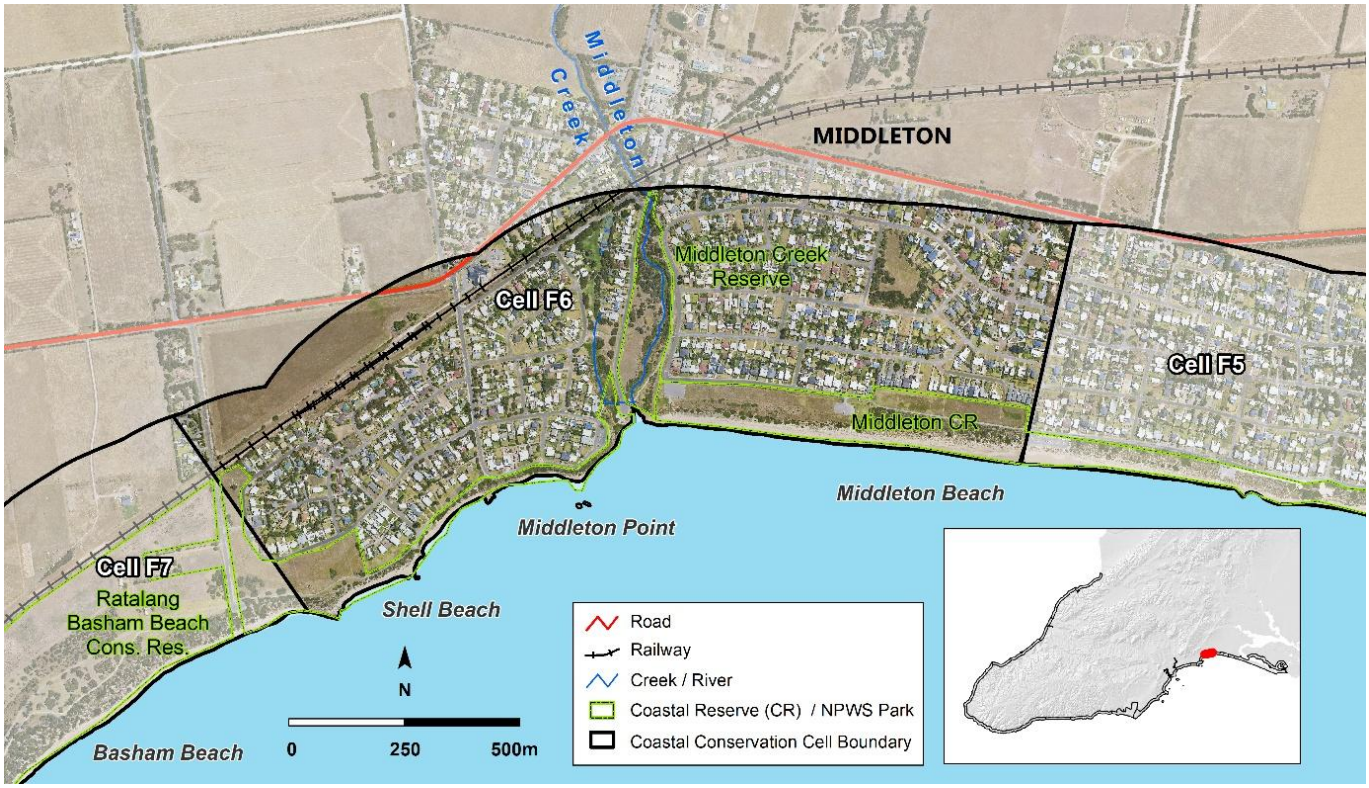
Southern Fleurieu Coastal Action Plan

Middleton (Ratalang) including Middleton Creek estuary (Ratalwar)

Cell F6

Overview

This cell covers a wide variety of coastal habitats (dunes, cliffs, rocky shores, a headland and an estuary) and demonstrates the increasing urban development of coastal areas, with pressures including weed incursion, stormwater and erosion. The area experiences high visitation from a growing local population (popular surf breaks and beach use (dog walking, exercise), and seasonal influxes through whale watching and tourist visitors). Middleton Creek has valuable habitats for local fauna and flora, but also a large weed presence, particularly of garden escapes. The nearshore intertidal reef supports a wide variety of macroalgal, seagrass, molluscs and echinoderms.



Cell detail

This cell extends from Chapman Road, Middleton approximately 1.5km to Shell Beach (Seaview Ave, Middleton). This cell is in the Alexandrina Council local government area.

Tenure, Land Use and Values

Residential coastal plain with coastal and creek line council reserves. The wide coastal reserve immediately east of Middleton Creek (creek to Chapman Av.) is invaluable as a buffer to erosion and should be defended against development pressure. Farm and urban stormwater run-off to the Middleton Creek. Erosion episodes of the marl cliffs and creek banks contribute to turbidity in the nearshore zone (Caton et al 2007). The remaining narrow coastal reserves provide an invaluable buffer zone. Since 2012, the waters surrounding this cell are within the boundaries of the Encounter Marine Park.

Native title has been determined for Ngarrindjeri people over land and sea Country within this cell under the *Native Title Act 1993 (Cth).*

The SteamRanger railway corridor occupies a linear area of the northern boundary of this cell.

The cell is utilised for recreational surfing, fishing and walking. The beach is an important habitat and fishing area for Western Australian Salmon (*Arripis truttaceus*), Mulloway (*Argyrosomus japonicus)*, Yelloweye Mullet, (*Aldrichetta forsteri*), and Goolwa Cockle/Pipi (*Plebidonax deltoides)* (Bryars 2013).

Friends of the Hooded Plover Fleurieu Peninsula (supported by BirdLife Australia) and Team Oystercatcher volunteers (SA Shorebird Foundation) monitor and raise awareness of beach nesting and shorebird species within the cell. Several coastal community groups have undertaken revegetation activities as part of national tree day-based activities across this cell over the last decade. These efforts have significantly increased the species diversity and reduced erosion of the dunes and cliff lines within the cell.

Landforms

“This entire beach is composed of fine sand and exposed to waves averaging over 2m. These break across a 500m wide double bar surf zone, characterized by numerous spilling breakers and substantial wave set-up and set-down at the shoreline and, during lower wave conditions, widely spaced rips. At Middleton a strong permanent rip runs out against the rocks.” (Short, 2001, p.98). The beach is backed by a low marl bluff; and fronted by a small foredune (c. 10m wide). Bourman (1974) records erosion c.200m of this bluff and the dunes that were here, over a period of 100 years, to 1970. Recently, recession continues through slumping at times of saturation and wave removal of slumped material, but has slowed considerably, and may well have been reversed. Settlement is established on a gently sloping low platform of clay marl. The lower Middleton Creek is incised into this platform (Caton et al 2007).

Western et al (2019) compared the position of the shoreline from 1949 to 2018 and identified areas of erosion and accretion. Concluding that the coastline in most places appears to have been stable for 70 years however in some places it has eroded. Furthermore within this cell the top of the cliffs receded 7-13m from 1949 to 2006 with an incipient foredune has developed since 2006, at a distance from the base of the cliffs of ~12-15m (Western et al 2019).

The Middleton Beach geological monument (reference 1116) is located from Middleton estuary to the western boundary of the cell and displays the Petrel Cove Formation, Kanmantoo Group, Middleton Sandstone.

Middleton, low marl bluff and Middleton Creek (Coast Protection Board, March 2024)

First Nations cultural heritage and connection to land and sea Country

This cell holds high cultural value and significance for the Ramindjeri people of the Ngarrindjeri Nation. It forms part of their Dreaming stories and contains numerous stories, places, and artefacts of cultural importance. Ramindjeri cultural heritage is present throughout the entire cell, everywhere you tread. The Ramindjeri lived, hunted, played, swam, and danced here. Those working within and restoring these areas may encounter artefacts or evidence of cultural significance to the Ramindjeri people and the broader Ngarrindjeri Nation. These areas must be known, recognised, respected, and protected.

Creeks, wetlands, estuaries, dunes, cliff lines, islands and coastal areas are important gathering places that support a variety of habitats and food sources essential for sustaining and protecting Nga:tji. Nga:tji are the personal totems of the Ngarrindjeri people. They embody deep cultural values, symbolising kinship, spiritual protection, and an embedded responsibility to care for the land, waters, and ecosystems they inhabit.

Landscape features and culturally significant sites within this cell include and number of important sites, camping grounds, midden sites, stone tools and artefacts are located throughout the sandhills. A trade path used by Clan groups, extending north from Middleton Creek, also existed within this cell. It illustrates the long-standing relationships between neighbouring clan groups and the exchange of locally sourced materials, including stone tools, food, and other cultural items.

This cell is also a particularly important site in the Ngurunderi Creation and Dreaming story, which tells of the Ngarrindjeri people's creation of the land and waters, including the River Murray and its mouth, Kandukang (west) and Tapalwora (east). This ancestral narrative extends westward along the southern coast of the Fleurieu Peninsula, encompassing the rugged shoreline, estuaries, and coastal landscapes all the way to Cape Jervis (Parrewar-angk). These areas hold deep cultural and spiritual significance for the Ramindjeri people, with Dreaming tracks, songlines, and important sites embedded throughout the region.

The coastline with its cliffs, beaches, and native vegetation reflects Ngurunderi’s journey as he shaped the land, rested at key locations, and followed the tracks of his wives. Cape Jervis (Parrewar-angk) marks an important point in

this story, serving as both a physical and spiritual place in the landscape. It connects the mainland to Kangaroo Island (Ngurungaui), continuing the cultural narrative of creation, movement, and connection to Country.

Within this cell, the Dreaming story tells how Ngurunderi pulled up a great tree from the coastal slopes and placed it into the sea, forming the seabed to help catch fish.

Please respect that cultural concepts and content included in this plan are the Aboriginal Cultural and Intellectual property (ACIP) of the Ramindjeri people of the Ngarrindjeri Nation (provided by Cedric Varcoe, Ramindjeri Cultural Leader living on Country) (cells 1-20). They may not be used or adapted by any other parties without consent.

Terrestrial biodiversity

Whole cell

This cell has a variety of coastal habitats, including dunes, cliffs, rocky shores, a headland and an estuary. The cell is largely fragmented with a high distribution of coastal weeds, however areas and individuals of remnant vegetation and revegetation with local coastal native species have been undertaken over the last decade to improve connectivity of areas and flora species diversity.

The coastal foredune and cliff line at Middleton Point supports small pockets of remnant native coastal species including Rolling Spinifex (*Spinifex hirsutus*), Common Boobialla (*Myoporum insulare*) and Native Pigface (*Carpobrotus rossii*), but has historically been dominated by a range of weed species, particularly garden escapes. Exotic grasses on the clay plateau above clifftops at the eastern end of the cell, with rebuilding/establishing sand dunes and associated species below. Middleton Creek banks and slopes are dominated by common riparian and coastal weeds which, while they do help to prevent erosion, also limit species diversity and biodiversity values.

Middleton Point Cliffs with native Rolling Spinifex (Spinifex hirsutus) and Common Boobialla (Myoporum insulare), also present Gazania (Gazania linearis) a common garden escape and declared weed species. (R Lewis)

Extensive revegetation and weed control efforts have been undertaken across areas of the cell by Council, Landscapes Boards, coastal community groups, to improve species diversity, reduce erosion and improve habitats.

Multiple common butterfly species that are observed across the Fleurieu Peninsula are found in this cell, including Southern Grass-dart (*Ocybadistes walkeri hypochlora*), White-banded Grass-dart (*Taractrocera papyria papyria*),

Meadow Argus (*Junonia villida calybe*), Australian Painted Lady (*Vanessa kershawi*), Australian Admiral (*Vanessa ited*), Lesser Wanderer (*Danaus petilia*), Monarch (*Danaus plexippus Plexippus),* Long-tailed Pea-blue (*Lampides boeticus*), Two-spotted Line-blue (*Nacaduba biocellata biocellata),* Wattle Blue (*Theclinesthes miskini miskini*), Salt-bush Blue (*Theclinesthes serpentatus serpentatus*) and Common Grass-blue (*Zizina otis labradus*) (Stolarski 2024). Many of the species of conservation significance do not occur in this cell, as their host plants are not present or are in low numbers and unable to support reintroduction from neighbouring cells.

In addition to established breeding territories of the nationally vulnerable Hooded Plover (*Thinornis cucullatus cucullatus*), suitable foraging habitats exist for Pied *(Haematopus longirostris)* and Sooty Oystercatchers *(Haematopus fuliginosus fuliginosus);* both species have a conservation rating of rare in SA and use the beach and intertidal rock platform at Middleton Point as an important foraging site for Goolwa Cockles/Pipis and other marine invertebrates (beach worms). Seagrass wrack (also known as Beach cast wrack) found regularly on these beaches has an important ecological function recycling nutrients back to coastal waters as well as protection and stabilisation of the shoreline and coastal dunes by acting as a trap that binds drifting sands and reduces sand erosion during winter (PIRSA 2014). Beach wrack also provides an important role as habitat and shelter for Hooded Plovers (*Thinornis cucullatus cucullatus*) and Pied *(Haematopus longirostris)* and Sooty Oystercatchers *(Haematopus fuliginosus fuliginosus)* as well as other shorebirds and juvenile fish. Beach cast wrack collection within Encounter Marine Park is prohibited in all zones except general managed use zones. Therefore, no removal of beach wrack is permitted in this cell or the Encounter Bay area.

Hooded Plover (Thinornis cucullatus cucullatus) fledglings on Middleton Beach (M Stokes)

Local dune systems provide refuge and likely valued habitat for a range of seabird species, including the White-bellied Sea Eagle (*Haliaeetus leucogaster*), Eastern Osprey (*Pandion haliaetus cristatus*), Little Black Cormorant (*Phalacrocorax sulcirostris*), Black-faced Cormorant (*Phalacrocorax fuscescens*), Pacific Gull (*Larus pacificus georgii*), Silver Gull (*Chroicocephalus novaehollandiae)* and Kelp Gull *(Larus dominicanus*). Irregular sightings of a range of pelagic birds are also reported in this and adjacent cells, including albatrosses, petrels, shearwaters and gannets, as well as marine mammals (Subantarctic Fur Seals) (Shaughnessy et al., 2014).

Middleton Creek estuary

Middleton Creek is a recognised estuary (DEH 2007).

The condition of the estuary is quite degraded, with a number of coastal weed species and garden escapes. Fragmented pockets of remnant vegetation can be found within the lower estuary. Historically this area would have supported a vegetation association of *Gahnia trifida &/or G. filum* Sedgeland and Coastal Swamp Paper-bark Low Open Forests, but only individual species (or plants) remain on site due to landscape and flow regime changes that limit connectivity with the marine environment.

Middleton Creek and estuary (R Lewis)

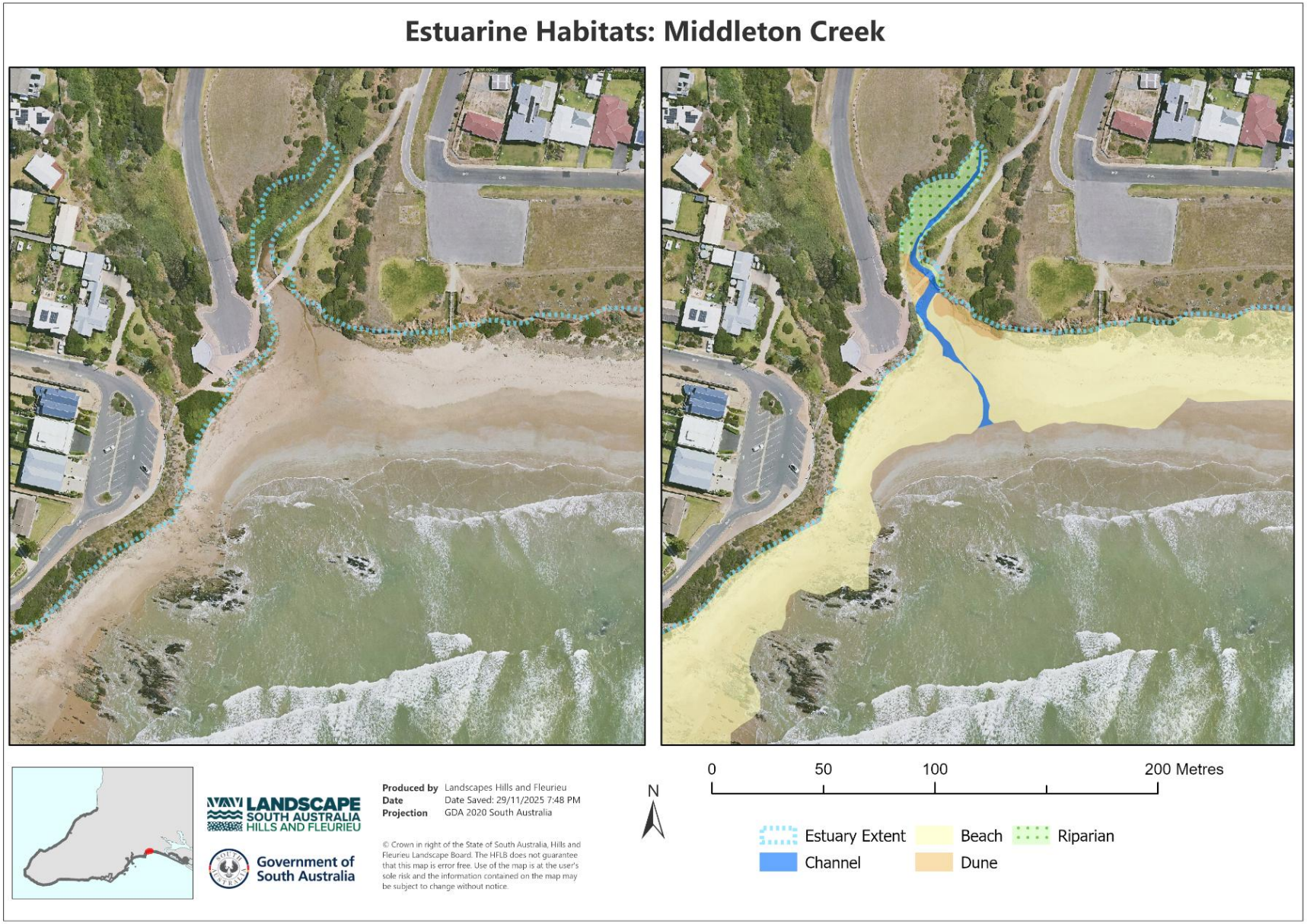


Fig 6.1 Middleton Creek estuarine habitats map

Vegetation Communities

Coastal Dunes

Coastal Shrublands & Tall Shrublands

- Coast Daisy-bush (*Olearia axillaris) +* Coast Beard-heath (*Leucopogon parviflorus) +* Coastal Wattle (*Acacia longifolia ssp. sophorae) +/-* Common Boobialla (*Myoporum insulare)* mid open shrubland over Sea-berry Saltbush (*Rhagodia candolleana ssp. candolleana)* low shrubs over Thyme Riceflower (*Pimelea serpyllifolia ssp. serpyllifolia) +* Bower Spinach *(Tetragonia implexicoma) +/- Coastal Climbing Lignum (Muehlenbeckia gunnii) +/-* Short-stem Flax-lily (*Dianella brevicaulis)*

Creekline and estuary

- Cutting Grass (*Gahnia trifida) &/or* Thatching Grass (*Gahnia filum)* Sedgeland and Coastal Swamp Paper-bark Low Open Forests & Tall Shrublands of Saline Swamps
- Drooping Sheoak *(Allocasuarina verticillata)* Low Woodland over an open grassy and herbaceous understorey Hard Mat-rush (*Lomandra multiflora ssp. dura) +* Scented Mat-rush *(Lomandra effusa) +* Wallaby Grass *(Rytidosperma spp.) +* Spear Grass *(Austrostipa spp.)*

Cliffline

- Coastal Cliff Low Shrublands, Hummock Grasslands & Very Low Open Woodlands

Nearshore Habitats

This cell forms part of the Encounter Marine Park. Most of the marine areas of cell F6 are within a Habitat Protection Zone (HPZ-7), part of cell F6 is within a Sanctuary Zone (SZ-6). These areas include part of the nursery grounds for the endangered Southern Right Whale and is part of the designated *Encounter Bay Whale Nursery Protection Area*, from the Murray Mouth to The Bluff Victor Harbor. A Special Purpose Area (SPA-10) allows for rod and line fishing only from the shore within the Sanctuary Zone (SZ-6).

Bryars (2013) describes this cell as dominated by bare sand (including Middleton Beach) and patchy low profile reef, mainly offshore but with some sections inshore around Middleton Point (figure F6.2).

No seagrass has been mapped for this cell. Subtidal reefs in the general area are composed of granite, limestone or metamorphic rock (Haig et al. 2006, Turner et al. 2007, Baker et al. 2008). Offshore reefs within this cell are possibly limestone (see Haig et al. 2006), while the inshore (and intertidal) reefs around Middleton Point are possibly igneous or metamorphic rock (see Benkendorff and Thomas 2007). The inshore bare sand is characterised by a high energy beach system with 500 m wide dissipative surf zone and fine sand (Short 2001).

The cell is regionally significant due to the extensive beach (soft bottom/ bare sand) habitat and intertidal reef habitat around Middleton Point.

The Slender-spined Globefish (Diodon nicthemerus) occurs across nearshore habitats of the Fleurieu Peninsula, where it inhabits shallow coastal reefs and sandy-vegetated margins. It is a small porcupinefish species distinguished by its slender, fixed spines and mottled patterning. It shelters close to the seabed while foraging for hard-shelled invertebrates. (A Burnell)

Surveys of subtidal reefs in nearby cells have found a high diversity of fishes, invertebrates and macroalgae (e.g., Haig et al. 2006, Turner et al. 2007, DEH 2008, Brook and Bryars 2014, Brock et al. 2023). Haig et al. (2006) undertook video surveys and made limited specimen collections from grab samples in the region. The intertidal reef at Middleton has been surveyed for macroalgal, seagrass, mollusc and echinoderm species richness, and is characterised by a range of macroalgae (red, green and brown) and numerous (>35) mollusc species (Benkendorff et al. 2008). The cell lies inside the Encounter Bay region, which is a known ‘hot-spot’ for macroalgal species diversity (see Baker and Gurgel 2010). Bryars (2003) listed ten fish and three macroinvertebrate fisheries taxa for the surf

beach habitat between Middleton Beach and Goolwa Beach, and 16 fish and seven macroinvertebrate fisheries taxa for the reef habitat between King Head and Middleton Point.

Reef life surveys and other benthic subtidal reef data in the current cell (F6), and adjacent cells (F7-F12,), collated as the “Encounter” reefs subregion within the trend report (Brock et al. (2023), indicate stable or increasing fish and invertebrate species diversity, and macro-algal canopy cover. The collective list of marine species in the Encounter subregion include 52 bony fish, three shark and ray, 41 species of marine invertebrate, and seven species of crustacean (Edgar et al. 2012, 2014, 2020), Brock et al 2023, Brook and Bryars 2014).

Sea Sweep (Scorpis aequipinnis) are a common schooling species, typically occupying shallow coastal reefs, kelp-covered ledges, and areas of broken limestone reef. They are highly active mid-water feeders, moving in tight groups as they graze on plankton and small drifting organisms. Their constant schooling and movement make them an important component of local reef fish assemblages, contributing to energy transfer between pelagic and reef-associated food webs. (M Stokes)

The SA Coast Protection Board's Beach Profile Survey Program was first established in 1977 along the Fleurieu Peninsula to monitor and evaluate changes in beach and seabed level, with a network of over 600 profiles maintained across the state. Profiles are usually established perpendicular to the shoreline and may extend 1 to 10 km offshore. Erosion hotspots are monitored annually to identify risks to natural assets and infrastructure. Profiles are also used to monitor a range of coastal ecosystems and landforms including saltmarsh and mangroves, seagrass, sand dunes and cliff profiles and provide a rare and long-term dataset that informs evidence-based decision making and for coastal adaptation planning. The program utilises a range of terrestrial and hydrographic survey techniques involving high precision GPS equipment and at some locations, topographic and photogrammetry drone survey is undertaken, which uses overlapping photos to create a detailed 2D and 3D digital surface model to map detailed changes to the coastal landforms over time.

There are 2 beach profiles established in 1977 (615004 and 615007) and a cliff erosion survey established in 1999 (615008 at Coote Street) to the east of the cell) to monitor beach-dune and nearshore dynamics as well as cliff erosion over time. Flinders University through Dr Brian Caton, maintained a student monitoring data set to monitor cliff erosion. The CPB cliff erosion profiles were set up in 1999 to monitor changes in the cliff in response to reports of active retreat. A row of spikes located behind the cliff top, at set distances, is used to measure the cliff top offset and erosion rates over time. The profile data when graphed, shows the small dune that has built up in front of the cliffs with active beach restoration efforts by Alexandrina Council which has slowed the progression of erosion of the clay cliffs.

A topographic and photogrammetry drone survey was undertaken in late 2025 to provide a baseline 2D and 3D digital surface model of the cliff and low foredune fronting the cliffs, to monitor the recovery of the low dune following several significant winter storm surge events in 2025 to monitor changes to the coastal landforms over time in response to climate change induced conditions including sea level rise.

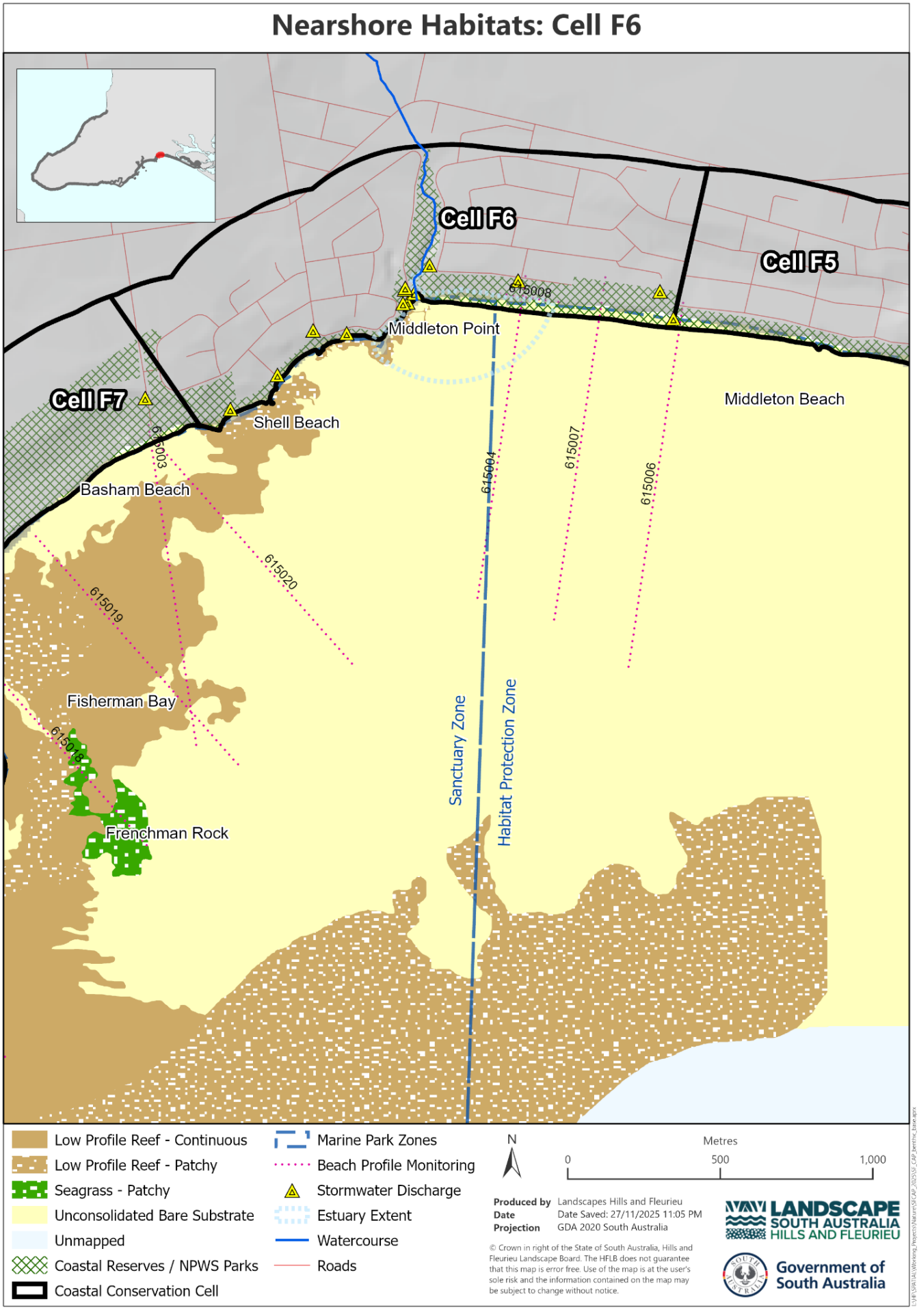


Figure 6.2. Nearshore habitats of Cell F6.

Threats

Whole cell

Increased visitation, development and permanent population growth, exacerbate pressure upon natural environments (e.g. increased formal and informal access, dogs on beaches, drone use, trampling from whale watching, litter, influxes from surfing events and increased recreational surfing). Public car parking pressures exist in this cell, which may have spill-over effects on the natural environment. Informal foot traffic significantly impacts cultural and environmental values. Local residences have created formal and informal access paths to the beach, dissecting the dunes, exacerbating weed spread, dune instability and erosion.

The assessment of land ownership and land use identifies certain land parcels as potential threats to coastal areas, based on factors such as their proximity to the shoreline or exposure to coastal hazards. These parcels are highlighted for possible intervention such as zoning changes, development restrictions, or land acquisition to reduce risks like erosion, storm-surge inundation, sea-level rise, or the impacts of current and future land uses (including development or agriculture) on coastal ecosystems.

This cell has very low areas of publicly owned land, while coastal reserves have been much reduced by erosion, subdivision, road and carpark construction. As a result, reserves remain as narrow clifftop strips, a riparian reserve, a single line of dunes and talus slopes below some cliffs (Caton et al 2007). These small areas also suffer from weed infestation from coastal weed species, introduced plants and garden escapes.

Narrow coastal reserves at Middleton Point (Coast Protection Board, March 2024)

The following declared and red alert weeds have been found within this cell: Gazania (*Gazania linearis),* Western Coastal Wattle *(Acacia cyclops),* African Boxthorn *(Lycium ferocissimum*), Boneseed *(Chrysanthemoides monilifera* spp*. monilifera),* Coast Tea-tree *(Gaudium laevigatum),* Golden Wreath Wattle *(Acacia saligna),* Sea Spurge *(Euphorbia paralias),* False Caper *(Euphorbia terracina),* Olives *(Olea europaea* ssp*. europaea),* Khaki Weed (*Alternanthera pungens),* Giant Reed *(Arundo donax),* Grey Buloak (*Casuarina glauca),* Lincoln Weed (*Diplotaxis tenuifolia),* Soursob *(Oxalis pes-caprae),* Hotttentot Fig *(Carpobrotus edulis),* New Zealand Mirror-bush (*Coprosma repens),* Horehound (*Marrubium vulgare),* Aleppo pine *(Pinus halepensis),* Coastal Galenia (*Aizoon pubescens),* Broad-leaf Aloe (*Aloe maculata),* Cape Weed *(Arctotheca calendula),* Onion Weed (*Asphodelus fistulosus),* Kikuyu *(Cenchrus clandestinus),* Feather-top (*Cenchrus longisetus),* Trailing African Daisy (*Dimorphotheca fruticose),* Cape

Marigold (*Dimorphotheca pluvialis),* Rodondo Creeper (*Drosanthemum candens),* Pyramid Tree (*Lagunaria patersonii),* Sea-lavender (*Limonium companyonis),* Tree Mallow (*Malva arborea),* Pincushion *(Sixalix atropurpurea),* Aster-weed (*Symphyotrichum subulatum),* and Sea Wheat-grass (*Thinopyrum junceiforme).*

Coastal dunes have large areas of Sea Wheat-grass (*Thinopyrum junceiforme*), Sea Spurge *(Euphorbia paralias),* Gazania *(*Gazania spp) and Sea Rocket (*Cakile maritima ssp. maritima*), whilst Middleton Creek has weed incursion from Athel Pine (*Tamarix aphylla*), Gazania (*Gazania sp.*), Kikuyu (*Cenchrus clandestinus)* and Couch (*Cynodon dactylon var. dactylon*). Cape Ivy (*Delairea odorata*) is also a significant issue at the Middleton Creek's lower reaches, where it is smothering large areas of riparian vegetation.

Sea Wheat-grass (Thinopyrum junceiforme) and Sea Spurge (Euphorbia paralias) control site with recovering native Rolling Spinifex (Spinifex hirsutus) growing from the rear for the foredune towards the beach trapping mobile sand with deep rooted runners (C Taylor)

Garden encroachments and deliberate planting of invasive garden plants are occurring by local residents. Garden escapes from local residences, such as Gazania and succulents, threaten coastal biodiversity by degrading condition and habitat values. Additional high priority weeds for control in this cell include Western Coastal Wattle and African Boxthorn.

Coastal fencing is degraded in this cell and informal foot traffic occurs from visitation and activities such as whale watching. Impacts from informal access threaten conservation values at Shell Beach, including causing erosion, dissecting the dunes, exacerbating weed spread and disturbing Hooded Plover nesting sites.

Shell Beach is a narrow sandy beach with rocky outcrops that are habitat for a range of invertebrates and feeding areas for many shorebirds. (C Taylor)

Nationally listed vulnerable Hooded Plovers nest at multiple breeding sites within this cell. Foxes, sea level rise, storm surge, dogs off-leash, and Sea Wheat-grass are impacting Hooded Plovers and beach nesting birds in this cell. Some spill-over from major events may impact Hooded Plover activity without active management. A variety of dog management areas (on and off leash) exist across a small geographic area based on location and the time of year.

Oystercatchers that regularly feed across this cell and amongst the rocky outcrops at Middleton Point experience disturbance from increasing beach and dog walkers, tourists, surfers and during whale watching season. During spring to early summer extensive areas of beach wrack (seagrass and algae) are washed up in this cell. If these coincide with dodge tides on warm days, significant mortalities of Goolwa Cockles/Pipis and other bivalves can occur (K Jones, pers comms), thereby affecting the distributions of Oystercatchers.

Sooty Oystercatchers (Haematopus fuliginosus fuliginosus) feeding on the intertidal platform and rocky headland habitats in this cell (M Stokes)

Potential pest animal threats to coastal fauna and flora from rabbits (*Oryctolagus cuniculus*), foxes (*Vulpes vulpes*), and cats (*Felis catus*). Large numbers of rabbits persist in the western half of this cell, despite annual pest control programs. Coordinated collaboration between landowners and managers is required to manage pest animals (refer to Regional Pest Management Strategies).

A sighting of the declared pest Common Myna (*Acridotheres tristis*) in Encounter Bay (on the coastal slopes adjacent to cell F12) was reported in 2024, and this is the only known location of the bird in South Australia. This aggressive invasive species, also known as the Indian Myna, is established throughout eastern Australia and poses a threat by evicting native birds from their nests, destroying eggs, and killing chicks. They also damage crops and orchards and are a nuisance for residents. A pest alert remains in place for any sightings to be reported via MynaScan to aid eradication efforts.

Recreational cockle harvesting can impact feeding and habitats through reduced food sources for beach nesting birds and migratory shorebirds. Commercial and recreational cockle harvesting for human consumption has increased since the 1990's (Durante 2022) and could impact feeding and habitats through reduced food sources for beach nesting birds and migratory shore birds. Maintain and improve recreational fishing and beach access information for the general public and targeted community groups.

Illegal boat-based fishing inside the Sanctuary Zone (SZ-6) within the Encounter Marine Park is a threat to the resident fish communities. These no-take areas are located at core conservation areas within marine parks, protecting vital feeding, breeding, nursery, and resting areas for marine life.

Middleton Creek estuary

Connectivity of estuary areas to both coast and marine waters through water flow is critical to maintain the health of the estuary. Typically, this connectedness is achieved through adequate freshwater inflows and tidal surges from the marine environment. Changes in either of these can dramatically influence local conditions for flora and fauna. Flow changes in the Middleton Creek estuary are poorly known with tidal flow occurring only a short distance above high tide level occasionally. Most of the connectivity between fresh and marine environments is dominated by freshwater inputs that vary greatly depending on catchment extraction, stormwater inputs and local weather conditions.

Stormwater is a factor in local erosion points within the creek slopes and marl bluffs. Stormwater management and flood mitigation is an issue connected to this cell, with flooding and ground water incidents affecting local housing, businesses and reserves.

Significant flooding occurred in November 2022 within the Middleton township causing a large number of private properties to be inundated, damage to public and privately owned infrastructure within the town and the closure of major roads. Substantial erosion of the Middleton creek line occurred from the large volumes of water directed across the catchment into one location. Gabion baskets from the Middleton Creek estuary washed out into the ocean, the footpaths were eroded and 90% undermined.

Bryars (2013) identified that the densely populated coastline (Middleton settlement) has intermittent (but unquantified) freshwater inputs from Middleton Creek and stormwater drains. Caton et al. (2007) identified that turbidity nearshore was affected by urban and farm stormwater run-off via Middleton Creek.

Outflow from the River Murray during flood events has also been significant in recent times, with associated turbid waters extending westward from the Murray Mouth across Encounter Bay to The Bluff and possibly further. The impacts of these episodic flows on nearshore habitats are unknown.

Bryars (2013) assessed the risk ratings for identified threats to reef and sand were low to moderate. Seagrass was not assessed as it does not occur within the cell.

Opportunities

Whole cell

Manage visitor numbers and impacts to ensure coastal areas can support growing demand, while maintaining and improving the quality of experiences without diminishing the values of the cell. Investigate improved infrastructure and fencing to ensure for environmentally sensitive path formalisation and low-impact walking trails, and further opportunities to reduce impacts on the coastal environment. Education, restrictions and compliance regarding off-leash dogs. Work with First Nation communities, tourism operators and agencies to support visitor education about coastal ecological and cultural values and appropriate behaviors.

Community education opportunities regarding:

- Migratory and residential shorebirds and sea birds (dogs on leads, nesting sites, citizen science projects, managing visitor disturbance) and interpretive signage at high use areas.
- Fragile nature of coastal areas that are sensitive to foot traffic, soil compaction and erosion.
- Education and targeted communications regarding Marine Parks (including no-fishing in Sanctuary Zones), nearshore habitats and estuary values
- Increased cultural awareness training and knowledge of culturally appropriate processes to respect known cultural heritage sites for land managers and coastal community groups
- Citizen science monitoring to contribute to intertidal reef monitoring, seagrass restoration, dolphin watch, beach pole monitoring, Fleurieu seabird monitoring program and beach nesting birds.
- Coastal gardens and resident/business owner education with a Gazania free Gardens project focus in this area.
- Value of place and coastal values, responsible beach use and reducing human impact on dunes and cliffs.
- There is opportunity for signage renewal across coastal areas to educate the community about coastal conservation, cultural significance and appropriate behaviours.

Review fencing and close unauthorised access paths from local residences and car parks. Rehabilitate and conserve areas affected by informal foot traffic, for example through fencing and/or revegetation with local native species, in conjunction with First Nations, community education and monitoring.

Continue undertaking high priority weed control and investment to improve conservation values in this cell. On-going monitoring, control and community education of high priority weed species and common garden escapes is required. Review garden encroachments to reinstate public reserves.

There is an opportunity to develop a Biodiversity Action Plan for this cell due to improved vegetation condition and habitat values, recognising the efforts of local community volunteers.

Opportunity for SteamRanger to develop an Environmental Management Plan to address weed control and pest animals, support train sight lines, manage erosion, and support community education along the railway corridor.

Increase suitable habitat for coastal butterfly populations through planting of host plants (including *Oxalis perennans* and *Poa spp.*) to increase habitat suitability for local introductions from neighbouring cells.

Continue to support collaborative efforts to protect and conserve Hooded Plover breeding habitats within this cell. Implement actions to support Hooded Plover conservation, including exclusions, temporary fencing and signage, and education with dog owners.

Hooded Plover (Thinornis cucullatus cucullatus) adults and three chicks foraging on Middleton Beach amongst fibre balls commonly seen on this beach (M Stokes)

This cell is important for coastal raptors and on-going monitoring and management is critical to minimise visitor disturbance and to support habitat condition for raptor populations. Investigate opportunities to support and implement the recovery plan for Eastern Osprey and White-bellied Sea Eagles (2022). Monitor, maintain and improve the quality of vegetation for the provision of wildlife habitat for priority species.

As part of the *Coastal Dune and Clifftop Vegetation Surveys* (1995–1997) (Opperman 1999), long-term monitoring sites were established across South Australia and the Southern Fleurieu region to assess the structure and composition of coastal dune and clifftop plant communities, and their relationships to regional and environmental factors. Given that nearly 30 years have passed since these surveys were undertaken, there is strong potential for shifts in geographical range and changes in species composition due to the long-term impacts of climate change. The *Survey of Remnant Vegetation of the Southern Fleurieu Peninsula* involved biological surveys conducted between 1987 and 1991 to establish baseline data on remnant vegetation and swamps in the region south of Adelaide, South Australia.

During the development of this plan, and through the assessment of flora and fauna (both native and introduced) species lists available via the Biological Database of South Australia (BDBSA), significant gaps were identified between recorded species and known species distributions within cells. To address these data deficiencies and improve the accuracy of long-term ecological records, both above foundational vegetation survey projects should be repeated and incorporated into an ongoing monitoring program. Fauna assessments across cells to establish population baselines, update existing records and species distribution, particularly of underrepresented groups (reptiles and invertebrates) should be undertaken.

There are opportunities for collaboration between partners, such as National Parks, Marine Parks, First Nations, landscape boards, volunteer groups, community and nature-based tourism operators for monitoring of sea birds, coastal raptors, marine mammals and other wildlife.

Supporting community volunteer, First Nations and private landowner efforts to undertake priority restoration and conservation work in this cell. Strengthening partnerships with adjoining landowners, volunteer organisations, researchers, and the wider community to foster collaboration and long-term management benefits for biodiversity protection and restoration.

Coast Daisy-bush (Olearia axillaris) is an important shrub in coastal dunes and commonly used in revegetation projects as a primary colonising species (C Taylor)

Opportunity to work with nature-based tourism operators to increase education and stewardship of local coastal environments. Investigate opportunities for Hooded Plover management to be included in permitting for major community events and nature-based tourism operations.

Collaborate with the SA Climate Ready Coasts program to enhance, resource, and implement coastal management initiatives and accelerate coastal hazard adaptation planning across South Australia. This program supports the development and delivery of Coastal Hazard Adaptation Plans (CHAPs), led by the Local Government Association (LGA) of South Australia in partnership with the SA Coast Protection Board, the Department for Environment and Water, the Adelaide Coastal Councils Network, and the SA Coastal Councils Alliance.

Middleton Creek estuary

Strengthen connectivity between coastal ecosystems and nature corridors along the estuary, increasing flora and fauna resilience to progressive climate change. Improvement to the estuarine flora and fauna habitats and connectivity with marine environments can be achieved through the development and employment of an Estuary Entrance Management Support System (EEMSS). This would include a framework for decision makers, considering both the ecological and infrastructure/amenity concerns. Improved management of estuaries within the region (and across the state) is required for a more strategic planning and management approach to deliver positive and coordinated outcomes for estuary habitats. Improved monitoring of ecological communities, connectivity with marine systems and water quality conditions within the estuary will allow more effective adaptive management; being aware of conditions and responding as required.

Increasing development pressure on surrounding areas is likely to increase stormwater flow into this catchment area. There is opportunity to develop guidelines for projects within Council areas to support improved stormwater management and reduce land-based impacts on coastal and nearshore marine environments with increasing catchment development. Continue to undertake restoration through fencing and planting areas of high erosion and sand movement. Continue to leverage previous investment in weed control to address priority weed species through a collaborative approach between land managers and support for coastal community groups.

Investigate improved stormwater and flood mitigation strategies while maintaining integrity of the dune system (WSUD). Explore options for natural detention areas within the Middleton Creek, to slow down high volumes of water and to create habitat for wildlife.

Support initiatives to collect and reuse stormwater (e.g. Alexandrina Council's Stormwater Detention and Retention Standards). Council to create a Stormwater Management Plan for Middleton, including the Middleton Creek, in conjunction with the relevant agencies, which needs to consider the impacts on the nearshore and estuarine environments.

Climate change threats to coastal biodiversity (see BMT 2025)

Potential climate change threats to coastal biodiversity

Cell F6 includes cliffs east of Middleton Creek, beach and dunes. The dunes support native vegetation of importance for flora and fauna, the beach is an important nesting area for birds, and the intertidal areas support infauna on which birds feed.

Biodiversity assets potentially vulnerable to climate change in this cell include:

- Coastal dunes and vegetation
- Estuary ecosystem
- Freshwater creek ecosystem
- Native vegetation
- Beach nesting birds
- Coastal cliffs

These ecosystems may be particularly vulnerable to the direct impacts of climate change, including sea level rise, coastal erosion, increased drought, higher temperatures and more intense storms.

At Middleton Creek, the overall level of the beach south of the creek has dropped as a result of stormwater outflow across the beach. This will continue to occur if the speed of flow is not reduced through upstream intervention measures.

Over time, increasing aridity will slow natural recovery from damage to dune vegetation. Rising sea levels will see increased storm damage to foredunes; Bruun Rule calculations of beach recession could be compromised by active littoral drift values here. However, recession of the order 10–20m over 50 years could be likely, given current IPCC forecasts. Changes in wave climate which accentuate the long period swell component would increase the likelihood of foredune damage. Cliffs will be eroded at varied rates, depending on their local composition. The ancient metamorphics of the Middleton headland will be little affected, however the marl bluff between the Middleton Creek and Chapman Road is vulnerable to tidal sapping at its base (Caton et al 2007).

The dunes east of Middleton Creek will be subject to sea-flood, and routine high tide modelling indicates increased impact on dunes. Erosion assessment is difficult due to the presence of a substantial offshore reef and lack of sediment data. The 1-in-100 ARI storm event would significantly impact the beach and dune, causing recession of the alluvial cliffs. High tidal action 1m greater than today would also routinely impact the dunes (probably removing them) and directly attack the base of the alluvial cliffs. Erosion modelling indicates a possible recession of 100m by 2100 (Western et al., 2019).

Increased runoff, particularly after heavy rains, can lead to erosion of beaches and rocky shores. Excessive sedimentation can also reduce biodiversity and disrupt the biodiversity of local ecosystems.

Cell Action Table

Component	Issue	Proposed Action	Priority	Key Players
Whole cell	Threats and opportunities to improve protection of cultural heritage within cell	Cultural consultation and collaboration to appropriately manage cultural heritage within this area. Prevent damage, disturbance, or interference to cultural heritage by adhering to the Aboriginal Heritage Act 1988.	High (cons/ threat)	NAC, Council, LHF, Coastal Community groups, Aboriginal Affairs and Reconciliation - Department of Premier and Cabinet
	Increased permanent population, visitation and recreational pressure on dunes and viewing points due to increased local population and tourist promotion.	Assess increased visitation capacity at known sites, repair or upgrade fencing to restrict unauthorised access and review car parking capacity. Manage visitor numbers within sustainable limits in ecologically and culturally sensitive and significant areas - consult with First Nations groups.	High (cons/ threat)	Council, NAC, land managers
		Investigate opportunities for community education and engagement regarding unique and valuable coastal landscape and fragile nature of coastal areas. Dedicated cultural education and training for land managers, agency staff and land stewards	High (Cons/ Soc)	Council, LHF, NPWSSA, NAC, Community groups
		Opportunity to work with nature-based tourism operators to enhance education and stewardship of local coastal environments, including opportunities to partner with First Nations groups who hold cultural obligations and authority to Sea Country	Medium (Cons)	Tourism operators, land managers, NAC, NPWSSA, coastal community groups
		Development of consistent signage and messaging for coastal values and compliance for conservation areas (public managed lands, coastal reserves) across the Fleurieu Peninsula coast. Increased awareness of local coastal values and responsible beach use. Co-design signage with First Nations/ knowledge holders.	Medium (Soc/ Cons)	Council, NPWSSA, NAC, LHF, coastal community groups
		Collaborate and manage access with beach-based users and businesses (e.g. SLSC, Surfing SA, surf/paddle boarders, swim/surf schools), to ensure protection of coastal areas and groups do not impact conservation and cultural value areas and species.	Medium (threat)	Council, DEW, land managers, NAC, coastal community groups, beach users and businesses
		Monitor, educate, and advocate to ensure that recreational activities (e.g., boating, paddleboarding, jet-skiing) do not increase interactions with marine wildlife or place additional pressure on coastal species and habitats.	High (threat)	Council, NPWSSA and land managers
		Events on beaches and coastal habitats must not impact on natural values, especially listed threatened species and communities, in the area or vicinity of events. Event organisers should be informed, where appropriate via permits, on their obligations to not inflict environmental harm and to undertake actions in accordance with relevant legislation and by-laws.	Medium (threat)	Council, DEW, NPWSSA, BirdLife Australia, event managers
	Informal access and degraded fencing are impacting conservation values of dunes.	Assessment of infrastructure and access paths including erosion and weed control issues and closure, monitoring and rehabilitation of unauthorised paths.	High (threat)	Council
	Weed control and threat to coastal biodiversity.	Consider development of a Biodiversity Action Plan for this cell due to improved vegetation condition and habitat values, recognising the efforts of local community volunteers.	High (cons/ threat)	Council, LHF, land managers, coastal community groups
		Support council and Coastal Community group campaigns to undertake targeted control of weed species, eradicate red alert weeds (Western Coastal Wattle, African boxthorn, Cape Ivy (creekline), Gazania).	High (threat)	Coastal community groups, Council, NAC business/ contractors/rangers, LHF.
		Monitor changes to dunes through BushRAT or similar monitoring to measure condition assessment and change.	High (Cons/ threat)	Council, LHF, Community Groups.
	Threat to coastal fauna and flora from pest animals (rabbits, foxes and cats).	Coordinated collaboration between landowners and managers is required to manage pest animals.	High (threat)	Councils, land owners, NAC business/ contractors/rangers, LHF
		Report sightings of feral animals (deer, fox, rabbit, cat and declared species) through the feral scan pest animal recording and management tool	High (threat)	Land managers, community, coastal community groups

Component	Issue	Proposed Action	Priority	Key Players
Whole cell	Protection of significant flora and fauna.	Protect existing populations through targeted weed control and restoration of habitats with local coastal species.	High (Cons/ threat)	Council, land managers, LHF, NAC business/ contractors/rangers, coastal community groups,
		Propagate local plants for reintroduction to other sites to maintain genetic diversity and increase source populations. Focus on native grass restoration where possible.	High (cons)	Council, land managers, LHF, NAC business/ contractors/rangers, coastal community groups, Local coastal plant nurseries
		Targeted interventions for threatened/ rare plant species and communities.	High (cons)	DEW, LHF, Council, coastal community groups
		Explore opportunities for greater local awareness of conservation value of area.	Medium (cons)	Council, LHF, coastal community groups
	Variety of dog control arrangements in small area causing confusion for beach users.	Review arrangement of areas of control under the existing dog by-law (2023) in cell to reduce confusion and increase compliance.	High (threat)	Council
	Butterfly habitats and host plant protection.	Identify locations of potential butterfly habitats and host plants with the cell.	High (cons)	Council, DEW, LHF, coastal community groups
		Extension of existing habitats and reintroduction of locally extinct butterfly species.	Medium (cons)	Council, DEW, LHF, NAC business/ contractors/rangers, coastal community groups
	Valuable habitat for coastal raptors (White-bellied Sea Eagle and Eastern Osprey).	Ongoing monitoring and management of high values nesting and foraging areas.	High (cons)	NPWSSA, DEW, LHF, NAC business/ contractors/rangers, Council
		Implement the recovery plan for Eastern Osprey and White-bellied Sea Eagles (2022).	High (cons)	DEW, NPWSSA, LHF
	Coordinated approach to monitoring of coastal wildlife	Collaboration between land manager and stakeholders to support research and citizen science of beach-nesting birds, seabird, coastal raptors, marine mammals and other wildlife.	Medium (cons)	DEW, NPWSSA, NAC business/ contractors/rangers, BirdLife Australia, LHF, Council, SA Whale Centre, Encounter Whales, ecotourism operators
	Aged baseline data and significant gaps in recorded flora and fauna species across the Southern Fleurieu region.	Repeat and integrate historical vegetation surveys into a long-term monitoring program to update records and address data deficiencies.	Medium (cons/ threat)	DEW, LHF, councils, coastal community groups
		Undertake fauna assessments across cells to establish baselines, update records and species distribution, particularly of underrepresented groups (reptiles and invertebrates).	Medium (cons/ threat)	DEW, LHF, councils, coastal community groups
		Identify potential funding sources to repeat these long-term flora monitoring sites and fauna assessments.	High (cons/ threat)	DEW, LHF, councils.
	Stormwater impacts from inland development are likely to impact marine intertidal habitats and may accelerate seabed deepening and coastal erosion. Turbidity and nutrients are a significant threat to reef and seagrass habitats. Stormwater impacts from inland development are likely to impact marine intertidal habitats and may accelerate seabed deepening and coastal erosion. Turbidity and nutrients are a significant threat to reef and seagrass habitats.	Consider locations within existing open space to install/retrofit sedimentation or detention areas increasing water quality and improve biodiversity values.	High (Cons/ threat)	Council, LHF
		Monitor and manage stormwater to minimise impacts in the coast and marine environment. Improvements in the stormwater system to reduce gross pollutants and erosive impact of stormwater discharge into the dunes. Implement Water Sensitive Urban Design (WSUD).	High (Threat) High (Threat)	Council, LHF, CPB, Water Sensitive SA Council, LHF, CPB, Water Sensitive SA
		Develop guidelines for projects within Council areas to support improved stormwater management and reduce land-based impacts on coastal and nearshore marine environments.	Medium (cons/ threat)	Council, CPB, LHF

Component	Issue	Proposed Action	Priority	Key Players
Whole cell	Estuary entrance may be opened / closed by Council largely for recreational/amenity reasons.	Develop an Estuary Entrance Management Support System (EEMSS) (1), including a framework for decision makers considering both the ecological and infrastructure/amenity concerns.	High (Cons / Soc / Econ)	Council, DEW, LHF, NAC
		Review opportunities to increase environmental flow through Water Allocation Planning (WAP), WWTP, low flow bypass on farm dams and other local opportunities to improve connectivity with marine environments.	Medium (cons)	DEW, LHF, Council
	Physical changes on the coast and natural assets from sea level rise (such as coastal squeeze on tidal habitats, erosion, vegetation loss, marine turbidity and light reduction)	Implementation of the Coastal Adaptation Plan, including key locations, recommendations and priorities for funding. Support partnerships for ongoing investigation and monitoring in the coastal zone, working with the Coast Protection Board to identify adaptation options for the future.	High (Cons. Threat)	CPB, Council, community, university and research agencies, Climate Ready Coasts Program
	Multiple community groups and volunteers across coastal areas	Acknowledge significant value, contribution and knowledge of coastal community groups. Facilitate opportunities for increased coordination and sharing of skills and information between community groups and volunteers to support landscape scale approach to coastal conservation and management.	High (cons)	Council, land managers, LHF, NAC, coastal community groups
SteamRanger rail corridor	Weed control within the rail corridor does not align with priority weed control and restoration activities in surrounding dunes and reserves	SteamRanger to develop an Environmental Management Plan referencing regional weed and restoration priorities and other local environmental plans.	High (threat/ cons)	SteamRanger, NAC business/ contractors/rangers, Council, LHF
		Restore areas of targeted weed control with local native coastal plants to increase biodiversity and reduce erosion.	High (cons/ threat)	SteamRanger, NAC business/ contractors/rangers, Council, coastal community groups
	Safety for pedestrians crossing rail corridor via unauthorised and informal access paths.	Assessment of unauthorised and informal access paths and support for sight line safety within rail corridor. Closing of identified pathways through revegetation with local coastal species or temporary fencing.	High (threat)	SteamRanger, Council
Coastal and riparian reserves	Weed infestation, including many invasive species.	Weed control and revegetation program within riparian reserve.	Medium (threat)	Council, NAC business/ contractors/rangers, LHF, community partnership.
	Ongoing weed incursions and weed control.	Target residences with educational materials, with regard to weeds particularly garden escapes.	High (Soc / Econ)	Council, coastal community groups, LHF, NPWSSA
		Review, control and monitoring of garden escape weeds from local residences to public land and intentional plantings and encroachments within the dunes and reserves.	High (threat)	Council, coastal community groups
Beach, dune and low cliff	Physical changes on the coast and natural assets from long term adjustment to climate change induced conditions including Sea Level Rise.	Continuation of monitoring of cross-shore cliff, dune, beach and nearshore sand level profiles. Topographic and photogrammetry drone surveys to provide detailed 2D and 3D digital surface models to monitor changes to the coastal landforms over time in response to climate change including more frequent and intense storm surge events and changes in wave climate and sea level rise.	Medium (threat)	DEW, CPB, Research Institutions, Universities.
		Ensure the buffer zone protection offered by coastal reserves is not encroached upon.	High (hazard)	Council, CPB,
Shell beach and dunes	Informal access from pedestrians causing erosion and threaten beach-nesting birds.	Assessment of multiple access paths including erosion issues and closure, monitoring and rehabilitation of unauthorised paths.	Medium (threat)	Council, NAC business/ contractors/rangers.
		Fence rear of dune along Encounter bikeway to prevent access and increase pedestrian safety while protecting beach nesting bird habitat from fragmentation and disturbance.	Medium (threat)	Council
		Signage and access control of foot traffic on dunes.	Medium (threat)	Council and community partnership

Component	Issue	Proposed Action	Priority	Key Players
Stormwater outlets to creek and foreshore	Localised erosion, conduit for weeds, sediments and nutrients.	Review impact on foreshore and creek of current stormwater arrangements. Consider impacts from localised urban infill.	Medium (threat)	Council.
		Development of Stormwater Management Plan for Middleton, including Middleton Creek including impacts on nearshore environments	High (threat)	Council, Stormwater Management Authority, LHF
		Support initiatives to collect and reuse stormwater (e.g. Alexandrina Council's Stormwater Detention and Retention Standards)	High (cons)	Council
	Stormwater impacts associated with inland development impacts marine and intertidal habitats and has implications for seabed deepening and acceleration of coastal erosion issues.	Investigate improves stormwater and flood mitigation strategies Implement Water Sensitive Urban Design (WSUD)to maintain integrity of dunes and beach levels Implement Water Sensitive Urban Design (WSUD).	High (threat)	Council
Beach-nesting birds	Hooded Plover nests and breeding areas threatened by disturbance by walkers and dogs.	Community monitoring, fences to mark nests. Signage and awareness raising activities to alert dog walkers and horse riders.	High (Cons / threat)	Council, BirdLife Australia, LHF, NAC business/ contractors/rangers, Friends of the Hooded Plover, Fleurieu Peninsula volunteers, coastal community groups, Oystercatcher monitoring volunteers
	Limited community knowledge of local conservation values and threats.	Provide education opportunities to raise awareness and protection of beach-nesting birds, such as Hooded Plovers and Sooty Oystercatchers (dogs on leads, nesting sites, citizen science projects, managing visitor and vehicle patrol disturbance).	High (cons)	Council, BirdLife Australia, LHF, NAC business/ contractors/rangers, Friends of the Hooded Plover, Fleurieu Peninsula volunteers, coastal community groups, Oystercatcher monitoring volunteers
	Protection of natural assets of high conservation values.	Support the introduction and implementation of Council by-laws related to dogs on lead in estuaries and high value areas.	High (threat)	Council, land owners, community, coastal community groups
	Incursion of multiple dune grass weed species is limiting suitable habitat for beach-nesting birds.	Support the staged removal of introduced weedy grasses and restoration of spinifex dunes.	High (threat)	Council, Land managers, LHF, NAC business/ contractors/rangers, coastal community groups, Friends of the Hooded Plover, Fleurieu Peninsula volunteers
		Increase community awareness of habitat needs for beach-nesting birds species.	High (threat/ cons)	Council, Land managers, LHF, coastal community groups, Friends of the Hooded Plover, Fleurieu Peninsula volunteers
Nearshore Habitats (Reef)	Sediments and nutrients from Middleton Creek and Middleton stormwater.	Support initiatives for catchment revegetation and improved land management practices.	High (threat/ cons)	Council, LHF
		Support initiatives to collect and reuse stormwater (e.g. Alexandrina Council's Stormwater Detention and Retention Standards).	High (cons)	Council, LHF
Climate (Cliffs and rocky headlands)	More intense rainfall events likely to increase soil erosion.	Restoration of native plant species to assist soil stabilisation.	High (Cons/threat)	Council, NAC business/ contractors/rangers, coastal community groups, LHF
	Increased aridity likely to make growing conditions less suitable to native vegetation fragments.	Restoration of native plant species to assist soil stabilisation.	High (Cons/threat)	Council, NAC business/ contractors/rangers, coastal community groups, LHF
	Increased sea levels contribute to more frequent and intense wave action, which accelerates cliff erosion.	Restoration of native plant species to assist soil stabilisation.	Medium (threat)	Council, NAC business/ contractors/rangers, coastal community groups, LHF

Component	Issue	Proposed Action	Priority	Key Players
Climate (Creek/ Estuary)	More intense rainfall events likely to lead to increased pollutants, nutrients and sediments washed into the estuary especially during first flush from the landward end.	Monitor stormwater quality and estuary condition.	Medium (threat)	DEW, EPA, CPB, LHF, coastal community groups
	Higher temperatures likely to lead to increased algal blooms with impacts on estuarine fauna.	Monitor stormwater quality and estuary condition.	Medium (threat)	DEW, EPA, CPB, LHF, coastal community groups, PIRSA
Climate (Beach and dunes)	Increased sea levels and more intense storms and higher winds can contribute to more frequent and intense wave action, which accelerates beach and dune erosion. Predicted increases in aridity can lead to reduced vegetation cover and increased dune drift and dune mobility.	Restrict public access to fragile dunes and implement restoration of native plant species.	Medium (threat)	Council, NAC business/ contractors/rangers, coastal community groups, LHF
		Implement restoration of native plant species.	Medium (threat)	Council, NAC business/ contractors/rangers, coastal community groups, LHF
		Monitor recession rate of beaches and sand dunes.	Medium (threat)	Council, coastal community groups, CPB, LHF
		Monitoring of cross-shore dune, beach and nearshore sand level profiles.	Low (Hazard) Medium (cons/threat)	DEW CPB, Research Institutions, Universities.
		Support cultural monitoring and communications to protect significant known heritage sites	High (threat)	NAC, First nations business/ contractors/ rangers, Council, DEW, LHF, coastal community groups
	Likely beach and dune recession consequent on climate change induced impacts including more frequent and intense storm surge events and changes in wave climate and sea level rise.	Use advances in technology (e.g. LiDAR and improved imagery capture), and more recently available information to update DEW Coastal Hazard Mapping spatial layer identifying the change in extent and stability of coastal dunes across South Australia since the previous hazard mapping was undertaken approximately 20 years ago	Medium (hazard, Cons/threat)	DEW, CPB, Research Institutes, Universities
Climate (Macroalgal reefs)	More intense rainfall events likely to lead to increased pollutants, nutrients and suspended sediments washed into coastal waters especially during first flush.	Monitor stormwater quality to reduce stressors on benthic flora.	Medium (threat)	DEW, PIRSA, LHF
	Increased storm surge can cause dislodgment of algae and seagrasses.	Monitor stormwater quality.	Medium (threat)	DEW, EPA, LHF
	Higher temperatures can lead to increased incidence and persistence of marine heatwaves and increased stress on temperate reefs and seagrasses, reducing biodiversity.	Monitor stormwater quality.	Medium (threat)	DEW, EPA, LHF
	Ocean acidification can impact the life history of marine species.	Improve stormwater quality to reduce stressors on benthic flora.	Medium (threat)	EPA, Council, DEW, LHF
		Undertake benthic flora mapping to determine areas or opportunities for restoration.	High (cons)	DEW, Landscape Boards

(1) An Estuary Entrance Management Support System (EEMSS) has been developed by Deakin University and a number of Victorian Catchment Boards. This system takes into account a number of uses (including recreation use), conservation and hydrological factors in assisting with the decision to open or close an entrance (Arundel (2006) also refer to Appendix 15 in Caton et al 2007).

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Cell Biota (Flora and Fauna)

Lists provided are specific to this cell from Biological Database of South Australia (BDBSA), technical updates, review of publications and local input. Conservation ratings (National, State and Sub regional) are included for flora and fauna.

Note: Restricted species as per Department for Environment and Water (DEW) specifications have been omitted from the tables due to the size of cells and requirement for 10km^2 buffering of data. However, records are included in the total species numbers per cell. Please contact DEW directly for restricted data requests.

FLORA Summary

Vegetation Block Metrics	Coastal reserve and Creek line (Council)			
Terrestrial Habitat Description/s	See Terrestrial biodiversity vegetation communities in cell description.			
# Flora in cell	184			
# Native Flora in cell	99			
# Introduced Flora in cell	85			
# Conservation Rated Flora in cell	2* (0 national, 2 state)			
# Threatened Ecological Communities (EPBC Act)	-			
Conservation Rated Flora	**Species**	**Common Name**	**EPBC Act Status**	**NPW Status**
	Eucalyptus fasciculosa	Pink Gum		R

All Native Flora in cell

Species	**Common Name**	**EPBC Status**	**NPW Act Status**	**Subregional Status***
Acacia cupularis	Cup Wattle			LC
Acacia longifolia ssp. sophorae	Coastal Wattle			LC
Acacia myrtifolia	Myrtle Wattle			LC
Acacia paradoxa	Kangaroo Thorn			LC
Allocasuarina muelleriana ssp. muelleriana	Common Oak-bush			LC
Allocasuarina striata	Stalked Oak-bush			
Allocasuarina verticillata	Drooping Sheoak			NT
Asperula conferta	Common Woodruff			RA
Atriplex cinerea	Coast Saltbush			LC
Atriplex nummularia ssp. nummularia	Old-man Saltbush			
Atriplex paludosa ssp. paludosa	Marsh Saltbush			LC
Atriplex semibaccata	Berry Saltbush			LC
Atriplex suberecta	Lagoon Saltbush			NT
Austrostipa flavescens	Coast Spear-grass			LC
*Austrostipa spp.^*	Spear Grass			
Bolboschoenus caldwellii	Salt Club-rush			LC
Callophyllis rangiferina				
Carex bichenoviana	Notched Sedge			
Carpobrotus rossii	Native Pigface			LC
Carpoglossum confluens				
Caulerpa brownii				
Caulerpa scalpelliformis				
Correa pulchella	Salmon Correa			
Crassilingua marginifera				

Species	Common Name	EPBC Status	NPW Act Status	Subregional Status*
Cynoglossum australe	Australian Hound's-tongue			LC
Cyperus laevigatus	Bore-drain Sedge			RA
Dianella brevicaulis	Short-stem Flax-lily			LC
Dictyota alternifida				
Disphyma crassifolium ssp. clavellatum	Round-leaf Pigface			LC
Distichlis distichophylla	Emu-grass			LC
Dodonaea viscosa ssp. spatulata	Sticky Hop-bush			LC
Drewiana nitella				
Dysphania pumilio	Small Crumbweed			LC
Ectocarpus siliculosus				
Einadia nutans ssp. nutans	Climbing Saltbush			LC
Enchylaena tomentosa var. tomentosa	Ruby Saltbush			LC
Eucalyptus camaldulensis ssp. camaldulensis	River Red Gum			LC
Eucalyptus cneorifolia	Kangaroo Island Narrow-leaf Mallee			
Eucalyptus fasciculosa	Pink Gum		R	LC
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum			RE
Eucalyptus odorata	Peppermint Box			
Eucalyptus porosa	Mallee Box			LC
Ficinia nodosa	Knobby Club-rush			LC
Frankenia pauciflora var. gunnii	Southern Sea-heath			LC
*Gahnia filum^*	Thatching Grass			LC
*Gahnia trifida^*	Cutting Grass			VU
Geranium potentilloides var. potentilloides	Downy Geranium			LC
Goodenia varia	Sticky Goodenia			NT
Halymenia plana				
Hemineura frondosa				
Juncus kraussii	Sea Rush			LC
Leiocarpa supina	Coast Plover-daisy			
Lepidosperma semiteres	Wire Rapier-sedge			
Leucophyta brownii	Coast Cushion Bush			LC
Leucopogon parviflorus	Coast Beard-heath			LC
Lobelia anceps	Angled Lobelia			NT
Logania minor	Spoon-leaf Logania			VU
*Lomandra effusa^*	Scented Mat-rush			LC
*Lomandra multiflora ssp. dura^*	Hard Mat-rush			
Lotus australis	Austral Trefoil			LC
Lythrum hyssopifolia	Lesser Loosestrife			LC
Maireana enchylaenoides	Wingless Fissure-plant			
Maireana oppositifolia	Salt Bluebush			LC
Melaleuca halmaturorum	Swamp Paper-bark			LC
Melaleuca lanceolata	Dryland Tea-tree			NT
Metamastophora flabellata				
Muehlenbeckia gunnii	Coastal Climbing Lignum			LC
Myoporum insulare	Common Boobialla			LC
Nitraria billardierei	Nitre-bush			LC
Olearia axillaris	Coast Daisy-bush			LC
Pachydictyon paniculatum				
Pelargonium australe	Austral Stork's-bill			LC
Phragmites australis	Common Reed			LC

Species	Common Name	EPBC Status	NPW Act Status	Subregional Status*
Pimelea glauca	Smooth Riceflower			LC
Pimelea serpyllifolia ssp. serpyllifolia	Thyme Riceflower			LC
Plocamium mertensii				
Ptilocladia pulchra				
Ptilothamnion schmitzii				
Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush			LC
Rhagodia spinescens	Spiny Saltbush			
Rytidosperma caespitosum	Common Wallaby-grass			
*Rytidosperma spp.^*	Wallaby Grass			
Samolus repens	Creeping Brookweed			LC
Sargassum varians				
Scaevola crassifolia	Cushion Fanflower			NT
Schoenoplectus pungens	Spiky Club-rush			LC
Schoenus deformis	Small Bog-rush			RA
Spergularia marina	Salt Sand-spurrey			NT
Spinifex hirsutus	Rolling Spinifex			LC
Sporobolus virginicus	Salt Couch			LC
Suaeda australis	Austral Seablite			LC
Tetragonia implexicoma	Bower Spinach			LC
Threlkeldia diffusa	Coast Bonefruit			LC
Thyridia repens	Creeping Monkey-flower			LC
Triglochin striata	Streaked Arrowgrass			LC
Typha domingensis	Narrow-leaf Bulrush			LC
Wilsonia backhousei	Narrow-leaf Wilsonia			NT
Zonaria turneriana				

^ denotes records from technical updates, review of publications and local input
*See Appendices for subregional map

Regional Conservation status, Mount Lofty Ranges IBRA (Interim Biogeographical Regionalisation for Australia) subregion (Gillam & Urban (2014). Regional Species Conservation Assessment Project, Phase 1 Report - Regional Species Status Assessments, Adelaide and Mount Lofty Ranges NRM Region. DEWNR: SA)

RE = Regionally Extinct CR = Critically Endangered EN = Endangered
VU = Vulnerable RA = Rare NT = Near Threatened
LC = Least Concern DD = Data Deficient NE = Not Evaluated

All Introduced Flora in cell

Species	Common Name	Red Alert Weeds	Declared Weeds	WONS
Acacia cyclops	Western Coastal Wattle	IC		
Acacia iteaphylla	Flinders Ranges Wattle	HP		
Acacia saligna	Golden Wreath Wattle	HP		
Aizoon pubescens	Coastal Galenia	IC		
Aloe maculata	Broad-leaf Aloe	HP		
Alternanthera pungens	Khaki Weed	IC	Yes	
*Alyssum linifolium**	Flax-leaf Alyssum			
Apium graveolens	Celery			
Arctotheca calendula	Cape Weed	HP		
Artemisia arborescens	Silver Wormwood			
Arundo donax	Giant Reed	HP	Yes	

Species	Common Name	Red Alert Weeds	Declared Weeds	WONS
Asphodelus fistulosus	Onion Weed	HP		
Atriplex prostrata	Creeping Saltbush			
Avena barbata	Bearded Oat			
Brachypodium distachyon	False Brome			
Brassica tournefortii	Wild Turnip			
Bromus catharticus	Prairie Grass			
Bromus diandrus	Great Brome			
Bromus hordeaceus ssp. hordeaceus	Soft Brome			
Cakile maritima ssp. maritima	Two-horned Sea Rocket			
Carpobrotus edulis ssp. edulis	Hottentot Fig	HP		
Casuarina glauca	Grey Buloak	IC	Yes	
Cenchrus clandestinus	Kikuyu	HP		
Cenchrus longisetus	Feather-top	HP		
Chenopodium album	Fat Hen			
Chrysanthemoides monilifera ssp. monilifera	Boneseed	IC	Yes	Yes
Cirsium vulgare	Spear Thistle			
*Convolvulus arvensis**	Field Bindweed	HP	Yes	
Coprosma repens	New Zealand Mirror-bush	IC	Yes	
Cotyledon orbiculata var. oblonga	Cotyledon			
Cynodon dactylon var. dactylon	Couch			
*Cynodon dactylon var. dactylon**	Couch			
*Delairea odorata**	Cape Ivy	IC		
Dimorphotheca fruticosa	Trailing African Daisy	HP		
Dimorphotheca pluvialis	Cape Marigold	HP		
Diplotaxis tenuifolia	Lincoln Weed		Yes	
Drosanthemum candens	Rodondo Creeper	IC		
Ehrharta longiflora	Annual Veldt Grass			
Erigeron sumatrensis	Tall Fleabane			
Erodium cicutarium	Cut-leaf Heron's-bill			
Eucalyptus platypus ssp. platypus	Round-leaved Moort			
Euphorbia paralias	Sea Spurge	HP		
Euphorbia serpens	Matted Sandmat			
Euphorbia terracina	False Caper	HP	Yes	
Gaudium laevigatum	Coast Tea-tree		Yes	
Gazania linearis	Gazania	IC	Yes	
*Gazania spp.**	Gazania		Yes	
Hakea drupacea				
Helminthotheca echioides	Ox-tongue			
Hordeum glaucum	Blue Barley-grass			
Hypochaeris radicata	Rough Cat's Ear			
Kickxia elatine ssp. crinita	Twining Toadflax			
Lagunaria patersonii	Pyramid Tree	HP		
Lagurus ovatus	Hare's Tail Grass			
Limonium companyonis	Sea-lavender	IC		
Lolium rigidum	Wimmera Ryegrass			
Lycium ferocissimum	African Boxthorn	IC	Yes	Yes
Malva arborea	Tree Mallow	HP		
Malva parviflora	Small-flower Marshmallow			
Marrubium vulgare	Horehound	IC	Yes	

Species	Common Name	Red Alert Weeds	Declared Weeds	WONS
Medicago polymorpha	Burr-medic			
Mesembryanthemum crystallinum	Common Iceplant	HP		
Olea europaea ssp. europaea	Olive	IC		
Oxalis pes-caprae	Soursob			
Parapholis incurva	Curly Ryegrass			
Paspalum distichum	Water Couch			
Paspalum vaginatum	Salt-water Couch			
Phalaris minor	Lesser Canary-grass			
Pinus halepensis	Aleppo Pine	IC	Yes	
Piptatherum miliaceum	Rice Millet			
Plantago coronopus ssp. coronopus	Bucks-horn Plantain			
Plantago lanceolata var. lanceolata	Ribwort			
Polygonum aviculare	Wireweed			
Polypogon monspeliensis	Annual Beard-grass			
Reichardia tingitana	False Sowthistle			
Rorippa nasturtium-aquaticum	Watercress			
Rumex crispus	Curled Dock			
Salvia verbenaca var.	Wild Sage			
Sixalix atropurpurea	Pincushion	IC		
Sonchus oleraceus	Common Sow-thistle			
Symphyotrichum subulatum	Aster-weed	HP		
*Tamarix aphylla**	Athel Pine		Yes	Yes
Thinopyrum junceiforme	Sea Wheat-grass	IC		
Trifolium campestre	Hop Clover			
Vicia sativa ssp. sativa	Common Vetch			

WONS = Weeds of National Significance.

Declared = Declared under the Landscape South Australia Act 2019. Pest plants that are a significant threat to agriculture, the natural environment and public health and safety are called declared plants. Land owners have a legal responsibility to manage these plants.

Red Alert = Weed Threat Level of four or greater out of nine. Plants in this categorised are either designated as requiring immediate control (IC – 6-9) or as a high priority for control (HP – 4-5). See Department for Environment and Water (2024)

Reference – Department for Environment and Water (2024). Threatening Processes - Environmental and Priority Weed Species. Southern Fleurieu Coastal Action Plan Review 2024. Prepared by SA Herbarium

FAUNA Summary

# Fauna in cell	50
# Native Fauna in cell	42
# Introduced Fauna in cell	8
# Conservation Rated Fauna in cell	11 (3 national, 11 state)

Conservation Rated Fauna				
Species	**Common Name**	**Class**	**EPBC Act Status**	**NPW Act Status**
Egretta sacra sacra	Pacific Reef Heron	AVES		R
Entomyzon cyanotis cyanotis	Blue-faced Honeyeater	AVES		R
Haematopus fuliginosus fuliginosus	Sooty Oystercatcher	AVES		R
Haematopus longirostris	Pied Oystercatcher	AVES		R
*Haliaeetus leucogaster^*	White-bellied Sea Eagle	AVES		E
*Larus dominicanus dominicanus^*	Kelp Gull	AVES		R
*Pandion haliaetus cristatus^*	Eastern Osprey	AVES		E
Thinornis cucullatus cucullatus	Hooded Plover	AVES	VU	V
*Zanda funerea whiteae^*	Yellow-tailed Black Cockatoo	AVES		V
*Pteropus poliocephalus^*	Grey-headed Flying-fox	MAM	VU	R
*Tachyglossus aculeatus^*	Short-beaked Echidna	MAM	ssp	ssp

All Native Fauna in cell

Species Name	**Common Name**	**Class**	**EPBC Act Status**	**NPW Act Status**	**Subregional Status**
*Aldrichetta forsteri^*	Yelloweye Mullet	ACT			
*Argyrosomus japonicus^*	Mulloway	ACT			
*Arripis trutta^*	Eastern Australian Salmon	ACT			
Galaxias maculatus	Common Galaxias	ACT			VU
Pseudaphritis urvillii	Congolli	ACT			EN
Crinia signifera	Common Froglet	AMP			NT
Limnodynastes dumerilii	Banjo Frog	AMP			NT
Limnodynastes tasmaniensis	Spotted Marsh Frog	AMP			NT
Chroicocephalus novaehollandiae novaehollandiae	Silver Gull	AVES			LC
Egretta novaehollandiae	White-faced Heron	AVES			LC
Egretta sacra sacra	Pacific Reef Heron	AVES		R	RA
Entomyzon cyanotis cyanotis	Blue-faced Honeyeater	AVES		R	
Haematopus fuliginosus fuliginosus	Sooty Oystercatcher	AVES		R	VU
Haematopus longirostris	Pied Oystercatcher	AVES		R	VU
*Haliaeetus leucogaster^*	White-bellied Sea Eagle	AVES		E	EN
*Larus dominicanus dominicanus^*	Kelp Gull	AVES		R	RA
*Larus pacificus georgii^*	Pacific Gull	AVES			LC
Melopsittacus undulatus	Budgerigar	AVES			RA
Microcarbo melanoleucos melanoleucos	Little Pied Cormorant	AVES			LC
*Pandion haliaetus cristatus^*	Eastern Osprey	AVES		E	
Phalacrocorax fuscescens	Black-faced Cormorant	AVES			NT
*Phalacrocorax sulcirostris^*	Little Black Cormorant	AVES			LC
Phalacrocorax varius hypoleucos	Australian Pied Cormorant	AVES			LC
Thalasseus bergii cristatus	Greater Crested Tern	AVES			LC
Thinornis cucullatus cucullatus	Hooded Plover	AVES	VU	V	EN
*Zanda funerea whiteae^*	Yellow-tailed Black Cockatoo	AVES		V	RA

Class: ACT = Actinopteri, **AMP** = Amphibia, **AVES** = Aves, **INV** = Invertebrates, **MAM** = Mammalia, **REP**= Reptilia

All Introduced Fauna in cell

Species	Common Name
*Acridotheres tristis^*	Common Myna
Carassius auratus	Goldfish
*Columba livia^*	Feral Pigeon
*Felis catus^*	Domestic Cat (Feral Cat)
*Mus musculus^*	House Mouse
*Oryctolagus cuniculus^*	Rabbit (European Rabbit)
*Sturnus vulgaris vulgaris^*	Common Starling
*Vulpes vulpes^*	Fox (Red Fox)

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