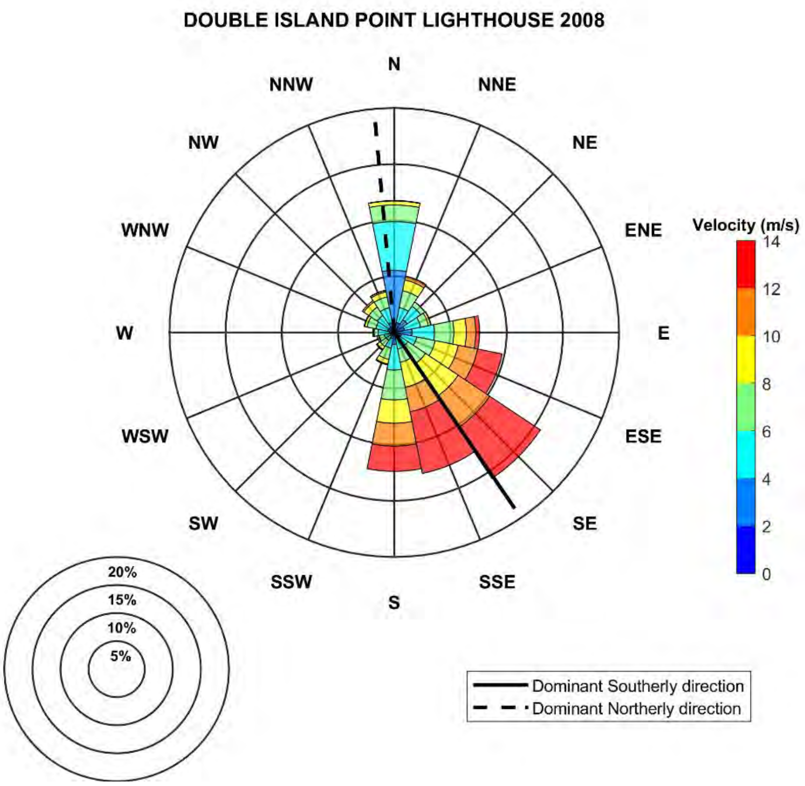



DOUBLE ISLAND POINT LIGHTHOUSE 2005
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
Velocity (m/s)
14
12
10
8
6
4
2
0
20%
15%
10%
5%
Dominant Southerly direction
Dominant Northerly direction

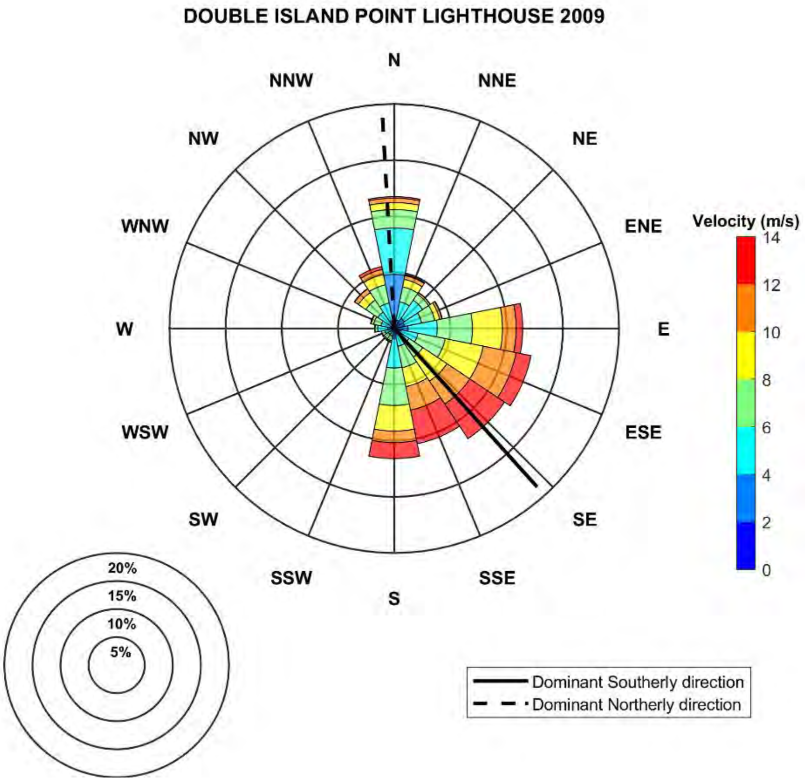

DOUBLE ISLAND POINT LIGHTHOUSE 2006
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
Velocity (m/s)
14
12
10
8
6
4
2
0
20%
15%
10%
5%
Dominant Southerly direction
Dominant Northerly direction

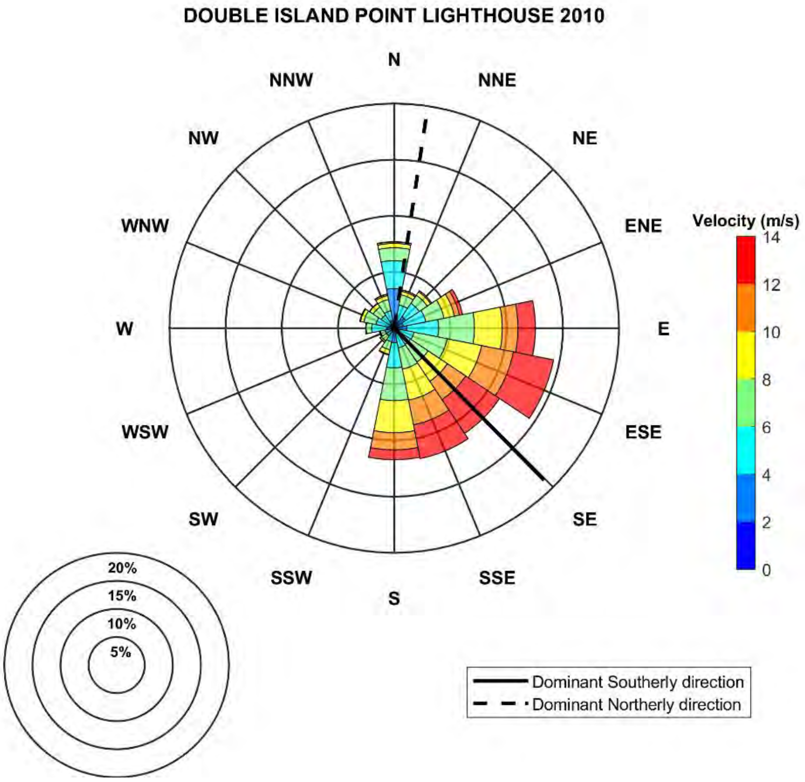
Wind Roses Double Island Point



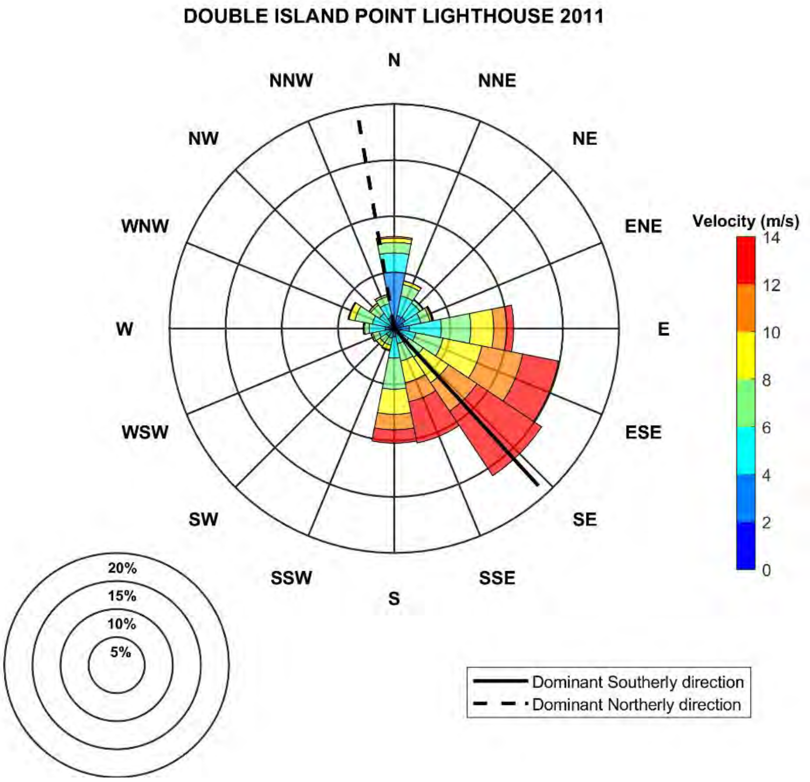


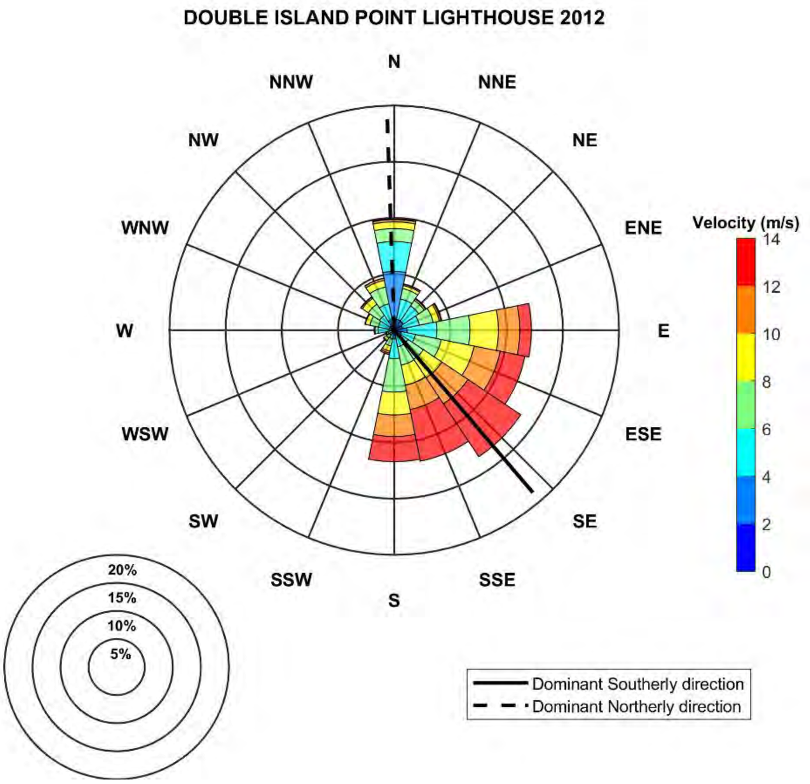
Wind Roses Double Island Point



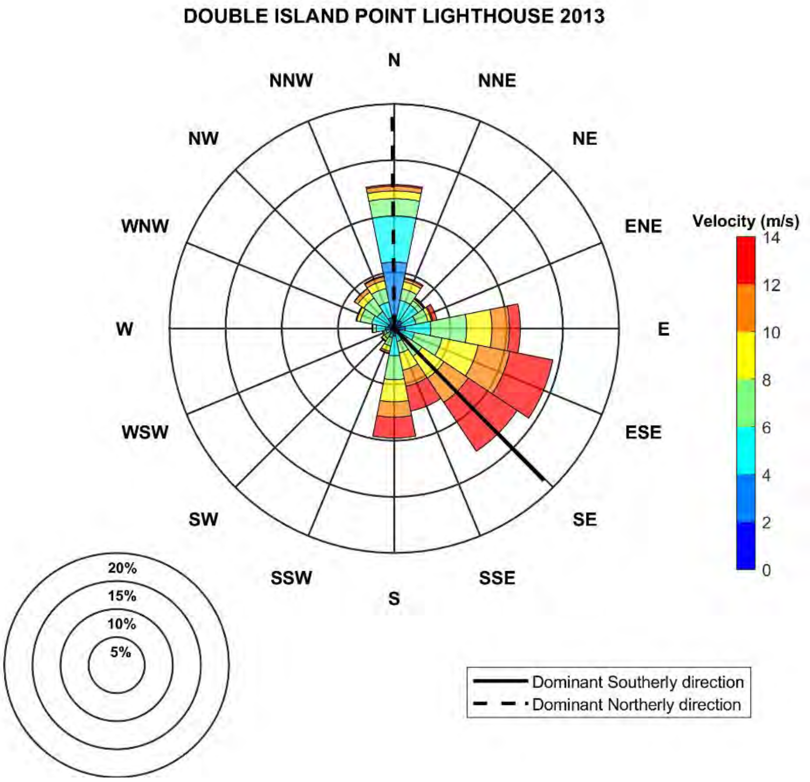


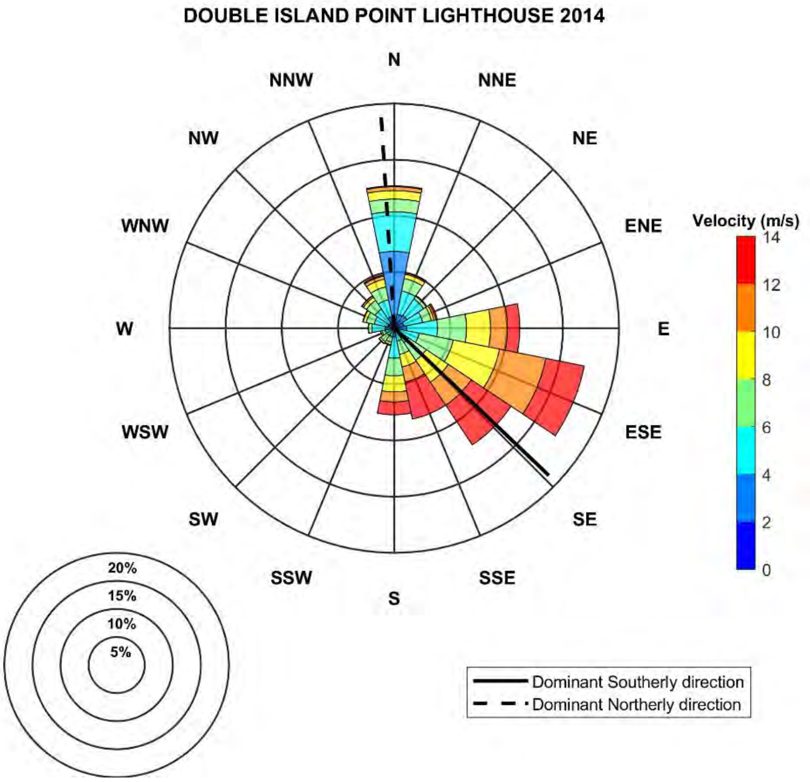
Wind Roses Double Island Point



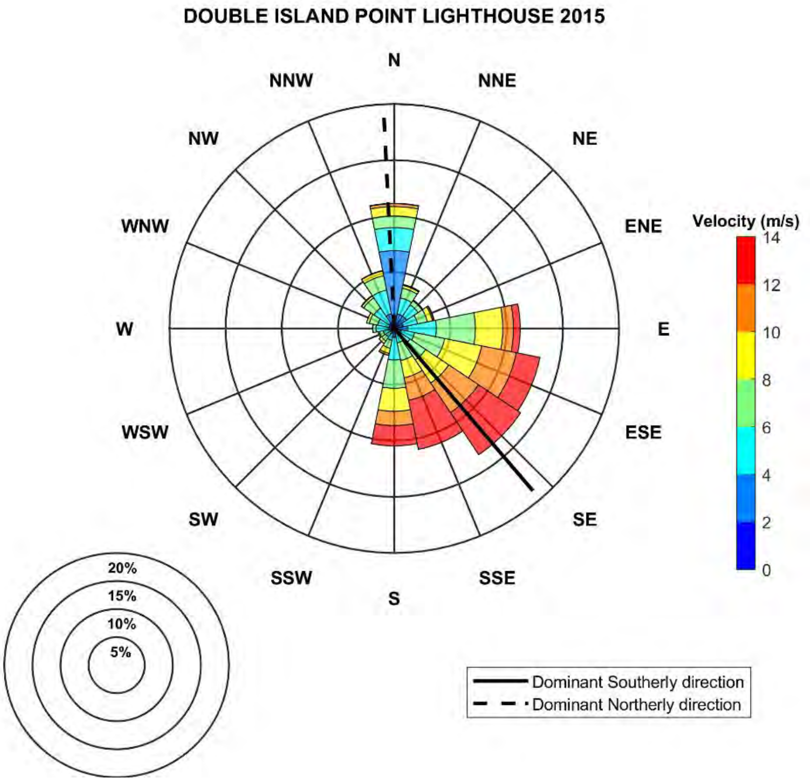


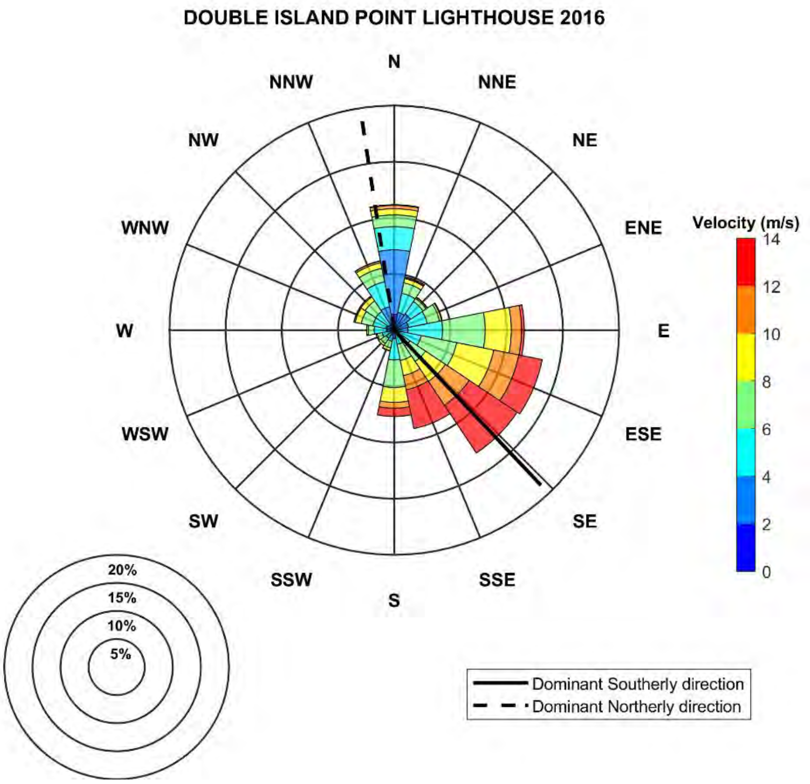
Wind Roses Double Island Point





Wind Roses Double Island Point





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