

Eyre Peninsula Saltmarsh Retreat Assessment Report



Prepared for the Department for Environment and Water

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Overview

Recently the Eyre Peninsula Natural Resources Management (EPNRM) Board has acquired Light Detection and Ranging (LiDAR) data for the entire Eyre Peninsula (EP) coastline (excluding islands) extending 1km inland. The LiDAR elevation data for the EP was acquired between March 5th 2018 and April 11th 2018 at a resolution of 1 m with ± 50 cm horizontal accuracy and ± 15 cm vertical accuracy at 95% confidence interval at a projected coordinate system of GDA94 MGA Zone 53S¹. This data was modelled to derive spatial layers for projected sea level rise flood mapping. This included mean high water spring tide level for 2019, 2050 and 2100, as well as 1 in 100 year (ARI) storm surge levels for 2019, 2050 and 2100. This data was presented by Sarira and Clarke (2019) in a report for DEW to inform coastal management. This project uses their data to analyse more specific predictions for coastal saltmarsh systems to inform their management.

Aim

The aim of this project is to identify areas on the EP where it could be possible for existing coastal saltmarsh systems to retreat further inland in response to rising sea levels, and then prioritise areas where ground works could be undertaken to assist retreat.

This will support planning for the “Saltmarsh Threat Abatement and Recovery (STAR) Project”. The STAR project aims to use the Coastal Action Plan² to prioritise initial on-ground works sites with high conservation value, moderate to high risk and high community visibility. Priority works will include; access management, revegetation, weed management, improving hydrological flows and removing marine debris³.

Prioritising of saltmarsh retreat sites will be based on conservation priority and threats present within the saltmarsh retreat areas. Conservation priority will be based on factors that indicate a site’s ecological importance such as wetland status (eg. National importance), important flora & fauna as well as factors that will mean the department has a high level of control to intervene such as crown lands, minister owned lands and reserves. Threats include mining licenses, land owned privately or by other government agencies, roads and off road vehicle tracks. This project will provide specific advice about the threats and conservation values present at each retreat area, and prioritise the sites based on this.

Methodology

1.1 Site selection

In areas with existing saltmarsh habitat, an inspection of the 1 in 100 year (ARI) storm surge data reveals that the 2019 (ARI) storm surge inundation level appears to be a strong predictor for the current landward extent of saltmarsh habitat (figure 1). This was assessed at all sites on the east and west coasts of the Eyre Peninsula and remains true for all sites. Based on this it is assumed that storm surge inundation level is a good predictor for landward saltmarsh extent and as such the 2100 (ARI) storm surge level was used as a predictor for 2100 landward extent of saltmarsh habitat.

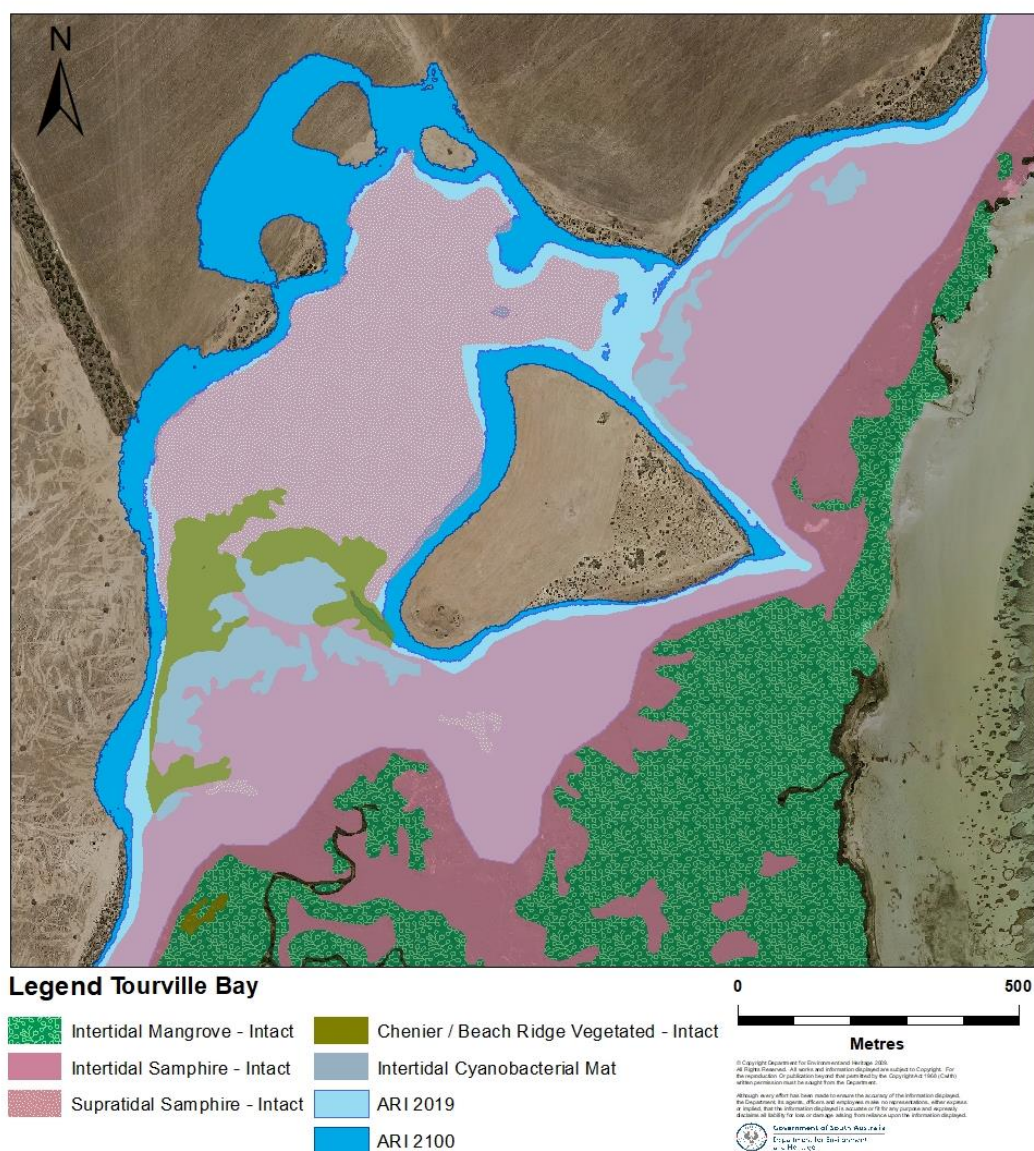


Figure 1 Current saltmarsh extent overlaid with 2019 and 2100 ARI flood levels at Tourville Bay

A union was performed on the 2019 ARI data across the Eyre Peninsula, as well as the 2100 ARI data, for ease of analysis.

This provided a clear area of retreat for existing saltmarsh systems in the next 80 years. To isolate this retreat area, the 2019 ARI layer was erased from the 2100 ARI layer. This retreat area was then selected within 100m of the existing saltmarsh vegetation and a new layer was created from this selection to exclude flood areas that are not adjacent to a current saltmarsh system (figure 2). This area was further reduced manually to account for areas that are disconnected from existing saltmarsh, where there is a natural ridge or barrier to prevent retreat, or the land is too steep/high for habitat type. This was done using firsthand knowledge of the sites, as well as oblique images of the coastline.

Current aerial imagery of the systems was also used to inspect extent of saltmarsh systems, as the Coastal Saltmarsh and Mangrove Mapping project was completed in 1997.

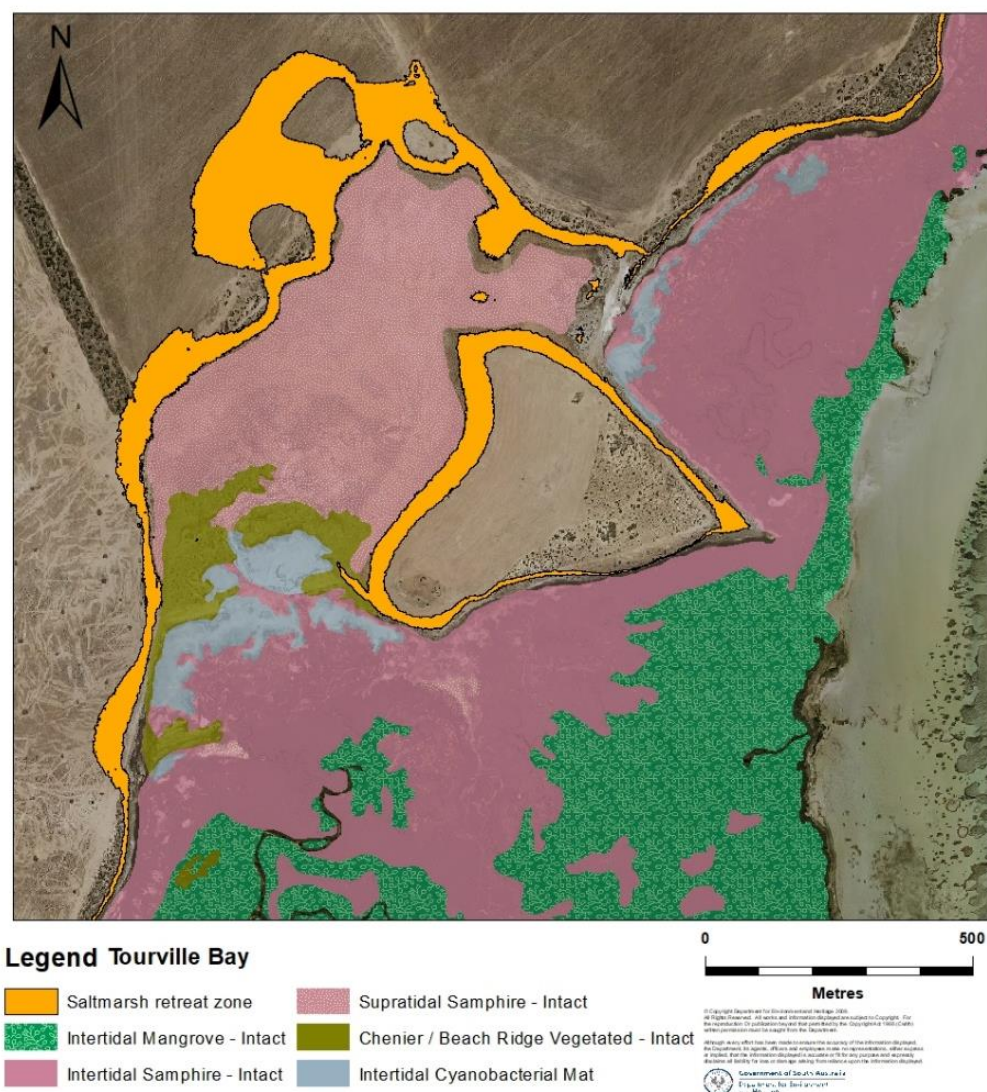


Figure 2 Current saltmarsh extent and saltmarsh retreat area at Tourville Bay

The saltmarsh retreat area was then divided into 24 systems (table 1) according to the natural breaks between saltmarsh vegetation.

Table 1 List of saltmarsh sites ranked by retreat area

Rank by Size	Site	Area (hecatres)
1	Franklin Harbour	1460
2	Western Shoal	1337
3	Munyaroo	881
4	Tumby Bay	662
5	Venus Bay	550
6	Tod River	453
7	Acraman Creek	364
8	False Bay	359
9	Smoky Bay	279
10	Murat Bay	276
11	Tourville Bay	263
12	Baird Bay	263
13	Horse Peninsula	155
14	Eyre Island	105
15	Kellidie Bay	92
16	Laura Bay	91
17	Port Lincoln	80
18	Point Gibson	71
19	Yangie Bay	64
20	Arno Bay	62
21	Point Longnose	43
22	Port Neill	23
23	Thevenard	14
24	Streaky Bay	9

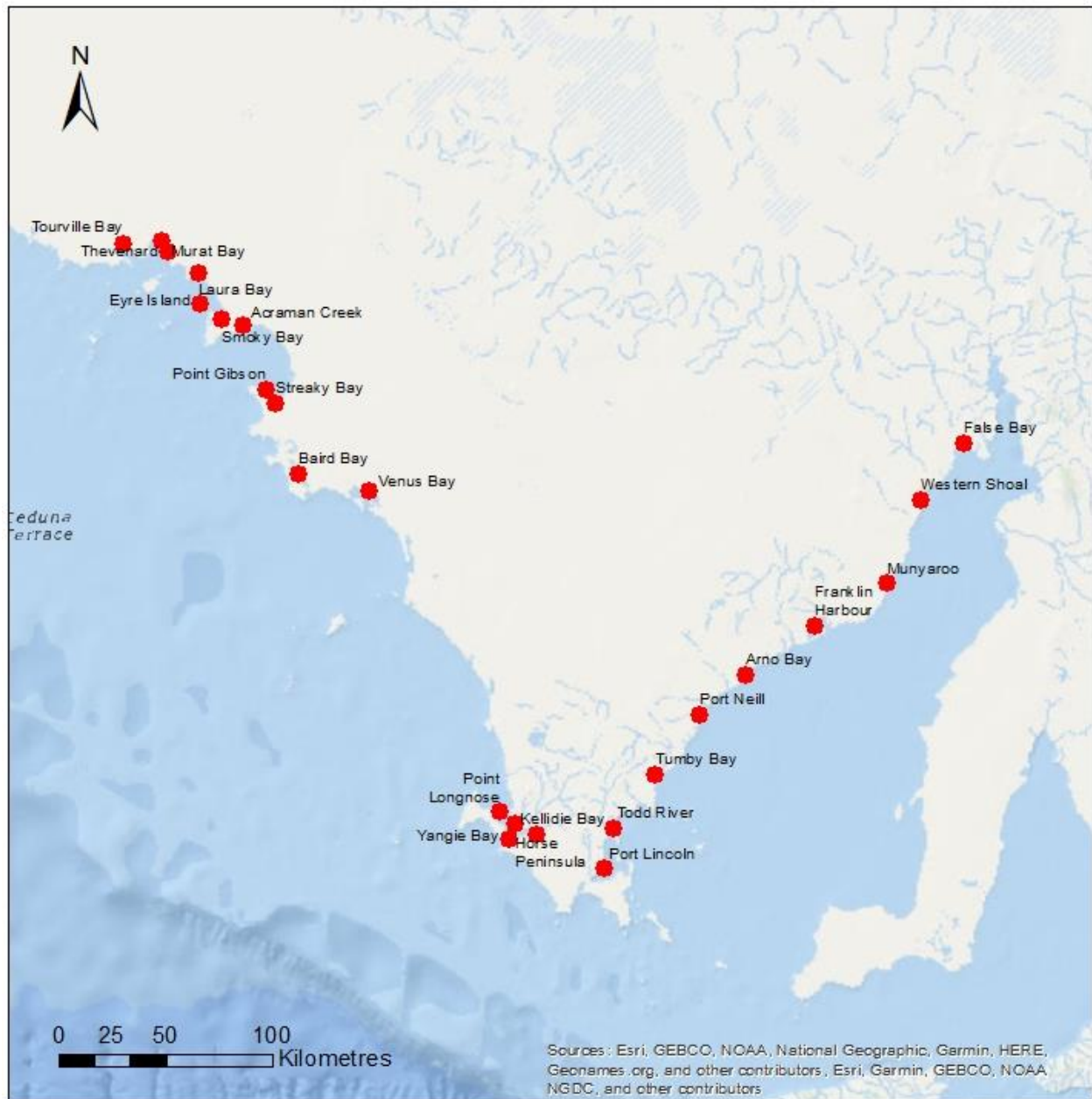


Figure 3 Map of the Eyre Peninsula, South Australia, showing locations of saltmarsh retreat areas with red points

1.2 Layer selection

The DEW data layers were evaluated and narrowed down to the few of most concern or use for analysis (table 2). This was based on determining factors that may pose a threat to the natural retreat of the saltmarsh systems or its quality and factors that would aid in the retreat or protection of the conservation values.

The relevant layers were then selected for overlapping with the saltmarsh retreat area and new layers from the selection were created for ease of analysis. Point or line layers were given a 50m buffer for analysis.

Table 2 Layers used in site assessment and classifications assigned to each

Layer name	Status
ADMIN.ZoningZones	Conservation/Threat
LANDSCAPE.LandUse_ALUM	Conservation/Threat
ADMIN.CrownLandsActReserves	Conservation
ADMIN.MECLand	Conservation
CONSERVATION.NpwsaReserves	Conservation
LANDSCAPE.WetlandsNationalImportance	Conservation
FAUNA.CoastalWaders	Conservation
FLORA.WONS	Threat
DCDB.Parcel_erase_minister_land	Threat
ADMIN.MineralExplorationLicenses	Threat
ADMIN.MiningProductionLeases	Threat
ADMIN.PetroleumApplications	Threat
ADMIN.PetroleumLicenses	Threat
ADMIN.MineralExplorationApplications	Threat
TOPO.Quarries	Threat
ORV.Tracks	Threat
TOPO.Roads	Threat

Most layers were categorised as entirely conservation or threat, but a few had individual attributes that varied between conservation and threat so were split into two layers by conservation and threat attributes. These were the Zoning and Landuse layers. Categorisation of their attributes can be found in Appendix 1.

Conservation layers included Crown lands, Minister of Environment owned land, NPWSA reserves and Wetlands of National Important. These layers were selected as they provide an indication that natural retreat is be more likely, or because DEW will have greater power to increase likelihood of retreat through land tenure.

Threat layers included land owned privately or by other government agencies, six mining layers which were amalgamated, off road vehicle tracks and roads. These layers all indicate a potential threat to natural saltmarsh retreat and/or quality which will need to be addressed to conserve the system.

Locations of weeds of national significance and coastal waders were initially assessed but as this data is point locations, it was deemed impractical for area analysis and not used in site assessment. Once classified, all assessment layers were processed as a “union” (combining all the layers together) with the saltmarsh retreat area to assess the interactions between them.

The attribute table from this union was exported to excel and manipulated as a pivot table (Appendix 2). This provided information on the presence or absence of each layer with the saltmarsh retreat area and the size and percentage of the retreat area the layer occupies.

1.3 Assessment scores

Each assessment layer present at each saltmarsh retreat site was given a rating from 0-3 to categorise the level of threat or conservation. These ratings were assigned based on the percentage of the site covered by the assessment layer (Table 3). The percentage of the assessment layer relating to each rating was decided by the significance of presence of the assessment layer and adjusted for relative area of the layers (Appendix 2).

Table 3 Rating system used to classify level of threat or conservation value at each site

Wetlands Status	Significant % of site coverage	CrownLand Status	Significant % of site coverage	MECLandS tatus	Significant % of site coverage	Npwsa reserves	Significant % of site coverage	Landuse conservati on	Significant % of site coverage	ZoningZones conservation	Significant % of site coverage
0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
1	1-5%	1	1-10%	1	1-15%	1	1-5%	1	1-40%	1	1-40%
2	5-10%	2	10-30%	2	15-30%	2	5-10%	2	40-60%	2	40-60%
3	>10%	3	>30%	3	>30%	3	>10%	3	>60%	3	>60%
ORV Tracks Status	Significant % of site coverage	Roads Status	Significant % of site coverage	Mining Status	Significant % of site coverage	DCDB Parcel Status	Significant % of site coverage	Landuse threat	Significant % of site coverage	ZoningZones threat	Significant % of site coverage
0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
1	1-5%	1	1-5%	1	1-15%	1	1-60%	1	1-20%	1	1-15%
2	5-10%	2	5-10%	2	15-30%	2	60-80%	2	20-45%	2	15-30%
3	>10%	3	>10%	3	>30%	3	>80%	3	>45%	3	>30%

These ratings were then summed for each site by conservation and threat. A high conservation value means either a large percentage of the site is covered by conservation layers, or that the conservation value is high. For example, Point Longnose and Yangie Bay both have high conservation values as they are entirely within Coffin Bay National Park. Whereas Port Lincoln has a low conservation value as it is predominantly metropolitan and has only a small percentage of conservation landuse area.

Results/Discussion

The overall conservation and threat values for each site give an indication of which may need more intervention to ensure retreat for the saltmarsh system (table 4). Although size of saltmarsh retreat area should be considered in relation to cost benefit for on ground works, the sites have been primarily prioritised by conservation value.

Table 4 Summary of Saltmarsh retreat areas by conservation and threat values against site size

Site	Area (hectares)	Rank by Size	Conservation	Threat
Acraman Creek	364	7	15	5
Yangie Bay	64	19	15	2
Point Longnose	43	21	15	2
Western Shoal	1337	2	14	8
Franklin Harbour	1460	1	13	12
Venus Bay	550	5	13	8
Horse Peninsula	155	13	13	7
Kellidie Bay	92	15	13	7
Munyaroo	881	3	12	9
Tod River	453	6	10	12
False Bay	359	8	10	9
Laura Bay	91	16	10	10
Point Gibson	71	18	10	9
Eyre Island	105	14	9	0
Tumby Bay	662	4	8	10
Tourville Bay	263	11	8	10
Thevenard	14	23	8	12
Streaky Bay	9	24	8	10
Smoky Bay	279	9	7	11
Murat Bay	276	10	7	12
Port Neill	23	22	7	16
Baird Bay	263	12	6	11
Arno Bay	62	20	6	14
Port Lincoln	80	17	3	15

The top 5 sites ranked by conservation value were assessed in detail for the threats present and actions required to mitigate them (table 5). Some of these sites value require little to no action but should be monitored to ensure natural retreat is taking place.

Table 5 Potential actions to mitigate threats at top 5 conservation sites

Acraman Creek		
Threat		Action required
Landuse	Grazing modified pastures	Discuss management of retreat area with land holders
	Cereals	Discuss management of retreat area with land holders
	Roads	Assess whether flow is being restricted on the eastern side of the site
Zoning	Primary production	Discuss management of retreat area with land holders
DCDB	10 parcels	Discuss management of retreat area with land holders
Roads	Local, Track 2WD	Assess whether flow is being restricted on the eastern side of the site
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
Point Longnose		
Threat		Action required
Roads	Track 4WD	Doesn't appear to restrict flow, clear roads marked, No action required
ORV Tracks	Present	Doesn't appear to restrict flow, clear tracks marked, No action required
Yangie Bay		
Threat		Action required
Roads	Track 4WD	Doesn't appear to restrict flow, clear roads marked, No action required
ORV Tracks	Present	Doesn't appear to restrict flow, some consolidation of tracks could assist vegetation expansion
Western Shoal		
Threat		Action required
Landuse	Petroleum exploration licence application	Advise change to application to avoid saltmarsh retreat area
	Navigation and communication	Infrastructure, no actions available
	Urban residential	Highly built up, no actions available
	Public services	Highly built up, no actions available
	Road	May not be impeding retreat- ground truth
	Recreation and culture	Discuss management of retreat area with land holders
	Rural residential with agriculture	Discuss management of retreat area with land holders
	Sewage	Discuss management of retreat area with land holders
Zoning	Coastal Marina	Insignificant retreat area- no action required
	Rural living	Discuss management of retreat area with land holders
	Infrastructure	Discuss management of retreat area with land holders
	Residential	Highly built up, no actions available
Mining	Petroleum exploration licence application	Advise change to application to avoid saltmarsh retreat area
Roads	Arterial, Collector, Highway, Local, SubArterial, Track 2WD	May not be impeding retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	78 parcels	Discuss management of retreat area with land holders

Franklin Harbour		
	Threat	Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Commercial services	Highly built up, no actions available
	Cropping	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Manufacturing and industrial	Existing infrastructure, no actions available
	Navigation and communication	Existing infrastructure, no actions available
	Ports and water transport	Insignificant retreat area- no action required
	Public services	Highly built up, no actions available
	Recreation and culture	Highly built up, no actions available
	Roads	May not be impeding retreat- ground truth
	Urban residential	Highly built up, no actions available
	Woody fodder plants	Insignificant retreat area- no action required
	Residential and farm infrastructure	Highly built up, no actions available
Zoning	Primary production	Investigate re-zoning boundaries to avoid retreat areas
	Industry	Appears unused - discuss allowing retreat with land holders
	Caravan and Tourist park	Highly built up, no actions available
	Residential	Highly built up, no actions available
	Town centre	Highly built up, no actions available
	Commercial	Some unused land - discuss allowing retreat with land holders
	Aquaculture	Highly built up, no actions available
Mining	Mineral Exploration Licence Application	Advise change to application to avoid saltmarsh retreat area
	Petroleum Exploration Licence Application	Advise change to application to avoid saltmarsh retreat area
Roads	Arterial, Collector, Local, SubArterial, Track 2WD	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	251 parcels	Discuss management of retreat area with land holders

In table 5 (above) the top sites have been analysed in further detail as to the possible management actions that could be undertaken. This will provide background for decisions to be made about where on ground works are to be undertaken by simply displaying what can be done where and why. Management action tables for the other 19 sites can be found in appendix 5.

A number of the saltmarsh retreat areas were cut off by the 1km inland extent of the LiDAR data and are not representative of the full retreat area possible. Aerial imagery of the sites provides a better idea of the inland extent of retreat such as at Tumby Bay (Figure 3). Inspection of the aerial imagery and ground truthing would be beneficial prior to action being taken at these sites (full list of sites effected in Appendix 4).

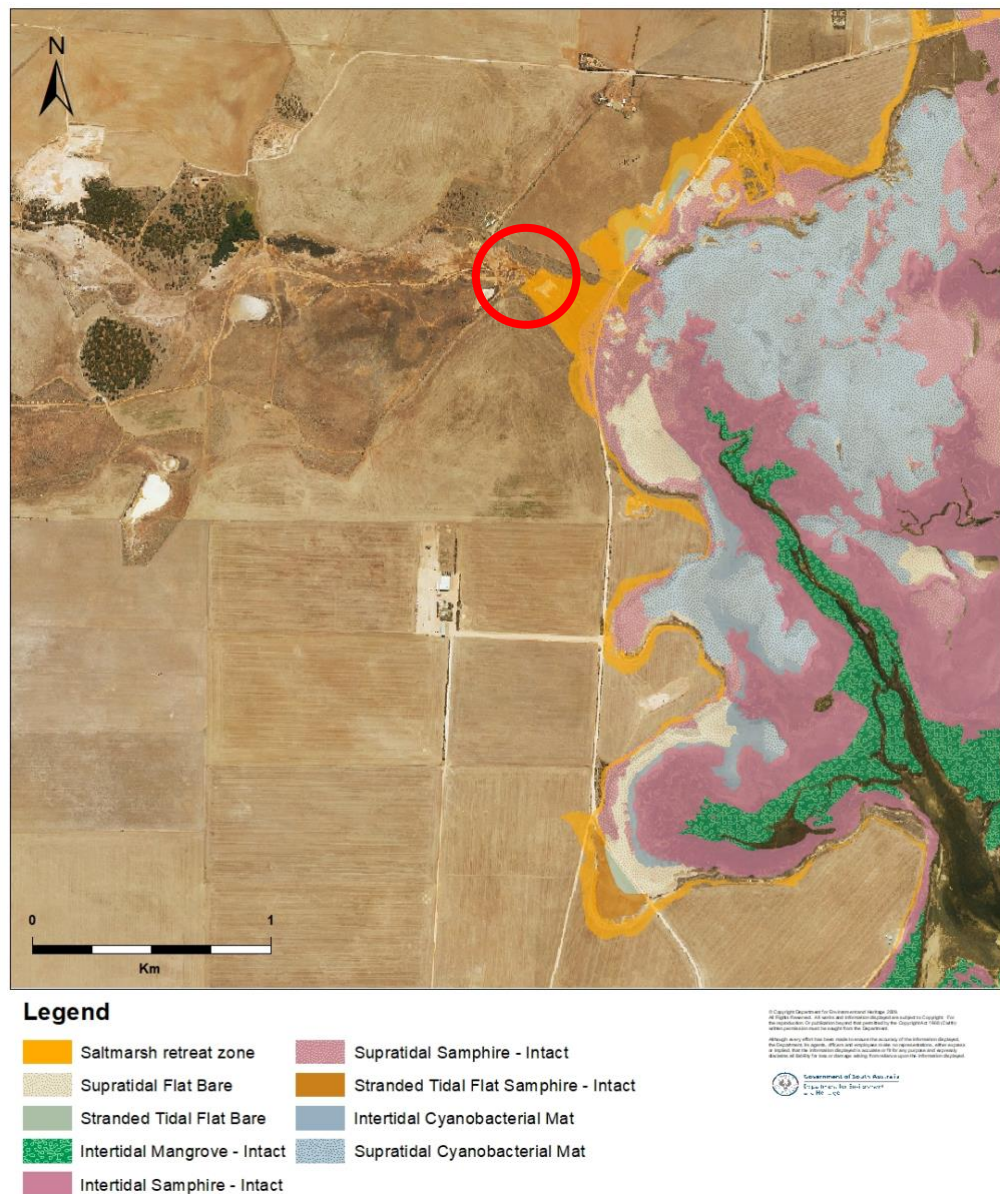


Figure 4 Saltmarsh retreat area at Tumby Bay showing potential for further retreat area beyond 1km LiDAR cutoff circled in red.

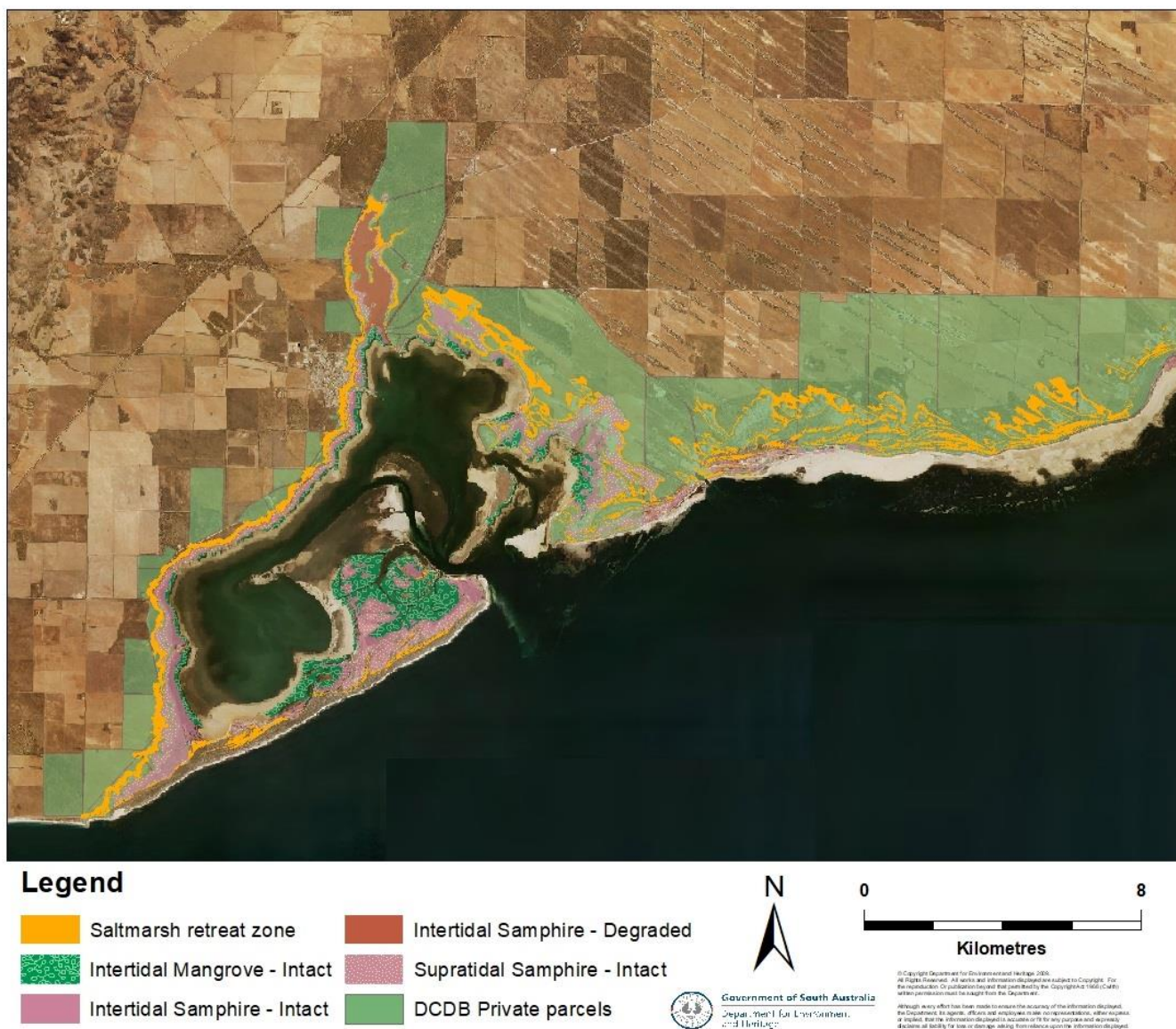


Figure 5 Map of Franklin Harbour showing current saltmarsh, the saltmarsh retreat area, and the largest threat at the site (DCDB)

Detailed site analysis can be undertaken before works are planned by utilising the map document to inspect exactly where threats overlap with retreat zones. This is displayed in figure 5 above.

Limitations

The LiDAR data used in analysis only went 1km inland from the coastline which restricted this assessment to that area also. Fourteen of the 24 saltmarsh retreat areas were visibly cut off at the distance (Appendix 4) however inspection of the aerial imagery and ground trothing could help estimate the areas of retreat beyond this 1km cut off.

When the union of layers was performed, there was a slight change to area of retreat sites. The cause of this could not be determined, however it was potentially created by an anomaly with slivers of layers that closely overlap such as Roads and ORV Tracks. The change in area was insignificant so did not affect assessment.

The coastal saltmarsh and mangrove mapping project which identifies and classifies the areas that contain these habitats was completed in 1997 and although it has had some updates in the time since then, it is not 100% accurate and therefore may have missed some areas of existing coastal saltmarsh.

This analysis only accounts for retreat of existing coastal saltmarsh systems, it does not include areas with potential to establish new saltmarsh habitat nor does it include inland saltmarsh systems that may become coastal with sea level rise. With the changing coastline in the future it could be possible for new coastal saltmarsh systems to be established either naturally or with some planting or seed dispersal. This could be an area of future research.

Reference list

1. Sarira, T & Clarke, K, 2019, "Projected Sea Level Rise Flood Mapping along the South East and Eyre Peninsula Coastlines", *prepared for the Department for Environment and Water by School of Biological Science, The University of Adelaide*
2. <https://www.naturalresources.sa.gov.au/eyrepeninsula/coast-and-marine/coast-marine-management>
3. <https://www.naturalresources.sa.gov.au/eyrepeninsula/projects-and-partners/star-project>

Appendix

Zoning	No. polygons	Status	LandUse	No. polygons	Status
Coastal Conservation	24	Conservation	Defence land - natural areas	1	Conservation
Coastal Open Space	17	Conservation	Estuary/coastal waters	2	Conservation
Conservation	1	Conservation	Estuary/coastal waters - conservation	19	Conservation
NO ZONES	6	Conservation	Grazing native vegetation	9	Conservation
Open Space	4	Conservation	Habitat/species management area	1	Conservation
Remote Area	1	Conservation	Lake	4	Conservation
Water Protection	3	Conservation	Landscape	10	Conservation
Community	1	Low Threat	Marsh/wetland	195	Conservation
Primary Production	9	Low Threat	Marsh/wetland - conservation	72	Conservation
Recreation	8	Low Threat	National park	5	Conservation
Rural Living	9	Low Threat	Natural feature protection	44	Conservation
Airfield	2	Threat	No defined use	2	Conservation
Aquaculture	7	Threat	Other conserved area	32	Conservation
Caravan and Tourist Park	9	Threat	Residual native cover	279	Conservation
Coastal Marina	6	Threat	Strict nature reserves	25	Conservation
Coastal Settlement	20	Threat	Wilderness area	4	Conservation
Commercial	3	Threat	Cropping	13	Low Threat
Defence	1	Threat	Grazing modified pastures	74	Low Threat
Deferred Urban	3	Threat	Recreation and culture	48	Low Threat
District Town Centre	1	Threat	Airports/aerodromes	4	Threat
Industry	5	Threat	Aquaculture	2	Threat
Industry Buffer	1	Threat	Cereals	51	Threat
Infrastructure	1	Threat	Commercial services	22	Threat
Mixed Use (Foreshore)	1	Threat	Environmental forest plantation	1	Threat
Mixed Use (Point Boston)	1	Threat	Estuary/coastal waters - intensive use	4	Threat
Residential	12	Threat	Intensive animal production	1	Threat
Settlement	2	Threat	Irrigated perennial horticulture	1	Threat
Special Industry (Hydro)	1	Threat	Lake - intensive use	11	Threat
Town Centre	2	Threat	Land in transition	3	Threat
Township	3	Threat	Manufacturing and industrial	20	Threat
			Marsh/wetland - production	6	Threat
			Navigation and communication	5	Threat
			Ports and water transport	8	Threat
			Public services	10	Threat
			Quarries	1	Threat
			Railways	3	Threat
			Reservoir	1	Threat
			Residential and farm infrastructure	41	Threat
			Roads	2	Threat
			Rural residential with agriculture	13	Threat
			Services	1	Threat
			Sewage/sewerage	4	Threat
			Transport and communication	1	Threat
			Urban residential	127	Threat
			Utilities	1	Threat
			Water storage - intensive use/farm dams	4	Threat
			Woody fodder plants	2	Threat

Appendix 1 Tables showing the division of the Zoning and Landuse layers between threat and conservation.

Retreat Areas	Wetlands			Crownland			MECland			Npwasa			Landuse			Zoning		
	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating
Acraman Creek	106.31	29%	3	0	0%	0	239.88	66%	3	236.99	65%	3	291.69	80%	3	314.64	86%	3
Amo Bay	0	0%	0	8.92	14%	2	0.93	1%	1	0	0%	0	33.93	54%	2	22.76	36%	1
Baird Bay	2.39	1%	1	0.14	0%	0	35.98	14%	1	3.87	1%	1	96.78	37%	1	157.13	59%	2
Eyre Island	0	0%	0	0	0%	0	105.33	100%	3	105.33	100%	3	105.33	100%	3	0	0%	0
False Bay	134.98	37%	3	41.82	11%	2	51.41	14%	1	0	0%	0	331.31	91%	3	115.75	32%	1
Franklin Harbour	273.70	19%	3	12.13	1%	1	217.43	15%	1	99.62	7%	2	1170.13	79%	3	1371.38	93%	3
Horse Peninsula	20.47	13%	3	4.53	3%	1	24.24	16%	2	1.01	1%	1	147.42	95%	3	146.42	94%	3
Kellidie Bay	2.62	3%	1	5.41	6%	1	45.01	48%	3	45.01	48%	3	52.05	56%	2	84.79	91%	3
Laura Bay	0	0%	0	0	0%	0	19.10	21%	2	17.72	19%	3	45.37	49%	2	67.79	73%	3
Munyaroo	0	0%	0	0	0%	0	287.04	33%	3	205.56	23%	3	756.29	86%	3	862.32	98%	3
Murat Bay	0	0%	0	25.89	9%	1	10.63	4%	1	0	0%	0	166.65	59%	2	180.34	64%	3
Point Gibson	44.57	60%	3	0	0%	0	5.69	8%	1	0	0%	0	63.38	86%	3	58.68	80%	3
Point Longnose	41.52	97%	3	0	0%	0	43.01	100%	3	43.01	100%	3	43.01	100%	3	43.01	100%	3
Port Lincoln	0	0%	0	1.85	2%	1	1.41	2%	1	0	0%	0	30.96	37%	1	0	0%	0
Port Neill	0	0%	0	0.87	4%	1	0	0%	0	0	0%	0	16.65	72%	3	14.10	61%	0
Smoky Bay	0	0%	0	7.62	3%	1	3.69	1%	1	0	0%	0	136.78	48%	2	253.80	89%	3
Streaky Bay	0	0%	0	6.41	71%	3	0	0%	0	0	0%	0	5.27	58%	2	5.60	62%	3
Thevenard	0	0%	0	1.33	9%	1	7.04	47%	3	0	0%	0	10.48	70%	3	5.18	34%	1
Tod River	52.12	11%	3	15.89	3%	1	19.12	4%	1	0	0%	0	254.20	56%	2	293.95	64%	3
Tourville Bay	13.45	5%	1	0.80	0%	0	22.92	8%	1	0	0%	0	186.70	70%	3	262.44	99%	3
Turnby Bay	52.28	8%	2	61.34	9%	1	33.92	5%	1	0	0%	0	364.40	54%	2	400.81	60%	2
Venus Bay	0	0%	0	70.65	13%	2	228.69	41%	3	220.66	40%	3	326.81	59%	2	350.91	63%	3
Western Shoal	0	0%	0	156.51	12%	2	658.43	49%	3	183.21	14%	3	1248.54	92%	3	1225.11	91%	3
Yangle Bay	10.40	16%	3	0	0%	0	64.30	100%	3	64.30	100%	3	64.30	100%	3	61.30	95%	3

Retreat Area	ORV Tracks			Roads			Mining			DCDB			Landuse			Zoning		
	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating	Area (ha)	% of system	Rating
Acraman Creek	6.99	2%	1	8.37	2%	1	0	0%	0	110.75	30%	1	74.15	20%	1	51.20	14%	1
Amo Bay	1.94	3%	1	4.97	8%	2	33.30	53%	3	46.97	75%	2	28.44	46%	3	39.61	64%	3
Baird Bay	9.74	4%	1	6.27	2%	1	0	0%	0	217.61	82%	3	167.69	63%	3	107.35	41%	3
Eyre Island	0.00	0%	0	0.00	0%	0	0	0%	0	0.00	0%	0	0	0%	0	0.00	0%	0
False Bay	25.46	7%	2	18.14	5%	1	105.48	29%	2	262.70	72%	2	34.25	9%	1	36.42	10%	1
Franklin Harbour	81.38	6%	2	41.97	3%	1	537.15	36%	3	1198.97	81%	3	304.03	21%	2	102.86	7%	1
Horse Peninsula	4.81	3%	1	2.59	2%	1	0	0%	0	126.29	81%	3	8.48	5%	1	9.35	6%	1
Kellidie Bay	6.20	7%	2	3.84	4%	1	0	0%	0	30.61	33%	1	40.78	44%	2	8.05	9%	1
Laura Bay	7.16	8%	2	4.41	5%	1	0	0%	0	61.17	66%	2	46.90	51%	3	24.47	27%	2
Munyaroo	16.28	2%	1	9.47	1%	1	720.26	82%	3	588.36	67%	2	126.51	14%	1	20.49	2%	1
Murat Bay	30.33	11%	3	15.69	6%	2	0.38	0%	0	218.43	78%	2	114.95	41%	2	101.27	36%	3
Point Gibson	8.32	11%	3	6.92	9%	2	0	0%	0	51.20	69%	2	10.36	14%	1	9.35	13%	1
Point Longnose	0.45	1%	1	0.42	1%	1	0	0%	0	0.00	0%	0	0	0%	0	0	0%	0
Port Lincoln	8.48	10%	3	12.24	15%	3	0	0%	0	68.68	82%	3	52.33	63%	3	83.29	100%	3
Port Neill	2.88	12%	3	1.83	8%	2	12.25	53%	3	19.53	84%	3	6.50	28%	2	9.06	39%	3
Smoky Bay	25.99	9%	2	18.16	6%	2	0	0%	0	265.42	93%	3	148.70	52%	3	31.68	11%	1
Streaky Bay	0.05	1%	1	1.26	14%	3	0	0%	0	0.67	7%	1	3.78	42%	2	3.45	38%	3
Thevenard	2.16	14%	3	1.99	13%	3	0	0%	0	4.86	32%	1	4.59	30%	2	9.89	66%	3
Tod River	25.98	6%	2	11.74	3%	1	5.40	1%	1	408.16	89%	3	201.88	44%	2	162.44	36%	3
Tourville Bay	20.52	8%	2	10.55	4%	1	27.54	10%	1	230.28	86%	3	79.73	30%	2	3.53	1%	1
Turnby Bay	31.02	5%	1	31.82	5%	1	1.63	0%	0	537.30	80%	3	304.89	46%	3	268.49	40%	2
Venus Bay	27.51	5%	1	24.77	4%	1	0	0%	0	220.30	39%	1	231.32	41%	2	200.09	36%	3
Western Shoal	60.85	5%	1	51.80	4%	1	933.66	69%	3	515.28	38%	1	101.89	8%	1	72.69	5%	1
Yangle Bay	1.88	3%	1	1.03	2%	1	0	0%	0	0.00	0%	0	0	0%	0	0.00	0%	0

Appendix 2 Pivot table outputs for Conservation and Threat layers

Site	Area (ha) of Current extent	Rank by size of Current extent	Area (ha) of Retreat zone	Rank by Size of Retreat zone
Franklin Harbour	26965	3	1460	1
Western Shoal	32923	1	1337	2
Munyaroo	18615	5	881	3
Tumby Bay	6143	9	662	4
Venus Bay	3187	12	550	5
Tod River	69	24	453	6
Acraman Creek	22443	4	364	7
False Bay	13602	6	359	8
Smoky Bay	10459	7	279	9
Murat Bay	966	16	276	10
Tourville Bay	28192	2	263	11
Baird Bay	2445	13	263	12
Horse Peninsula	2199	15	155	13
Eyre Island	6328	8	105	14
Kellidie Bay	471	18	92	15
Laura Bay	2358	14	91	16
Port Lincoln	347	20	80	17
Point Gibson	4102	10	71	18
Yangie Bay	862	17	64	19
Arno Bay	3209	11	62	20
Point Longnose	410	19	43	21
Port Neill	223	21	23	22
Thevenard	142	22	14	23
Streaky Bay	121	23	9	24

Appendix 3 Table showing the area of current saltmarsh systems calculated from coastal vegetation layer, comparing the ranking by current size with ranking by size of retreat area. Some disparity here can be explained by the definition and resolution of coastal saltmarsh within current mapping underrepresenting the existing size of the system. However, there will be a change in importance of some systems as they increase in size due to favourable retreat conditions.

Name	Layers clipped at 1km
Acraman Creek	X
Arno Bay	X
Baird Bay	X
Eyre Island	0
False Bay	X
Franklin Harbour	X
Horse Peninsula	0
Kellidie Bay	0
Laura Bay	0
Munyaroo	X
Murat Bay	X
Point Gibson	0
Point Longnose	0
Port Lincoln	0
Port Neill	0
Smoky Bay	X
Streaky Bay	0
Thevenard	0
Tod River	X
Tourville Bay	X
Tumby Bay	X
Venus Bay	X
Western Shoal	X
Yangie Bay	X

Appendix 4 Table showing with an 'X' which retreat areas are cut off at the 1km from coastline limit of the LiDAR data.

Appendix 5 Management action tables for all sites

		Venus Bay
Threat		Action required
Landuse	Grazing modified pastures	Discuss management of retreat area with land holders
	Cereals	Discuss management of retreat area with land holders
	Recreation and culture	Varied-Infrastructure, no actions available & discuss fencing
	Roads	May not impede retreat- ground truth
	Rural residential with agriculture	Insignificant retreat area- no action required
	Transport and communication	Insignificant retreat area- no action required
	Urban residential	Existing infrastructure, no actions available
Zoning	Caravan and Tourist Park	Existing infrastructure, no actions available
	Primary Production	Discuss management of retreat area with land holders
	Coastal settlement	Existing infrastructure, no actions available
	Township	Existing infrastructure, no actions available
Roads	Arterial, Local, SubArterial, Track 2WD	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	46 parcels	Discuss management of retreat area with land holders
		Horse Peninsula
Threat		Action required
Landuse	Cereals	Insignificant retreat area- no action required
	Grazing modified pastures	Discuss management of retreat area with land holders
	Residential and farm infrastructure	Insignificant retreat area- no action required
	Roads	May not impede retreat- ground truth
	Urban residential	Insignificant retreat area- no action required
Zoning	Coastal settlement	Discuss management of retreat area with land holders
	Primary Production	Insignificant retreat area- no action required
	Aquaculture	Discuss management of retreat area with land holders
Roads	Local, Track 2WD	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	68 parcels	Discuss management of retreat area with land holders
		Kellidie Bay
Threat		Action required
Landuse	Airports/aerodromes	Discuss management of retreat area with land holders
	Aquaculture	Industry, no actions possible
	Cereals	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Roads	Potentially restricting retreat, ground truth for culvert locations
Zoning	Primary production	Investigate re-zoning boundaries to avoid retreat areas
Roads	Local, SubArterial, Track 2WD	Potentially restricting retreat, ground truth for culvert locations
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	5 parcels	Discuss management of retreat area with land holders
		Munyaroo
Threat		Action required
Landuse	Cropping	Discuss management of retreat area with land holders
	Cereals	Discuss management of retreat area with land holders
	Roads	May not impede retreat- ground truth
Zoning	Primary Production	Discuss management of retreat area with land holders
Mining	Mineral Exploration Licence Application	Advise change to application to avoid saltmarsh retreat area
Roads	Local, Track 2WD	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	11 parcels	Discuss management of retreat area with land holders

		Todd River
Threat		Action required
Landuse	Airports/aerodromes	Discuss management of retreat area with land holders
	Cereals	Discuss management of retreat area with land holders
	Environmental forest plantation	Potential for modifying landscape to facilitate retreat
	Grazing modified pastures	Discuss management of retreat area with land holders
	Irrigated perennial horticulture	Industry, no action possible
	Manufacturing and industrial	Discuss management of retreat area with land holders
	Navigation and communication	Insignificant retreat area- no action required
	Quarries	Insignificant retreat area- no action required
	Recreation and culture	Investigate re-zoning to allow for retreat area
	Reservoir	Insignificant retreat area- no action required
	Roads	Ground truth whether roads will restrict flow
	Water storage- intensive use/farm dams	Insignificant retreat area- no action required
Zoning	Aquaculture	Discuss management of retreat area with land holders
	Mixed use (Point Boston)	Planned development - investigate opportunities for allowing retreat
	Primary Production	Discuss management of retreat area with land holders
	Settlement	Existing infrastructure, no actions available
	Airfield	Discuss management of retreat area with land holders
	Community	Discuss management of retreat area with land holders
Mining	Active construction materials	Discuss management of retreat area with land holders
Roads	Arterial, Collector, Local, Track 2WD	Ground truth whether roads will restrict flow
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	80 parcels	Discuss management of retreat area with land holders
		False Bay
Threat		Action required
Landuse	Commercial services	Insignificant retreat area- no action required
	Lake - intensive use	Existing infrastructure, no actions available
	Manufacturing and industrial	Insignificant retreat area- no action required
	Ports and water transport	Insignificant retreat area- no action required
	Residential and farm infrastructure	Existing infrastructure, no actions available
	Roads	May not impede retreat- ground truth
Zoning	Defence	Discuss management of retreat area with land holders
	Industry buffer	Discuss management of retreat area with land holders
Mining	Mineral Exploration Licence Application	Advise change to application to avoid saltmarsh retreat area
	Mineral Lease	Discuss management of retreat area with lease holders
	Petroleum Exploration Licence Application	Advise change to application to avoid saltmarsh retreat area
	Mineral Exploration Licence	Discuss management of retreat area with lease holders
Roads	Collector, Local, SubArterial, Track 2WD	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	77 parcels	Discuss management of retreat area with land holders
		Laura Bay
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Residential and farm infrastructure	Discuss management of retreat area with land holders
	Roads	May not impede retreat- ground truth
Zoning	Primary production	Investigate re-zoning boundaries to avoid retreat areas
Roads	Local, Track 2WD	May not impede retreat- ground truth
ORV Tracks	present	Consolidate tracks to reduce impact, access management
DCDB	5 parcels	Discuss management of retreat area with land holders

Point Gibson		
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Roads	Potentially restricting retreat, ground truth for possible management
Zoning	Primary production	Investigate re-zoning boundaries to avoid retreat areas
	Rural living	Discuss management of retreat area with land holders
Roads	Local, SubArterial, Track 2WD	Potentially restricting retreat, ground truth for possible management
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	10 parcels	Discuss management of retreat area with land holders
Tumby Bay		
Threat		Action required
Landuse	Airports/aerodromes	Discuss management of retreat area with land holders
	Cereals	Discuss management of retreat area with land holders
	Commerical services	Highly built up, no actions available
	Estuary/coastal waters - intensive use	Highly built up, no actions available
	Grazing modified pastures	Discuss management of retreat area with land holders
	Land in transition	Discuss management of retreat area with land holders
	Manufacturing and industrial	Highly built up, no actions available
	Marsh/wetland - procutions	Discuss management of retreat area with land holders
	Ports and water transport	Highly built up, no actions available
	Public services	Highly built up, no actions available
	Recreation and culture	Discuss management of retreat area with land holders
	Roads	Potentially restricting retreat, ground truth for culvert locations
	Rural residential with agriculture	Discuss management of retreat area with land holders
	Sewage/sewerage	Existing infrastructure- no actions available
	Urban residential	Highly built up, no actions available
	Woody fodder plants	Discuss management of retreat area with land holders
Zoning	Airfield	Discuss management of retreat area with land holders
	Caravan and Tourist Park	Highly built up, no actions available
	Deferred Urban	Investigate re-zoning boundaries to avoid retreat areas
	Industry	Investigate re-zoning boundaries to avoid retreat areas
	Primary Production	Investigate re-zoning boundaries to avoid retreat areas
	Recreation	Investigate re-zoning boundaries to avoid retreat areas
	Residential	Highly built up, no actions available
	Rural Living	Investigate re-zoning boundaries to avoid retreat areas
	Town Centre	Highly built up, no actions available
Roads	Collector, Local, SubArterial, Track 2WD	Potentially restricting retreat, ground truth for culvert locations
ORV Tracks	present	Consolidate tracks to reduce impact, access management
DCDB	547 parcels	Highly built up, no actions available
Tourville Bay		
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Roads	May not impede retreat- ground truth
Zoning	Primary production	Investigate re-zoning boundaries to avoid retreat areas
Mining	Mineral Exploration Licence	Discuss management of retreat area with land holders
Roads	Collector, Local, Track 2WD,	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	13 parcels	Discuss management of retreat area with land holders

		Thevenard
Threat		Action required
Landuse	Public services	Discuss management of retreat area with land holders
	Railways	Existing infrastructure- no actions available
	Recreation and culture	Discuss management of retreat area with land holders
	Roads	May not impede retreat- ground truth
	Urban residential	Discuss management of retreat area with land holders
Zoning	Industry	Discuss management of retreat area with land holders
	Recreation	Investigate re-zoning boundaries to avoid retreat areas
	Residential	Highly built up, no actions available
Roads	Collector, Local, SubArterial, Track 2WD	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	8 parcels	Discuss management of retreat area with land holders
		Streaky Bay
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Public services	Highly built up, no actions available
	Recreation and culture	Varies, some built up, some management possible
	Roads	Potentially restricting retreat, ground truth for culvert locations
	Sewage/sewerage	Existing infrastructure- no actions available
	Urban residential	Discuss management of retreat area with land holders
	Caravan and Tourist Park	Highly built up, no actions available
Zoning	Deferred Urban	Investigate re-zoning boundaries to avoid retreat areas
	Recreation	Discuss management of retreat area with land holders
	Residential	Discuss management of retreat area with land holders
	Roads	Local, SubArterial, Track 2WD
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	3 parcels	Discuss management of retreat area with land holders
		Smoky Bay
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Ports and water transport	Existing infrastructure- no actions available
	Recreation and culture	Discuss management of retreat area with land holders
	Roads	Potentially restricting retreat, ground truth for culvert locations
	Rural residential with agriculture	Discuss management of retreat area with land holders
	Services	Highly built up, no actions available
	Urban residential	Discuss management of retreat area with land holders
	Aquaculture	Discuss management of retreat area with land holders
Zoning	Caravan and Tourist Park	Highly built up, no actions available
	Commerical	Discuss management of retreat area with land holders
	Primary Production	Discuss management of retreat area with land holders
	Recreation	Discuss management of retreat area with land holders
	Residential	Highly built up, no actions available
	Roads	Collector, Local, Track 2WD
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	26 parcels	Discuss management of retreat area with land holders

Murat Bay		
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Commercial services	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Manufacturing and industrial	Highly built up, no actions available
	Public services	Highly built up, no actions available
	Railways	May not impede retreat- ground truth
	Recreation and culture	Discuss management of retreat area with land holders
	Residential and farm infrastructure	Discuss management of retreat area with land holders
	Roads	May not impede retreat- ground truth
	Rural residential with agriculture	Discuss management of retreat area with land holders
Zoning	Urban residential	Highly built up, no actions available
	Aquaculture	Discuss management of retreat area with land holders
	Commercial	Highly built up, no actions available
	Industry	Discuss management of retreat area with land holders
	Primary Production	Discuss management of retreat area with land holders
	Recreation	Discuss management of retreat area with land holders
	Residential	Discuss management of retreat area with land holders
Rural living	Rural living	Discuss management of retreat area with land holders
	Rural living	Discuss management of retreat area with land holders
Roads	Collector, Highway, Local, SubArterial, Track 2WD	May not impede retreat- ground truth
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	46 parcels	Discuss management of retreat area with land holders
Port Neill		
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Roads	Low impact, No action required
Zoning	Primary production	Discuss management of retreat area with land holders
	Rural Living	Discuss management of retreat area with land holders
Mining	Mineral Exploration Licence	Discuss management of retreat area with land holders
Roads	Local, Track 2WD	Low impact, No action required
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	13 parcels	Discuss management of retreat area with land holders
Baird Bay		
Threat		Action required
Landuse	Cereals	Discuss management of retreat area with land holders
	Grazing modified pastures	Discuss management of retreat area with land holders
	Roads	Consolidate roads
	Rural residential with agriculture	Discuss management of retreat area with land holders
	Urban residential	Investigate re-zoning eastern boundary to avoid retreat areas
Zoning	Coastal Settlement	Investigate re-zoning eastern boundary to avoid retreat areas
	Primary Production	Investigate re-zoning boundaries to avoid retreat areas
Roads	Local, Track 2WD	Consolidate roads
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	45 parcels	Discuss management of retreat area with land holders

Arno Bay		
Threat		Action required
Landuse	Cereals	Confer with land holders, install fencing around retreat areas
	Commercial services	Highly built up, no actions available
	Grazing modified pastures	Confer with land holders, install fencing around retreat areas
	Manufacturing and industrial	Highly built up, no actions available
	Navigation and communication	Highly built up, no actions available
	Ports and water transport	Highly built up, no actions available
	Public services	Highly built up, no actions available
	Recreation and culture	Potential for unused areas to be fenced for retreat
	Roads	Ground truthing to investigate restriction to flow/culvert locations
	Rural residential with agriculture	Discuss management of retreat area with land holders
	Urban residential	Highly built up, no actions available
Zoning	Aqua culture	Little infrastructure, discuss management of retreat areas
	Coastal Marina	Oppourtunity to divert/encourage retreat, re-zone north boundary
	Coastal settlement	Highly built up, no actions available
	Primary production	Investigate re-zoning southern boundary, fencing to allow retreat
	Recreation	Re-zoning un-used sections
	Residential	Little infrastructure, possible re-zoning
	Rural living	Confer with land holders, install fencing around retreat areas
Mining	Mineral Exploration Licence	Discuss management of retreat area with land holders
	Roads	Arterial, Collector, Local, Track 2WD
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	92 parcels	Discuss management of retreat area with land holders
Port Lincoln		
Threat		Action required
Landuse	Commercial services	Highly built up, no actions available
	Estuary/coastal waters - intensive use	Highly built up, no actions available
	Intensive animal production	Highly built up, no actions available
	Land in transition	Fence off, allow natural regeneration
	Manufacturing and industrial	Highly built up, no actions available
	Marsh/wetland - production	Fence off, allow natural regeneration
	Navigation and communication	Highly built up, no actions available
	Recreation and culture	Fence off, allow natural regeneration
	Roads	Reduce roads in vegetated area
	Urban residential	Highly built up, no actions available
	Water storage - intensive use/farm dams	Fence off, allow natural regeneration
Zoning	Coastal Marina	Highly built up, no actions available
	Deferred Urban	Investigate re-zoning as park- board walks for public access?
	District Town Centre	Highly built up, no actions available
	Industry	Highly built up, no actions available
	Recreation	Investigate re-zoning as park- board walks for public access?
Roads	Residential	Highly built up, no actions available
	Arterial, Collector, Local, SubArterial, Track 2WD	Consolidate tracks to reduce impact, access management
ORV Tracks	Present	Consolidate tracks to reduce impact, access management
DCDB	275 parcels	Highly built up, no actions available