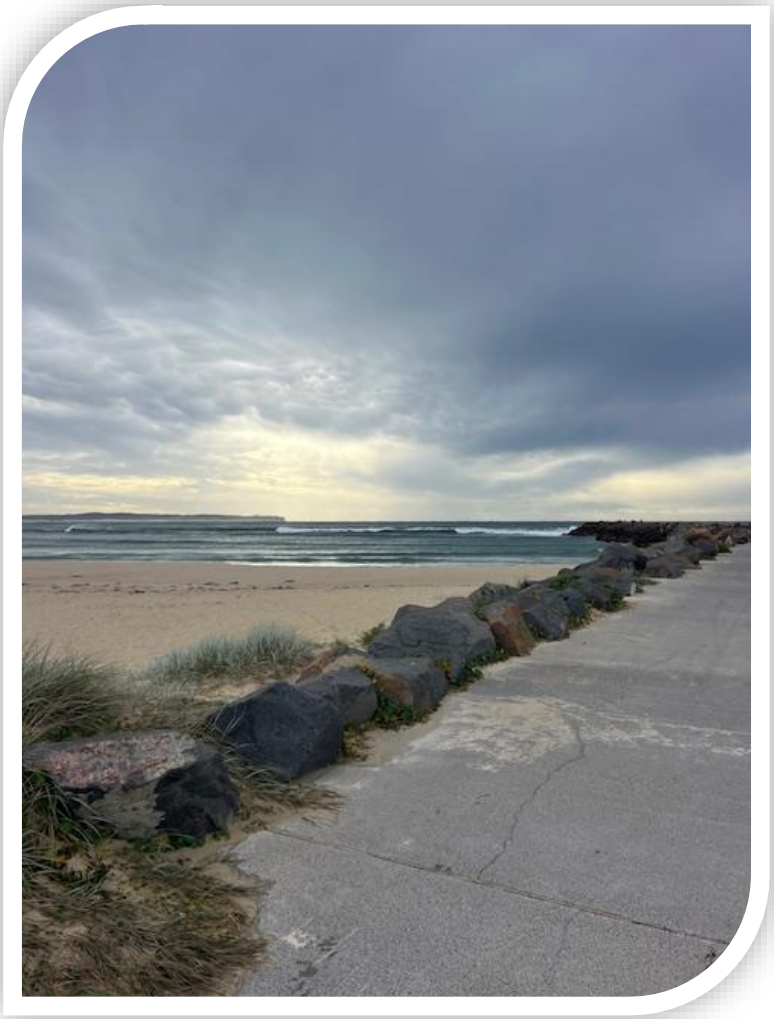
CM9 Ref. SCSPF24/160

Blacksmiths Beach

Dune Management Plan



The Soil Conservation Service acknowledges the traditional custodians of the land where we live and work and pays respect to Elders past, present and emerging. Through our work on what was and always will be Aboriginal land, we commit to our shared responsibility to heal and protect Country for all future generations.

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Blacksmiths Beach - Dune Management Plan

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1.0	19/08/2024	Andy Findlay	Comment review
1.1	06/03/2025	Andy Findlay	Comment review -Final issue

Disclaimer
The information contained in this publication is based on knowledge and understanding at the time of writing, March 2025. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of Soil Conservation Service or the user's independent adviser.

Contents

1. Introduction

1.1.Soil Conservation Service Capability

The capability of the Soil Conservation Service (SCS) as a leader in providing planning, practical application and experience has been founded by a long-term working knowledge of the complexities of coastal degradation issues along the eastern seaboard.

SCS has successfully developed and delivered Sydney's largest dune stabilisation project, which has been an ongoing program since 1974. The specialised team maintained the dune system between Cronulla and Kurnell ,which was moving up to 15m inland each year. Through rehabilitation and maintenance techniques, the success of the project demonstrates that early intervention and revegetation are powerful tools in coastal management.

The, "sand drift team" ,has been an integral part in managing the coastal fringe and, on a localised scale, has worked alongside Lake Macquarie City Council in the past stabilising dredge sand in the vicinity of Blacksmiths Beach. SCS have also undertaken some access management and provided guidance on layout and installation of dune formation fencing adjacent to the Swansea Belmont Surf lifesaving Club (SLSC) at Blacksmiths beach.

It is this experience and knowledge that SCS will employ to develop the Dune Management Plan for Blacksmiths Beach.

1.2. Background

SCS has been engaged by (LMCC) to develop a Dune Management Plan for Blacksmiths Beach (study area, Image 1).

Lake Macquarie City is in the Hunter region, 120km north of Sydney. The coastal zone of Lake Macquarie consists of the largest coastal estuary in Australia and approximately 27km of open coast which includes long barrier beaches such as Nine Mile Beach.

Blacksmiths Beach is the southern extent of the Nile Mile Beach which extends from Redhead in the north to Swansea Channel in the south and has an extensive dune system that has been managed in the past (Belmont Wetlands State Park Dune Management Plan, Umwelt 2019).

Development and implementation of a dune management plan to improve resilience of the dunes at Blacksmiths Beach is an action identified in the Lake Macquarie Coastal Zone Management Program (CMP 2023). Blacksmith's Beach has also been identified as a key coastal risk area with potential for interaction of coastal erosion/recession and lake inundation over the next century.

The following dune management issues at Blacksmiths Beach have been identified by Council-

- vulnerability of landward assets from coastal erosion events (particularly the Maneela Street viewing platform) and other beach access tracks.
- vulnerability of landward assets (built and natural) from wave overtopping.
- Community concern over loss of surf amenity

- dune Vegetation potentially impacting on Lifeguards slight lines to the southern corner.
- conflicting community views regarding the management of dune vegetation (noting the domination of bitou bush in the southern corner of the beach)
- aeolian sand builds up impacting on beach access (particularly the disabled beach access ramps in front of the surf club)
- maintaining and (building upon), the strong volunteer Landcare effort (that has been undertaken for decades in some areas of the beach)
- access Management
- management of historic dune fencing (pedestrian)
- beach cleaning activities (to assist in dune management)

SCS will aim to develop dune management strategies to focus on restoring the natural dune formation, process and functions at Blacksmiths concentrating on the following:

- dune stabilisation and formation methodologies that can be implemented on Blacksmith's Beach to provide resilience to coastal hazards
- vegetation management
- access management
- associated costs/options for management activities

The scope will be supported by the various studies that have been undertaken at Blacksmiths Beach and be consistent with the Lake Macquarie CMP 2023.

Image 1 – Study area near maps 2024

1.3. Blacksmiths Beach study area

The dune conditions and targeted management strategies vary within the study area, therefore the study area will be broken up into three separable portions, pictured below.

Image 2 – Study area near maps 2024

In describing the separable portions Council provided SCS with studies undertaken on Blacksmiths Beach that were used to inform the Lake Macquarie Coastal Management Program. These included but not limited to

- Wave Overtopping Assessment (Salients 2021) &
- Surf Amenity Assessment (WRL 2020).

SCS reviewed the data and undertook site inspections in June 2024 to capture current management activities that seem to be occurring and current coastal dune conditions. There were two site inspections undertaken and in between was a large swell event (15-18th June) that provided SCS with some understanding on beach adjustments at Blacksmiths.

1.3.1. Separable portion 1 (SP1)

Separable portion 1 covers the ocean side of the northern break wall of Swansea Channel to the southern corner of the Blacksmith Beach car park and is approximately 340m in length. The shallow passage of Swansea Channel and rock outcrops including moon Island to the south provide protection from the dominant swell direction to the southeast. This is enhanced by the break wall, providing a sheltered zone from the predominant south-easterly winds (Appendix 5.4-wind rose chart). This portion is the southernmost extent of the southeast facing embayment where typically nett sand loss occurs from longshore transport. Studies *(BMT-WBM 2015)* support a gradual accretion from coastal processes including the increased vegetation trapping aeolian sand deposits. The nature of an embayment type beach such as Nine Mile is that sediment transport is cyclic and can move upcoast or down coast dependant on climatic factors.

There are several formal and informal beach access paths within this zone including a vehicular access at the southern extent for commercial activities and a shore parallel hind dune track. This portion is used by recreational beachgoers to access the break wall and Grannies Pool.

The dune morphology adjacent to the break wall consists of a particularly low-lying foredune with the crest being as low as 3.8m AHD (Wave Overtopping Assesment – Salients 2021). Prior to the construction of training walls in Swansea Channel this area would have been a mobile dune shoal and has since been evolving with the establishment and growth of vegetation. The crest height increases slightly moving northwards to 5m AHD where the dune profile also steepens. There is evidence of previous breakthroughs with three overtopping events since 2015 and erosion to the frontal dune where the mature hind dune vegetation line is set back over a 50m stretch.

The surf zone at the southern end is variable, dependant on the nearshore conditions. The profile typically excludes any longshore bars and beach berms making it reflective in nature. Historical bathymetry indicates there has been a general trend of deepening in this portion.

Vegetation communities in this portion range from beach spinifex to coastal sand dune scrub and banksia scrub (seed dataset). From an aerial imagery observation (Near Maps 2010-2024) the vegetation has prograded and become dense. There is a healthy monoculture of bitou bush within the frontal dune system and hind dunes are stabilised with coastal sand and banksia scrub woodland species.

1.3.2. Separable portion 2 (SP2)

Separable portion 2 will predominantly cover a 300m stretch between the Swansea Belmont SLSC and the Crown Reserve to the north. The infrastructure adjacent to the beach including the car park and SLSC has been Identified as key locations potentially at risk to coastal erosion and inundation (CMP 2023). The dune crest in this portion of the study area is below 6.5m AHD (Blacksmiths Beach Wave Overtopping Assessment 2021). Similarly to SP1 the break wall to the south provides protection from the prevailing south easterly winds and dominant swell direction.

The dune morphology in this portion is fragmented with no incipient dune and set-back foredune. The foredune contains limited vegetation and several minor blow outs allowing the landward migration of aeolian sand. Review of the aerial imagery (Near maps 2010-2024) indicates segmented dune paddocks with management strategies including fencing and planting being implemented to combat this issue. With the SLSC adjacent to beach dune instability would have a major influence from human disturbance. The northern section of this portion transitions into a typical beach profile including a beach berm, incipient dune, foredune and hind dune.

The surf zone is that similar to SP1 with an offshore reef located 300m seaward that provides energy dissipation on large east-southeast swells.

1.3.3. Separable portion 3 (SP3)

Separable portion 3 encompasses the Crown Reserve on Ungala Road to Awabakal Avenue, a length of 1km. The area comprises of a restructured dune system divided into fenced dune paddocks, walkways, and observation platforms (Case study – Blacksmiths Dune Restoration

2014). This area has been successfully managed by the Blacksmiths Beach Dune care group, formed in June 1990.

The foredune and hind dune provide protection to the Blacksmiths residential area, which lies about 100m landward of the crest of the dune. The urban development and infrastructure encroaching onto the coastal fringe behind the shore parallel dune system is identified as being at risk of inundation. The beach access paths and viewing platform located of Maneela Street lie in this portion and have been identified as being at risk of erosion and inundation (CMP 2023). Many of the access paths have constructed walkways with floating boardwalks made from Endurpolank materials. These terminate at the seaside crest of the hind dune and are well constructed, away from coastal interactions.

The dune morphology has typical features of a dynamic beach dune system, an existing foredune and hind dune that has previously been reworked and vegetated remains as the coastal buffer zone. In the southern nearshore zone, there is evidence of an incipient dune that slowly transitions into an established foredune moving further north towards the study area extent. The historical imagery prior to reshaping in 1993 shows hummocks of sea cabbage and spinifex formed in the nearshore zone which would have, if given the chance built an incipient dune. These ephemeral features such as hummocks tend to be eroded completely by larger storm events on a regular basis & this is evident of the lower foredune in this portion (crest varies between 6.5-8m in height). It is evident there is an inflection point around the Maneela Street beach access and visual observations see general recession in this portion (Near maps 2010-2024), however historical shoreline position data shows this is cyclic in nature.

The surf zone comprises of nearshore bars and troughs that trend northward with longshore sediment transport. This is consistent on a regional scale with the adopted Lake Macquarie City LGA upper limit of 21,000m^3 /year northward net littoral transport (CMP 2023), on a localised scale the transport rates vary. Within this portion deepening and straightening has occurred lowering the quality of the surf. Further to the north, Transverse Bar and Rip setting currently dominates the surf zone with a steep beach face and cusps consistent with a high energy wave dominated beach.

The vegetation has prograded and become dense in this portion reducing the aeolian sand being deposited on infrastructure, the trapping of sand will continually increase the dune height providing further resilience. The predominant vegetation communities don't vary to that of SP1 and the foredune is well vegetated with primary species including spinifex and coastal geranium. The hind dune is a mix of native tertiary species including those typically found within coastal scrub banksia forests and some littoral rainforest species introduced through bush regeneration efforts. The success of bush regeneration is evident with the diversity of species found in this portion. Bitou bush and asparagus weed are present and managed by the Landcare group in this region. Originally impenetrable the bitou bush is now at a manageable level and ongoing spraying is being undertaken.

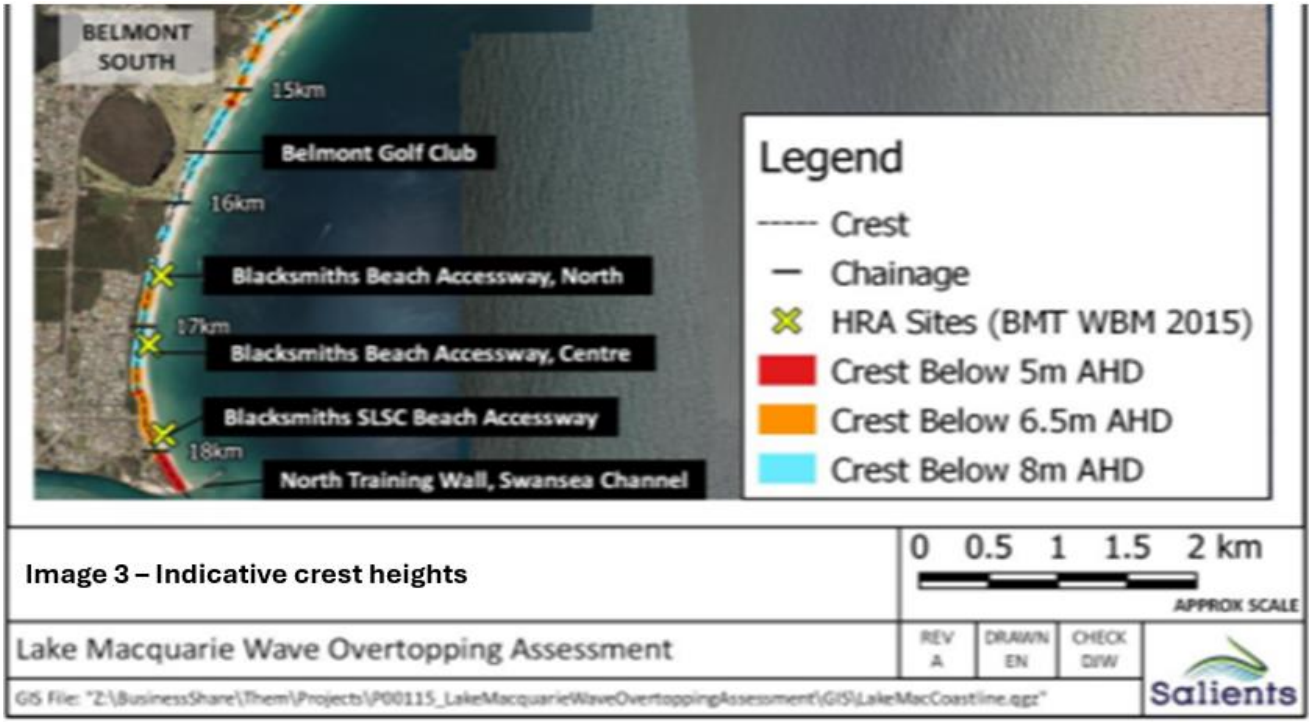


Image 3 – Indicative crest heights

1.4. Project objectives

The objective of this report is to provide LMCC practical guidance on certain management aspects within the specified separable portions with a broad scale focus on

- dune stabilisation and formation methodologies that can be implemented on Blacksmith's Beach to provide resilience to coastal hazards including recession and wave overtopping.
- vegetation management – focusing on controlling and managing the bitou bush monoculture in SP1.
- access management – associated with infrastructure and community value in SP2 & SP3.
- associated costs/options for management activities –tabulated costs as if SCS were to be engaged to undertake proposed activities.

The dune management plan excludes the design of dune nourishment activities using externally sourced sand. It is noted one of the management strategies within the CMP identifies the use of dredge sand for beach nourishment activities in accordance with the Dune Management Plans (C4.4).

The plan will also exclude the design of dune nourishment to facilitate emergency works identified in the Coastal Zone Emergency Action Subplan (CZEAP). These works constitute the placement of sand on a beach or sand dune adjacent to a beach to mitigate the effects of coastal hazard on land.

The proposed objectives will not be reactive in nature but rather be able to be prioritised and implemented in the short term with minimal budget.

2. The coastal environment

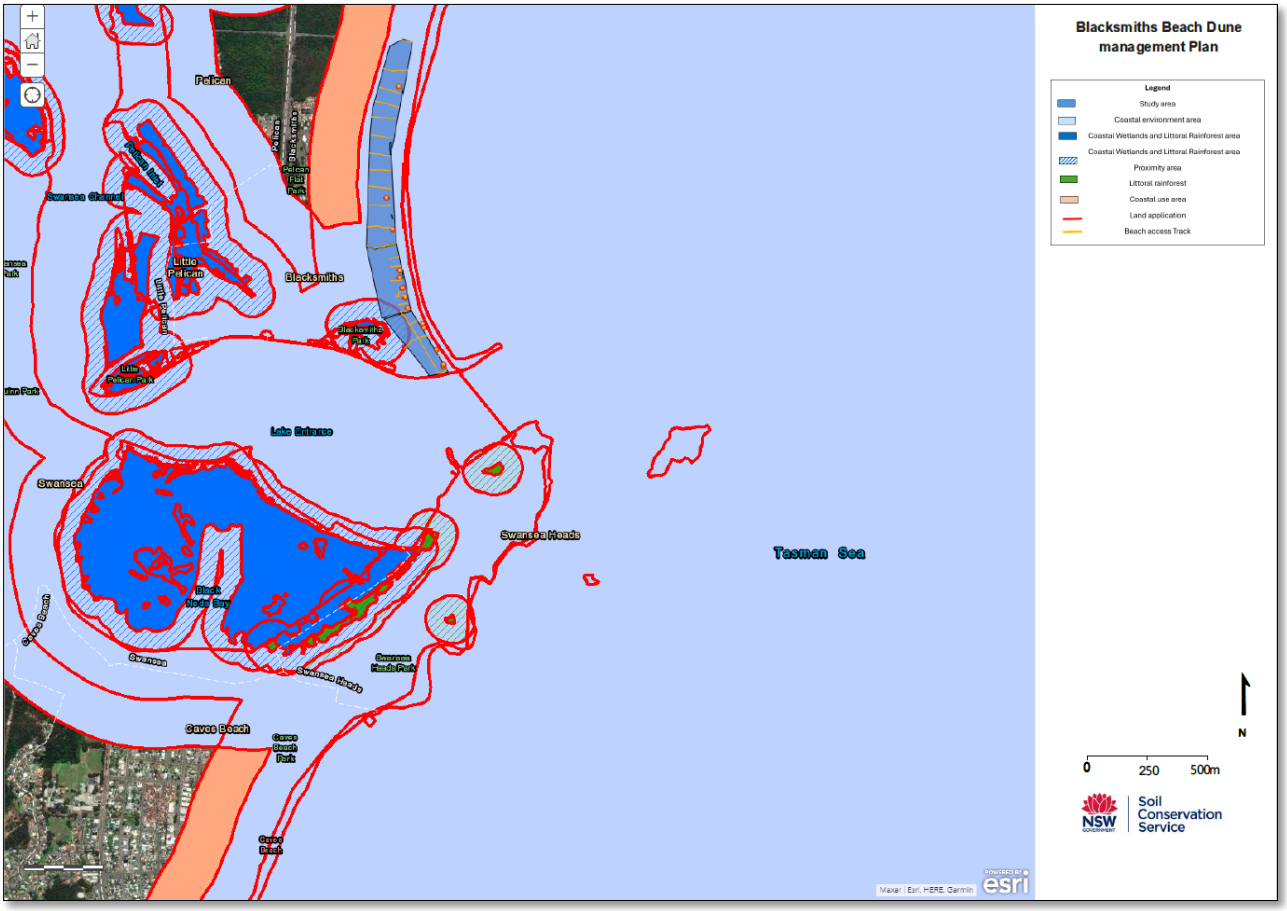
2.1. Coastal Management Program

2.1.1. Key legislation

In 2015, a Coastal Zone Management Plan (CZMP) was prepared for the Lake Macquarie Coastal Zone, in accordance with the objects of the *NSW Coastal Protection Act 1979*.

The current Coastal Management Program (CMP) for the Lake Macquarie coastal zone provides an update of the CZMP and responds to the objects of the Resilience and Hazards SEPP 2021 & *Coastal Management Act 2016* and meets all necessary requirements identified in the NSW Coastal Manual.

The CM Act, Coastal environment areas – areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons, headlands and marine and estuarine waters. As per the map below the entire study site is in the coastal environment and coastal use area with a portion located within proximity to coastal wetlands and littoral rainforest area. Note there is currently no map for coastal vulnerability area.



The 3 main coastal management areas under the CM Act 2016 at Blacksmiths have strategies assigned and are outlined in the CMP. The strategies listed are those relevant to the management of dune systems.

Table 1 – Management objectives

Coastal Environment area	To reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change. To maintain the presence of beaches, dunes and the natural features of foreshores, considering the beach system operating at the relevant place. To maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms.
Coastal use area	To protect and enhance the scenic, social and cultural values of the coast by ensuring that: adequate public open space is provided, including for recreational activities and associated infrastructure, and the use of the surf zone is considered.
Coastal Wetlands and littoral rainforest areas	To protect coastal wetlands and littoral rainforests in their natural state, including their biological diversity and ecosystem integrity. To improve the resilience of coastal wetlands and littoral rainforests to the impacts of climate change, including opportunities for migration. To promote the rehabilitation and restoration of degraded coastal wetlands and littoral rainforests.

2.1.2. Key Actions

Relevant actions to address the selected strategies under the CMP are listed in section 4.4.1 - Actions to be implemented by Council or by public authorities.

- A3.3 Maintain priority access to beaches, install fencing and matting on beach access ways to protect dune vegetation and habitats (priority locations are Blacksmiths, Caves and Redhead beaches). Include signage and other education material regarding domestic animals/4WD access

- A3.5 Develop and implement dune management plans for priority areas (Blacksmiths, Redhead, Nine Mile, Caves Beach and Catherine Hill Bay).

- A3.8 Raise and reinforce low points in the dunes (using on-site sand, or sand sources from dredging works) Locations include Nine Mile Beach, Caves Beach and Catherine Hill Bay Beach. Priority area is Nine Mile Beach (southern portions).

- A3.11 Conduct beach management works to revegetate, reshape and increase dune volume/recovery after storms, and to control weeds. (Blacksmiths, Redhead, Nine Mile, Caves Beach and Catherine Hill Bay).

The CMP also includes actions to investigate the feasibility of a sand transfer scheme to enable the placement of dredge sand onto Blacksmiths Beach to assist with dune resilience and surf amenity.

The former Lake Macquaire Coastal Zone Management Plan (CZMP) still has ongoing actions that are relevant to Blacksmiths and consistent with the CMP 2023.

- Conduct beach management works such as beach scraping to reshape dunes and increase dune volume/recovery after storms if necessary.

- Re-instate city wide beach maintenance program and continue dune rehabilitation works. This includes dune fencing, access controls, invasive species control and replanting native colonising species. Provide stronger in-house support and direction for Landcare volunteers.

- Focus on control of bitou bush by eliminating new colonisation on dunes, headlands and around wetlands, as a priority. This may require revisiting ‘cleaned up’ sites to remove new seedlings.

2.2. Coastal processes

Prevailing wind and waves

The prevailing wind direction along the Lake Macquarie coastline is south-southeasterly during spring and summer and north westerly during autumn and winter. Annually, the majority of strong winds are from the south southeasterly. Wind direction and strength influence wind-related transport of sand and local wave conditions.

The dominant wave direction along the Hunter coast is from the southeast. There is a seasonal trend with wave direction east-southeast during summer with larger northeast wind driven swells also occurring. The predominant swell direction from the south east supports an assumed northward drift of sand deposits along the Lake Macquarie Coast. Wave sizing varies, typically it’s the larger southerly driven swells that have waves in the 2-3m and greater than 3m range.

Climate change

Another driver for change is the response to climate change which includes sea level rise, and an increase to intensity and frequency of storm events. The average rate of sea level rise on a global scale in 2018 was 3.7mm /year and the Internation Panel on Climate Change predict a likely sea level increase on the central NSW coast of between 0.21m and 1.06m by 2100. Coupled with more intense storm events, ongoing recession is expected to be a response. The rate of recession can be slowed by improved dune management and sand nourishment.

2.2.1. Dune formation

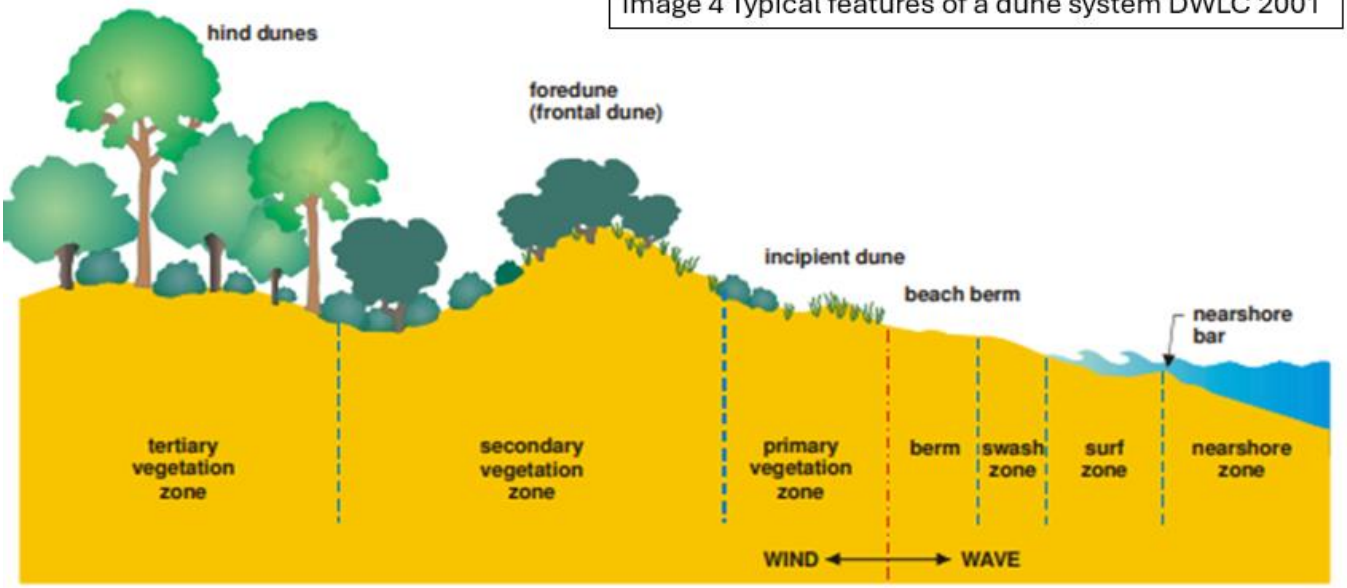
A typical natural dune as identified in the NSW Department of Land and Water Conservation (DLWC) 2001 -Coastal Dune Management Manual is represented in image 4. The natural dune state is formed by coastal processes including prevailing winds and waves which vary in intensity and effectiveness.

The typical profile consists of a seaward side and landward side which are dynamic in nature, continually eroding or accreting. The seaward side consists of a mobile beach berm, incipient foredune dune and established foredune, while the landward side consists of a more resilient, well developed hind dune.

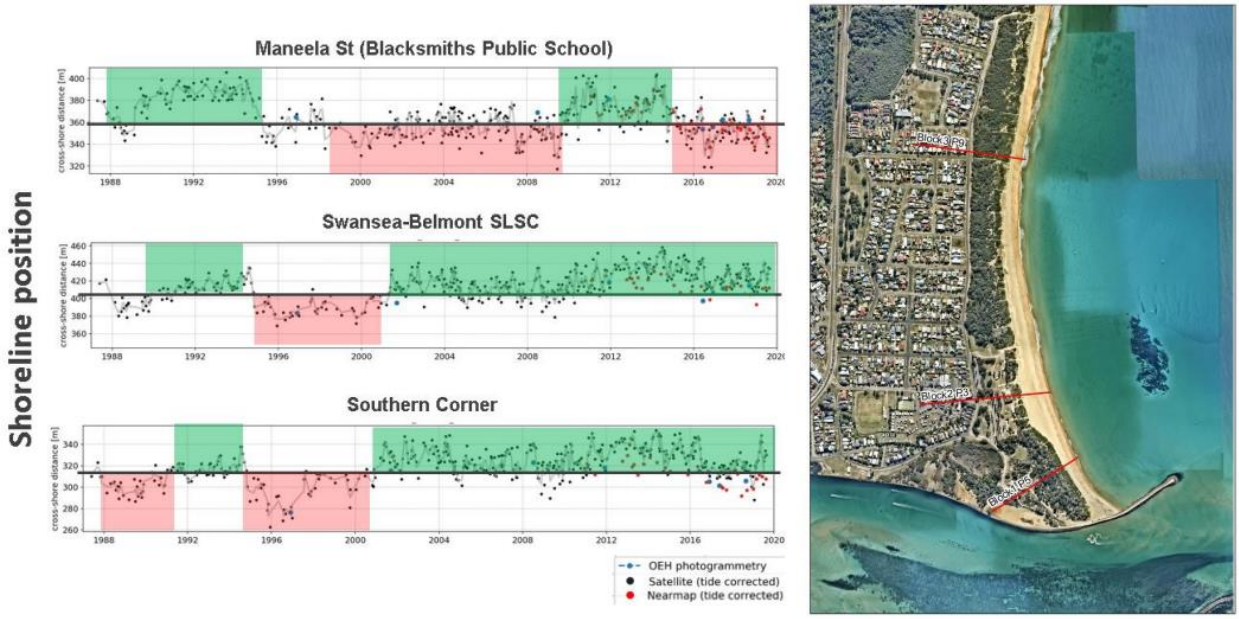
Dune Feature	Description
Beach berm	A beach berm is a terrace of sand that has formed in the back beach above the high-water line. Berms are commonly found on beaches that have coarse sand and are the result of the deposition of material by low-energy waves.
Incipient dune	An incipient foredune is located immediately seaward of the established foredune. An incipient foredune is a small bench or platform of windblown sand at the rear of a beach. During accretion dominant phases these can grow rapidly, both upwards and seawards and are progressively colonised by grasses and creepers.
Foredune	The established foredune lies between the incipient dune and the hind dunes. They are a more massive and persistent beachscape feature although their attack by waves during severe or prolonged storm episodes is a naturally recurring phenomenon. Their size, shape and stability are also controlled strongly by vegetation cover.

Hind dune	Hind dunes are located at the back of the dune system, typically the largest and most persistent of the dune features, located furthest from the sea. The vegetation communities are mature, and stability comes from highly vegetated cover.

Image 4 Typical features of a dune system DWLC 2001



Changes to the beach and dune system are cyclic in nature and occur regularly within the nearshore zone (seaward side). El Nino years have a more southerly wave climate while La Nina years have an east to northeast wave climate. For Blacksmiths this is evident in the Water Research Lab Blacksmiths Surf Amenity Assessment 2020 –that shows both positive and negative shoreline distances over time. Storm conditions remove sand from the beach front and dunes and deposit sand offshore, while in the summer months calmer conditions allow the deposition of the sands back onto the beaches. During accretion periods aeolian sand is trapped in vegetation & builds up the dunes. If the balance is skewed in the cycle short-term fluctuations (storm events) mask long-term recession /accretion.



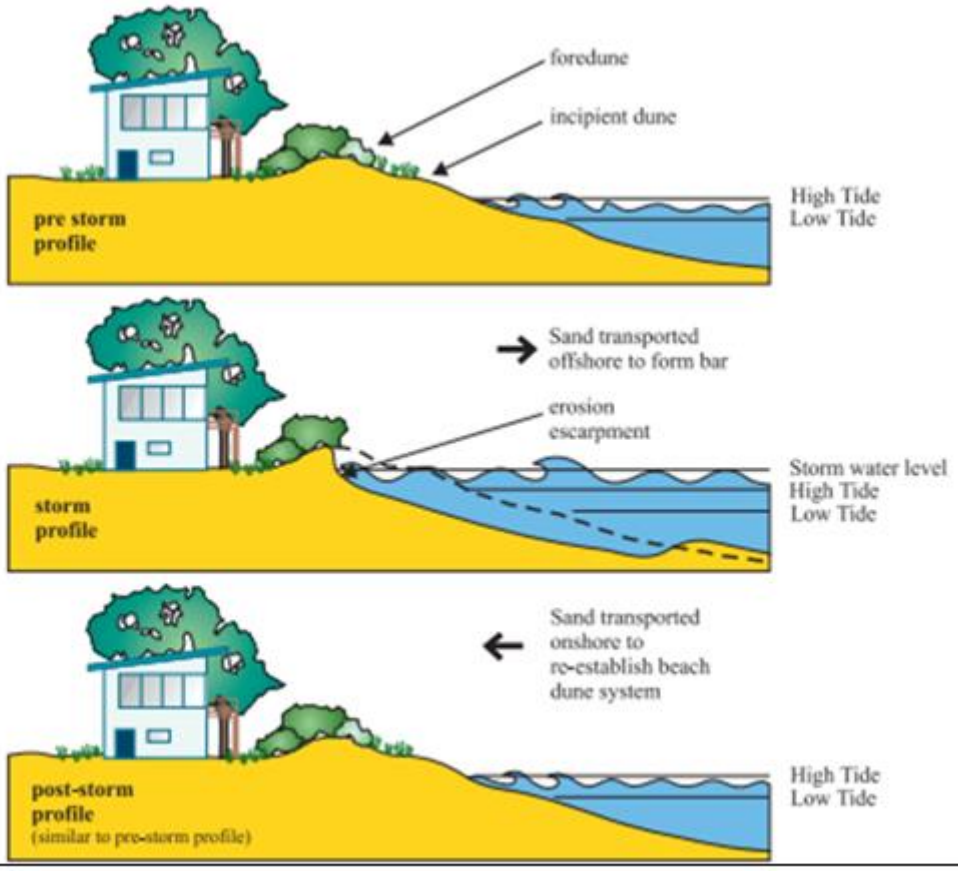


Image 6 – Response to beach erosion with no recession DWLC 2001

3. Dune management

It is crucial to maintain or enhance the resilience of the dunes as in their natural state, a well-formed dune system is the greatest defence against coastal erosion/recession. The soft characteristic of dunes responds greater than any other management strategy.

Best practice dune management principles are identified in the Coastal Dune Management Manual DWLC 2001 and include:

- dune reconstruction
- weed management and rehabilitation

Dune reconstruction	**Weed management and rehabilitation**
Dune forming fences	Managing weeds on coastal dunes - Bitou Bush
Dune stabilisers (brush and mulch)	Revegetation techniques
Dune re-shaping with earth moving equipment	Beach accessways design and protective fencing construction
Signage	Maintenance & monitoring techniques

3.1. Current dune management measures

Current coastal dune management activities are undertaken on a case-by-case basis dependent on coastal erosion events or community concern. Some observed measures that are currently being implemented include

In response to recession/erosion in 2023 Council completed track maintenance at Maneela Street and path re-direction to protect the

dunes and provide a safe access. The works re-aligned the access and infilled a blow out with beach scraping activities and straw bales. The previous access was originally perpendicular to the beach front, before migrating to the south east and now successfully orientated to the north east.

Dune formation fencing has been installed periodically over the last four years to mitigate aeolian sand deposits covering infrastructure around the surf club and lifesaving tower. The dune fencing has been orientated to the north east and has accumulated sand.There are about 7 shade mesh fences situated a suitable distance apart. The vegetation cover has slowly increased in line with sand volume and is populated predominantly by primary dune species. It is unknown if a planting regime was incorporated into the dune fencing area. This area has also had dune paddocks fenced off with typical dune fencing to direct pedestrian access points, which has assisted in revegetation efforts. The dune fencing would incur a high activity rate during summer, and it is unsure if maintenance is carried out.

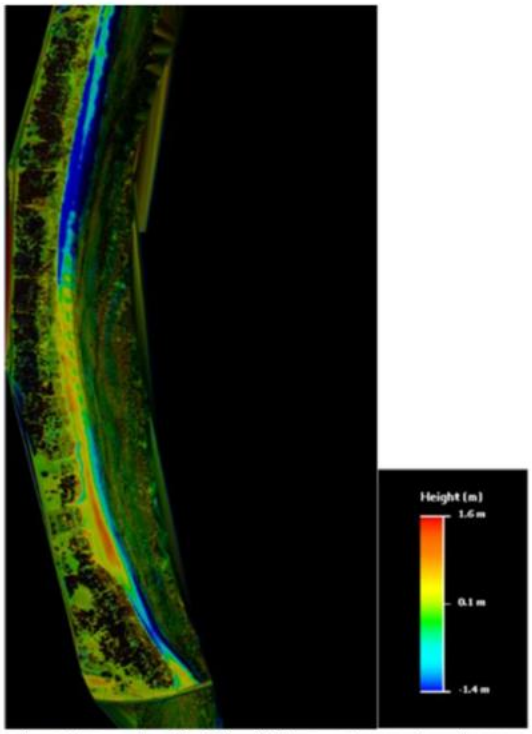
It is evident that seagrass mulch from beach scraping activities is used to infill foredune blow out areas. This was observed at two distinct areas in SP1 and SP3 and looks to be opportunistic.

Seagrass mulch (wrack) acts as a surface wind barrier while also providing structure and a rich source of organic matter within the dune. It is mixed in with aeolian sand and thickly laid with evidence of primary dune species (*Tetragonia tetragonoides*) emerging.

Landcare has worked in conjunction with Council and the Local Aboriginal Land Council to remove bitou bush colonisation north of the surf club - Awabakal Avenue. More recently Asparagus Fern removal has also been targeted in the mapped red area.

The weed management strategy ,undertaken have been paired with vegetation enhancement to the hind dune system and these management activities should continue with ongoing support from Council.

It is evident some patches of bitou had been targeted in SP3 and SP1 south of the surf club and is consistent with the intended outcome of the portion.

 Figure 4 LiDAR comparison of beach/dune height between July 2016 and November 2021	Council has been flying drone mounted LiDAR frequently (three times a year) providing details of change analysis along the entire length of the beach including at Blacksmiths. The data captured assists in tracking success of dune management works and dune vegetation density.

3.2. Proposed management actions

The preferred options for Dune management activities throughout the Blacksmith's Beach site are discussed. It is noted Council will engage with community on the following actions as views of management strategies are subjective to social and cultural values of the beach front. The photos below show where certain management activities could take place were captured during the site inspection. These photos highlight the southern portion (SP1 and SP2) of the study area as priority.


Blacksmiths Beach
Pelican
Pelican Blacksmiths
Pelican Flat Park
Blacksmiths Park
Little Pelican
Little Pelican Blacksmiths
Maxar | Esri, HERE, Garmin
POWERED BY esri


Separable portion 1
Weed management to Bitou Bush monoculture – progressively working from south-north.
Maintain living buffer of 1.5m surrounding Bitou management area and Access tracks
General trend of revegetation strategy - work from existing remnant hind dune vegetating outwards progressively to increase diversity.
Infill minor "blow out" along foredune face with Seaweed wrack or brush matting from access clearing -Track 21.
Manage access as per recommendation
Natural recolonisation by beach spinifex
Increase vehicle access height from beach scraping/won material from Granny's pool sand removal program. Stabilise increased level with Surface treatment - Mulch
Tue Jun 25 2024
Imagery © 2024 Nearmap, HERE
50 m


Separable portion 2
Promote natural recolonisation by beach spinifex
Extend dune formation fencing
Re-align & extend exclusion fence
Manage access as per recommendation
Proposed dune paddocks that require new & or maintained pedestrian exclusion fencing.
Straw bale installation – re-orientate to SE & infill Dune formation fencing.
Straw bale installation – maintain NE.
Bitou bush and Gazania weed management as per SP1
Extend and re-align exclusion fencing south corner
Memorial – maintain access
Kolang St
Boikon St
Garrawarra St
Ungala Rd
Commerce St
Ling St
Pelican Cct
Cabbage St
Paradise Way
Bali St
Tue Jun 25 2024


Separable portion 3a
Infill as per access recommendations with brush matting from clearing
Foredune crest access – infill with brush/seaweed wrack to minimise pedestrian activity and provide baseline to aeolian erosion level.
Suggest access closure with Brush matting
Extend fencing and install T-junction at termination of foredune crest
Tue Jun 25 2024


Separable portion 3b
Corner posts with T- junction instead of H post installed
Suggest access closure with Brush matting
Pacific Hwy
Soldiers Rd
Awabakal Ave
Kalinda St
Mallawa St
Amaroo St
Manoela St
Ungala Rd
Blacksmiths Beach
Tue Jun 25 2024

3.3. Methodology for management strategies

3.3.1. Protective fencing, access and infrastructure

Protective fencing mitigates damage from pedestrian activity. It is typical for humans to take the shortest and most convenient path and the foot traffic damages vegetation within the dune system, which leads to instability. This is evident around high-use areas such as SP2 and the southern crest of the foredune in SP3. There are a couple of isolated spots within SP3, which will also be managed with dune forming techniques with the intention to block access.

The fencing alignment proposed focuses on the seaward alignment of the dune and creates exclusion zones around identified dune paddocks. The fencing currently in place requires some realignment and maintenance to be effective. The majority of the access points at Blacksmiths are 100m in length with only the last 50m from beach to dune crest requiring maintenance. The lee side of the dune system pedestrian fencing is in a suitable condition throughout. The most cost effective and practical solution is to work within the existing plain wire fencing alignments. Installation techniques are highlighted in Appendix 5.3.

The maintenance activities for pedestrian fencing suggests H & T finish configurations, these are corner post layouts where:

- H – two posts and 1 rail.
- T – 3 posts with 1 centre post and 2 rails.

The position, alignment and maintenance of beach access way fencing will be covered in Appendix 5.1. The access points have been numbered from north to south along with naming conventions that coincide with their existing street names. The named access paths have been considered as having high community value, with other paths that are not as well used being managed as proposed in Appendices.

There are constructed access pathways at the following locations

- Track 1 – Vehicular access that is constructed as per typical Vehicle board & chain design and covers the crest, landward and seaward slope of the foredune. Board and chain access pathways are design to be flexible and can be adjusted to suit the dune profile. It is recommended to lift the access upon inundation.
- Track 6,8,9,10,11,17 – Enduroplank access that has been constructed as per *Enduroplank installation guide – floating boardwalk* and falls short of the incipient dune. These access pathways have been constructed on heavily trafficked accessways where the dune is reasonably stable. The exception to this is the track 17 where it has been constructed in an exposed area that can be buried by drifting sand, undermined by wind and waves or initiate erosion by runoff. Monthly or after storm events, checks should be undertaken where these access pathways area constructed in unstable areas. Enduroplank products are protected

from UV degradation and typically have a 40-year life expectancy so in a stable area these rigid structures require minimal maintenance.

There are two viewing platforms within the study area (Track 6 & 10), it is assumed they have been appropriately designed and key aspects of coastal processes taken into consideration. With a similar expectation to rigid accessways these viewing platforms should be constructed in reasonably stable locations ie (set back from the beach).

Track 10 viewing platform is set back in the dune profile and would be less likely to interact with coastal process. Track 6 is on the crest of the current foredune and has a higher likelihood of interaction with coastal process. Monitoring of the condition of these viewing platforms should be undertaken in conjunction with beach access inspections.

3.3.2. Dune forming techniques

The below techniques are suitable for small blow out sections of the dune or longer-term stabilisation projects, each technique should be applied to suit the situation.

Sand drift fencing

Typically, for dune restoration sand forming fencing is placed perpendicular to the dominant sand transporting wind. This is to ensure that the sheltered zone (windward or lee side of the fence) creates an energy drop-out zone allowing sand to settle. Sand will settle in a zone that is 5-10m the height of the fence therefore spacings should be in that range. Sand drift fencing should also take into account the volume of sand available, fetch distance and pedestrian exclusion.

During the higher periods of sand availability (summer and spring) where the predominant sand source is from the north east it is advised to orientate the fencing to this direction at Blacksmiths.

The fence material should be porous with about 40% porosity (shade cloth or Sarlon fencing works well) and it is typically attached to treated pine posts about 1.5m in height. Further specifications and installation techniques are highlighted in Appendix 5.2. It is important to note that dune formation is progressive and additional fencing should be installed throughout maintenance periods.

Straw bales

Straw bales are alternative materials that can be used to trap sand, like sand drift fencing they are installed linear in nature with closer spacings. The straw bales should be installed within a trench one quarter the depth of the bale. They are typically 900mm x400mm and transported by machine to the dune scrap, placed by hand.

In Blacksmiths where the predominant wind direction is from the southeast and leading sand source is from the north east, both orientations will capture sand. It is therefore advised that infill and additional sand trapping methods in SP2 be placed to face to the southeast direction. Successful infill is demonstrated in Appendix 5.5.

Biomimicry

Biomimicry, which is a practice that mimics natural strategies, can also be implemented to build up sand dunes. The role that vegetation plays in capturing sand creating a rough surface and baffling wind allows the entrapment of aeolian sand. The practice has been implemented overseas to trap sand in dunes affected by hurricanes by placing wooden timbers throughout the open dune profile.

At Blacksmiths the availability of vegetation from access management activities would allow such a strategy to be implemented.

As with seaweed /mulch applications this technique is opportunistic and should be carried out immediately after access track maintenance or clearing of donor areas. The predominant species that will be used is *acacia longifolia* , The coastal wattle is found throughout SP3 and when seeding in spring will provide a seed bank within the brush matted area to enhance revegetation.

Branches should be cut with snips with at least 200mm of stem to allow the branches to be pushed into the sand on an angle of 10-15 degrees, the branch should be between 600-1000mm in length, longer branches should be cut down. The technique works best with high density vegetation and placement of stem ends to the predominant wind direction, the appropriate spacing should be 2-3m.

Seaweed wrack /mulch

Seagrass mulch (wrack) acts as a surface wind barrier whilst also providing structure and a rich source of organic matter within the dune. The surface covers slow the velocity of the wind and erosion potential. As an alternative to geotextiles seaweed wrack/ vegetation mulch can be spread on access paths and tracks to reduce erosion potential. Mulch can be used opportunistically and previous applications around the Hunter region at Anna Bay have provided good results for access stabilisation.

It is advised to place mulch at a thickness of 75-100mm, within the mobile portion of the dune – i.e. For pedestrian access tracks at Blacksmiths it would be typically from where the Enduroplank ends to the crest of the foredune. Placement would be easiest with machinery, however it can be done manually. To promote success a fine layer of sand can be placed over the mulch, a baseline for continual increase in height. It is envisaged for vehicular access in SP1 and other pedestrian accesses around 25m^3 will be required for each application.

In areas not destined for access, i.e. the foredune crest and blow outs it is suggested that seaweed wrack is mixed in with aeolian sand and thickly laid. There are two locations where this is occurring at Blacksmiths, and it is advised to keep this ongoing with the beach scraping tractor. Specific areas have been allocated in SP1 and SP3a and focus should be in these areas until primary dune formation species take over.

3.3.3. Weed management

Vegetation plays an important part in the evolution of dunes, as it serves multiple ecological and physical purposes. This includes weed species that assist in dune formation such as bitou bush however often the positives are outweighed by negative effects of such species.

Bitou bush was promoted in the coastal environment due to its rapid growth and ability to stabilise soils, however its ability to form dense monocultures and rapidly spread became a threat to biodiversity and is now a Weed of National Significance (WoNS).

Whilst a complete vegetation survey was not undertaken or included in the scope of this report, several key weed species were opportunistically identified within the project area, including WoNS. Overall, the Blacksmiths dune system was found to have high native vegetation cover and only scattered incidence of weeds throughout. The southern zone SP1 contains a dense monoculture of bitou bush - around 1.4ha with isolated plants moving further north. Weed control in dune systems, particular within sensitive dunes such as those within Blacksmiths requires careful consideration. All plant matter, including weed species, provide an important sand-binding function within the dune and contribute organic matter. Any weed plant removal can put dune stability at risk and as such must be carried out with minimal disturbance. Overall, it is recommended to leave the majority of weed material in situ. If weeds are managed it is important to ensure that they are treated strategically and in the appropriate season to prevent reproduction and reduce the weed seed bank. It is also critical to plan and ensure consistency with existing strategies or work already occurring in the area.

The following management requirements should be implemented

- weeds are to be reduced in SP1 50% within 1 year and mosaic management of weed re-growth targeted around remnant vegetation pockets thereafter. Any growth is to be maintained below 20% which is considered manageable.
- weeds are to be reduced in SP2 & SP3 by 80% within 1 year and any growth is to be maintained below 20% which is considered manageable.
- encroachment of weeds into each portion is to be prevented.

Key weed species identified and associated recommended management actions are presented below.

Bitou Bush

Rating: Weed of National Significance

Risk to coastal areas: High

Located: SP1/SP2/SP3

Treatment: Search and locate; any time of year is suitable for control preferably prior to seeding in Autum. Isolated plants should be assessed with size and hand weeding is preferred, If plants are large, it is usually difficult to cut and paste so foliar spraying using a backpack or quick spray unit will work. For dense monocultures as located in SP1 a quick spray unit with 100m long hoses would suffice.

Discussion: This species is widespread throughout the dune paddocks especially in SP1 where there is a dense monoculture. The treatment of bitou bush in this zone should be undertaken with a qualified bush regeneration team. The team should concentrate on working from a southerly to

northerly direction leaving a buffer zone of 2m on the coastal fringe and alongside formed access tracks. Preferred treatment method of foliar spraying should be undertaken with glyphosate mixed with a dye for visual detection of areas that have been sprayed. The seed bank for bitou bush can last up to seven years so follow up control post primary treatment should be considered and developed as an ongoing program. The Bitou bush skeletons can often house the new seedlings which can be hand pulled or spot sprayed.

With the buffer zones maintained other management activities should be incorporated including planting of primary & secondary species. The proposed methodology would include spraying Bitou bush, allowing time for die-back and further treatment. Planting from established remnant native vegetation outwards where protected pockets will allow growth. The trampling of the bitou bush skeletons will provide access and organic material for new growth of native plantings. The buffer zone should be maintained to ensure new infestation does not take hold prior to complete removal at a time that revegetation strategies have provided stabilisation which would be considered at 70 percent original density coverage. The risk of dune instability will be minimised by keeping the structure of the weed in place , this can be enhanced by temporary dune stabilisers such as brush cuttings, mulch and jute products.

Asparagus Weed (Asparagus spp.)

Rating: Weed of National Significance

Risk to coastal areas: High

Located: SP1/SP3

Treatment: Search and locate, anytime of year is suitable for control and treatment should include manual and chemical application techniques highlighted below.

Discussion: This species is not so widespread on the foredune system but located in the hind dune and in areas sheltered by hind dune canopy species. Although not widespread it has the ability to take over and smother the growth of native seedlings. As plants are located within soft soil/sandy loam it is suggested that manual removal (hand pulling or crowning) will be most successful. This can be undertaken at any time, prior to planting is preferred. If leaving on site wedged in a tree fork or upside down just be aware that the plant can still grow from rhizomes attached to tubers. Transport and removal to a waste facility offsite is best practice.

Lantana

Rating: Weed of National Significance

Risk to coastal areas: Medium-High

Located: SP1/SP3

Treatment: Search and locate, anytime of year is suitable for control and treatment should include manual and chemical application techniques highlighted below.

Discussion: This species was observed in patches throughout the hind dune adjacent to access tracks, therefore will be easy to identify and treat. The treatment of this weed should be undertaken by a qualified bush regeneration team. The soft soils of the hind dune will provide ease for physical removal methods and plants should be assessed based on size. Larger specimens should be targeted with the cut & paste method. Cut stems around 15cm from the ground and apply herbicide within 15 seconds ensure every stem is treated.

Gazania (Gazania sp.)

Rating: Declared Weed

Risk to coastal areas: Medium

Located: SP2/SP3

Treatment: Search and locate, poison in winter and early spring (prior to or during early flowering) using a surfactant and remove juveniles manually.

Discussion: This species appeared to be confined mainly to the edges of beach access tracks and foredune, as scattered plants. It is recommended to locate individual plants and work with a bush regeneration team to have the plants treated with a suitable poison. Nearby juveniles should be located and hand-pulled, being careful to remove all rhizomes. Any removed individuals must be contained, transported and disposed of in accordance with required regulations.

3.3.4. Vegetation enhancement

For weed management activities in SP1 and SP2 it is beneficial to follow up or work in conjunction with vegetation enhancement techniques which will meet the following objectives

- restoring degraded coastal zone
- revegetate the native vegetation to the following zones (incipient, foredune and hind dune).
- increase native species abundance and diversity
- reduce weeds and prevent further erosion.

No vegetation enhancement has been considered for SP3 currently has an effective coverage of native species abundance and weed control activities would be focused proactively every 12 months as indicated in the implementation schedule.

The enhancement works will occur as when weed management works are undertaken, natural regeneration from the surrounding remnant native plants will be too slow. Planting species that are well suited to the geographical location within the dune zone will ensure success. Below represents certain species and their typical location.

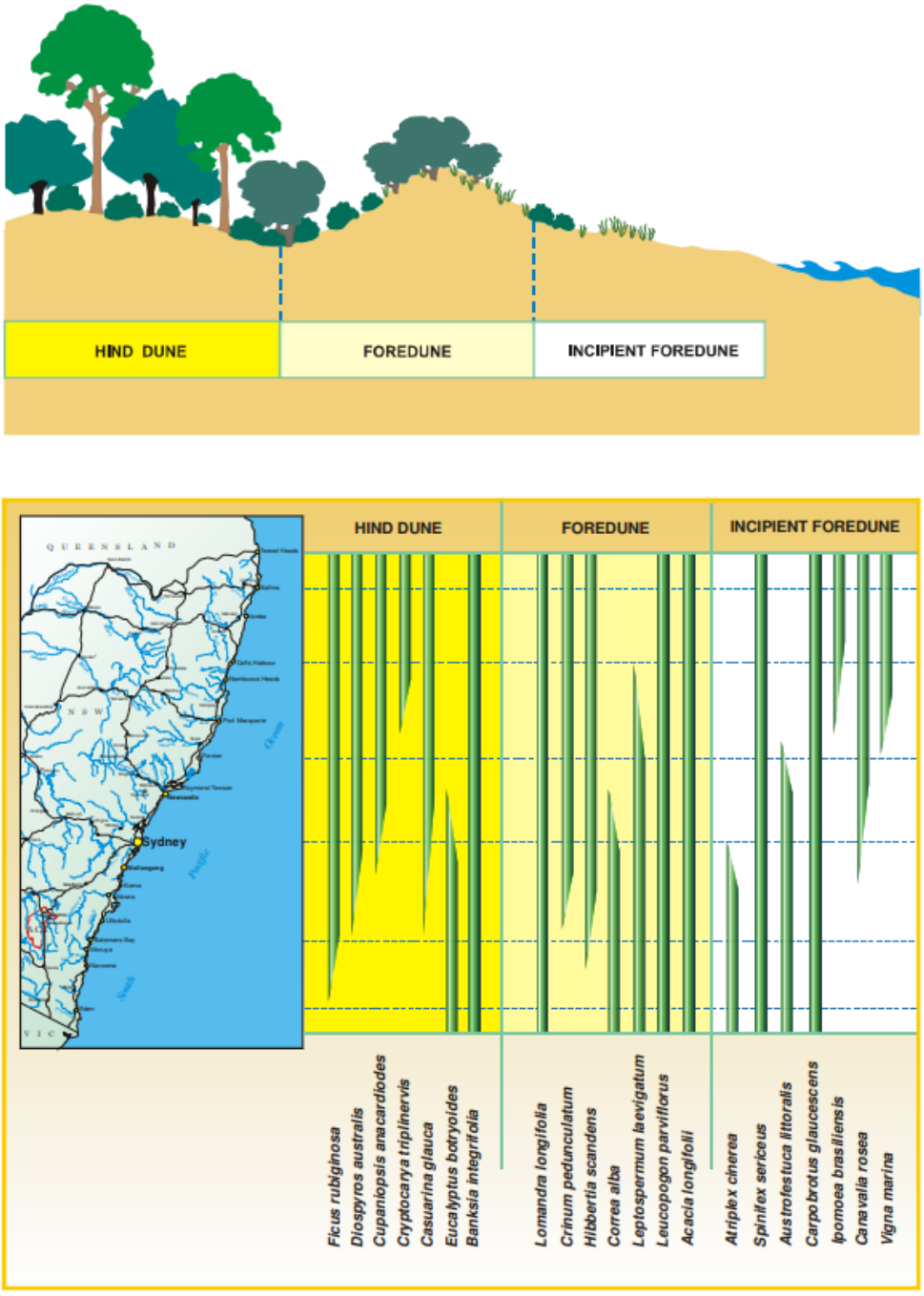


Figure 6.3 Typical geographical range of some common dune plants along the NSW coast.

3.3.5. Access

Access for all works will require some planning, as not all sites are accessible from local roads. There is some roadside access available for most of the beach pedestrian access paths. Materials can be carried onto the site from parking areas along Ungala Road. Where appropriate, beach access for vehicles could be arranged with Council to provide more efficient access to some sites. This will need to be timed with the occurrence of a low tide and at times of low beach usage by the public. Any works that occur adjacent to publicly accessible areas should incorporate temporary

exclusion fencing to eliminating foot and vehicle traffic from the restoration area. The fence should be a simple post and flag fence.

3.4. Implementation schedule – Revegetation works

Objective	Key Performance Indicator (KPI)	How will this KPI be assessed?	Designated time to meet KPI	If KPI cannot be met by designated time
Weed control SP1	Weeds are to be reduced in this portion by 50% for the first year and mosaic management of weed re-growth targeted around remnant vegetation pockets thereafter.	Site assessment	Primary weed removal to be conducted by 2 herbicide applications - Treatments are to occur with two weeks between each treatment and a further two weeks after the last treatment prior to any further enhancement works. supported by supplementary hand weeding - Ongoing - Review every 6 months.	Increase site visits for weed control
Weed control SP2 and SP3	Weeds are to be reduced in this by 80% for the first year (1) and any regrowth is to be maintained below 20% for the remaining years	Site assessment	Ongoing Landcare works + supplementary hand weeding - Review every 12 months.	Increase site visits for weed control
Vegetation enhancement SP1+SP2	Revegetation - coastal sand dune scrub and Banksia scrub is to be completed in conjunction with weed control. Plantings are to follow the species listed in 3.3.4 and meet the following diversity criteria: -Incipient dune 5 plants per $1m^2$ -Foredune 4 plants	Site assessment	Staged to tie into weed control works, particularly the removal of bitou bush which will have ability to shelter the new plants in the skeletons. Should also have considerations for 70% coverage throughout the weed management and timing should be	Revegetation cannot be delayed as it is critical to have coverage in the coastal zone for resilience - Increase planting rates as required or incorporate direct seeding techniques in Autum for species including Spinifex.

	per 1m^2 -Hind dune 2 plants per 1m^2		considered around Autum.	
Survival of plantings	>90% survival rate of all plantings installed within SP1	Site assessment	Spring - annually	Replace plants that have not survived, if plants continue to die more regular watering visits are to be scheduled

3.5. Work scheduling /timing

Task	Scheduling	Trigger	Works
Protective fencing	Inspect every 3 weeks during summer (Dec-Feb) and every other third month outside of summer. Check after every significant storm event.	Bottom wire is buried Posts fallen over /hanging wire not strained	As required to meet specifications outlined in Plain wire fencing design DWLC 2001
Access Tracks maintenance	Inspect every 3 months post undertaking of 5.1 Beach access track recommendations and after storm events. Constructed access pathways should be inspected upon interaction with coastal inundation or failure from scour/inundation	Sand over access greater than 1m drop at seaward extent of access Enduroplank access scour along leading edges. Vegetation encroaching through fencing wires.	As required -Close access for maintenance Replace access or remove build-up of sand with lightweight machinery such as a75hp Posi track with broom attachment. Place sand from beach scraping activities at seaward edge of access. Conduct brush cutting activities.
Sand drift fencing	Inspect every 6 months or after a significant wind event	2/3 of dune fencing buried Scour at toe of dune fencing	As required to meet specifications outlined in Dune forming fence design DWLC 2002
Straw bales	Inspect and replace after 6 months - high use areas will lead to faster degradation so during summer more regular inspections should be undertaken	Straw bales have lost shape and integrity, retaining string broken.	Replace as required upon inspection
Biomimicry	Opportunistic - Reactive to "blow out" areas. Inspect foredune after significant storm events.	Visual inspection of incipient dune	Conduct brush matting activities
Seaweed wrack /Mulch	Opportunistic - Reactive to "blow out" areas. Inspect foredune after significant storm events.	Visual inspection of incipient dune	Conduct beach scraping of seaweed wrack and place strategically in "blow out" locations

4. References

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Bitou Bush Management Manual: Current Management and Control Options for Bitou Bush (Chrysanthemoides monilifera ssp. rotundata) in Australia-January 2008, Department of Environment and Climate Change (NSW)

Weeds Australia - www.weeds.org.au

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Lake Macquarie City Council 2015, Lake Macquarie Coastal Management Plan

Surf amenity assessment- Blacksmith's surf amenity assessment UNSW 2020

Wave Overtopping Wave Overtopping Assessment - Salients 2021

https://www.seed.nsw.gov.au/

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https://weeds.dpi.nsw.gov.au/Weeds/

https://www.ipcc.ch/

5. Appendix

5.1. Beach access track recommendations

Track 1

Closed to recreational vehicle access. Board and chain in good condition with steel exclusion wire/posts rusting.

Replacement with typical plain wire exclusion fence to crest of foredune.

Track 2

Fencing needs re-instating by lifting posts and re-straining wires. End posts need lifting and suggest corner posts installed.

Track 3

Re-instate fencing and lift posts/rails and install wire.

Track 4

Informal access point bollard and wire roped off – no formal entry points off road way suggest closure.

Brush mating required to aid in closure.

Track 5

Raise fencing and re-instate wires, extend at beach front by 5m and encompass crest to ensure no pedestrian access parallel to beach front on the foredune crest.

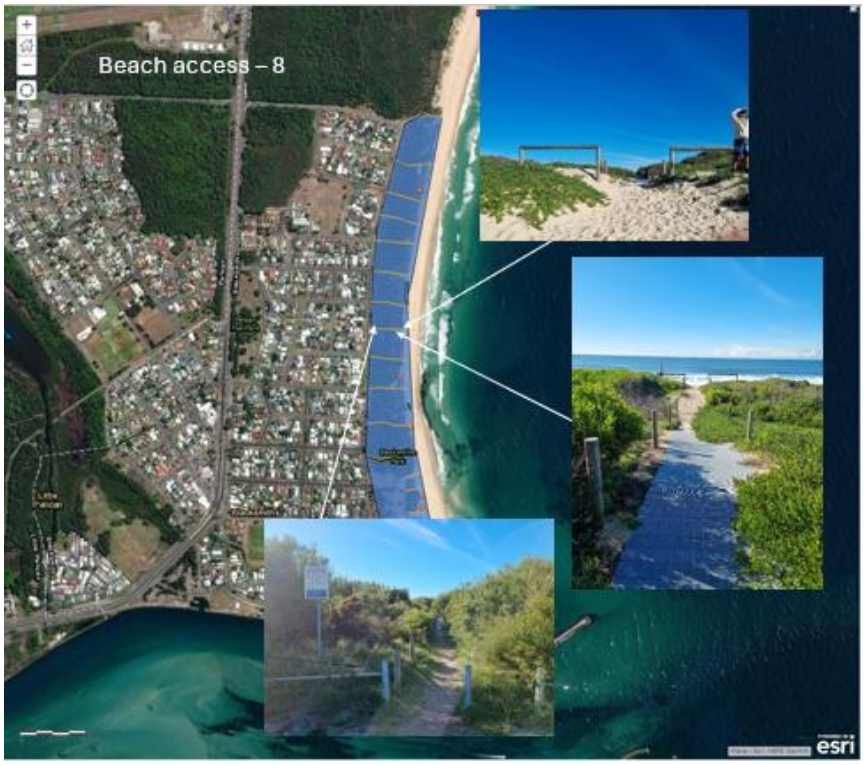
Track 6

Fencing wire leading towards lookout to be re-instated and tensioned.

Track 7

Incised at beach front, posts need lifting and re-installing and wire replaced.

Install T junction at beach front and infill incised areas with brush matting from track clearing.



Track 8

Fencing wires need replacing, posts need lifting and re-instating.

Brush cleared and used for infill.

Track 9

Hind dune entry well established, enduroplank functioning well, beach front requires fencing to be lifted and wire re-instated and vegetation maintained and used in brush matting areas.

Track 10

Posts and rails need raising on foredune, wire will also need replacing.

Brush matt northeast facing access under the lookout to minimise pedestrian activity.

Track 11

Good condition, maintain vegetation management on foredune and continue maintenance on fencing wire.

Track 12

Incipient dune vegetation in good condition, access narrow and not well used – suggest closure by removal of signage and brush matting access.

Track 13

Requires pedestrian exclusion fencing from gate to top of foredune to restrict hind dune pedestrian activity

Track 14

Extend beach-front pedestrian access fencing to ensure pedestrian activity minimised on dune crest.

Track 15

Scour on north side of access at termination to beach, build up on south side. Wind fencing to be extended to capture sand.

Re-align fencing width at beach front from 6m to 3.5m to suit widest beach entry off car park to reduce build up lee side of dune crest.

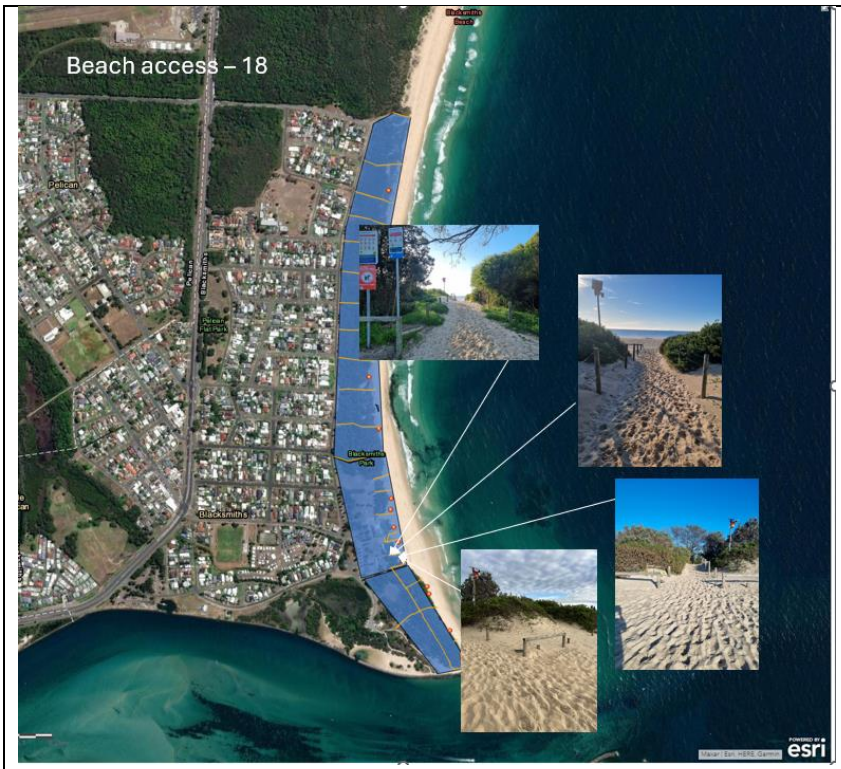
Track 16

Ensure sand build up is managed using machinery.

Track 17

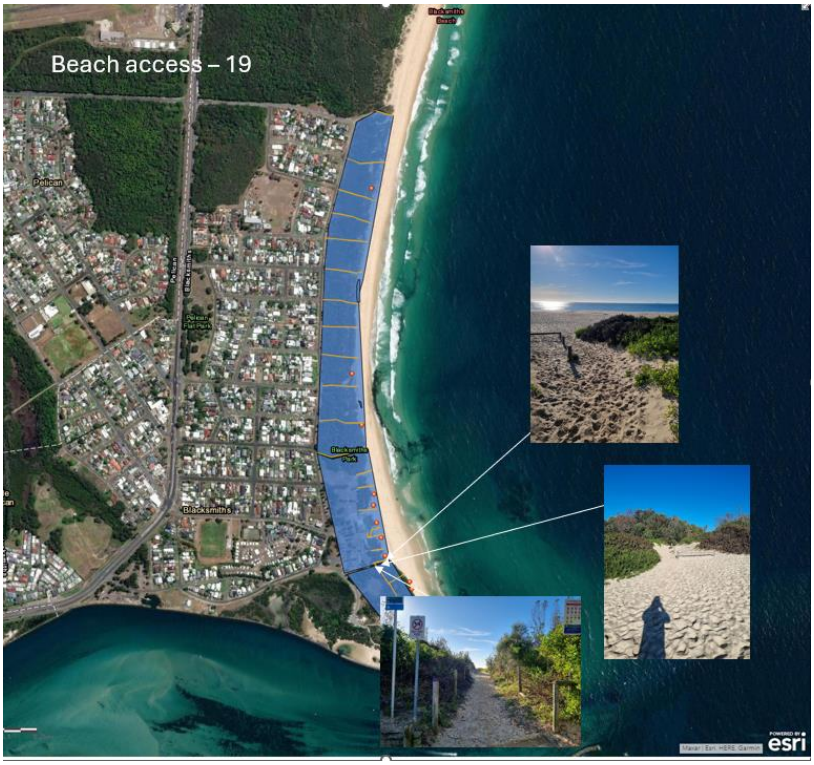
Dune fencing alignment creating baffle and slight scour adjacent to enduroplank-Install straw bales.

Maintain fencing.



Track 18

Evident that north west sand migration from build-up adjacent to fence line. Fencing requires lifting and re-wiring, extend pedestrian exclusion to join southern beach front fencing. Access to memorial should be maintained.



Track 19

Lift fencing at beach and re-wire.

T join on north side to be maintained and left in situ – no T join on south side.

Track 20

Top wire needs replacing (northern side), vegetation control required.

Utilise brush matting as proposed.

Track 21

Replace fencing wire and undertake vegetation maintenance. Formalise access as a thoroughfare from Break wall vehicle access road. Maintain alignment with dog leg on foredune and southeast facing exit.

Track 22

Vehicular access track – increase height by 300mm from beach scraping activities and install mulch covering 100mm thick.

5.2. Dune formation detail

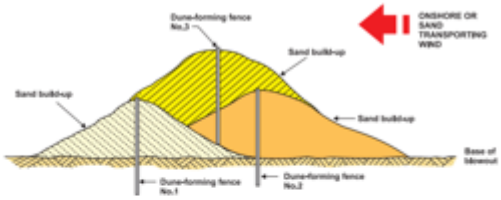


Figure 4.2b Sequence for progressive installation of dune-forming fences.

DWLC 2001 – dune formation fencing detail

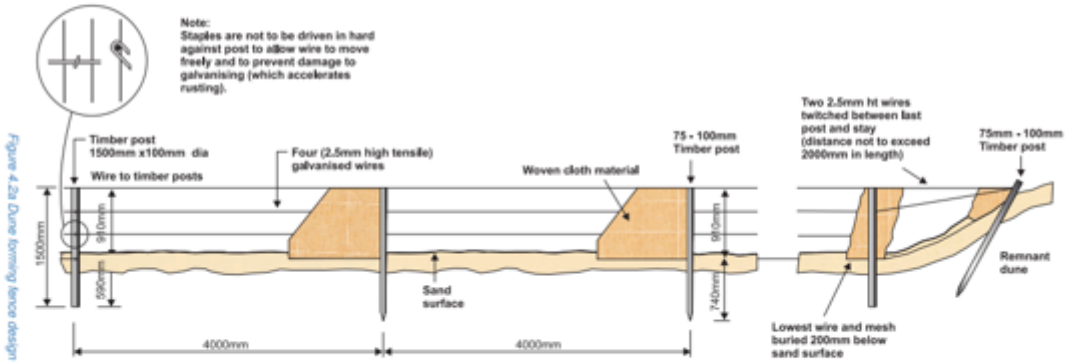


Figure 4.2a Dune forming fence design

Coastal Dune Management

Notes:

1. Wire and mesh to go on seaward or prevailing weather side of fence.
2. Mesh to be fastened to all wires using ring fasteners at 100-150mm intervals on top wire and 300mm intervals on other wires.
3. Use one wooden post every 4000mm.
4. Metal posts should be avoided.

5.3. Plain wire fence detail

DWLC 2001 – Plain wire fence detail

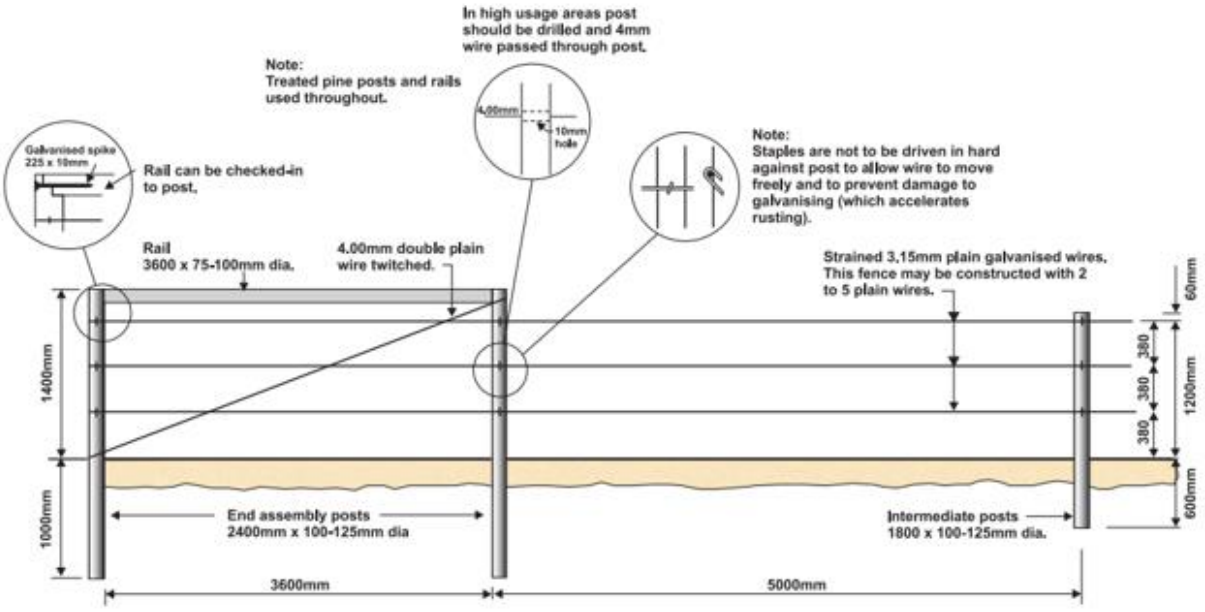
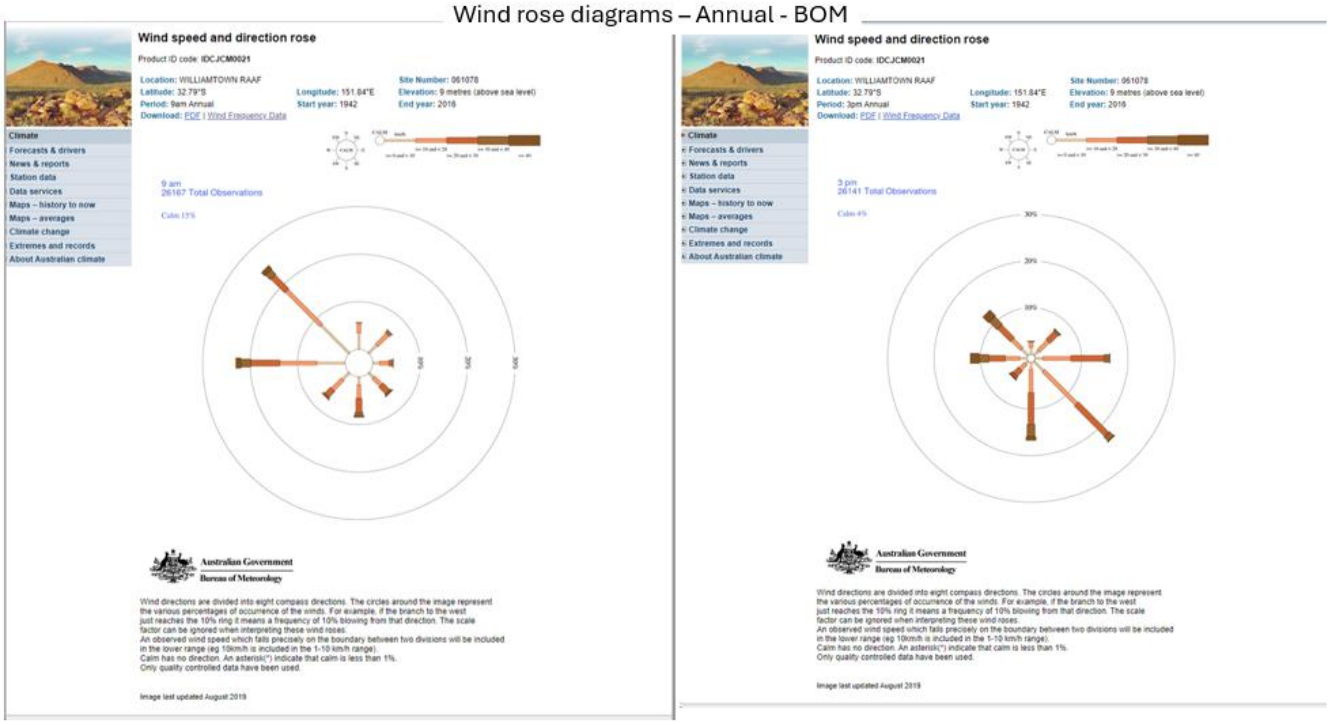


Figure 4.6a Plain Wire Fence

Coastal Dune Management

5.4. Wind rose diagrams – Hunter Coast

Wind rose diagrams – Annual - BOM



5.5. Infill of dune formation fencing