

Dalhousie Creek Entrance Management Strategy

Part 2: Background Information and Review of Environmental Factors



FINAL REPORT

Dalhousie Creek Entrance Management Strategy: Background and REF

Note:

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18-033 DALHOUSIE CREEK ENTRANCE MANAGEMENT STRATEGY PART 2: BACKGROUND INFORMATION AND REVIEW OF ENVIRONMENTAL FACTORS

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1. INTRODUCTION

The Entrance Management Strategy for the Dalhousie Creek entrance precinct comprises two separate documents being:

Part 1: Entrance Management Policy and Implementation Plan.

Part 2: Background Information and Review of Environmental Factors.

Part 1 documents the desired state of the entrance precinct formulated in consultation with stakeholders, details the action plan to address key issues and outlines implementation steps as well as monitoring measures.

Part 2 (this document) should be read in conjunction with Part 1. It provides a summary of relevant information, regulatory considerations and approval requirements, as well as providing an assessment of likely impacts and identification of mitigation measures to support the entrance management strategy.

2. DESCRIPTION OF WORKS

The Entrance Management Strategy applies to the Hungry Head/Urunga Surf Life Saving Club (USLSC) precinct of the Bellinghen coastline as shown in Figure 1. The intended strategy and related actions is provided in Part 1 and are only summarised here.

The general approach is to manage the entrance precinct in three incremental stages. Stage 1 will undertake beach scraping over a 150m length of the swash zone of Hungry Head Beach to harvest sand to be used for beach nourishment and dune building (see Part 1 – Appendix 1 – Drawing 1). The beach nourishment will raise the beach in the vicinity of the USLSC lookout and access points to restore eroded dunes in this location and to raise the beach so that it is less susceptible to inundation by high water levels in Dalhousie Creek. In concert with this activity, a low point ('dry notch') will be established along the alignment of the desired Dalhousie Creek breakout location. Beach scraping is proposed to be conducted up to 4 times per year on an on-going basis, with a combined indicative transfer volume of up to 6,000 m³ per year. Initial excavation of the dry notch is estimated to involve around 500 m³, which would also be used for beach nourishment, however the long-term maintenance of this notch is likely to require the movement of far less sand. It is recommended that works are undertaken by a combination of bulldozer (e.g. D6) and excavator (say 30 tonne) which would access the beach via the existing emergency 4WD access track.

Escalation to Stage 2 management will only occur if Stage 1 is not effective in controlling the entrance location of Dalhousie Creek. In this instance, the north bank of the creek will be controlled by the placement of Geotextile Sand Containers (GSCs) to form a partially buried revetment of approximately 50m in length along a west to east alignment from 'the rock' (see Part 1 – Appendix 1 – Drawing 2). This wall will stop the northward migration of Dalhousie Creek along the beach, thereby affording protection to the priority beach nourishment area outlined in Stage 1. It is recommended that beach scraping and beach nourishment activities are continued as required to ensure that public amenity of the beach continues to be maintained.

Stage 3 is the replacement of the GSC structure with rock work. This would only be undertaken if the concept has proven successful by monitoring of the efficacy of the GSCs and would be subject to further detailed design and stakeholder input to determine exact specifications, however it is proposed that this rockwork would effectively take the same alignment and basic form as the GSC revetment.

The proposal also includes permanent decommissioning of the redundant access steps leading to the old surf club site as well as vegetation management activities in this location.

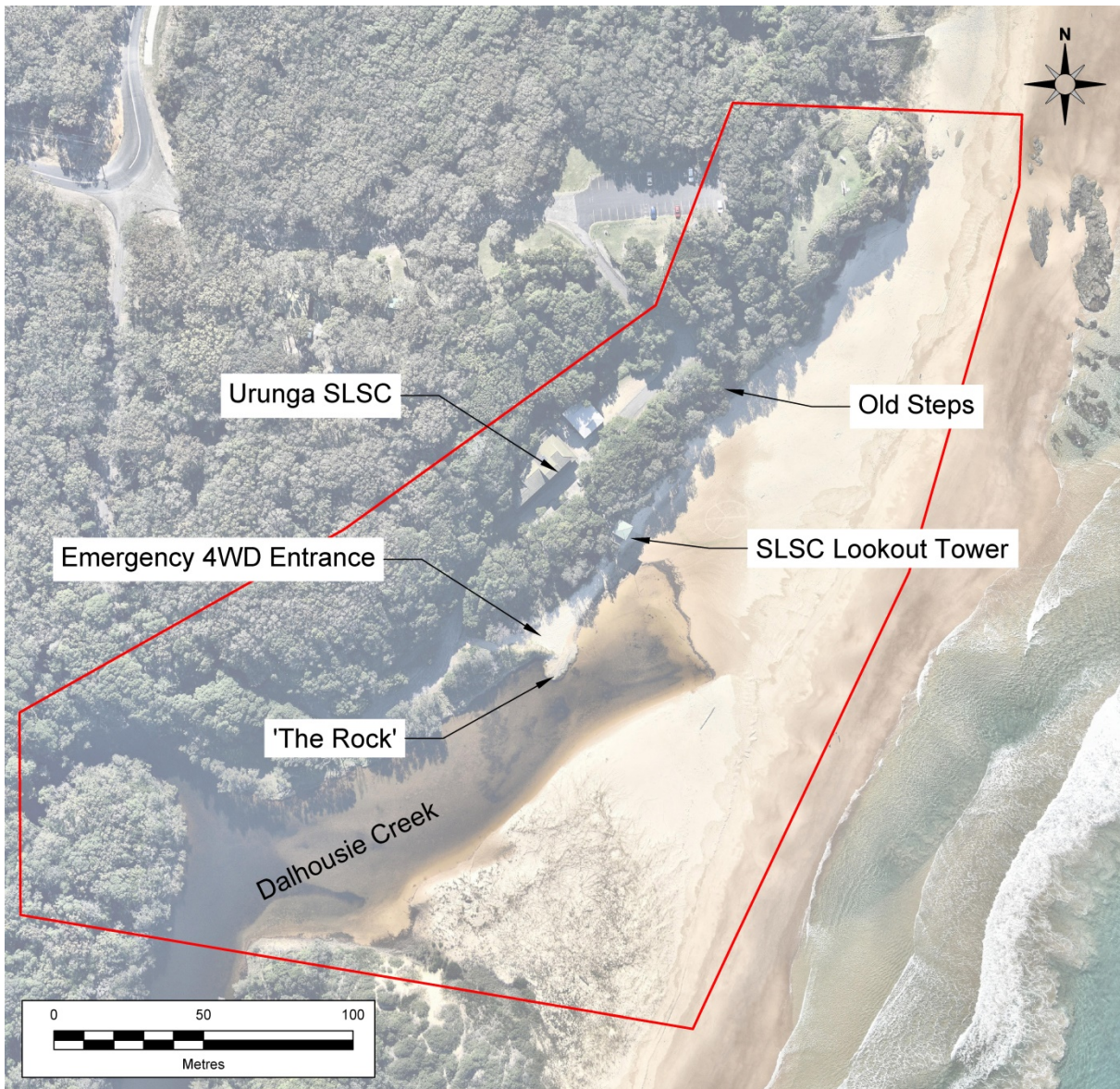


Figure 1. Dalhousie Creek entrance precinct (outlined)

3. REASONS FOR THE ACTIVITY

The position of the Dalhousie Creek entrance as well as water levels within the creek is critical in determining the accessibility, amenity and public safety of this section of beach. Until 1997, artificial entrance opening was undertaken annually for the purpose of controlling the entrance location, improving beach amenity and also to address community concerns regarding water quality and odour issues which were apparent when the creek remained closed for extended periods. Since 1997, the creek usually remains closed, but still opens naturally once or twice a year in response to rainfall, beach state and ocean conditions.

Significant erosion of Hungry Head beach, coupled with extended high water levels in the creek during 2015 resulted in creek inundation of most of the beach in front of the USLSC lookout tower and cut off USLSC and public access to the beach. A subsequent creek breakout event occurred toward the north of the entrance precinct, resulting in additional scour of the beach along the already eroded dune scarp. Further erosion of the dunes occurred during the January 2016 king tides, and informal pathways were created by the public to gain better access to the beach. This created additional issues

through impacts to native vegetation, further erosion, reduction of visual amenity and increasing public safety risk.

3.1 Options and Consideration of Alternatives

3.1.1 Status quo

The current management strategy has been unable to address stakeholder concerns. There has been erosion of the northern bank of the creek causing significant periods where Hungry Head beach has been poorly accessible and USLSC activities have been compromised. Although an alternative pedestrian beach access to the north has been formalised, this access is less suitable for less mobile beach users and leads to an unpatrolled section of coastline.

Due to the natural propensity for the creek to flow northward along the coastline, inundation and breakout events are leading to scour of the dune face to the point where further erosion would damage access stairs, significantly hamper emergency access and potentially lead to structural destabilisation of the USLSC lookout.

3.1.2 Relocate USLSC activities

This option would result in the discontinuation of USLSC patrols on this beach and encourage members of the public to use other beaches in the Shire. This option has been considered, however there are no obvious sites for nearby alternative surf club location. Infrastructure to support similar numbers of beach goers such as car parking, USLSC lookouts, toilets, etc. would also need to be created.

The current beach, if maintained in the desired condition, would provide for a high level of public amenity, with opportunities to safely enjoy Dalhousie Creek itself, as well as the adjoining beach and entrance flats.

The option to relocate the USLSC has been considered in the past and is discussed in the Bellingham CZMP (BMT WBM, 2017). The CZMP identifies the USLSC building as high risk at the 2050 projection and recommends the development of a Precinct Plan that considers the options for the building including relocate, retrofit or protect. The preferred option, as identified in the CZMP, is to relocate the building outside of the hazard zone if a suitable site is found to be available. The trigger for the implementation of the identified option is when the erosion escarpment is 30m from the roadway and therefore is considered to be a long-term strategy.

3.1.3 Artificial opening

Artificial opening as was undertaken prior to 1997 was undoubtedly successful in controlling the initial location of breakout, however it is unknown to what degree subsequent migration of the entrance channel occurred.

Previous artificial opening occurred prior to the December holiday period each year, which ensured that creek levels were not problematic for this popular period, but was not designed to mimic natural breakout events, which occur at varying times of the year. As the continued health of Dalhousie Creek is a key aim of the current project, it is considered that allowing the creek hydrology to respond, as much as possible, to natural influences is most likely to protect ecological resilience.

Artificial opening does not address the key issue of the continued erosion of Hungry Head beach. Artificial opening may temporarily place the entrance in a more favourable location, however due to coastal processes, the entrance position will tend to migrate north resulting to conditions similar to the current. The state of the beach is such that there is a limited sand resource available to act as a buffer during erosive events, including an artificial opening event, and access to the beach may still be compromised, necessitating *ad hoc* access or structures. The proposed strategy will not only

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encourage the entrance to naturally break out but encourage the location of the break out to a more favourable location but importantly will also restore sand resources to the north of the entrance, adjacent to the lookout, creating and maintaining more resilient beach conditions.

3.1.4 North bank revetment and training wall

This strategy would be highly effective in controlling the northward extent of the creek, but would require extension of a training wall beyond the full extent off the desired beach width (nominated as a minimum of 50m at high tide). Without sand nourishment, it is likely that there would be high degree of exposure of such a wall, which would reduce the aesthetic appeal of this area and potentially reduce accessibility and public safety.

A northern training wall could lead to concentration of creek flows at this location, which may result in longer creek opening durations and potential for increased marinisation of the estuary itself as it remains exposed to greater tidal influence. A training wall would typically lead to increased scour on this outside bend, however bed rock is prominent throughout the entrance area and may serve to reduce depth of scour. Although some survey of bed rock has been undertaken during a previous breakout event, geotechnical conditions at the site are not well understood.

Despite these issues, it is considered that in combination with sand nourishment as recommended in this strategy, some revetment works, particularly to protect the emergency 4WD entrance may be warranted.

4. STAKEHOLDER CONSULTATION

An agency consultation letter was sent to Department of Primary Industries - Fisheries, Office of Environment & Heritage (OEH); Department of Industry – Lands & Water (DoI - Crown Lands); Bellingen Shire Council (BSC); Coffs Harbour and District Local Aboriginal Land Council (CDLALC) and NTSCorp. This letter outlined the scope of the project and invited comments on the proposal by 30 August 2018. Appendix 2 provides a sample copy of the letter, responses received and how these responses are addressed.

In addition to written correspondence, agency representatives from DPI – Fisheries, OEH and DoI – Crown Lands were invited to attend an on-site workshop for the project. An OEH representative attended the site workshop where project requirements and options were discussed. Telephone discussions regarding the project have also been held with DPI – Fisheries and DoI – Crown Lands.

Other representatives at the stakeholder workshop included members of Australian Lifeguard Service (ALS), the Urunga SLSC and representatives from various sections of Bellingen Shire Council. Gumbayngirr Elder Uncle Mark Flanders opened the workshop with a Welcome to Country and provided valuable input during the discussions.

A second workshop to present the recommended entrance management strategy was held with agency and local stakeholders including: DoI – Crown Lands, OEH, the Coffs Harbour and District LALC, and the USLSC . A presentation of the strategy was also made to BSC Councillors.

5. REGULATORY CONSIDERATIONS

5.1 Land Management Arrangements

The Dalhousie Creek entrance lies solely within the boundaries of Lot 102, DP755552 (Figure 2). This lot is Crown Land within the Bellingen Coast Regional Crown Reserve and Bellinger Heads State Park. Bellinger Heads State Park comprises Reserve 1014608 for Community Purposes, Public Recreation & Coastal Environmental Protection and Tourist Facilities & Services notified in the Government Gazette 7 March 2008 (LPMA, 2010). Bellinger Heads State Park Trust which was

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established in 2009 manages the State Park. Bellingen Shire Council and the Lands Administration Ministerial Corporation are appointed to manage the affairs of the State Park Trust subject to a Memorandum of Understanding covering the allocation and exercise of functions associated with the Trust (LPMA, 2010).

It is understood that the Trust manages the reserve to the mean high water mark (MHWM) and land below MHWM is managed by DoI – Crown Lands.

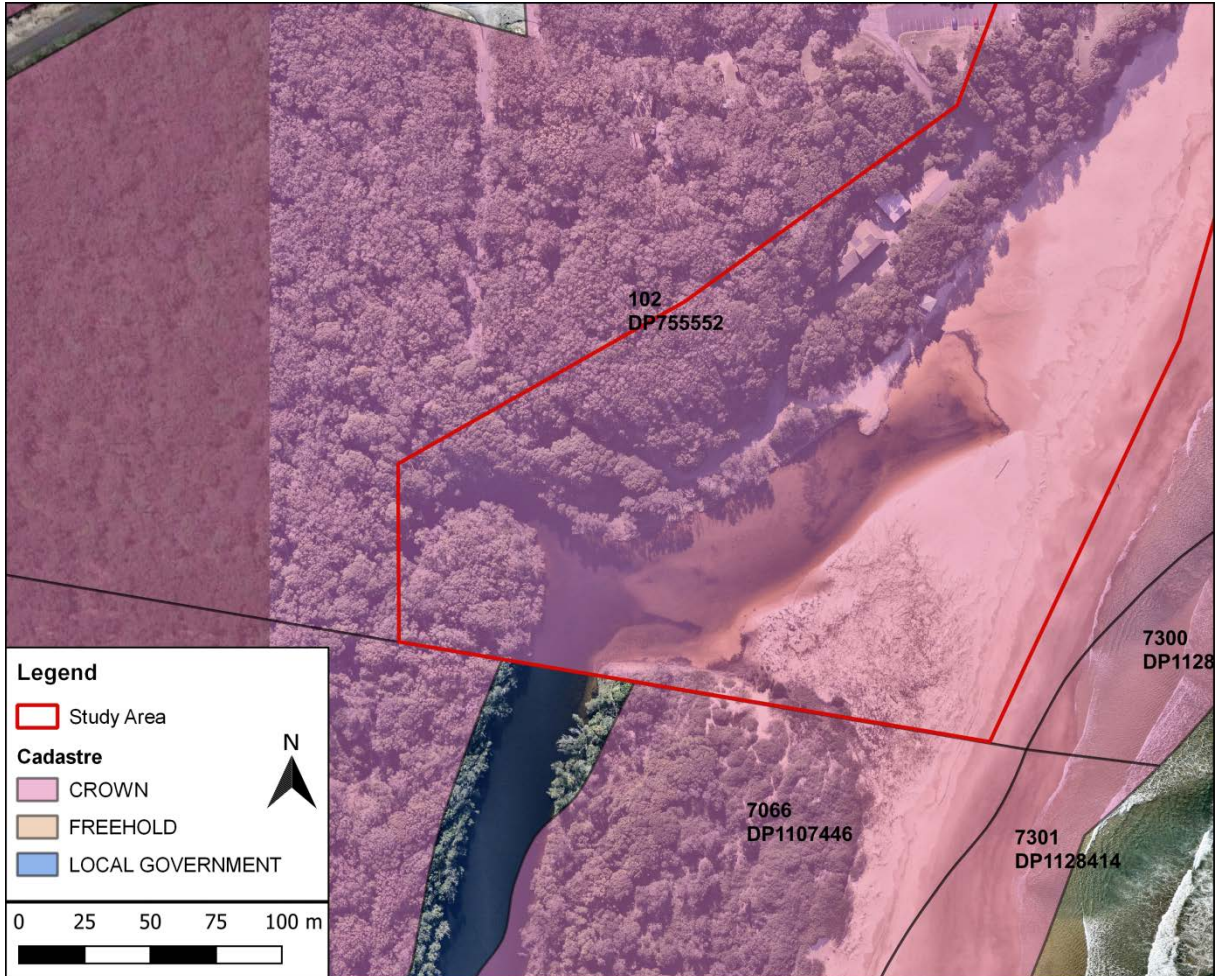


Figure 2: Controlling authority of land within the vicinity of Dalhousie Creek entrance

5.2 Legislative Requirements

The following section discusses legislation relevant to the proposed works.

5.2.1 Environmental Planning & Assessment Act 1979 and Regulations

The Environmental Planning and Assessment Act, 1979 (EP&A Act) and the EP&A Regulation, 2000 provide a framework for environmental planning in NSW. An entrance management strategy that requires entrance management of an ICOLL will require assessment under this act. An assessment of the likely impacts of a proposal which may have an impact on the environment is required under the Act prior to a decision to proceed with the proposal.

The Act imposes requirements for controlling development under two parts:

1. Part 4 of the Act controls development that requires consent or is prohibited under an environmental planning instrument; and

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2. Part 5 of the Act imposes requirements for assessing the impact of development that does not require consent under an environmental planning instrument.

The relevant environmental planning instruments that regulate use and development under this legislation are discussed below.

The proposed works do not require consent (Section 5.2.1.2) and are not considered to be prohibited under an environmental planning instrument and therefore require assessment under Part 5 of the Act. BSC is the proponent and determining authority responsible for deciding whether to approve or proceed with the activity. An environmental assessment in the form of a Review of Environmental Factors is required in accordance with Part 5 of the Environmental Planning and Assessment Act, 1979 (EP&A Act) and Section 111 of the Act, which requires that the proponent (BSC) take into account to the fullest extent possible all matters affecting or likely to affect the environment due to the proposed activity.

5.2.1.1. Bellingen Local Environmental Plan 2010

The precinct area is zoned RE1 Public Recreation, E2 Environmental Conservation and W1 Natural Waterway. Environmental protection works are permitted without consent within zone RE1 but require consent in zone E2 and W1.

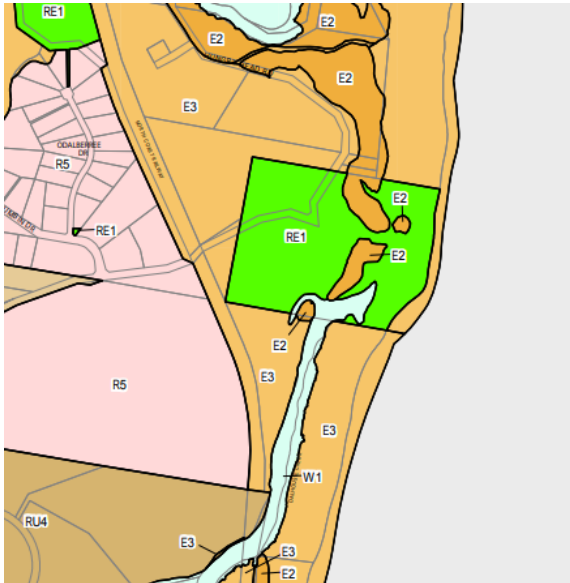


Figure 3: Bellingen LEP 2010 zoning

5.2.1.2. State Environmental Planning Policy (Infrastructure) 2007

The State Environmental Planning Policy (Infrastructure) 2007 (known as the Infrastructure SEPP) assists in providing infrastructure by modifying planning provisions to improve efficiency and service delivery.

Under Part 3 Division 25, Clause 129 of the Infrastructure SEPP:

129 (10)... development for the purpose of waterway or foreshore management activities may be carried out by or on behalf of a public authority without consent on any land.

Under Clause 128, waterway or foreshore management activities means:

(c) coastal management and beach nourishment, including erosion control, dune or foreshore stabilisation works, headland management, weed management, revegetation activities and foreshore access ways....

The proposed entrance management works are permitted without consent under Division 25, Clause 129 of the Infrastructure SEPP.

5.2.2 Coastal Management Act 2016

The Coastal Management Act 2016 communicates the NSW Government's vision for coastal management. The Act reflects the vital natural, social, cultural and economic values of NSW coastal areas and promotes the principles of ecologically sustainable development in managing these values. The legislative and policy framework introduced by recent coastal reforms recognises natural coastal processes and the local and regional dynamic character of the coast and promotes land use planning decisions that accommodate them. The reforms ensure coordinated planning and management of the coast and support public participation in these activities.

The Act provides for the integrated management of the coastal environment of NSW consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the state. The Act:

- Establishes high level statutory objects for integrated coastal management in NSW, namely:
 - (a) to protect and enhance natural coastal processes and coastal environmental values including natural character, scenic value, biological diversity and ecosystem integrity and resilience, and
 - (b) to support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety, and
 - (c) to acknowledge Aboriginal peoples' spiritual, social, customary and economic use of the coastal zone, and
 - (d) to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies, and
 - (e) to facilitate ecologically sustainable development in the coastal zone and promote sustainable land use planning decision-making, and
 - (f) to mitigate current and future risks from coastal hazards, taking into account the effects of climate change, and
 - (g) to recognise that the local and regional scale effects of coastal processes, and the inherently ambulatory and dynamic nature of the shoreline, may result in the loss of coastal land to the sea (including estuaries and other arms of the sea), and to manage coastal use and development accordingly, and
 - (h) to promote integrated and co-ordinated coastal planning, management and reporting, and
 - (i) to encourage and promote plans and strategies to improve the resilience of coastal assets to the impacts of an uncertain climate future including impacts of extreme storm events, and
 - (j) to ensure co-ordination of the policies and activities of government and public authorities relating to the coastal zone and to facilitate the proper integration of their management activities, and
 - (k) to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions, and
 - (l) to facilitate the identification of land in the coastal zone for acquisition by public or local authorities in order to promote the protection, enhancement, maintenance and restoration of the environment of the coastal zone, and

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(m) to support the objects of the *Marine Estate Management Act 2014*.

- Defines the NSW coastal zone as being made up of four distinct 'coastal management areas' and sets out specific management objectives for each of those areas;
- Establishes a new independent coastal advisory body, the NSW Coastal Council;
- Requires local councils to embed coastal management within the Integrated Planning and Reporting (IP&R) framework established in the *Local Government Act 1993*. This approach will ensure that coastal management needs inform, and are informed by, councils' overall service delivery, financial and asset management planning responsibilities; and
- Provides for public authorities to take into consideration the objectives and processes to achieve integrated management of the NSW coast.

5.2.2.1. Coastal Management SEPP

The Coastal Management SEPP 2018 is part of the new coastal management framework being implemented by the NSW Department of Planning and Environment and the Office of Environment and Heritage, which integrates and builds previous coastal SEPPs – SEPP 14 (Coastal Wetland), SEPP 26 (Littoral Rainforest) and SEPP 71 (Coastal Protection) – which are now repealed. The CM SEPP includes areas mapped as *Littoral Rainforests* (Hungry Head), *Coastal Wetlands* (to the north and both *Coastal Environment Area* and *Coastal Use Area* throughout the Dalhousie Creek precinct. The Coastal Management SEPP gives effect to the objectives of the Coastal Management Act 2016 from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.



Figure 4: Coastal Management Areas.

The Coastal Management SEPP states that (Part 1, Clause 7):

(1) In the event of an inconsistency between this Policy and another environmental planning instrument, whether made before or after the commencement of this Policy, this Policy prevails to the extent of the inconsistency.

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Part 3, Clause 19 of the Coastal Management SEPP allows for coastal protection works to be undertaken by or on behalf of a public authority without development consent if the works are:

(2)(a) (i) identified in the relevant certified coastal management program, or

(ii) beach nourishment, or

(iii) the placing of sandbags for a period of not more than 90 days, or

(iv) routine maintenance works or repairs to any existing coastal protection works

The certified Bellingen Shire CZMP lists two relevant actions as discussed in Section 5.3.3. The intent of these actions is directed towards ensuring continued appropriate access and the proposed works that are permissible without consent under SEPP Infrastructure are not inconsistent with the Coastal Management SEPP in this regard.

5.2.3 Crown Land Management Act 2016

The *Crown Land Management Act 2016* (CLM Act) was delivered and passed by the NSW Government in 2016 and commenced on the 1st July 2018. All aspects of management and improvement of Crown Land in NSW falls under this new legislation. As works are to be undertaken on Crown Land, landholder's consent, in the form of a licence from Dol – Crown Lands is required (see section 5.4.1).

5.2.4 Fisheries Management Act 1994

The objectives of the Fisheries Management Act 1994 (FM Act) are to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. To meet the primary objectives, Part 7 of the FM Act deals with the protection of aquatic habitats and Part 7A deals with threatened species conservation.

Under Section 200 of the FM Act, a permit is required for dredging or reclamation work carried out by a local government authority, unless these works are authorised by a relevant public authority (other than a local government authority) or under the CLM Act. The proposed works will require a Crown Lands licence (Section 5.4.1) and will subsequently be authorised under the CLM Act. If any marine vegetation (saltmarshes, mangroves, seagrass and seaweeds) is considered to be affected by the proposal, a permit to harm (cut, remove, damage, destroy, shade, etc.) marine vegetation under s205 would be required. The proposed works are not expected to harm any marine vegetation and therefore a permit under s205 is not considered to be required for the proposed works.

5.2.5 Biodiversity Conservation Act 2016

The NSW Government Biodiversity Conservation Act 2016 came into effect in August 2017 replacing the repealed Threatened Species Conservation Act 1995, Native Vegetation Act 2003 and National Parks and Wildlife Act 1974 (animal and plant provisions only). The purpose of this Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The Act provides provisions for the protection of threatened or protected animal and plant species, threatened ecological communities and areas of outstanding biodiversity value.

The Act sets out the assessment framework for threatened species and ecological communities, which are now listed under this Act, for activities and approvals under Part 5 of the Environmental Planning and Assessment Act 1979. To determine whether the proposed activity is likely to significantly affect threatened species or ecological communities, or their habitats a test of significance must be applied. If it is found that the proposed activity is likely to significantly affect threatened species or will be carried out in a declared area of outstanding biodiversity value, the proponent must either apply the Biodiversity Offsets Scheme or prepare a species impact statement (SIS). If the proposed activity will

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not have a significant impact on threatened species or areas of outstanding biodiversity value it will continue to be assessed under s.111 of the Environmental Planning and Assessment Act 1979.

Tests of significance on relevant threatened species were undertaken for this project (See Appendix 3). Results from the tests indicated that the proposed works are unlikely to significantly affect threatened species or ecological communities, or their habitats or areas of outstanding biodiversity value and therefore will continue to be assessed under s.111 of the Environmental Planning and Assessment Act 1979.

5.2.6 Marine Estate Management Act 2014

The aims of the Coastal Management Act also support the aims of the Marine Estate Management Act 2014, as the coastal zone forms part of the marine estate. The Marine Estate Management Act 2014 provides for strategic and integrated management of the whole marine estate – marine waters, coasts and estuaries. The Act does this by:

- Providing for the management of the marine estate consistent with the principles of ecologically sustainable development;
- Establishing two advisory committees, a Marine Estate Management Authority and Marine Estate Expert Knowledge Panel;
- Requiring the development of a Marine Estate Management Strategy to address priority threats identified through threat and risk assessment;
- Facilitating the maintenance of ecological integrity, and economic, social, cultural and scientific opportunities;
- Promoting the coordination of government programs; and
- Providing for a comprehensive system of marine parks and aquatic reserves.

This Act mainly governs aquatic reserves and marine parks. No aquatic reserves or marine parks exist within the Dalhousie Creek precinct and the proposed works are not expected to impact any aquatic reserves or marine parks.

5.2.7 Water Management Act 2000

In stream works are regulated by the controlled activity provisions of the Water Management Act 2000. The NSW Office of Water administers the Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary.

Under Section 38 of the Water Management (General) Regulation, 2011 a public authority is exempt from Section 91E (1) of the Act in relation to all controlled activities that it carries out in, on or under waterfront land.

5.2.8 Environment Protection and Biodiversity Conservation Act, 1999 (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places defined in the EPBC Act as matters of national environmental significance. The Act lists threatened species or ecological communities that are recognised as a matter of national environmental significance. Under the EPBC Act, an action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of

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national environmental significance. In order to determine whether an action is likely to have a significant impact, an assessment of significance on relevant matters is required. Search results from the EPBC Act Protected Matters Search Tool (Appendix 5) and ecological knowledge were used to identify EPBC Act listed species/communities potentially affected by the proposal. Two groups of species, marine turtles and migratory shorebirds, were identified and assessments of significance were undertaken (Appendix 3). Results from the assessments of significance concluded that the proposed works are unlikely to have a significant effect on the listed species. On this basis, referral of the project to the Department of Environment in relation to potential impacts on the listed species is not required.

5.2.9 National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 (NPW Act) provides for the statutory protection of protected flora and fauna and Aboriginal cultural heritage places, objects and features. It is an offence under the NPW Act to cause harm or desecration to any Aboriginal heritage items, objects or places discovered during operations. No Aboriginal heritage places, objects or features are known to occur within the proposed works area although the general area is of significant value to the Aboriginal people (Section 6.11).

5.2.10 Heritage Act 1997

All non-Aboriginal archaeological relics across NSW (including NPWS estate) over 50 years old are managed under the Heritage Act 1977. Any works or activities that may disturb non-Aboriginal archaeological relics must have an Excavation Permit, which is a separate approval under the Heritage Act 1977. No known heritage sites or archaeological relics have been identified within the proposed works site (Appendix 6) and therefore such sites are not expected to be disturbed by the proposed works.

5.3 Relevant Plans of Management

5.3.1 Bellingen Coast Regional Crown Reserve Plan of Management

The Bellingen Coast Regional Crown Reserve Plan of Management provides the framework for future management and direction for the Crown Reserve under Division 6 of the Crown Lands Act, 1989. The Plan of Management (LPMA, 2010) sets out overarching principles for the ongoing management of the reserve by establishing the reserve values, a vision and management objectives and strategies. It also provides a framework for future detailed site or issue specific planning.

The vision for the Bellingen Coast Regional Crown Reserve is to protect and enhance the environmental, social, economic and recreational values of the Bellingen Coast Regional Crown Reserve to ensure long term sustainability and to encourage continued public access and enjoyment.

The relevant management precincts within the Plan are precinct 3 – Urunga Lagoon/Hungry Head and precinct 4 – Dalhousie Creek/Wenonah Head/Oyster Creek. The Plan of Management includes the Bellingher Heads State Park Operational Plan which includes specific management strategies for the area which are relevant to the entrance management strategy including:

- Identify areas of active or potential erosion along waterways and mitigate as appropriate
- Review access and management trail requirements
- Maintain 4WD beach access for emergency vehicles in recognition of natural process constraints
- Close and rehabilitate informal tracks
- Encourage indigenous participation in the management of the State Park

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- Consult with relevant groups regarding required recreational facilities and identify opportunities where existing recreation facility provision could be enhanced
- Consult with Hungry Head and North Beach Surf Life Saving Clubs, Land Care and other groups to determine their existing requirements and future needs to enhance volunteer numbers.

All proposed works are considered to be consistent with the Plan of Management.

5.3.2 Hungry Head Reserve Plan of Management

Hungry Head reserve means Hungry Head Beach Reserve No.37514, notified on 23 April 1904 for public recreation, which comprises of lot 102 DP 755552 and Lot 1 DP 620967. A Plan of Management for Hungry Head Reserve was prepared in 2003 by DLWC (2003). The plan establishes a basis for management, vision statement, management principles and management strategies.

The vision statement for the management of Hungry Head Reserve is 'To provide for public enjoyment and appreciation of the natural values of the Reserve; and to conserve those natural values for future generations.'

The plan establishes five management units within the reserve including:

- Headland
- Rainforest
- Amenities
- Bushland
- Cabins

The proposed entrance management works lie within the rainforest unit and management objectives outlined in the plan relevant to the proposed works include:

- Protect, maintain and rehabilitate areas of environmentally sensitive vegetation.
- Minimise the visual impact of man-made features upon the natural environment.
- Identify and protect sensitive native fauna.
- Protect and maintain the water quality of Dalhousie Creek.
- Support the efficient and effective operation of the surf patrol and rescue service.
- Maximise the safety of persons visiting the reserve.

All proposed works are considered to be consistent with the Plan of Management.

5.3.3 Bellingen Coastal Zone Management Plan

The Bellingen Coastal Zone Management Plan (CZMP) was finalised in 2017. The CZMP formally manages the risks from coastal hazards to valuable land and assets at present and in the future, and to preserve the unique natural values of the Bellingen coastline. The CZMP focuses on land potentially affected by coastal hazards across the Bellingen coastline extending from Tuckers Rocks in the north to North Valla Beach in the south encompassing Dalhousie Creek and Hungry Head Beach. Coastal hazards managed by this plan include beach erosion, long-term shoreline recession and coastal inundation. Within the plan a risk assessment to determine the level of risk to land, assets and values from the coastal hazards was undertaken.

Relevant actions in the CZMP are:

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- BA.1 - Rationalise, maintain and improve beach access ways (pedestrian and 4WD), to provide quality and safe public access onto beaches, while protecting beach and dune condition. Improve dune health and resilience to erosion by rationalising the occurrences of superfluous / ad hoc access points and constructing / improving and maintaining adequate ground cover and dune fencing.
- BA.2 - Re-contour unsafe beach access conditions resulting from storm activity, and remediate associated beach access infrastructure (paths / fences) when they become degraded. The requisite for such works will be identified through beach monitoring (MO.3).

The proposed works are considered to be consistent with the CZMP.

5.4 Approvals

All components of the proposed works are permissible without consent, if undertaken by or on behalf of a public authority (Council) under Division 25, Clause 129 of the *State Environmental Planning Policy (Infrastructure) 2007*.

BSC is the proponent and determining authority responsible for deciding whether to approve or proceed with the activity. An environmental assessment in the form of a Review of Environmental Factors (this document) is required in accordance with Part 5 of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) and Section 111 of the Act, which requires that the proponent (BSC) take into account to the fullest extent possible all matters affecting or likely to affect the environment due to the proposed activity.

5.4.1 Crown Lands licence

To ensure NSW Crown Land is used correctly, DoI – Crown Lands issues licences, leases and permits under the Crown Land Management Act 2016 for different uses of Crown Land. Licences are issued for a range of purposes and uses as deemed fit by the Minister.

As discussed in Section 5.1 proposed works will be undertaken on Crown Land under management of the Bellinger Heads State Park Trust or on Crown Land below MHW, managed directly by DoI – Crown Lands. The management arrangement of the land is quite complex, however discussions with DoI – Crown Lands indicate that a Crown Lands licence is likely to be required to undertake the works.

To obtain a licence, an application form would have to be completed and submitted to DoI – Crown Lands along with an assessment fee.

5.4.2 Dredging and/or reclamation permit

Any person, business, company or local government authority proposing to dredge, excavate or remove material (including sand, mud, large woody debris, aquatic vegetation, boulders, gravel etc.) from a waterway, or reclaim or place fill within a waterway requires a permit from the Department of Primary Industries (DPI Fisheries) unless the work has been authorised under the Crown Lands Management Act 2016 or by a relevant public authority (not a local government authority). The permit is issued under Section 200 of the *Fisheries Management Act 1994*.

If it is confirmed that a Crown Lands licence is required for the proposed works then a dredging and/or reclamation permit will not be required. However, if it is deemed that a Crown lands licence is not required then a dredging and/or reclamation permit will be required for the proposed works.

An application would need to be completed and submitted to DPI Fisheries for approval along with a cash fee. DPI – Fisheries will require a determined REF for the project to accompany the permit application.

6. DESCRIPTION OF THE EXISTING ENVIRONMENT

6.1 Site Description

Dalhousie Creek is an ICOLL located approximately 25 km south-southwest of Coffs Harbour on the NSW north coast, and situated in the Bellingen Shire Council (BSC) Local Government Area (LGA). The creek enters the ocean at Hungry Head, a very small village with tourist cabins, and the Urunga Surf Lifesaving Club (USLSC). Hungry Head Beach forms part of a sandy barrier dune system that extends from Second Headland in the south to Hungry Head (headland) in the north. The dunes are backed by back-barrier flats and Dalhousie Creek which is deflected to the north. The local coastal landscape is largely undeveloped, with the exception of the North Coast Railway line that backs the beach and dunes and the USLSC and associated beach access facilities at Hungry Head. Catchment land use is predominantly vegetated and includes logged forest, unlogged coastal forest, riparian and wetland areas, primary production and rural residential development.

The area is Crown land and forms part of the Bellinger Heads State Park. The park is managed by the Bellinger Heads State Park Trust which consists of representatives from the Department of Industry – Lands and Bellingen Shire Council. Bellinger Heads State Park comprises Reserve 1014608 for Community Purposes, Public Recreation & Coastal Environmental Protection and Tourist Facilities & Services.

Hungry Head Reserve is located to the south of the lagoon and the main features include the beach, headland, Dalhousie Creek lagoon and several significant patches of Littoral Rainforest. The reserve also includes ten self-contained holiday cabins, a caretaker's residence and day use recreation facilities. The Urunga Surf Life Saving Club is also located within the reserve, with members providing a patrolled beach area on summer weekends. The local indigenous people have a strong association with the littoral rainforest of the reserve and the area is regarded as culturally significant. This precinct is dominated by natural areas including the lagoon, headland and sandy beaches, with day use areas concentrated at the northern and southern ends. Environmental protection, nature conservation and recreation are the dominant land uses (LPMA, 2010).

The reserve lands, from Dalhousie Creek south to Oyster Creek on the eastern side of the railway line, are subject to a Native Title Determination (NCD2017/004). This includes Second Headland, where a small settlement exists, and Wenonah Head (Third Headland). The natural areas include dunal vegetation and several Endangered Ecological Communities. Third Headland also has significance with the local Aboriginal community (LPMA, 2010).

6.2 Waterways

Dalhousie Creek is a relatively small coastal lagoon which is only intermittently open to the ocean. Dalhousie Creek has a catchment area of 6.3 km² (OEH, 2018a) which extends approximately 4 km from the entrance and is bordered by Hungry Head Road to the north and Schnapper Beach Road to the south (Figure 5). Dalhousie Creek has an average depth of 0.3m and a waterway area of 0.075 km² (BMT WBM, 2015). Land use areas within the catchment are presented in Table 1.

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Table 1: Summary of land use within Dalhousie creek catchment

Land Use	Percentage of Catchment (%)
Water	3.25
Unlogged Bushland/Riparian/Wetlands	12.5
Sand/Beach	1
Unimproved Pasture (Grazing)	3.6
Horticulture	7.5
Urban (Low Density)	4.2
Power line corridor	1.28
Roads	1
Forestry	61.8

Source: Powell *et al.*, (2007).

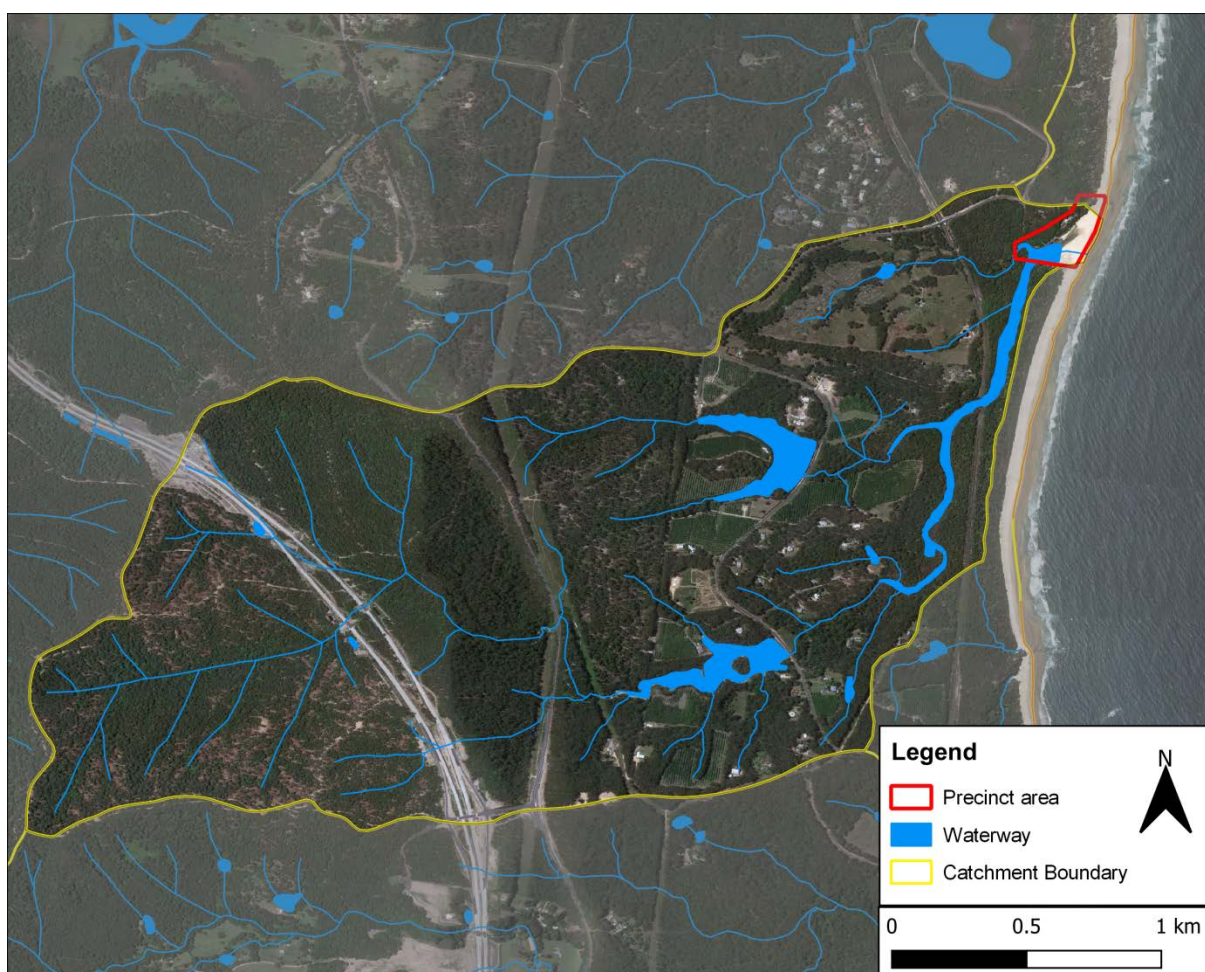


Figure 5: Dalhousie Creek catchment

6.3 Water quality

Limited water quality data is available. Powell *et al.*, (2007) briefly discusses water quality in Dalhousie, however, only in the context of catchment scale modelling scenarios.

6.4 Topography and Soils

The topography of the Dalhousie Creek entrance area varies considerably according to beach and weather conditions and is discussed further in Sections 6.5 and 6.6. To the north of the entrance lies Hungry Head which is a coastal headland. The base geology comprises the mixed metamorphics of the Nambucca River plate (LPMA, 2010). To the south of the entrance lies a barrier dune system.

The entrance area and beach is dominated by coastal marine sands. Rocky outcrops occur in the vicinity of the 4WD access entry and (depending on conditions) approximately 100 m north of the USLSC towards the headland and east of this point.

6.5 ICOLL Entrance Dynamics

Dalhousie Creek is considered to be an ICOLL, meaning that it is not permanently open to the ocean, with opening events only occurring intermittently. An opening event occurs when the ICOLL breaks or breaches the beach berm and openly flows into the ocean. ICOLL entrance opening event frequency and patterns are governed by a diverse range of factors including:

- Existing entrance position;
- Rainfall intensity, frequency and patterns - drives water levels within the ICOLL;
- Geology – underlying bedrock guides where the entrance may open;
- Coastal geomorphology – sand supply and movement determine the beach berm height. The height of the berm influences when the entrance may open;
- Swell height and patterns – swell patterns drive the coastal geomorphology process effecting sand movement and supply. Large swells may also breach the berm and create an entrance opening event.

Due to the multitude of factors controlling entrance opening events the frequency and duration of opening events varies significantly both across ICOLL's and within a particular ICOLL. The Dalhousie Creek entrance position or water levels within the creek have not been monitored so no data on entrance position or opening regimes of the creek is available, however anecdotal reports suggest that Dalhousie Creek opens on average twice per year. The creek was regularly artificially opened once per year until around 1997 to maintain public safety and access within the vicinity of the entrance and also to improve water quality and odour issues which were apparent when the creek remained closed for extended periods.

Analysis of aerial photographs of the entrance was undertaken to gain an understanding of the entrance position patterns. The position of the creek entrance was mapped on 25 aerial photographs dated from between June 2004 and June 2018. The entrance position from each aerial was overlaid (Figure 6) to provide an understanding of the general entrance position of Dalhousie Creek. It should be noted that aerial photograph dates were random and the majority from post-2013. Only several opening events (some with multiple photos of one event) were captured and therefore there is not concise documentation of the entrance position across the 14 years and hence conclusions around entrance opening frequency and water levels cannot be drawn. However, general patterns can be interpolated from the aerial analysis including:

- Of the entrance opening events captured;
 - The majority occurred north of a south east bearing from the USLSC lookout tower with some as far north as the rock out crops east of the headland.

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- The break-outs occurred along a similar alignment.
- Dalhousie Creek is almost permanently aligned to the northern bank until the rocky outcrop at the 4WD access.
- Dalhousie Creek is most often aligned to the northern bank adjacent to the USLSC lookout tower.

From the aerial photography analyses it is evident, that in the past 5 years, the position of the Dalhousie Creek entrance has generally been aligned to the northern bank, restricting access to the beach adjacent to the USLSC lookout tower.

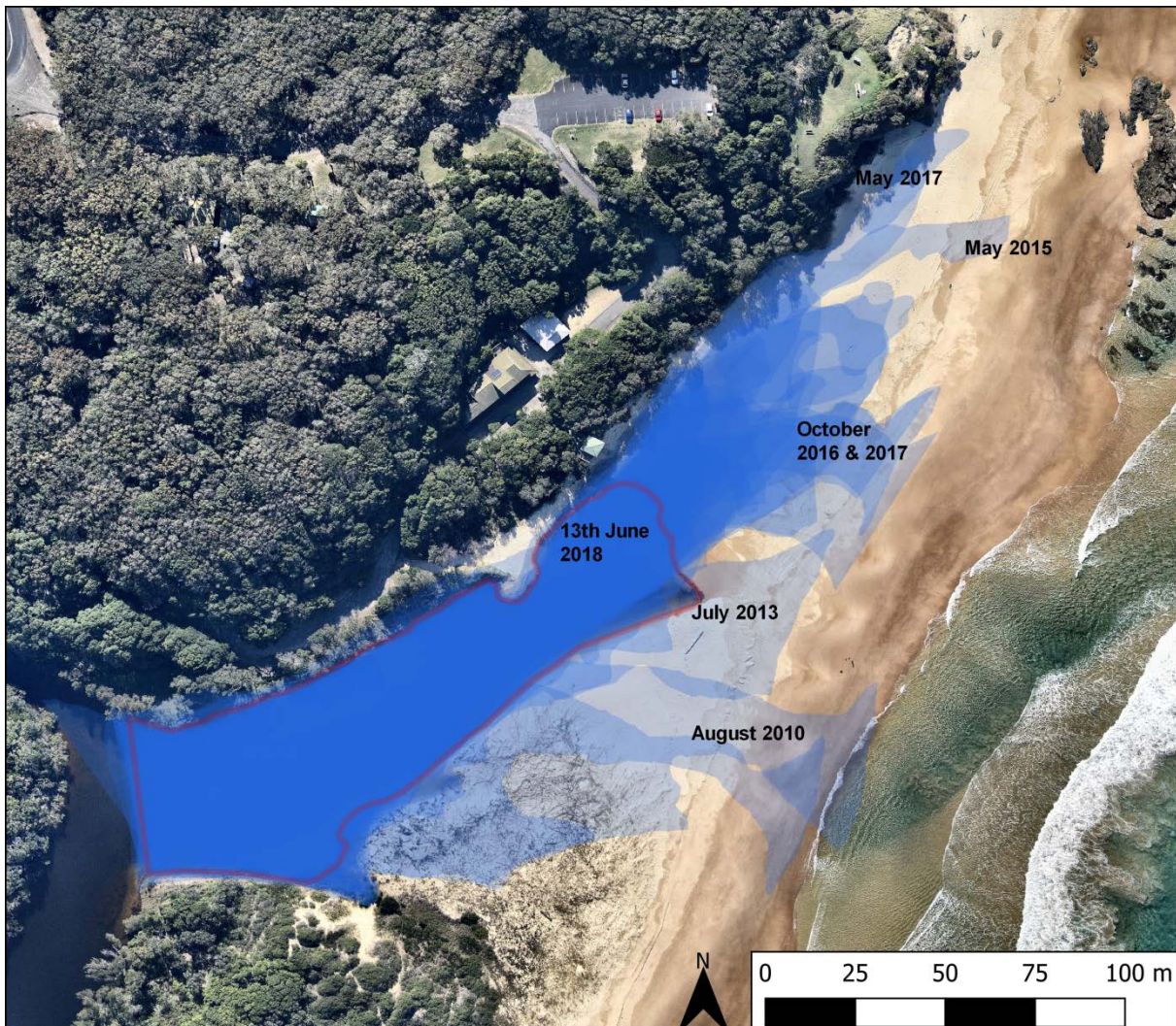


Figure 6: Comparison of entrance positions from aerial photography (2004-2018)

6.6 Coastal Processes

6.6.1 Swell Patterns

The dominant principal swell directions experienced at Hungry Head are from between south-south-east and east (Table 2). South-south-east is the most dominant followed by south-east, east-south-east and east respectively. Swell directions tend more southerly between May and June and tend most easterly in direction during November to January. These are swell directions recorded at the Coffs Harbour wave buoy situated approximately 30 km north east off the coast of Hungry Head. Actual swell directions experienced at Hungry Head may vary slightly due to influences from coastal

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bathymetry and formations, however, this data provides an indication of dominant general swell directions experienced at Hungry Head.

Table 3 provides a summary of wave height exceedances recorded at the Coffs Harbour wave buoy between 1976 and 2012. Within this period the maximum swell height recorded was 7.36 m with an average of 1.58m. Average swell heights vary slightly throughout the year with the largest average swell heights occurring between March and August with June and July experiencing the largest swells. As discussed above, actual swell heights experienced at Hungry Head are likely to be different to those recorded due to bathymetric and coastline influences, however, the general trends are applicable.

Table 2: Wave direction occurrence table (2012-2016) Coffs Harbour wave rider buoy

Monthly Occurrence Probability														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Principal Wave Direction (°TN)														
N	(348.75 - 11.24)	0.07	0.00	0.08	0.14	0.03	0.20	0.37	0.75	0.33	0.51	0.57	0.07	0.259
NNE	(11.25 - 33.74)	2.51	0.07	0.70	0.50	0.17	1.19	0.37	3.26	4.19	5.58	6.35	3.28	2.303
NE	(33.75 - 56.24)	4.40	1.61	2.63	0.53	0.62	2.06	1.73	3.12	7.65	10.98	12.46	7.89	4.543
ENE	(56.25 - 78.74)	8.87	4.55	11.69	3.46	4.09	5.22	7.95	1.46	3.24	5.80	6.28	10.07	5.999
E	(78.75 - 101.24)	25.34	33.05	24.38	17.94	11.76	8.39	9.30	4.45	6.84	8.16	9.10	16.38	14.528
ESE	(101.25 - 123.74)	19.84	22.73	20.47	26.57	11.59	13.96	10.02	9.37	8.65	13.05	13.46	20.82	15.834
SE	(123.75 - 146.24)	18.33	16.84	17.57	19.69	19.85	21.19	21.83	22.57	19.28	20.48	22.60	16.20	19.737
SSE	(146.25 - 168.74)	14.55	13.54	14.55	22.61	35.81	36.05	37.22	41.85	38.59	23.99	20.31	16.52	26.534
S	(168.75 - 191.24)	5.02	6.03	6.04	7.35	14.86	9.61	9.88	11.78	10.56	9.35	7.57	7.12	8.795
SSW	(191.25 - 213.74)	1.00	1.45	1.78	1.03	1.17	1.51	0.54	0.37	0.59	1.81	1.07	1.55	1.156
SW	(213.75 - 236.24)	0.03	0.13	0.12	0.18	0.03	0.32	0.10	0.64	0.07	0.11	0.14	0.11	0.170
WSW	(236.25 - 258.74)	0.00	0.00	0.00	0.00	0.00	0.12	0.07	0.27	0.00	0.14	0.00	0.00	0.052
W	(258.75 - 281.24)	0.03	0.00	0.00	0.00	0.00	0.12	0.03	0.00	0.00	0.04	0.00	0.00	0.020
WNW	(281.25 - 303.74)	0.00	0.00	0.00	0.00	0.00	0.03	0.10	0.03	0.00	0.00	0.00	0.00	0.014
NW	(303.75 - 326.24)	0.00	0.00	0.00	0.00	0.00	0.03	0.31	0.07	0.00	0.00	0.00	0.00	0.035
NNW	(326.25 - 348.74)	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.07	0.00	0.020
Monthly Statistics														
Average		112.44	117.17	115.43	126.76	139.09	135.39	134.18	138.90	129.73	118.77	113.17	113.57	124.84

Source: MHL (2016a)

Table 3: Wave height exceedance table (1976-2012). Coffs harbour wave rider buoy.

Hsig	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	Hsig
0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.000	0.00
0.50	99.94	99.99	99.97	99.89	99.74	99.87	99.87	99.84	99.98	99.98	99.73	99.87	99.889	0.50
1.00	82.45	84.33	89.82	87.57	85.12	84.27	84.93	78.37	80.87	82.67	82.57	80.70	83.579	1.00
1.50	41.90	45.27	54.29	51.36	54.65	51.08	51.49	39.99	39.71	38.18	39.19	37.09	45.265	1.50
2.00	17.93	22.20	24.01	24.48	27.69	27.00	25.64	18.35	16.43	16.46	17.18	14.63	20.932	2.00
2.50	6.65	9.28	10.43	11.15	12.34	12.54	12.61	8.22	7.10	7.12	7.96	5.43	9.215	2.50
3.00	2.06	3.96	4.98	5.05	5.20	6.50	5.59	3.75	2.72	2.92	3.53	2.36	4.038	3.00
3.50	0.80	1.83	2.22	2.21	2.60	3.65	2.24	1.59	1.08	1.23	1.55	0.92	1.816	3.50
4.00	0.27	0.79	0.89	0.91	1.52	1.85	0.76	0.56	0.28	0.47	0.60	0.39	0.768	4.00
4.50	0.04	0.31	0.40	0.32	0.82	0.93	0.27	0.29	0.05	0.14	0.27	0.15	0.329	4.50
5.00	0.02	0.13	0.10	0.08	0.42	0.41	0.12	0.09	0.00	0.02	0.09	0.03	0.122	5.00
5.50	0.00	0.08	0.05	0.02	0.13	0.20	0.06	0.03	0.00	0.00	0.01	0.01	0.049	5.50
6.00	0.00	0.04	0.01	0.01	0.04	0.12	0.04	0.01	0.00	0.00	0.01	0.00	0.021	6.00
6.50	0.00	0.00	0.00	0.00	0.01	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.007	6.50
7.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.001	7.00
7.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	7.50
Average :	1.46	1.54	1.64	1.60	1.63	1.67	1.63	1.47	1.49	1.47	1.46	1.41	1.58	
Maximum :	5.28	6.47	6.21	6.22	6.51	7.36	6.84	6.39	4.91	5.69	6.03	5.80	7.36	
Minimum :	0.46	0.47	0.29	0.26	0.34	0.38	0.40	0.44	0.38	0.48	0.36	0.29	0.26	

Source: MHL (2016b)

6.6.2 Sand movement

The predominant general overall direction of sand movement along the coastline within the vicinity of Hungry Head is from south to north. The process driving the northward movement of sand is longshore transport. Longshore transport occurs when the dominant swell direction (south-east) approaches the shoreline at an angle and generates currents along the shoreline which transports the sand with it. This process generally occurs within the nearshore area, decreasing in strength with distance offshore. BMT WBM (2014) estimated the net longshore transport rate within the Bellingen Shire to be 60, 000 m³/yr.

Although there is a general northward movement of sand along the coast, there is also a localised cross-shore movement of sand on a beach. Cross-shore sand movement drives the formation of beach berms and sand dunes. This process is particularly important in determining creek entrance position and opening events. The general cross-shore sand movement process is as follows:

- During storm events increased swell and water levels erode sand from the upper beach/frontal dune system and transport to the nearshore offshore.
- The offshore movement of sand typically creates a sand bar/s parallel to the beach. This sand bar dissipates wave energy reducing the effect of waves in the beach.
- During calmer weather, under the influence of smaller waves, sand migrates from the bars onto the beach to form a beach berm.
- Sand from the beach berm is then transported further ashore by wind forming dunes.
- Process repeats according to weather.

The above processes are occurring at the entrance to Dalhousie Creek and are a significant influence on the position of the entrance.

6.7 Terrestrial Vegetation

Flametree Ecological Consulting (2006) undertook mapping of coastal vegetation across the Bellingen Shire in 2006. Figure 7 illustrates vegetation communities mapped within the vicinity of the Dalhousie Creek entrance and reflects current vegetation. Vegetation information in this section is extracted from Flametree Ecological Consulting (2006).

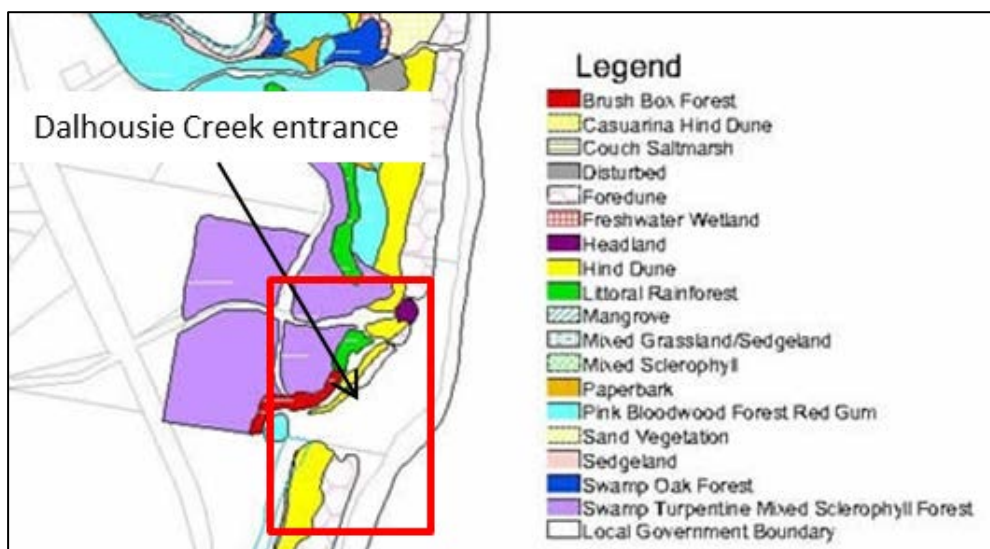


Figure 7: Vegetation communities within the vicinity of the study area

Source: Flametree Ecological Consulting (2006)

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On the northern bank of Dalhousie Creek entrance, in the surf club and lookout tower area, between the foreshore and the access road, fore-dune vegetation exists immediately adjacent to the foreshore and hind-dune vegetation dominates towards the top near the road. Further north behind the surf club there is a stand of littoral rainforest (listed as an endangered ecological community) and Swamp Turpentine Mixed Sclerophyll Forest. To the south west of the surf club, adjacent to the backwater of Dalhousie Creek Brush Box Forest exists. Along the foreshore, north of the USLSC lookout tower, fore and hind dune vegetation stretches up to the headland.

The southern bank of the Dalhousie Creek entrance is dominated by fore-dune vegetation on the eastern side of the main dune and hind dune vegetation on the western side facing Dalhousie Creek. The sand bar forming north of the main dune is being colonised by fore dune vegetation (Coastal Spinifex, Goatsfoot).

Table 4: Vegetation type description. Source: Flametree Ecological consulting (2006)

Vegetation Type	Description
Foredune	<p>Begins on the beach and ends, generally, at the crest of the most seaward dune.</p> <p>Dominant species - Spinifex, Coast Wattle, Bitou Bush</p> <p>Other species - Glory Lily, Native Coastal Morning Glory</p>
Hind dune	<p>Occurs, generally, on the crest and down the landward side of coastal sand-dunes.</p> <p>Dominant canopy species - Coast Banksia and/or Tuckeroo</p> <p>Other canopy species - Beach Alectryon</p> <p>Understorey species - Coast Wattle, Beach Acronychia, Three-veined Laurel and other Littoral Rainforest species</p> <p>Ground-layer species - Blady Grass, Ferns</p>
Littoral rainforest	<p>Dominant canopy species - Varied, including Tuckeroo, Cheese Tree, Plumpine, Red Bean, Brush Box, Hard Quandong, Guioa, Brush Cherry, Yellow Tulip, Beach Acronychia, Three-veined Laurel, Beach Alectryon, Snow Wood, Lilly Pilly etc.</p> <p>Understorey species - Young canopy species</p> <p>Ground-layer species - Basket Grass</p>
Brush box forest	<p>Occurs on steep south-facing slopes on rock.</p> <p>Dominant canopy species - Brush Box</p> <p>Other canopy species - Coast Banksia</p> <p>Understorey species - Rainforest species such as Tuckeroo, Guioa, Three-veined Laurel, Native Guava, Flintwood, Scentless Rosewood, Bolwarra, Hard Quandong, Midgen Berry</p> <p>Ground-layer species - Bracken, other ferns, Scrambling Lily</p>

6.8 Estuarine Vegetation

Dalhousie Creek supports areas of estuarine vegetation including mangroves, seagrass and saltmarsh. DPI (2006) mapping indicates that areas of seagrass and mangroves are present within lower Dalhousie Creek (Figure 8), generally downstream of the railway bridge and mangroves and saltmarsh upstream of the railway bridge. Figure 8 indicates mangroves fringing both banks immediately upstream of the entrance area and seagrass along the western edge of the creek. Seagrass species recorded in the creek by DPI (2006) include *Zostera sp.* and *Halophila sp.* Although the DPI (2006) mapping is now quite dated it provides an indication of the likely presence of estuarine vegetation in Dalhousie Creek.

During a site visit (early June 2018) Hydrosphere Consulting personnel undertook an inspection of lower Dalhousie Creek (downstream of the railway bridge). During the visit large scattered meadows of *Halophila sp.* were visible throughout the entire lower creek. Due to the very clear water clarity and shallow nature of the waterway meadows were growing across large areas ranging from open sandy straights to substrates around rocky areas. No areas of *Zostera sp.* were evident during the site visit. Mangroves were fringing much of the lower waterway with no areas of saltmarsh identified however is likely to occur upstream of the railway bridge.

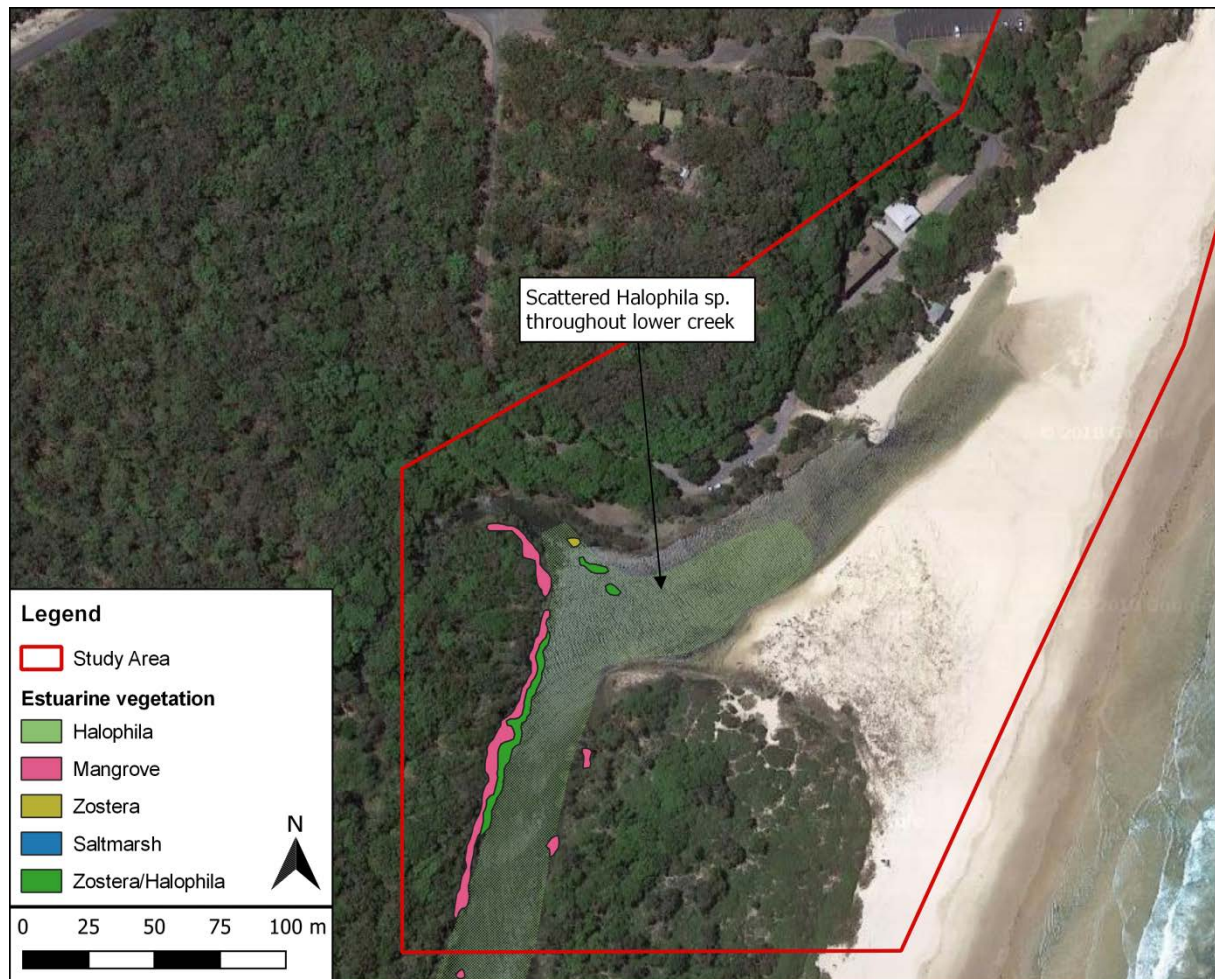


Figure 8: Estuarine vegetation mapping. Source: NSW DPI (2006)

6.9 Fauna

Searches of the following databases were conducted to assist in evaluating the potential for threatened and protected species to be present within the works area:

- Protected Matters Search Tool (EPBC Act)
- BioNet

Refer to Appendix 4 for threatened species within 500 m of the precinct identified in the Bionet search results. Appendix 5 lists species '*known to occur*' or with '*habitat known to occur*' within the precinct area as identified in the EPBC Protected Matters Search Tool.

6.9.1 ICOLL fauna

No specific studies have been undertaken however, Dalhousie Creek is likely to support a range of ICOLL fauna. Fauna likely to be encountered within Dalhousie Creek include (but not limited to):

- A diverse range of fish species - recreationally popular fish species including Flathead, Bream, Whiting, Mullet. Other fish species likely to occur within Dalhousie Creek which are relatively cryptic or associated with very specific habitats and hence are not observed regularly include native Gudgeons and Gobies.
- Crabs – The recreationally important Mud Crab and other smaller species.
- Benthic infauna – bivalves, polychaetes, gastropods and amphipods
- Various prawn (*Melicertus plebejus* and *Metapenaeus spp.*) shrimp species (*Macrobrachium spp.*).

The majority of species are likely to traverse the entrance area at various life cycle stages.

6.9.2 Marine and shoreline

Benthic infauna

No specific studies have been undertaken on Hungry Head beach however sandy beaches host a diverse range of benthic infauna (often small animals that inhabit the sandy sediments of a beach). Many of the species are microscopic in size (meiofauna) and not visible to the naked eye. The general public are usually only aware of the larger macrofauna – the most conspicuous being the pipi (*Donax deltooides*), various species of crabs (e.g. the ghost crab, *Ocypode cordimana*) and polychaete beach worms (e.g. *Australonuphis spp.*), all of which are often utilised as bait resource by beach anglers.

The number and type of fauna inhabiting a beach will vary according to the physical features of a beach. For example, a high energy coarse grained beach is likely to hold fewer animals than a low energy fine grained beach. This pattern of distribution is partly due to higher burrow stability with finer/mixed grain sizes in comparison to the highly mobile environment of Hungry Head beach which is openly exposed to the predominate south-easterly wind and swell conditions.

The abundance and distribution of beach infauna generally change according to the tide with different fauna preferring specific areas of the intertidal zone, although generally a higher number of fauna are found lower in the tidal zone closer to the low water spring tide mark (Hacking, 1996; Schlacher & Thompson, 2007). Air breathing crabs (Decapods), Isopods and insects tend to inhabit the upper tidal zone and shoreline while the water dependent polychaete worms, crustaceans and molluscs inhabit the lower tidal zone (Hacking, 1996). Many species also move throughout the tidal cycle to occupy preferred zones of depth, water movement and sediment composition. As a result the lateral distribution of beach infauna across a beach profile will vary according to a variety of factors such as tide state, wave energy and beach slope characteristics.

Hacking (1998) included Boambee Beach, located approximately 20 km north of Hungry Beach, in a study of faunal composition of NSW Beaches, which indicated that this beach is typical of other warm-temperate/sub-tropical east coast ocean beaches. Hungry Head Beach, within the vicinity of the proposed works is a similar alignment and nature to Boambee beach and therefore species encountered at Boambee beach are likely to be similar to Hungry Head Beach. A number of infauna species are likely to inhabit the beach sediments within the proposed works area at Hungry Head Beach (Table 5).

Table 5: Inferred infauna low-tide distribution at Hungry Head Beach (based on Hacking, 1998)

Group	Common name	Typical species	Typical Beach Zone
Bivalves	Pipis	<i>Donax spp.</i>	<i>Swash Zone/Upper Swash</i>
Polychaetes	Sandworms	Various	<i>Swash Zone</i>
Nemertea	Ribbonworm	<i>Nemertean</i>	<i>Swash Zone</i>
Isopods	Marine Isopod	<i>Pseudolana spp.</i>	<i>Swash Zone</i>
Amphipods	Amphipod	<i>Urohaustorius spp.</i>	<i>Mid beach/Upper beach</i>
Decapods	Crabs	<i>Ocypode cordimana</i>	<i>Mid beach/Upper beach</i>
Insect larva	Insects	Diptera	<i>Upper beach</i>

Turtles

Several turtle species are likely to use the nearshore environment within the vicinity of Hungry Head Beach including:

- Loggerhead Turtle (*Caretta caretta*) – listed as Endangered under both the BC Act and EPBC Act.
- Green Turtle (*Chelonia mydas*) – listed as Vulnerable under both the BC Act and EPBC Act.
- Leatherback Turtle (*Dermochelys coriacea*) – listed as Endangered under both the BC Act and EPBC Act.

Of those species, the Loggerhead and Green Turtle may potentially use the beach for nesting. The Leatherback Turtle may use coastal marine waters for feeding however only rarely breeds in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago (OEH, 2018b). There are occasional breeding records from the NSW coast, including from between Ballina and Lennox Head in northern NSW (OEH, 2018b).

Further information is provided in Appendix 3.

Shorebirds

Numerous shorebird species are likely to use the beach and foreshore habitat within the vicinity of the Dalhousie Creek entrance within the proposed works area for a range of different purposes (Table 6). The shorebirds expected to be encountered can be divided into two broad groups, resident and migratory shorebirds.

Table 6: Shorebird species likely to use habitat within the vicinity of the proposed works

Species	Conservation Status	Occurrence	Potential Habitat usage	Time of year
Resident				
Beach Stone - curlew (<i>Esacus magnirostris</i>)	Critically Endangered (BC Act)	There is only one record from 1999 of <i>E. magnirostris</i> occurring at the entrance of Dalhousie Creek. More recent (2015) observations have been in the nearby Bellinger River estuary. The species may use habitat within the vicinity of Dalhousie Creek entrance.	Intertidal zone for feeding. <i>E. magnirostris</i> occur more prevalently on ocean beaches during the non-breeding season.	March - August
			Potential to nest on upper beach and fore dune areas, most likely on southern side of entrance (due to less disturbance).	September to February
Australian Pied Oystercatcher (<i>Haematopus longirostris</i>)	Endangered (BC Act)	None have been officially recorded within the vicinity of the Dalhousie creek entrance. However, numerous records exist both north and south of the site and habitat features are conducive to those favoured by the species and therefore the species are expected to use the area.	Intertidal zone for feeding (particularly <i>Donax deltoides</i> (pipi)). Upper beach and fore dune for roosting.	All year
			Potential to nest on upper beach and fore dune areas, most likely on southern side of entrance (due to less disturbance).	August and February
Sooty Oystercatcher (<i>Haematopus fuliginosus</i>)	Vulnerable (BC Act)	None recorded within the vicinity of Dalhousie Creek entrance however the rocky headland immediately north of the entrance provides habitat suitable for this species.	Forage and roost on rocky habitat(north of works area).	All year
Little Tern (<i>Sternula albifrons</i>)	Endangered (BC Act)	None recorded within the vicinity of Dalhousie Creek entrance.	Entrance area provides potential nesting habitat	October - February
Migratory shorebirds				
Various (see Appendices 3, 4 and 5)	Various	None recorded.	Intertidal beach provides suitable foraging habitat and beach berm at entrance provides suitable roosting habitat	September - April

6.9.3 Terrestrial

Limited terrestrial fauna is expected to use habitat within the Dalhousie Creek entrance area. Common terrestrial bird, lizard, snake and rodent species are likely to use dune vegetation.

6.10 Heritage

Searches of the NSW State Heritage Database and Bellingen LEP 2010 did not identify any heritage sites within the proposed works areas.

6.11 Aboriginal Cultural Heritage

A search of the AHIMS database revealed an Aboriginal site within the vicinity of the Dalhousie Creek entrance. Search results indicate that the site is located within the Dalhousie Creek entrance however this contrary other reports which indicate it is situated on the headland. The description of the site as a 'Bat Site' is consistent with the headland location and it is considered that the database record is reflecting the general location only.

A Native Title Determination (NCD2017/004) for the Gumbaynggirr people exists on the lot (Lot 7066 DP1107446) immediately south of the Dalhousie Creek entrance. Part of the original claim area (NC1998/015) is still listed as an active claim by the Gumbaynggirr People on the Native Title Register (Figure 9).

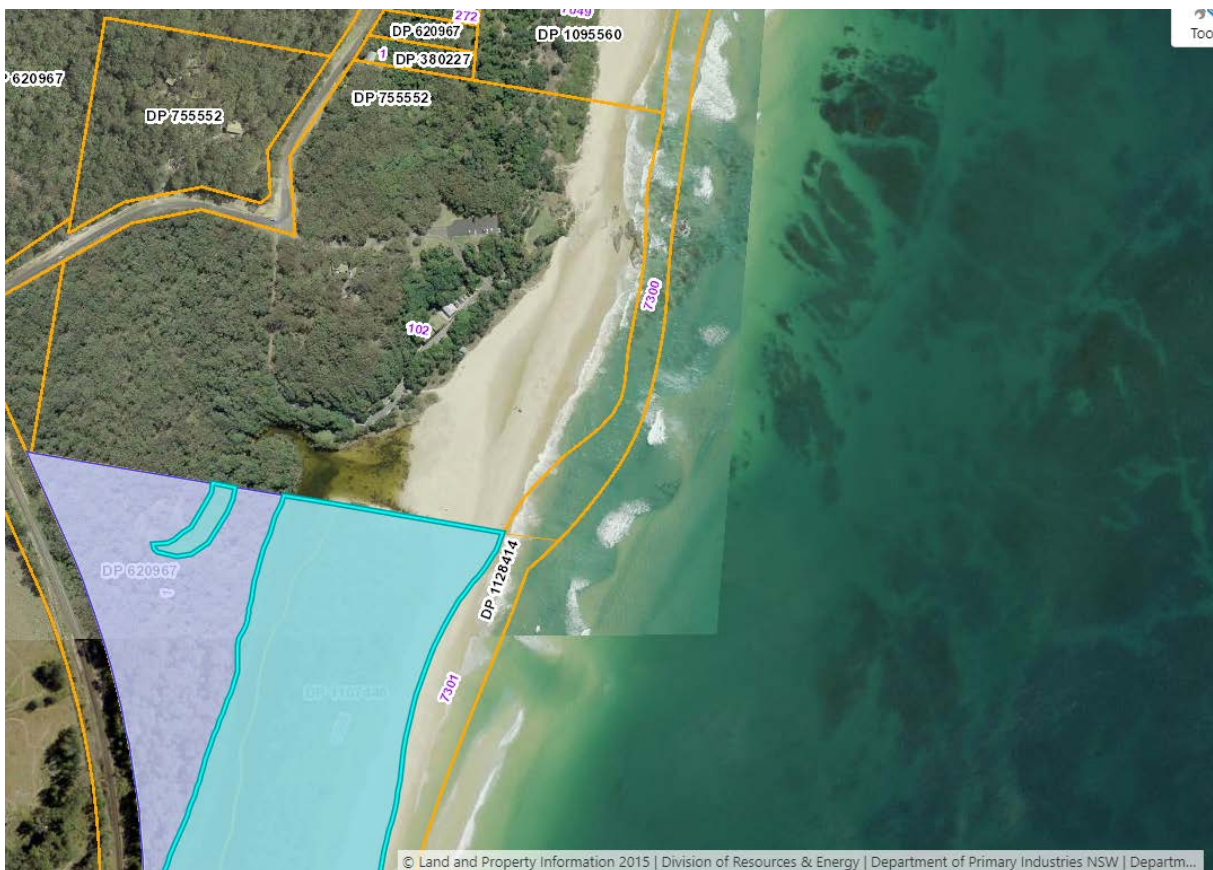


Figure 9: Native Title Determination (light blue) and Claim (dark blue) areas within the vicinity of the Dalhousie Creek entrance. Source: SEED mapping

7. IMPACT ASSESSMENT

This section identifies and characterises the likely potential environmental risks and impacts associated with the proposal. Suitable environmental management procedures and control measures have been identified to reduce the level of risk to an acceptable level.

7.1 Water Quality

The proposed works are not expected to alter the opening regime (frequency or duration) of Dalhousie Creek and therefore are not expected to alter the long term water quality of Dalhousie Creek. If the creek alignment is north of the 4WD access track during sand placement works, sand may be placed directly within the water. Any such works may create turbid water directly within the vicinity of the works. Any turbid water created is expected to be restricted to within the direct vicinity of the work area due to lack of tidal movement and very minimal fines within the sand. Sand used will be directly sourced from the beach and therefore will be clean marine sands. No external material will be imported.

All beach scraping and placement works will be undertaken above the ocean water level at all times and therefore no impact on the turbidity of the nearshore environment is expected.

As with any mobile plant, there is a potential for spills of machinery fluids (fuel, coolant, lubricants, hydraulic fluids). Mitigation measures are outlined in Section 8.2 to minimise any potential risks from fluid spills.

No long term impacts on water quality are expected from the proposed works. Short term, minor localised impacts on turbidity of Dalhousie Creek may occur during sand placement however the risk of occurrence is considered to be very minimal and any impact acceptable.

7.2 Coastal processes

7.2.1 Stage 1

The coastal longshore sediment transport rate at Hungry Head is estimated to be 60,000 m³/year (BMT WBM, 2014). Sand to be scraped and placed higher on the beach (initially ~6,000 m³, but likely to be in reduced volumes in subsequent years) represents approximately 10% of the total annual sediment transport rate. The majority of this material will be placed above the influence of normal water level/swell conditions, however it will still form part of the active sand budget during periods of erosion where it will be returned again to the nearshore environment.

The proposed works will inherently alter the physical characteristics of, and processes occurring on, the beach and within the vicinity of the proposed works area in a number of ways including:

- Dry notch establishment – Will result in an altered beach berm height and profile within the dry notch area and alter location of creek opening and resultant channel. Break out event may result in the reduction of the northerly extent of the fore dune and in the long term reduce the northerly migration of the fore dune/sand bar.
- Sand scraping – Artificial removal of sand from the lower beach will result in the onshore migration of sand from the nearshore zone.
- Sand placement – Restoration of dunes. Creation of upper beach replacing part of the terminal pool of the remnant lagoon, which will enable dune creating processes. Will temporarily remove sand from the active sand budget.

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The effect of the proposed works on coastal processes should be evaluated in the 5-yearly review.

Table 7: Estimated works areas and indicative sand volumes

Activity	Location on beach	Area of works (m ²)	Volume (m ³)	Frequency
Dry notch establishment	Within dry notch area 0-50m south of 'the rock', <+1.8 m AHD.	5,000	500	Once (depending on conditions, may be required again)
Dry notch maintenance	Within dry notch area 0-50m south of 'the rock', <+1.8 m AHD.	<5,000	<500	4/year
Beach scraping	Mid beach (-0.5 to +1.8 m AHD)	5,000	1,500m ³	4/year
Sand placement	Upper beach	6,000 m ²	Variable	4/year

7.2.2 Stage 2

In addition to the impacts outlined in Section 7.2.1 the construction of a Geotextile Sand Container (GSC) structure will artificially train the northern extent of the entrance opening preventing scour of the creek during breakout and prevent the northward migration of the entrance opening. This will stabilise and minimise erosion of the beach by entrance breakout north of this point.

The aim of the GSC structure is to guide the direction of entrance break out events rather than to interrupt coastal sand movement. As discussed previously, the structure will be mostly buried which will reduce the risk of sand depletion and scour often observed up-drift from coastal groynes. The groynes are intended to be a temporary measure to trial their efficacy and potential for a long-term rock structure. As a result, other than influencing opening location, and in addition to Stage 1 impacts the GSC revetment is not expected to significantly affect coastal processes occurring at the site.

7.2.3 Stage 3

The potential impacts of a rock wall on coastal processes will be evaluated during the monitoring of the GSC revetment structure, however, at this stage are expected to be similar, only longer term, than those impacts of the GSC structure.

7.2.4 Climate change influences and impacts

BMT WBM (2014) defined the following major climate change driven hazards as threatening the Bellinghen coastline now and into the future:

- Beach erosion that occurs during a short term storm event or series of events in close succession. Erosion of beaches is typically balanced by recovery during non-storm periods, as the previously eroded sand is moved back onshore;
- Long term shoreline recession that occurs due to a sediment deficit which can be exacerbated by man-made structures (e.g. river training walls), and future sea level rise; and

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- Coastal inundation that occurs during high tides combined with storms, and will increase in the future due to sea level rise relative to present day conditions. Coastal inundation of back beach areas can occur directly via coastal creeks and estuaries, or through wave run-up and overtopping of the crest of frontal dunes and sea defence structures.

Figure 10 illustrates the projected 2050 coastal erosion risk for the Dalhousie Creek entrance area. The northern bank lies within the extreme coastal risk area as does the majority of the entrance area, including the dry notch and beach scraping areas.

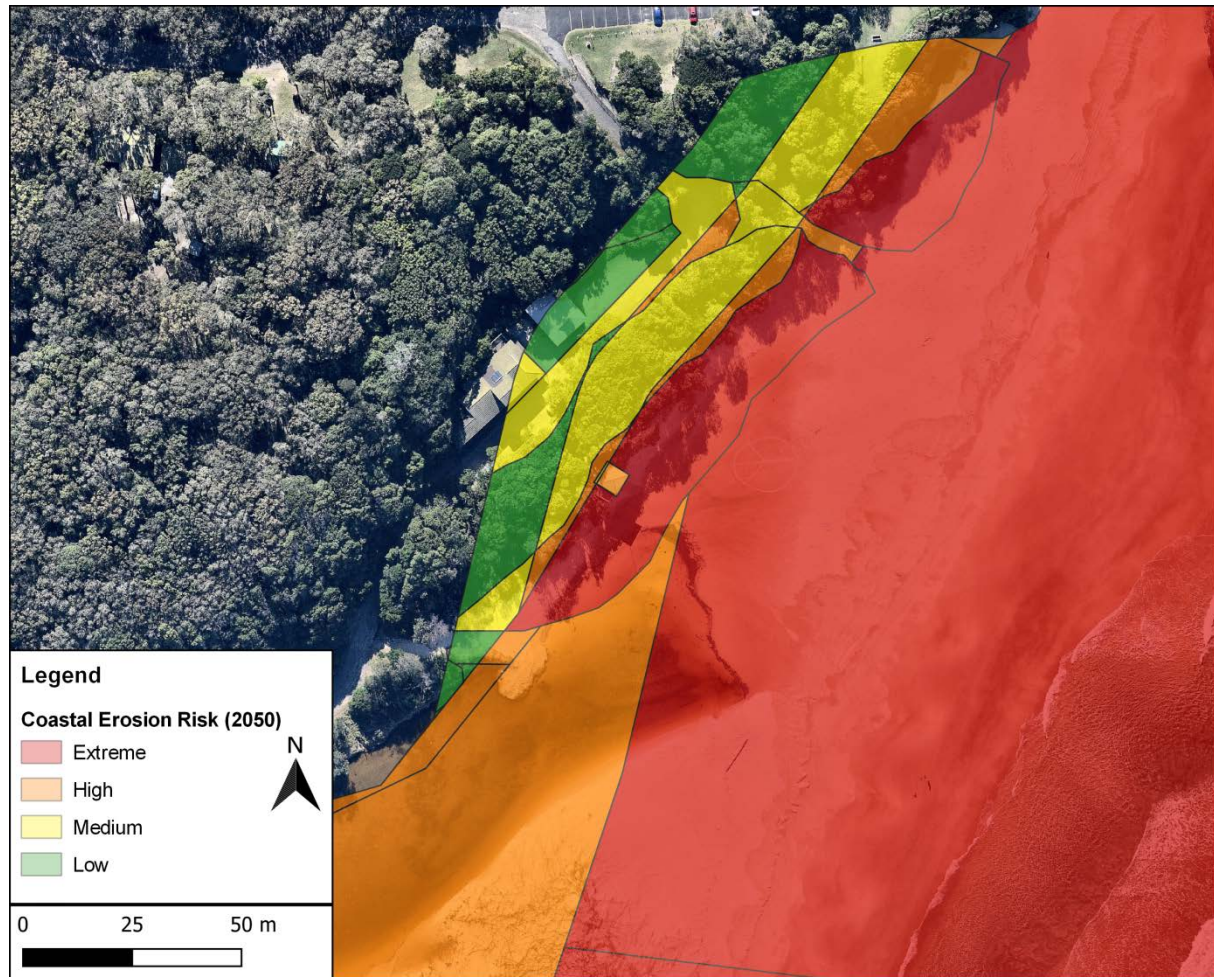


Figure 10: 2050 Coastal erosion risk. Source: Data from BMT WBM (2014)

The impact of climate change and sea level rise on ICOLLs is complex. Cummings *et al.*, (2012) suggest that climate change and sea level rise are likely to impact ICOLLs as follows:

- Sea level rise will result in an increased berm height and raised entrance bed levels.
- Entrance berms are also likely to move laterally in a landward direction due to shoreline recession (Mackenzie *et al.*, 2009);
- Higher beach berm levels would result in increasing mean lake levels and flood levels by the amount of sea level rise
- Increases in wave power would hasten closures after breakouts and, while prolonged droughts could increase closure times, intensified precipitation and runoff could increase the frequency of breakouts.

Powell *et al.*, (2007) modelled the impacts of sea level rise on Dalhousie Creek. Results suggested that in the short term, sea level rise is likely to increase creek berm height due to the position of the entrance at the north end of the beach resulting in a decrease in creek breakout events. As sea levels

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rise further, more effective openings are predicted to return the frequency of breakout events to current level.

More recently, BMT WBM (2014) undertook modelling of future sea level rise impacts on the Bellinghen coast including entrance conditions of ICOLLs, including Dalhousie Creek. BMT WBM (2014) noted that without reliable data for existing berm heights at the ICOLL entrances, it was not possible to assess a likely berm height at present or in the future with sea level rise. For future timeframes, berm heights are expected to increase by an amount roughly equal to the rise in sea level (BMT, 2012).

All stages

The Dalhousie Creek entrance area is a highly dynamic coastal environment and which is subject to a large range of influences including the effects of climate change and sea level rise. The Bellinghen Coastal Zone Management Plan (BMT WBM, 2017) provides management actions to address long-term beach erosion issues and overall coastline management. The actions proposed in this Entrance Management Strategy will need to be adaptive to changing circumstances, but does not aim to address long-term erosion risk, but rather short-term entrance position and beach condition. The proposed works/strategy will be subject to a five-yearly review. This review will need to consider the status of CZMP implementation as well as adjusting the strategy as necessary to meet the overall objectives for coastline management. Potential changes may include adjustments in design berm heights, dry notch location and dimension and beach elevations.

7.3 Vegetation

7.3.1 Estuarine Vegetation

Stage 1

No estuarine vegetation (mangroves, seagrass, saltmarsh) is present within the footprint or the vicinity of the proposed works and therefore no direct impacts estuarine vegetation are expected. There is potential for indirect impacts on estuarine vegetation, particularly seagrass and saltmarsh, if water level patterns within Dalhousie Creek are significantly altered. The intention of the proposed works is not to artificially open the creek entrance or alter opening frequency or duration but rather simply control where the entrance opens. Measures are outlined in Section 8 to ensure that the proposed works do not significantly alter long term water level or entrance opening patterns. Therefore, the proposed works are not expected to impact estuarine vegetation within Dalhousie Creek.

Stage 2 and 3

No incremental impacts on estuarine vegetation are expected as a result of the implementation of Stage 2 and 3 works.

7.3.2 Terrestrial Vegetation

Stage 1

No terrestrial vegetation is directly within the footprint of the proposed works and therefore the works are not expected to directly negatively impact terrestrial vegetation. The creation of the dry notch to encourage the location of the entrance opening may result in the loss of a relatively small area (600 m²) of fore dune vegetation on the southern side of the entrance during initial dry notch establishment. However, vegetation is expected to re-colonise this area following initial works but may be subject to scour during breakout events. The proposed positioning of the dry notch and encouragement of the creek opening in this more southerly position is likely to prevent further northward migration of the southern sand dunes and resultant establishment of fore dune/hind dune vegetation in this area in the long term. However, it should be noted that this position of the entrance is not an unnatural position

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with aerial photography analysis (Figure 6, Section 6.5) indicating entrance opening events within this vicinity in the past.

Sand placement within the sand placement area on the northern side of the entrance north of the 4WD access will result in upper beach creation and formation of fore dunes and rehabilitation of former sand dunes. Approximately 2500 m² of dune habitat is expected to be created however the extent of which this is colonised by dune vegetation is subject to a range of factors. The sand placement will provide a buffer to the existing vegetation from further erosion events. This dune rehabilitation work will be undertaken in conjunction with revegetation of existing dune vegetation and encourage establishment of further fore dune vegetation. Widening the beach and formalising access points will provide better public access to the beach and reduce ad hoc access paths through dune vegetation which currently negatively impacts dune vegetation. In the long term, the sand placement works are expected to have a significant positive impact on dune vegetation on the northern side of the entrance by providing a buffer against future erosion, reducing impacts of ad hoc public access, rehabilitation of existing vegetation and creation of further dune vegetation habitat. Any negative impact on dune vegetation on the southern side of the entrance is expected to be outweighed by the positive impacts on vegetation on the northern side of the entrance.

Stage 2 and 3

No incremental negative impacts on terrestrial vegetation are expected as a result of the implementation of Stage 2 and 3 works.

7.4 Terrestrial Fauna

No impacts on terrestrial fauna are expected as a result of the proposed works.

7.5 Marine and shoreline fauna

7.5.1 ICOLL fauna

Stage 1

There is potential for indirect impacts on ICOLL fauna if the creek opening timing, frequency and duration are significantly altered. The intention of the proposed works is not to artificially open the creek entrance or alter opening frequency or duration but rather simply control where the entrance opens. Measures are outlined in Section 10.1 to ensure that the proposed works do not significantly alter long term water level or entrance opening patterns. As a result the proposed works are not expected to impact fauna within Dalhousie Creek.

Stage 2 and 3

No incremental impacts on estuarine vegetation are expected as a result of the implementation of Stage 2 and 3 works.

7.5.2 Benthic infauna

Stage 1

Beach infauna is expected to be directly impacted by the proposed works through direct impact of machinery (i.e. being run over and crushed). The majority of beach infauna typically concentrate in the lower tidal zone however machinery use may overlap with species with habitat preferences for the upper beach (ghost crab and isopods), or the upper section of the middle shore (beach worm and pipi). These species are efficient burrowers and this may potentially afford some protection from vehicles. Ghost crabs become most susceptible to traffic impacts at night when they are on the beach surface actively feeding. Sand scraping and placement works will only be undertaken during daylight

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hours and therefore the risk of running over mobile crabs on the surface is significantly reduced. Measures are outlined in Section 8.3 to minimise the impact of direct machinery impact on beach infauna.

The proposed works may also impact on beach infauna is through the actual scraping and placement of sand. This process can impact beach infauna either directly through contact/crushing from machinery, burial within the sand stockpile or dislocation/death when excavated/bulldozed. Indirect impact occurs through alteration of sediment processes and beach slope, effects on food resources and possibly vibration.

No field studies on this aspect have been undertaken for Hungry Head Beach, however a study conducted by Smith *et al.* (2011) on the effects of beach scraping on beach infauna at New Brighton beach NSW provides an excellent indication of the potential impacts on beach infauna. These scraping works involved removing up to 0.5m of sand from the intertidal zone along 1.3 km of beach, a much larger and more significant operation than proposed for this project (0.25 m over 130 m x 40 m area). The Smith *et al.* (2011) study concluded that beach scraping had no detectable effect on the infauna biodiversity and assemblage patterns at New Brighton beach, even within one day of the impact. As most beach animals inhabit the upper layer of the beach (e.g. the top 0.1 m), the works would have resulted in the complete defaunation of the impacted areas (Smith *et al.*, 2011). However, the lower beach and shallow sub-tidal region, which generally has a higher diversity (Hacking, 1998) and was undisturbed by scraping, may act as a source of highly mobile recruits that are capable of rapidly colonising disturbed areas. Many of the mobile crustaceans, which were by far the most numerous animals encountered during the study, are scavengers and have the ability to move to food sources washed in by the tide (Smith *et al.*, 2011). These are also the taxa that show the greatest level of natural migration with tidal movement (Hacking, 1996).

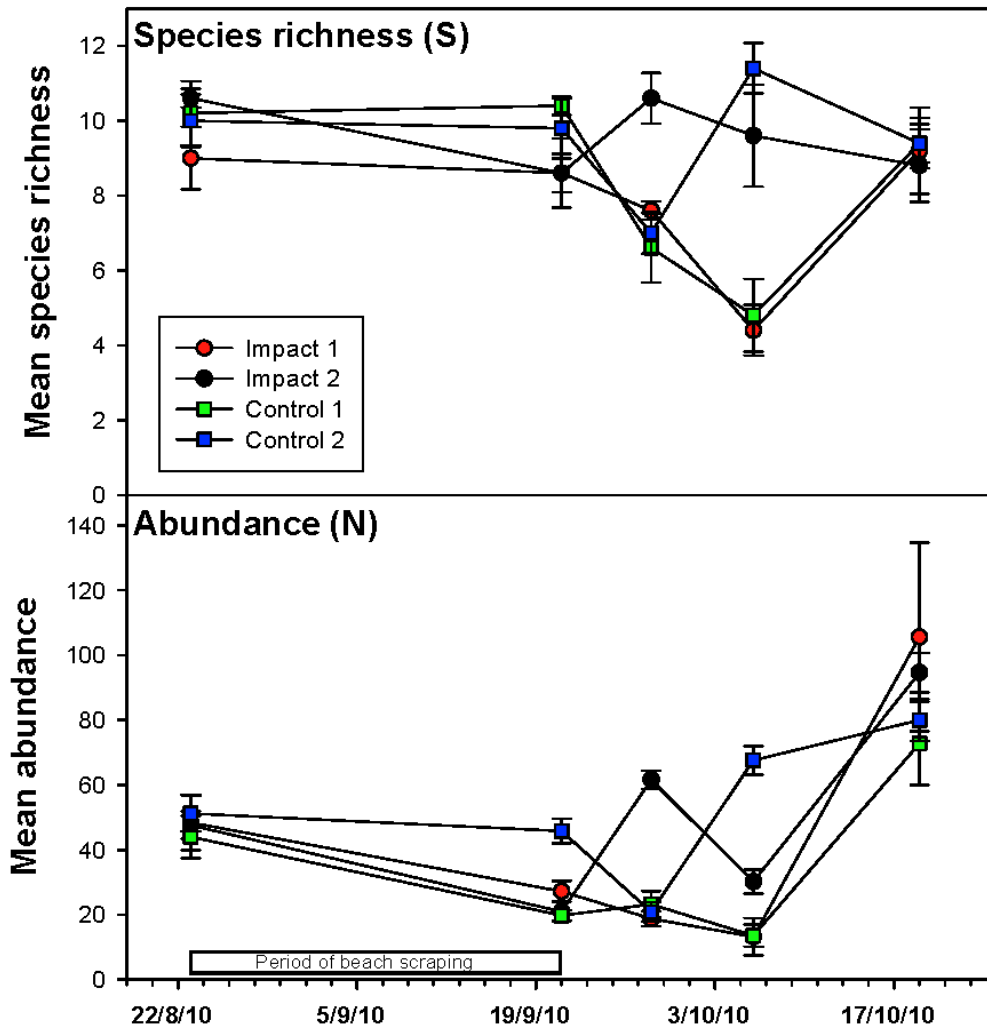


Figure 11: Species richness and abundance in response to beach scraping (Smith *et al.* 2011)

Smith *et al.* (2011) also attribute rapid recover to the highly dynamic conditions at the beach and the fact that the overall beach characteristics (e.g. beach granularity) were unaltered. Their conclusion was that large scale physical processes, in particular, the prevailing wave climate, were the greatest drivers of beach fauna composition and abundance.

The proposed works may negatively impact on some beach infauna species during dry notch establishment/maintenance, beach scraping and placement. However, the creation and maintenance of upper beach and dune habitat on the northern side of the entrance will create a large area of suitable habitat for upper beach infauna. Overall, given the implementation of recommended mitigation measures and the relatively small scale area of disturbance and intermittent (4/year) nature of the proposed beach scraping and sand placement any impact on beach infauna is expected to be minor and acceptable.

Stage 2 and 3

No incremental impacts on beach infauna are expected as a result of the implementation of Stage 2 and 3 works.

7.5.3 Marine turtles

All stages

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No marine turtles have been recorded nesting within the footprint or within the vicinity of the proposed works area however the sandy beach habitat, particularly south of the current entrance position, provides potentially suitable nesting habitat for Green Turtle (*Chelonia mydas*) and Loggerhead Turtle (*Caretta caretta*) and their future presence at the site cannot be discounted. Both species are a threatened species and relevant assessments of significance and discussion of potential impacts have been prepared for the species (Appendix 3).

Results from the assessments of significance indicate that the proposed works are unlikely to significantly negatively impact either species. Measures to minimise disturbance of the species are outlined in Section 8.4.

7.5.4 Shorebirds

All stages

A number of threatened resident shorebird species and migratory shorebird species may potentially utilise habitat within the proposed works site. Relevant assessments of significance and discussion of potential impacts have been prepared where considered necessary (Appendix 3).

Results from the assessments of significance indicate that the proposed works are unlikely to significantly negatively impact shorebird species. Measures to minimise disturbance of shorebirds are outlined in Section 8.3.

7.6 Air Quality

All stages

The potential for minor air quality impacts may arise during the works from generation of exhaust from machinery. With the control measures in place during construction (Section 8.2), these short-term and minor air quality impacts are not expected to significantly impact the community.

7.7 Noise

All stages

Noise monitoring has not been conducted at the site but it is reasonable to assume that background noise levels are low given the passive recreational nature of the area. The level of noise generated by machinery during works is expected to exceed background ambient noise levels. Such exceedances will only be temporary and restricted to works hours. It may result in an impact on beach amenity during works but due to the temporary nature any impact on the community is expected to be minor. Measures are outlined in Section 8.1 to minimise any noise impact on beach users.

7.8 Waste

All stages

General construction and personnel waste will be generated during the proposed works although it is expected to be minimal. The waste management measures recommended in Section 8.1 will manage any impacts.

7.9 Beach Access

Stage 1

Currently public access to Hungry Head Beach is severely compromised by erosion of the foreshore caused by the alignment of the Dalhousie Creek entrance. The proposed works are expected to improve public access to the beach in a number of ways including:

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- Encourage creek entrance opening to occur to the south of the 4WD access and thereby minimising the risk of erosion by the creek;
- Increase beach levels in the vicinity of the 4WD access track to restore emergency and USLSC access to the beach;
- Restore erosion of and increase beach levels within the vicinity of the USLSC lookout tower access way;
- Improve current pedestrian access ways;
- Increase in beach and dune levels to mitigate future erosion of access.

The proposed works are expected to significantly improve public access to Hungry Head Beach in the long term. However, it should be noted access to areas of the beach will be temporarily restricted during actual works. This will be required to maintain public safety. Relevant mitigation measures are outlined in Section 8.5. Any impact caused by temporary restricted access during works will be temporary and minor is expected to be outweighed by the long term improvements in public access.

Stage 2 and 3

No further incremental negative impacts on beach access are expected as a result of the implementation of Stage 2 and 3 works. Implementation of these stages would be expected to only further protect and improve public access to the beach.

7.10 Beach Amenity

Stage 1

The Dalhousie Creek entrance precinct could be considered to have a high natural amenity. The presence of machinery undertaking beach enhancement works on the beach may have a perceived impact on the general and visual amenity of the area. Any impact on visual amenity is expected to be restricted to the works phase (i.e. when machinery are on the beach) and therefore any impact is expected to be minor and temporary. In the long term, the creation of a large upper beach area, fore dunes and restoration of existing hind dunes is expected to improve the overall visual amenity of the area.

Stage 2

The presence of GSCs on the beach may slightly detract from the visual amenity of the beach area. However, with the application of measures outlined in Section 8.7 impacts of the GSCs on visual amenity can be reduced to an acceptable level.

Stage 3

As with GSCs, the presence of a rock wall on the beach may slightly detract from the visual amenity of the beach area. However, with the application of measures outlined in Section 8.7 impacts of the rock wall on visual amenity can be reduced to an acceptable level.

7.11 Cultural Heritage

All stages

No specific cultural heritage values/sites have been identified at the site. However, given the extensive indigenous history of the area and the location of the aboriginal site on the headland within close vicinity of the works site, there is potential for aboriginal cultural heritage values to exist within the proposed works areas. The measures recommended in Section 8.6 will inform the management of any potential Aboriginal Cultural Heritage Values.

8. PROPOSED ENVIRONMENTAL PROTECTION MEASURES

To ensure an acceptable level of impact from the works, it will be necessary to implement a range of risk mitigation measures as outlined below.

8.1 General measures

- All beach scraping works involving machinery are to be undertaken outside peak beach usage periods (i.e. not weekends, public holidays or school holidays). This does not include passive works such as monitoring.
- Hours of operation for any noise generating activity (Monday to Friday 7.00am to 6.00pm);
- All waste including construction waste and litter, food scraps, etc. are to be removed from site and disposed of at appropriate waste management facilities;
- All contractor personnel to be briefed on environmental issues, sensitive areas and application of all relevant environmental management measures.

8.2 Pollution

- Any storage of fuel, lubricants or other compounds to occur within appropriately bunded/secured areas off the beach.
- Appropriate spill kits (aquatic and land spills) to be present on site and/or within all vehicles.
- No refuelling or maintenance (except emergency) is to be conducted on the beach or within 50 m of creek/beach or drains leading to the creek/beach.
- All plant to be used on the beach is to be clean (no fluid leaks or excessive foreign material) well maintained and in good working order.

8.3 Coastal processes

- The maximum dry notch bed level is to be less than +1.8 m AHD, and marginally (say 0.1m) lower than the natural berm level as surveyed prior to each works event;
- Beach scraping to only remove sand down to 0.25 m below existing ground level;
- GSC placement and rock wall to be designed and constructed in a manner as to not significantly interrupt coastal sand movement but rather to direct creek flow and resultant entrance position.

8.4 Marine and shoreline fauna

- Heavy machinery are not to traverse the area below mean low tide (even if drivable sand is available – e.g. during spring low tides) in order to reduce the impact on concentrated beach infauna within this zone.
- Plan works to minimise heavy machinery movements as much as practically possible.
- During marine turtle breeding season (October-May) a survey for evidence of marine turtle nests (turtle tracks, hatchlings) should be undertaken across the site at the commencement of each day of operations. If evidence is identified, work should not commence in immediate area and NPWS should be contacted immediately;
- Similarly, a survey of the site for evidence of Little Tern, Australian Pied Oystercatcher and Beach Stone-curlew nesting should be undertaken on each day prior to commencement of works during breeding season (September-February). If evidence is identified, work should not commence in the immediate area, NPWS should be contacted immediately;

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- Works should not commence at or adjacent (within 200 m) to any large flocks of migratory birds.

8.5 Beach safety

- During works a visible barrier will be installed at the boundaries of the operational area to clearly demarcate the works area and alert the public to activities.
- Operators on the beach will take all reasonable and practicable measures to protect any persons who may enter or approach the works site from being exposed to risks to their health, safety and welfare.
- Operators of heavy machinery and vehicles will operate the vehicles at safe speeds at all times, consistent with the conditions on the beach, and will not exceed 30 km/h at any time.
- Any rock to be placed in a manner so as to not create a public safety hazard (i.e. appropriate roundness, sufficient stability of rocks, minimise voids etc.)

8.6 Aboriginal/Cultural Heritage

- In the case of an unexpected find occurring within the area of the proposed activity then the procedures as set out on page 13 of the OEH Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (OEH 2010) must be followed;
- Any suspected artefacts or human remains should be protected and notified to NPWS and for remains, NSW Police in accordance with this code of practice.

8.7 Visual Amenity

- GSCs should be constructed from a neutral sandy coloured material and filled with native sand;
- Integrity of GSCs should be regularly monitored to ensure debris from broken bags does not occur;
- GSCs and rock wall should be placed in an inconspicuous manner, at least partially covered by sand.

8.8 Monitoring and Review

- Discussion of monitoring requirements and plan review is provided in Part 1: Entrance Management Policy & Implementation

9. CONSIDERATION OF FACTORS UNDER CLAUSE 228 OF THE EP&A REGULATION 2000

Clause 228 of the *EP&A Regulation 2000* indicates, for purposes of Part 5 of the Act, the factors that must be taken into account when consideration is being given to the likely impact of an activity on the environment. The various factors and findings following the environmental impact assessment and considering the environmental control measures of the proposed works are presented below.

a) Any environmental impact on a community

Beach enhancement works will have a temporary impact on beach amenity and beach access. However, the works are expected to have significant long term positive impacts for the community through the provision of vastly improved beach access and amenity.

b) Any transformation of a locality

The works are expected to alter the beach formation within the vicinity of the Dalhousie Creek entrance. However the works are expected to rehabilitate erosion and significantly improve beach access to Hungry Head beach and increase the attractiveness of the areas for recreational activities.

c) Any environmental impact on the ecosystem of the locality

Minor adverse impacts on ecosystems are expected with the environmental measures in place as discussed in Section 8. Discussion on the impacts on beach infauna are provided in Section 7.5.2 Assessments of significance for potential impacts on threatened species (shorebirds and marine turtles) in the attachments to this REF.

d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality

The beach enhancement works through the improvement of beach access, creation of large areas of upper beach are expected to have a significant positive impact on the recreational value of Hungry Head Beach. Temporary impacts on the aesthetic value of the area may occur however the works are expected to improve the overall aesthetics of the area in the long term. No reduction in the scientific or environmental quality of the locality is expected.

e) Any effect on a locality, place or building having aesthetic, anthropological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations

No impacts anticipated.

f) Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)

No significant impacts anticipated.

g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air

No significant impacts anticipated.

h) Any long-term effects on the environment

No impacts anticipated.

i) Any degradation of the quality of the environment

No impacts anticipated. The project is anticipated to lead to a long-term improvement of the environment.

j) Any risk to the safety of the environment.

No impacts on public safety are anticipated. Significant improvement in public safety is envisaged.

k) Any reduction in the range of beneficial uses

No impacts anticipated. Significant improvement in beneficial use is envisaged.

l) Any pollution of the environment

No impacts anticipated. All pollution risks during construction can be managed through standard measures.

m) Any environmental problems associated with the disposal of waste

No impacts anticipated.

n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply.

No impacts anticipated.

o) Any cumulative environmental effect with other existing or likely future activities.

No impacts anticipated.

p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions.

No significant impacts anticipated.

10. CONCLUSION

Pursuant to the provisions of the Environmental Planning and Assessment Act, 1979 (EP&A Act), this Review of Environmental Factors (REF) has been prepared by Hydrosphere Consulting on behalf of Bellingen Shire Council. The applicable environmental planning instrument for the proposed works is State Environmental Planning Policy (SEPP) (Infrastructure), 2007. Under this SEPP, the works do not require development consent and therefore have been assessed under Part 5 of the EP&A Act. Bellingen Shire Council is the determining authority for the proposed works. Under Part 5 of the EP&A Act, Bellingen Shire Council must examine and take into account to the fullest extent possible all matters which are likely to affect the environment if the activity goes ahead.

Consideration has been given to the likely impact of the proposed works on the environment, having regard to all relevant factors. With application of site specific environmental control measures the expected environmental impacts of the proposal are considered to be localised, short-term and minor.

Based on the outcomes of the assessment presented in this REF it is concluded that by adopting the identified measures, it is unlikely that the proposal would result in significant adverse environmental impacts.

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APPENDIX 1: SITE PHOTOGRAPHS – JUNE 2018



Plate 1. Drone image showing USLSC clubhouse, lookout, 4WD entrance and creek mouth. Note wet sand due to low-lying nature of beach immediately east of the lookout.



Plate 2. Pedestrian access stairs running under the USLSC lookout tower (looking south east)

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Plate 3. Temporary access ramp for pedestrians under USLSC lookout tower (looking west)



Plate 4. USLSC lookout tower and pedestrian access ramp (looking north east)

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Plate 5. View from emergency 4WD access point (looking north east)



Plate 6. Remains of old access stairs and old surf club foundations (looking west)

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Plate 7. Eastern bank of middle Dalhousie Creek



Plate 8. Lower reaches of Dalhousie Creek (looking north east towards entrance)

APPENDIX 2: CONSULTATION

As a part of the Dalhousie Creek Entrance Management Strategy REF consultation process a number of key stakeholders were contacted with regard to the proposal and invited to provide comment. Contact with stakeholders was initiated by Hydrosphere Consulting on behalf of BSC on 9th August 2018 notifying these stakeholders of the proposed activities. Follow-up contact (phone call/email) was made with stakeholders to elicit a response if one was not received within the requested response timeframe (21 days). Stakeholder responses were received in writing by letter or email. The intention of stakeholder consultation is to ensure that issues raised by stakeholders are addressed in the preparation of the REF. The feedback received as part of this process is summarised below as well as being discussed in the relevant REF sections as indicated below.

AGENCY	SUMMARY OF SUBMISSION	COMMENTS/ RESPONSE	Location in REF
DPI Fisheries	Justification for the works and options of lesser impact that have been considered, for example, the feasibility of planned retreat of the USLSC tower and relocation of the 4WD access point. This should include a discussion on the likely extent and rate of erosion to the foreshore if the entrance is left 'unmanaged'.	Details provided in relevant sections REF. Future coastal erosion and shoreline recession details are provide in <i>Bellinghen Coastal Zone Management Study (BMT WBM, 2014)</i> . The entrance area and the northern bank (north of 'the rock') lies within a 2050 extreme erosion risk area as identified in BMT WBM (2014).	Section 3 (Part 2: REF) Section 7.2.4 (Part 2: REF)
	Specific details of the location and dimensions (including elevations and approximate sand volumes) of the dry notch and details of the beach nourishment works (including the extent of infilling of the existing channel).	Details provided in relevant sections REF and strategy documents.	Section 2 (Part 2: REF) Section 3 (Part 1: Strategy) Appendix 1 (Part 1: Strategy)
	A discussion on how Stage 1 activities may affect the frequency of natural break out events.	The intention of the works is not to alter the frequency of natural breakout events (considered to be 1 – 2 times per year). Mechanisms have been incorporated into the strategy to ensure this including maintenance of dry notch bed level, monitoring of berm heights and artificial opening of the entrance if required.	Section 3 and Section 5 (Part 1: Strategy)

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AGENCY	SUMMARY OF SUBMISSION	COMMENTS/ RESPONSE	Location in REF
	The trigger level and other requirements for initiating an artificial opening. Note that a permanent water level gauge within Dalhousie Creek may provide useful information for both monitoring and artificial opening decisions.	Artificial opening of Dalhousie Creek is considered as a last resort entrance management option. The strategy has been designed to minimise the need for artificial entrance opening however mechanisms have incorporated into the strategy to facilitate artificial opening of the creek if required, including the installation and monitoring of a water level monitor within Dalhousie Creek.	Section 4.2.4 and Section 5 (Part 1: Strategy)
Office of Environment and Heritage	Provided standard requirements that may need to be addressed in an REF.	It is considered that relevant requirements have been adequately addressed throughout the REF.	-
	Include assessment of the potential impacts on biodiversity, including threatened species, populations, ecological communities, or their habitats likely to occur on or near the site as well as Aboriginal cultural heritage values, flooding and estuary management.	See relevant sections of REF.	Section 7 (Part 2: REF)
	Given the nature of Dalhousie Creek as an ICOLL and the elevation of surrounding properties it is unlikely that the entrance management strategy will present any significant flood issues. Nonetheless the impacts of the proposal on flood risk should be considered.		
Coffs Harbour and District Local Aboriginal Land Council	No objections to the proposed works.	-	-
	Understand that the works might be complex and are wary of the environmental impacts of the proposed works.	The REF examines and takes into account to the fullest extent possible all matters which are likely to affect the environment as a result of the proposed works.	Section 7 (Part 2: REF)
	Advise of the interest of the Gumbaynggirr people and their successful Native Title determination in that area last year	Notification of the project has been undertaken through NTSCorp..	Section 4 (Part 2: REF)
	Suggest to offer interested parties the opportunity to undertake a sight inspection with yourselves or Bellingen Shire Council to better understand the works and provide more meaningful input.	Two site workshops have been undertaken where relevant stakeholders have been invited to attend. A CHDLALC representative attended the second workshop.	
DoI – Lands and Water	Key consideration for the Strategy will be the requisite licencing arrangements with Department of Industry – Crown Lands for works to be undertaken on Crown land.	It is understood that a Crown Lands licence is likely to be required for the proposed works.	Section 5.4 (Part: REF)

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AGENCY	SUMMARY OF SUBMISSION	COMMENTS/ RESPONSE	Location in REF
	Important to fully recognise and appreciate the extent of Aboriginal interests in the lands at Dalhousie Creek following the recent Gumbaynggirr Native Title Consent Determination.	See relevant sections of REF.	Section 6.11 and 7.11 (Part 1: REF)
NTSCorp	No response received by 30/08/2018. A phone call from NTSCorp was received on 03/09/2018 indicating that NTSCorp would be sending out letters regarding the works to interested parties.	-	-

APPENDIX 3: ASSESSMENTS OF SIGNIFICANCE

Biodiversity Conservation Act 2016 – Tests of Significance

Background

The *Biodiversity Conservation Act 2016* (herein the 'BC Act') sets out the assessment framework for threatened species and ecological communities, which are now listed under this Act, for activities and approvals under Part 5 of the *Environmental Planning and Assessment Act 1979*. To determine whether the proposed activity is likely to significantly affect threatened species or ecological communities, or their habitats a 'test of significance' must be applied. The criteria for this test are set out in Section 7.3 of the BC Act. If it is found that the proposed activity is likely to significantly affect threatened species or will be carried out in a declared area of outstanding biodiversity value, the proponent must either apply the Biodiversity Offsets Scheme or prepare a Species Impact Statement (SIS). If the proposed activity will not have a significant impact on threatened species or areas of outstanding biodiversity value it will continue to be assessed under s.111 of the *Environmental Planning and Assessment Act 1979*.

The Dalhousie Creek entrance area provides habitat for a range of flora and fauna species and communities of which are considered in Section 6.7 – 6.9 of the main project REF (i.e. *Part 2: Background Information and Review of Environmental Factors*). The following species are listed as threatened species under the BC Act and have been recorded at or have habitat conducive to their presence within the Dalhousie Creek entrance area and are potentially exposed to risks by the proposed works:

- Australian Pied Oystercatcher (*Haematopus longirostris*) – Endangered
- Beach Stone-curlew (*Esacus magnirostris*) - Critically Endangered
- Little Tern (*Sternula albifrons*) – Endangered
- Green Turtle (*Chelonia mydas*) – Vulnerable
- Loggerhead Turtle (*Caretta caretta*) - Endangered

Tests of significance for the above species have been prepared in accordance with the BC Act and are presented in the following sections.

The term 'beach enhancement works' used throughout this document refers to the full scope of works described within Section 2 of the project REF and includes:

- Dry notch establishment and maintenance;
- Beach scraping;
- Sand placement and upper beach and dune creation;
- Dune rehabilitation;
- Placement of the geotextile containers; and
- Construction of the rock wall.

Tests of Significance

Australian Pied Oystercatcher (*Haematopus longirostris*)

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

H. longirostris generally forage, roost and nest on sandy beach environments. *H. longirostris* are likely to utilise the intertidal zone for foraging and the upper beach zone for roosting and potentially nesting, particularly to the south of the entrance. The *H. longirostris* breeding season is considered to be from late winter (August) to late summer (January) (OEH, 2017) and generally exhibit a high level of site fidelity - nesting at the same site every year (Dept. of Lands, 2007).

There are no records of *H. longirostris* nesting within the Dalhousie Creek entrance precinct although the species have been observed foraging and roosting in the area. The Dalhousie Creek entrance precinct is not located within a Pied Oystercatcher Priority location as identified by DECCW (2010). The nearest Pied Oystercatcher Priority location as identified in DECCW (2010) is the Nambucca River estuary, located approximately 14 km to the south. Nonetheless, *H. longirostris* habitat exists within the proposed works area at the Dalhousie Creek entrance. The upper beach and foredunes provide potential roosting and nesting habitat. This habitat on the northern side of the entrance is a high recreation area that is frequently used by humans (particularly during the warmer months) which is likely to deter nesting *H. longirostris* from the area. A large stretch of suitable alternative habitat with a lower degree of disturbance is located along Hungry Head Beach to the south. The upper beach and foredunes to the south of the entrance are likely to be more favourable nesting and roosting habitat. *H. longirostris* are likely to intermittently utilise the intertidal beach for foraging.

Nesting and roosting pairs may be disturbed by machinery during beach enhancement works and the works may temporarily alter nesting habitat. The area of interest on the northern side of the entrance has undergone serious erosion in recent years. The resulting lack of suitable nesting habitat, combined with significant levels of human disturbance means that this northern side is unlikely to currently offer any important habitat for this species. The beach nourishment and dune building aspect of this proposal could potentially add new nesting habitat, although the human disturbance aspect will remain and any benefits in this regard will be marginal. The provision of an attractive beach on the northern side of the entrance and the establishment of the creek entrance further to south is likely to encourage people (a disturbance to *H. longirostris*) to stay on the northern side of the entrance away from more favourable *H. longirostris* habitat to the south, potentially reducing human impacts on the species in the long term.

H. longirostris feed on benthic invertebrates, predominantly bivalves and particularly *Donax deltooides* (pipi), foraged from within the intertidal zone. *D. deltooides* tend to concentrate on the lower beach however are a mobile species that will move along the beach slope as required by beach conditions.

The intermittent (up to 4 times per year) use of heavy machinery may temporarily disturb and deter foraging *H. longirostris* from the intertidal zone within and directly adjacent to the beach scraping area during the works. However, due to the restricted location of scraping in a high human disturbance area, as well as the large areas of similar habitat nearby, this is considered to be a minor spatial impact.

Beach scraping works may temporarily directly impact *D. deltooides* during works however are expected to recover soon after works and hence the small scale spatial impacts are also expected to be minor in duration. The proposal also seeks to reduce impact on *D. deltooides* by restricting works to above mean low tide level. Due to the intermittent nature of the works, relatively small area affected,

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avoidance of areas of maximum prey density and reported high recovery rates of benthic infauna any impact on the *H. longirostris* feeding resource is expected to be minor and temporary.

To reduce the potential for any impact on *H. longirostris* habitat within the Dalhousie Creek entrance precinct area the following recommendations should be implemented:

- Where works are to be undertaken between August and January a survey of the site for evidence of *H. longirostris* nesting should be undertaken on each day prior to commencement of works. If individuals are identified, works are to cease within 100 m of individuals and NPWS are to be contacted.
- A speed limit of 30 km/h for machinery within the works area should be implemented to minimise any risk of direct mortality of birds by construction machinery.
- Works machinery and vehicles are to be restricted to the defined access tracks and works areas.

The proposal is not expected to have an adverse impact on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not applicable.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The Dalhousie Creek entrance area will be disturbed by machinery noise and traffic and workers during beach works. This impact is expected to be minor and temporary as it is restricted to actual works that will be undertaken intermittently (4 times per year). Due to the frequent recreational use of the beach, the works area is not considered high value habitat. The works will result in a beach, dune and entrance channel morphology that is within the bounds of natural variability and the works disturbance factor is temporary and not likely to be significant.

The beach enhancement works have the potential to improve habitat on the northern side of the entrance. As mentioned above, the provision of an attractive beach on the northern side of the entrance and the establishment of the creek entrance further to south may entice people (a disturbance to *H. longirostris*) to stay on the northern side of the entrance away from more favourable *H. longirostris* habitat to the south, potentially reducing human impacts on the species and improving habitat value to the south of the entrance.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

Due to the nature of the works *H. longirostris* habitat is unlikely to become fragmented or isolated from other areas of habitat.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The small area of potential *H. longirostris* habitat that is likely to be temporarily disturbed is considered to be of low importance in terms of the long-term survival of the species, population or ecological community in the locality.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No area of outstanding biodiversity value present.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

The proposed works are not or part of key threatening process nor are they expected to increase the impact of a key threatening process.

Beach Stone-curlew (*Esacus magnirostris*)

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

E. magnirostris feed on a variety of crustaceans (mainly crabs) across a range of intertidal habitats including sand flats, sandbars, beaches, mangroves and rocky shorelines (NSW Scientific Committee, 2008). Breeding occurs from early spring through to early autumn, with nests usually being a scrape in the sand above the high tide mark. Nesting sites are generally on sandbanks, sand-spits in estuaries, among mangroves or sandy areas surrounded by short grass. *E. magnirostris* occur more prevalently on ocean beaches during the non-breeding season.

There is one record, from 1999, of *E. magnirostris* occurring within the vicinity of the Dalhousie Creek entrance however there have been no recorded observations since. The Dalhousie Creek entrance precinct is not located within a Beach Stone-Curlew Priority location as identified by DECCW (2010). The nearest Beach Stone-Curlew Priority (3) location as identified in DECCW (2010) is the Bellinger River estuary. The Nambucca River estuary, located approximately 14 km to the south, is considered to be a Priority 1 location for Beach Stone-Curlew. Further, the Dalhousie Creek entrance area is a frequently used recreational area that experiences high levels of human traffic which is likely to currently disturb or deter *E. magnirostris* from frequently utilising the area. Nevertheless, the area does provide some potential foraging habitat for *E. magnirostris*, particularly during the non-breeding season when they are more likely to utilise ocean beaches.

Beach enhancement works will temporarily disturb potential feeding habitat, however, given the restricted location of scraping in a high human disturbance area, as well as the nearby areas of similar habitat, is considered to be a minor impact. Nearby foraging birds may be disturbed during works however, *E. magnirostris* are generally nocturnal feeders (Mellish & Rohweder, 2012) and as works are restricted to daylight hours and are intermittent, occurring approximately 4 times per year, any foraging individuals are unlikely to be significantly disturbed. The beach enhancement works have the potential to temporarily change beach infauna assemblages which are potential *E. magnirostris* prey. In general, beach infauna are very well adapted to living in a highly dynamic environment (Hacking, 1996; Smith *et al.*, 2011). Smith *et al.*, (2011) found that beach infauna assemblages rapidly recover following beach scraping operations. As such beach assemblages within the works area are expected to return to pre-works condition within a relatively short period of time and this factor is not expected to significantly impact *E. magnirostris*.

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The provision of an attractive beach on the northern side of the entrance and the establishment of the creek entrance further to south is likely to encourage people (a disturbance to *E. magnirostris*) to stay on the northern side of the entrance away from more favourable *E. magnirostris* habitat to the south, potentially reducing human impacts on the species in the long term.

Any impact on *E. magnirostris* as a result of the proposed works is considered to be minor and temporary and is such that it is not expected to have an adverse impact on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction. To reduce the potential for any impact on *E. magnirostris* habitat around the dewatering and nourishment site the following recommendations should be implemented:

- Where works are to be undertaken between September and February a survey of the site for evidence of *E. magnirostris* nesting should be undertaken on each day prior to commencement of works
- A speed limit of 30 km/h for machinery within the works area should be implemented to minimise any risk of direct mortality of birds by construction machinery.
- Works machinery and vehicles are to be restricted to the defined access tracks and works areas.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not applicable.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The area of the proposed beach enhancement works will be disturbed by machinery noise and traffic and workers during the activity. Beach nourishment operations may also temporarily disturb foraging habitat and alter food resources at the site. These impacts are expected to be minor and temporary. Due to the frequent recreational use of the beach, the works area is not considered high value habitat. The works will result in a beach, dune and entrance channel morphology that is within the bounds of natural variability and the works disturbance factor is temporary and not likely to be significant.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

Due to the nature of the works *E. magnirostris* habitat is unlikely to become fragmented or isolated from other areas of habitat.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

Beach enhancement works may temporarily disturb feeding *E. magnirostris* and temporarily alter foraging habitat within the beach scraping and sand placement areas. This impact is expected to be

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minor and temporary and due to the relatively small area and other nearby (less disturbed) habitat, the habitat within the vicinity of the beach enhancement work is considered to be insignificant.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No area of outstanding biodiversity value present.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

The proposed works are not or part of key threatening process nor are they expected to increase the impact of a key threatening process.

Little Tern (*Sternula albifrons*)

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

S. albifrons migrate to the east coast of Australia to breed during September to November. Generally nesting occurs from October through January-February before birds leave from March to May (NPWS, 2003). *S. albifrons* generally nest on open, flat or gently sloping ground with good visibility all around, on a loose, sandy substrate with abundant surface shell-grit or pebbles, and bare or almost bare of vegetation (NPWS, 2003). Nests are generally a small scrape in the sand above the high tide mark on sand-spits, sand islands or beaches within or adjacent to the estuaries of rivers, creeks and coastal lakes (NPWS, 2003).

There are no recent or historical records of *S. albifrons* occurring within the Dalhousie Creek entrance area however the area does provide potential *S. albifrons* nesting and roosting habitat, particularly the berm at the entrance and the low fore dunes on the southern side of the entrance. There is some potential that the species may intermittently utilise the habitat for nesting and roosting. However, it is likely that frequent human activity occurring on the beach is a threat to the breeding success of *S. albifrons* at this location and as such is not likely to be heavily utilised by breeding individuals.

The beach enhancement works, particularly the dry notch establishment and maintenance have the potential to impact nesting habitat and disturb *S. albifrons* present. To minimise the risk of any impacts it is recommended that during *S. albifrons* breeding season (September - November) the beach enhancement works area be inspected for *S. albifrons* and potential *S. albifrons* nests and young (runners) prior to the start of works each day. If individuals are identified, works are to cease within 100 m of individuals and NPWS are to be contacted.

The provision of an attractive beach on the northern side of the entrance and the establishment of the creek entrance further to south is likely to encourage people (a disturbance to *S. albifrons*) to stay on the northern side of the entrance away from more favourable *S. albifrons* habitat to the south, potentially reducing human impacts on the species in the long term.

The proposal is not expected to have an adverse impact on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

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Not applicable.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The Dalhousie Creek entrance area will be disturbed by machinery during beach enhancement works. Due to the frequent recreational use of the beach, the works area is not considered high value habitat. The works will result in a beach, dune and entrance channel morphology that is within the bounds of natural variability and the works disturbance factor is temporary and not likely to be significant.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

S. albifrons habitat is unlikely to become fragmented or isolated from other areas of habitat.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

Due to the currently disturbed nature of the site, the small area of potential *S. albifrons* habitat that is likely to be temporarily disturbed is considered to be insignificant.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No area of outstanding biodiversity value present.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

The proposed works are not or part of key threatening process nor are they expected to increase the impact of a key threatening process.

Loggerhead Turtle (*Caretta caretta*) and Green Turtle (*Chelonia mydas*)

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Both species (*C. caretta* and *C. mydas*) of marine turtle require open sandy beaches to lay eggs with sand temperatures between 25-33°C to successfully hatch. The Dalhousie Creek entrance area is potential nesting habitat for both species of turtle with the area being at the very southern tip of their nesting ranges. There is some potential that females may temporarily visit the beach to nest during their breeding seasons- in southern Queensland this can occur from October to March for *C. caretta* (Limpus 2008a) and from October to May for *C. mydas* (Limpus, 2008b). There are no records of either species nesting within the vicinity of the Dalhousie Creek entrance area. There are scattered records of both species nesting on Coffs Coast beaches further to the north however they are very sparse. Nonetheless, the Dalhousie Creek area does potentially provide nesting habitat for both species.

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The proposed beach enhancement works have the potential to impact turtle nesting habitat. The works will alter beach habitat although not to the detriment of nesting potential. The upper beach and dune creation may improve nesting habitat, although is likely to be low value due to high human activity, however is likely to be an improvement on current habitat. The most likely threat from the works is direct impact on the nests by machinery. The beach scraping works are unlikely to impact nests as the works are occurring below high tide mark however sand placement, upper beach/dune creation and dry notch establishment and maintenance could potentially directly affect nests. To minimise this risk it is recommended that during breeding/hatching season (October- May) a survey for evidence of marine turtles (tracks/nests) is undertaken each day prior to the commencement of works. If any evidence is identified works should not commence within the vicinity of the area (and NPWS should be contacted immediately). The works are not expected to disturb nesting females or hatched juveniles as this generally occurs at night.

With the application of the recommended mitigation measures the proposed works are not expected to adversely impact turtle nesting habitat. The proposal is not expected to have an adverse impact on the lifecycle of either species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Not applicable.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

No nesting habitat is expected to be removed as a result of the proposed works. The current beach habitat will be altered as a result of the works however is not expected to negatively impact nesting habitat. As mentioned above the upper beach and dune creation may improve nesting habitat. Nests may be directly impacted by machinery however the measure recommended above is expected to mitigate this potential threat.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

Marine turtle nesting habitat is unlikely to become fragmented or isolated from other areas of habitat.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The majority of major nesting sites for both species on the east coast occur on the Queensland coast and offshore islands of the Great Barrier Reef with the exception of minor *C. caretta* nesting sites in NSW (Figure 1, Figure 2). Rare *C. mydas* breeding events occur in far northern NSW although mostly unsuccessful (Cogger, n.d).

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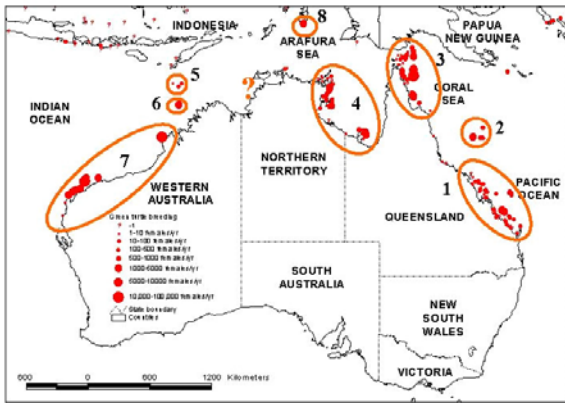


Figure 1: Australian breeding *Chelonia mydas* stocks. Source: Limpus (2008b)

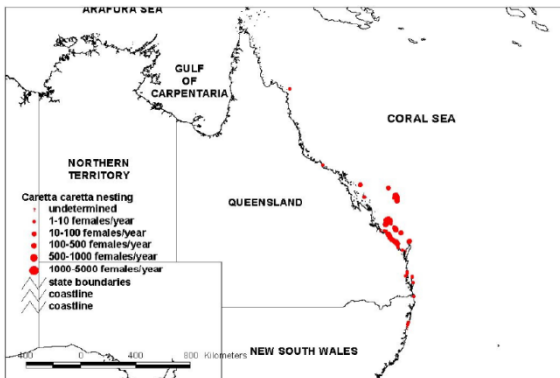


Figure 2: Distribution of *C. caretta* nesting sites in eastern Australia. Source: Limpus (2008a)

The small area of marginal potential *C. caretta* and *C. mydas* nesting habitat that is potentially temporarily disturbed is considered to be insignificant. To reduce the potential for any impact on marine turtle nesting habitat the recommendations in section a) of this assessment should be implemented.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No area of outstanding biodiversity value present.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

The proposed works are not or part of key threatening process nor are they expected to increase the impact of a key threatening process.

Environmental Protection and Biodiversity Conservation Act 1999 Assessments of Significance

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places. The Act lists threatened species or ecological communities that are recognised as a matter of national environmental significance.

Under the EPBC Act an action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. In order to determine whether an action is likely to have a significant impact, an assessment against the impact criteria discussed below is required.

Migratory Shorebirds

Background

Shorebirds (often called waders) are birds that commonly feed by wading in shallow water or saturated substrate along the shores of lakes, rivers and the sea (Geering *et al.* 2007). Shorebirds are generally considered as either resident shorebirds (i.e. do not undertake large-scale migrations) or migratory shorebirds (i.e. undertake large migrations). Many migratory shorebirds that occur in Australia generally breed in the northern hemisphere during the southern winter before migrating to Australia for the summer to feed before migrating back north before the winter. Shorebirds migrating to and from Australia utilise what is termed the East-Asian Australasian Flyway.

Thirty-six international migratory shorebird species regularly visit Australia each year which are all listed as migratory under the EPBC Act (DEWHA, 2009). Four of those species, listed below, are known to occur or have habitat that is known to occur within the vicinity of the Dalhousie Creek entrance area. There are numerous other species that may occur in the area.

- Red Knot (*Calidris canutus*)
- Common Sandpiper (*Actitis hypoleucos*)
- Sharp-tailed Sandpiper (*Calidris acuminata*)
- Bar-tailed Godwit (*Limosa lapponica*)

This assessment is undertaken on the species listed above and is considered representative of migratory shorebirds in general and therefore any risks identified will be applicable to all migratory shorebird species likely to interact with the project.

Migratory shorebirds were not observed within the proposed works site during the site inspection (although this was outside of the main migratory period) and documented records of migratory shorebirds in the immediate area are scarce (e.g. There were no records of migratory shorebirds in BioNET NSW NPWS Atlas of NSW Wildlife search). However, the intertidal beach does provide potential foraging habitat and the upper beach and berms provide potential roosting habitat and therefore it is possible that migratory shorebirds may intermittently utilise the habitat. Although, the site is not considered to be an internationally or regionally significant priority shorebird site (Bamford *et al.* 2008; DECCW 2010).

The Dalhousie Creek entrance area is unlikely to provide any significant foraging or roosting habitat for migratory shorebird species. DEWHA (2009) states that nationally important habitat for migratory shorebird species is defined as habitat that supports at least:

- 0.1 per cent of the flyway population of a single species

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- 2,000 migratory shorebirds, or
- 15 shorebird species.

There is no specific migratory shorebird data for the proposed works site, however, the limited local data available indicates that the site is unlikely to be considered as 'important habitat' as defined by DEWHA (2009). Given the relatively limited extent of available potential habitat at the site for migratory shorebirds, local availability of similar or better (i.e. Bellinger/Kalang Estuary and adjacent beaches) habitat, the site is not considered to be important migratory shorebird habitat. Nevertheless, the site provides some potential migratory shorebird foraging habitat and roosting habitat and therefore their presence at the site must be considered.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

a) Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species,

Migratory shorebird habitat within the proposed works site is unlikely to constitute important habitat for migratory shorebird species. Consequently the proposal is not considered likely to substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory shorebird species. However, the proposed works site does contain potential migratory shorebird habitat which may be intermittently utilised by migratory shorebirds.

The upper beach, in particular upper beach berms and fore-dunes, may potentially be utilised by migratory shorebirds as roosting habitat. The area of interest on the northern side of the entrance has undergone serious erosion in recent years. The resulting lack of suitable roosting habitat, combined with significant levels of human disturbance means that this northern side is unlikely to currently offer any important habitat for this species. The beach nourishment and dune building aspect of this proposal could potentially add new nesting habitat, although the human disturbance aspect will remain and any benefits in this regard will be marginal. There is some potential that beach enhancement works may temporarily affect potential roosting habitat whilst works are being undertaken. However, in the long-term beach, beach enhancement may improve potential migratory shorebird roosting habitat by stabilising potential roosting areas on the northern side of the entrance. The provision of an attractive beach on the northern side of the entrance and the establishment of the creek entrance further to south may encourage people (a disturbance to shorebirds) to stay on the northern side of the entrance away from more favourable shorebird habitat to the south, potentially reducing human impacts on migratory shorebirds in the long term.

Migratory shorebirds are likely to feed on small organisms (e.g. bivalves) in the intertidal foreshore zone at the proposed placement site. The proposal is not expected to have a significant impact on benthic biota diversity within the intertidal zone and subsequently have an insignificant impact on migratory shorebird foraging habitat at the site.

To minimise the risk of disturbance on roosting migratory shorebirds by the proposed works it is recommended that where practical and possible and within other operational constraints, the disturbance footprint of the beach nourishment area should be minimised, such that the extent of effects on species utilising the beach is reduced. Additionally, beach nourishment works should aim to be undertaken during the migratory shorebird breeding season (generally, the winter months between May and August) when the majority migrate to the northern hemisphere to breed. Although not all

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individuals migrate every breeding season, the potential for migratory shorebirds to be present is reduced.

Although beach nourishment works are unlikely to result in any direct mortality of migratory shorebirds. A speed limit of 30 km/h for machinery within the works area should be implemented to minimise any risk of direct mortality of migratory shorebirds by construction machinery. All machinery and vehicles to be restricted to the defined access tracks and works areas.

b) Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

As mentioned above, migratory shorebird habitat within the proposed works site is unlikely to constitute important habitat for migratory shorebird species. Additionally, the nature of the proposed works is such that it is unlikely to result in, or exacerbate, the introduction or establishment of an invasive species at the site.

c) Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

The site provides a small area of potential migratory shorebird foraging habitat and roosting habitat in a locality with other areas of similar or better quality habitat. However, the site does not provide any significant or important foraging, roosting or nesting habitat for migratory shorebirds. The site is currently disturbed by high recreational use.

The mitigation measures above (section a) should be implemented to minimise any potential risk of disrupting the lifecycle of migratory shorebirds. Due to the current disturbance and proposed mitigation measures, the proposed works are not considered likely to seriously disrupt the lifecycle (breeding, feeding, migration or nesting behaviour) of an ecologically significant proportion of the population of a migratory shorebird species.

Conclusion regarding significance under the EPBC Act 1999

It is concluded that with the implementation of the recommended mitigation measures identified in *Part 2: Background Information and Review of Environmental Factors*, the proposed works are unlikely to have a significant effect on the listed species of migratory shorebirds. On this basis, referral of the project to the Department of Environment in relation to potential impacts on the listed species of migratory shorebirds is not required.

Marine Turtles

Both species (*C. caretta* and *C. mydas*) of marine turtle require open sandy beaches to lay eggs with sand temperatures between 25-33°C to successfully hatch. The Dalhousie Creek entrance area is potential nesting habitat for both species of turtle with the area being at the very southern tip of their nesting ranges. There is some potential females may temporarily visit the beach to nest during their breeding seasons- in southern Queensland this can occur from October to March for *C. caretta* (Limpus 2008a) and from October to May for *C. mydas* (Limpus, 2008b). There are no records of either species nesting within the vicinity of the Dalhousie Creek entrance area. A search of the EPBC Act Protected Matters Search Tool of the proposed works site revealed that *C. caretta* and *C. mydas* species or species habitat is known to occur within the area. There are scattered records of both species nesting on Coffs Coast beaches further to the north however they are very sparse. Nonetheless, the Dalhousie Creek area does provide potential nesting habitat for both species.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

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a) Lead to a long-term decrease in the size of a population

Both species (*C. caretta* and *C. mydas*) of marine turtle require open sandy beaches to lay eggs with sand temperatures between 25-33°C to successfully hatch. The area of the proposed works site at the Dalhousie Creek entrance is potential nesting habitat for both species of turtle with the area being at the very southern tip of their nesting ranges. There is some potential females may temporarily visit the beach to nest during their breeding seasons- in southern Queensland this can occur from October to March for *C. caretta* (Limpus 2008a) and from October to May for *C. mydas* (Limpus, 2008b).

The proposed beach enhancement works have the potential to impact turtle nesting habitat. The works will alter beach habitat although not to the detriment of nesting potential. The upper beach and dune creation may improve nesting habitat, although is likely to be low value due to high human activity, however is likely to be an improvement on current habitat. The most likely threat from the works is direct impact on the nests by machinery. The beach scraping works are unlikely to impact nests as the works are occurring below high tide mark however sand placement, upper beach/dune creation and dry notch establishment and maintenance could potentially directly affect nests.

To reduce any potential impacts on marine turtles at the proposed works site it is recommended that during breeding/hatching season (October- May) a survey for evidence of marine turtles (tracks/nests) is undertaken each day prior to the commencement of works. If any evidence is identified works should not commence within the vicinity of the area and NPWS should be contacted immediately.

Due to the frequent disturbance on the beach from recreational activities and marginal nesting habitat, and the application of the mitigation measures the proposal is not expected to have an adverse impact on either *C. caretta* or *C. mydas* such that it will lead to a long-term decrease in the size of a population.

b) Reduce the area of occupancy of the species

As detailed above, both *C. caretta* and *C. mydas* nest on sandy beaches along the north east coast of Australia during the warmer months. The area of potential nesting habitat within the proposed works site is considered to be relatively small. There is some potential females may temporarily visit this area to nest during their breeding seasons.

The area is currently disturbed by frequent human activity. The proposed works may potentially cause a minor and temporary impact on potential nesting habitat. However, with consideration of the existing disturbances, relatively small area affected, potential intermittent use of the habitat by the subject species, and the implementation of recommendation measures outlined section a), it is considered unlikely that the proposed works will significantly reduce the area of occupancy of either *C. caretta* or *C. mydas*.

c) Fragment an existing population into two or more populations

As mentioned above, the proposed works are at the southern extent of the breeding distribution of both species. Given the relatively small area of the proposed works and the nature of the proposed works, it is considered unlikely that the proposed works will fragment an existing population of *C. caretta* or *C. mydas* into two or more populations.

d) Adversely affect habitat critical to the survival of a species

Although there are no recorded observations of marine turtles nesting at (or in the vicinity) of the site, *C. mydas* and more likely *C. caretta*, may intermittently utilise the habitat at the site for nesting purposes during their breeding seasons- in southern Queensland this can occur from October to March for *C. caretta* (Limpus 2008a) and from October to May for *C. mydas* (Limpus, 2008b). Habitat

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within the proposed works area is a relatively small area of potential marginal marine turtle nesting habitat and is not considered to be habitat critical to the survival of either species.

e) Disrupt the breeding cycle of a population

The majority of major nesting sites for both species on the east coast occur on the Queensland coast and offshore islands of the Great Barrier Reef with the exception of minor *C. caretta* nesting sites in NSW (Figure 1, Figure 2). Rare *C. mydas* breeding events occur in far northern NSW although mostly unsuccessful (Cogger, n.d).

The small area of marginal potential *C. caretta* and *C. mydas* nesting habitat that is potentially temporarily disturbed is considered to be insignificant and therefore the proposed works are unlikely to disrupt the breeding cycle of a population of either species. To reduce the potential for any impact on marine turtle breeding the recommendations in section a) of this assessment should be implemented.

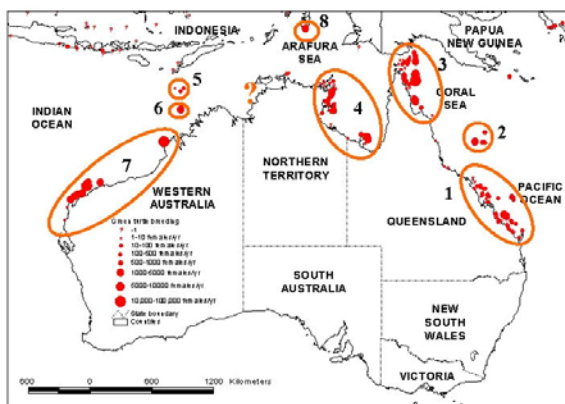


Figure 4: Australian breeding *Chelonia mydas* stocks. Source: Limpus (2008b)

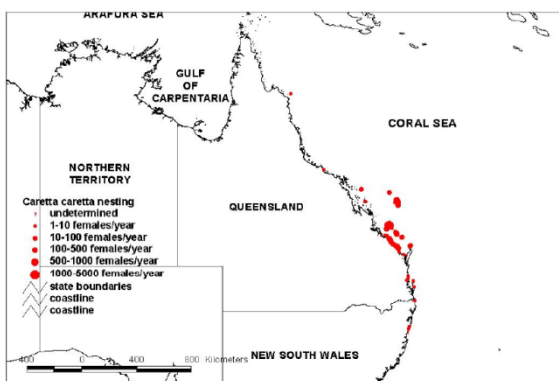


Figure 5: Distribution of *C. caretta* nesting sites in eastern Australia. Source: Limpus (2008a)

f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

As stated above, habitat within the proposed works area is a relatively small area of marginal potential nesting habitat for *C. caretta* and *C. mydas*. The proposed beach enhancement works have the potential to impact turtle nesting habitat. The works will alter beach habitat although not to the

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detriment of nesting potential. The upper beach and dune creation may improve nesting habitat, although is likely to be low value due to high human activity, however is likely to be an improvement on current habitat. The most likely threat from the works is direct impact on the nests by machinery. The beach scraping works are unlikely to impact nests as the works are occurring below high tide mark however sand placement, upper beach/dune creation and dry notch establishment and maintenance could potentially directly affect nests. The applications of the mitigation measures in section a) will minimise any potential impacts. Consequently, the proposed works are considered unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species (*C. caretta*, *C. mydas*) are likely to decline.

g) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

The nature of the proposed works is such that it is unlikely to result in, or exacerbate, the introduction or establishment of invasive species that are harmful to a critically endangered or endangered species.

h) Introduce disease that may cause the species to decline

It is considered unlikely that the proposed works will introduce disease that may cause *C. caretta* or *C. mydas* to decline.

i) Interfere with the recovery of the species.

Although not directly in conflict with the recovery of *C. caretta* or *C. mydas* the proposed works have the potential to have a minor temporary impact on the species. With consideration of the relatively small area of potentially affected habitat, minor and temporary potential impacts and the recommended control measures identified within this assessment, it is unlikely the proposed works would significantly interfere with the recovery of *C. caretta* or *C. mydas*.

Conclusion regarding significance under the EPBC Act 1999

It is concluded that if the recommended mitigation measures identified in *Part 2: Background Information and Review of Environmental Factors* are implemented effectively, the proposed works are unlikely to have a significant effect on the Loggerhead Turtle (*C. caretta*) or Green Turtle (*C. mydas*). On this basis, referral of the project to the Department of Environment in relation to potential impacts on *C. caretta* and *C. mydas* is not required.

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APPENDIX 4: BIONET SEARCH RESULTS

Table 8: NSW Bionet Wildlife Atlas Search Results – results within 500 m of precinct area

Common Name	Species	Type	Habitat & Ecology	Conservation Status			Potential to be affected	Assessment of significance required?
				FM Act	BC Act	EPBC		
Green Turtle	<i>Chelonia mydas</i>	Reptile	Ocean-dwelling species spending most of its life at sea. Eggs laid in holes dug in beaches throughout their range.	-	Vulnerable,	Vulnerable	Possible	Yes
Square-tailed Kite	<i>Lophoictinia isura</i>	Bird	Distribution ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	-	Vulnerable	-	Unlikely	No
Eastern Osprey	<i>Pandion cristatus</i>	Marine Bird	Range of habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. Construct nests in a variety of natural and artificial sites including in dead or partly dead trees or bushes; on cliffs, rocks, rock stacks or islets; on the ground on rocky headlands, coral cays, deserted beaches, sand hills or saltmarshes; and on artificial nest platforms, pylons, jetties, lighthouses, navigation towers.	-	Vulnerable	Marine, Migratory	Unlikely	No
Beach Stone-curlew	<i>Esacus magnirostris</i>	Shorebird	Forage almost exclusively within the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Beach Stone-curlews breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves.	-	Critically Endangered	Marine	Possible	Yes
Scented Acronychia	<i>Acronychia littoralis</i>	Plant	Found between Fraser Island in the north and Port Macquarie in the south. Occurs in transition zones between littoral rainforest and swamp sclerophyll forest; between littoral and coastal cypress pine communities; and margins of littoral forest.	-	Endangered	Endangered	Unlikely	No

APPENDIX 5: EPBC ACT SEARCH TOOL RESULTS

Table 9: EPBC Act Protected Matters Search Tool Results (within 1 km of precinct area)

Common Name	Species	Type	Habitat & Ecology	Conservation Status			Potential to be affected	Assessment of significance required?
				FM Act	BC Act	EPBC		
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Waterbird	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	-	Endangered	Endangered	Unlikely	No
Red Knot	<i>Calidris canutus</i>	Shorebird	Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps.	-	-	Endangered, Marine, Migratory	Possible	Yes
Spotted-tail Quoll	<i>Dasyurus maculatus</i>	Mammal	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals.	-	Vulnerable	Endangered	Unlikely	No
Humpback Whale	<i>Megaptera novaeangliae</i>	Marine Mammal	Humpback Whales are ocean dwelling marine mammals. The population of Australia's east coast migrates from summer cold-water feeding grounds in Subantarctic waters to warm-water winter breeding grounds in the central Great Barrier Reef. They are regularly observed in NSW waters in June and July, on northward migration and October and November, on southward migration. While they are known to occasionally enter estuaries, the majority of their time is spent in the open ocean.	-	-	Vulnerable	Unlikely	No
Koala	<i>Phascolarctos cinereus</i>	Mammal	Inhabit eucalypt woodlands and forests	-	Vulnerable	Vulnerable	Unlikely	No

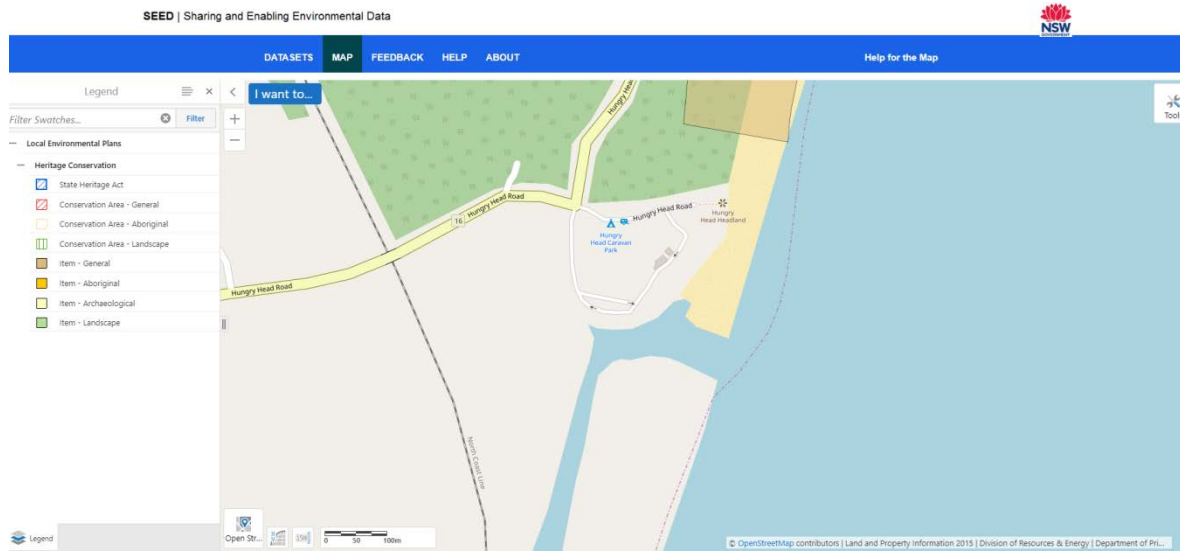
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Common Name	Species	Type	Habitat & Ecology	Conservation Status			Potential to be affected	Assessment of significance required?
				FM Act	BC Act	EPBC		
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Mammal	Occur in rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas. Forage on fruits and blossoms of more than 80 species of plants. Prefer eucalypt blossom with native figs being the most popular fruit. Chew leaves and appear to eat the salt glands from mangroves. Congregate in large camps of up to 200,000 individuals from early until late summer usually in gullies close to water.	-	Vulnerable	Vulnerable	Unlikely	No
Loggerhead Turtle	<i>Caretta caretta</i>	Reptile	Loggerhead Turtles are ocean-dwellers, foraging in deeper water for fish, jellyfish and bottom-dwelling animals. The female comes ashore to lay her eggs in a hole dug on the beach in tropical regions during the warmer months	-	Endangered,	Endangered	Possible	Yes
Green Turtle	<i>Chelonia mydas</i>	Reptile	Ocean-dwelling species spending most of its life at sea. Eggs laid in holes dug in beaches throughout their range.	-	Vulnerable,	Vulnerable	Possible	Yes
Leatherback Turtle	<i>Dermochelys coriacea</i>	Reptile	A pelagic feeder, found in tropical, subtropical and temperate waters venturing close to shore mainly during the nesting season in which they require sandy beaches to nest.	-	Endangered	Endangered, Migratory, Marine	Unlikely	No
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	Reptile	Hawksbills nest on insular and mainland sandy beaches throughout the tropics and subtropics. They are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes including major gyre systems, neritic developmental foraging habitat that may comprise coral reefs or other hard bottom habitats, sea grass, algal beds, or mangrove bays and creeks or mudflats.	-		Vulnerable	Unlikely	No
Great White Shark	<i>Carcharodon carcharias</i>	Shark	Great white sharks are found throughout the world's oceans mostly in temperate and sometimes warm waters but occasionally in cold environments. Coastal and offshore waters of the continental and insular shelves and offshore continental islands	-	-	Vulnerable	Unlikely	No
White-throated Needletail	<i>Hirundapus caudacutus</i>	Bird	Migratory terrestrial aerial bird that roosts in trees.	-	-	Migratory Species	Unlikely	No

Dalhousie Creek Entrance Management Strategy: Background and REF

Common Name	Species	Type	Habitat & Ecology	Conservation Status			Potential to be affected	Assessment of significance required?
				FM Act	BC Act	EPBC		
Black-faced Monarch	<i>Monarcha melanopsis</i>	Bird	Migratory terrestrial bird species found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	-	-	Migratory Species	Unlikely	No
Spectacled Monarch	<i>Monarcha trivirgatus</i>	Bird	The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	-	-	Migratory Species	Unlikely	No
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Bird	Migratory terrestrial bird species found in tall forests, preferring wetter habitats such as heavily forested gullies.	-	-	Migratory Species	Unlikely	No
Common Sandpiper	<i>Actitis hypoleucos</i>	Shorebird	In Australia, the Common Sandpiper is found in coastal or inland wetlands, both saline or fresh. It is found mainly on muddy edges or rocky shores. They are migratory, generally breeding in Eurasia during the Australian winter. Eats small molluscs, aquatic and terrestrial insects	-	-	Migratory Species	Possible	Yes
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Shorebird	Prefers the grassy edges of shallow inland freshwater wetlands. It is also found around flooded fields, mudflats, mangroves, rocky shores and beaches. A summer migrant from Arctic Siberia, being found on wetlands throughout Australia.	-	-	Migratory Species	Possible	Yes
Bar-tailed Godwit	<i>Limosa lapponica</i>	Shorebird	Migrates from northern hemisphere. Inhabits coastal mudflats, sandbars and shorelines. Prefer exposed sandy substrates on intertidal flats, banks and beaches. Also prefer soft mud, often with beds of eelgrass <i>Zostera</i> or other seagrasses. Roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh.	-	-	Marine, Migratory	Possible	Yes
Osprey	<i>Pandion haliaetus</i>	Marine Bird	Coastal waters and estuaries	-	-	Marine, Migratory	Unlikely	No
Great Egret	<i>Ardea alba</i>	Waterbird	Migratory wetland bird species that inhabits inland and coastal wetlands and frequents river margins, lakes shores, marshes and flood-plains.	-	-	Marine, Migratory	Unlikely	No
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Marine Bird	Usually coastal areas including beaches, normally seen perched high in a tree, or soaring over waterways and adjacent land.	-	-	Migratory Species	Unlikely	No

APPENDIX 6: HERITAGE SEARCH RESULTS



Search Aboriginal Places & State Heritage Register

The combined map search below is for Aboriginal Places and State Heritage Register items only. It does not include Interim Heritage Orders, State Agency Heritage Registers and Local Environmental Plans.

The location of Aboriginal Places and State Heritage Register items are marked on the map as a single approximation point for general identification and research purposes only.

Location information for some Aboriginal Places (e.g. burial grounds and sacred sites) have been generalised because of their cultural sensitivity. Location information for restricted Aboriginal Places is not shown at all. If an activity or development is proposed that may potentially impact on or harm (i.e., damage, deface or destroy) an Aboriginal Place, then proponents must undertake a search for the exact boundaries of Aboriginal Places through **AHIMS Web Services**.

Downloading of State Heritage Register spatial datasets and associated metadata into a Geographical Information System (GIS) software package is available through **Data NSW**.

Listing Type: All Aboriginal Places State Heritage Register

Local government area:

Item name/Database ID:

SHR number:

Location:

Local Aboriginal Land Council (LALC):

State theme:

Item type:

Item Group:

Item category:

