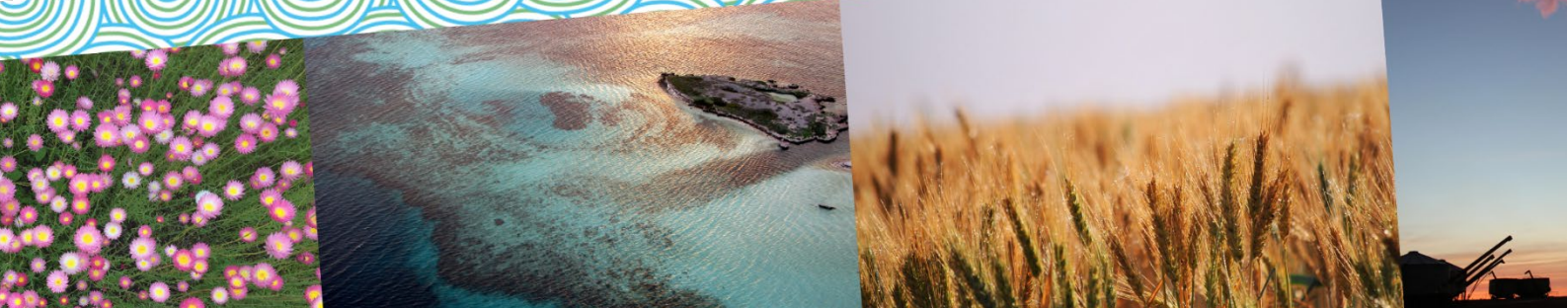
NACC

# Regional Saltmarsh Management Plan 2025 - 2035

## Recommendations for management of Subtropical and Temperate Coastal Saltmarsh in the Northern Agricultural Region

Australian Government

Catalysing Community Conservation



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# Acknowledgement of Country

NACC NRM respectfully acknowledge theYamatji and Noongar people who are the Traditional Owners and original natural resource managers of the Northern Agricultural Region and pay our respect to all of the Aboriginal Elders and leaders in the region, past, present and emerging

# INTRODUCTION

One of 54 Natural Resource Managers (NRM) in Australia, NACC NRM is dedicated to the conservation and protection of our regions unique and diverse Biodiversity and Agricultural assets. As the Northern Agricultural Region's (NAR's) key NRM organisation and custodian of the regional strategy – known as NARvis – NACC NRM is committed to the effective and engaged delivery of environmental projects and aims to ensure they align with the recognised needs and priorities of the community and the protection of threatened species of the NAR region.

NACC NRM has maintained a strong Coastal and Marine Program over the last 15 years which has included projects on protecting and raising awareness on the importance of Subtropical and Temperate Coastal Saltmarsh. Knowledge of this Threatened Ecological Community (TEC), as well as strong local connections to resource managers and community, places NACC NRM in a strong position to ensure increased TEC protection well into the future.

NACC NRM has received funding from the Federal Government via the Department of Climate Change, Energy, the Environment and Water's Panel of Regional Delivery Partners for the project entitled "Improving Subtropical and Temperate Coastal Saltmarsh in the Northern Agricultural Region". This project is funded from mid-2023 to mid-2028. This Regional Saltmarsh Management Plan is one of the outcomes of this project.

# PROJECT SCOPE

The TEC of Subtropical and Temperate Coastal Saltmarsh (hereafter, Coastal Saltmarsh) is poorly understood in the NAR. Defining characteristics of this TEC, as listed in the relevant Conservation Advice, are as follows:

- Occurs in southern Australia south of 23°37' S latitude, including Tasmania and islands;
- Occurs on coastal margins, including estuaries and coastal embayments;
- Occurs on places with some tidal connection, including those with groundwater tidal influence;
- Occurs on sandy or muddy substrates;
- Consists of dense to patchy areas of characteristic saltmarsh plant species; and
- Proportional cover of 50% or less of tree canopy or seagrass.

The primary aim of this project is to identify and map this TEC in the NAR using these criteria.

Condition and threat assessments will be undertaken for all TEC areas identified and recommendations for threat abatement are contained in this Management Plan. This Plan will guide present and future management investment for the conservation of this TEC in the NAR. Some priority threat abatement actions, including weed control, access control and debris removal, will be undertaken as part of the current project. Further priority actions that fall outside the scope of the current project will be identified with the aim of providing guidance for future projects to conserve this TEC.

# PROJECT LOCATION

As indicated above, the entire coastline of the NAR falls within the range of this TEC, with populations likely occurring in the estuaries at the furthest extremes of north (Murchison) and south (Moore) of the region (Figure 1). Additionally, some land-locked coastal lagoons may

be classified as Coastal Saltmarsh if all criteria, particularly ocean connection via groundwater, can be established.

Coastal Saltmarsh may also occur on islands off the NAR coast, including the Abrolhos Islands, however these areas are not included in this project. However, further study of currently unmapped Coastal Saltmarsh, such as that occurring on islands, is highlighted in this Plan.

## COASTAL SALTMARSH CONSERVATION STATUS

Coastal Saltmarsh is listed as a threatened ecological community, categorised as “vulnerable”, under the Commonwealth Government’s Environment Protection and Biodiverstiy Conservation Act 1999 (EPBC Act). This categorisation is assigned if, at the time of listing it in the EPBC Act, the ecological community is not critically endangered or endangered but faces a high risk of extinction in the wild in the medium-term future (indicative timeframe being the next 50 years). Listing a TEC under the EPBC Act recognises that important natural assets are under pressure and that holistic environmental protection actions are necessary. This can see extra protection awarded to threatened species that utilise the community, or species which may not yet be listed but are in decline. TEC listing also increases awareness of nationally significant ecosystems that are under threat, providing a meaningful platform from which appropriate management decisions can be made to halt, reduce or reverse the decline of threatened flora, fauna and ecosystems. A Conservation Advice is prepared at the time of listing – a Conservation Advice was prepared for Coastal Saltmarsh in 2013 (*Subtropical and Temperate Coastal Saltmarsh Conservation Advice, 2013*).

Coastal Saltmarsh is listed as a Priority Ecological Community (PEC), categorised as “Priority 3(iii)”, with the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA). Priority 3 is defined as a poorly known ecological community which has not been adequately surveyed or well defined. This can include communities that are comparatively well known across several localities but do not meet survey requirements and/or are not well defined. However, there are known threatening processes that could affect their survival. There are three sub-categories, of which the third (iii) includes ecological communities that consist of large, and/or widespread occurrences, which are not necessarily represented in the reserve system. Processes such as hydrological change, clearing, grazing by domestic and/or feral stock and inappropriate fire regimes threaten to modify the ecological community. It should be noted that the description, area and condition thresholds outlined in the Coastal Saltmarsh Conservation Advice also apply to the Priority ecological community.

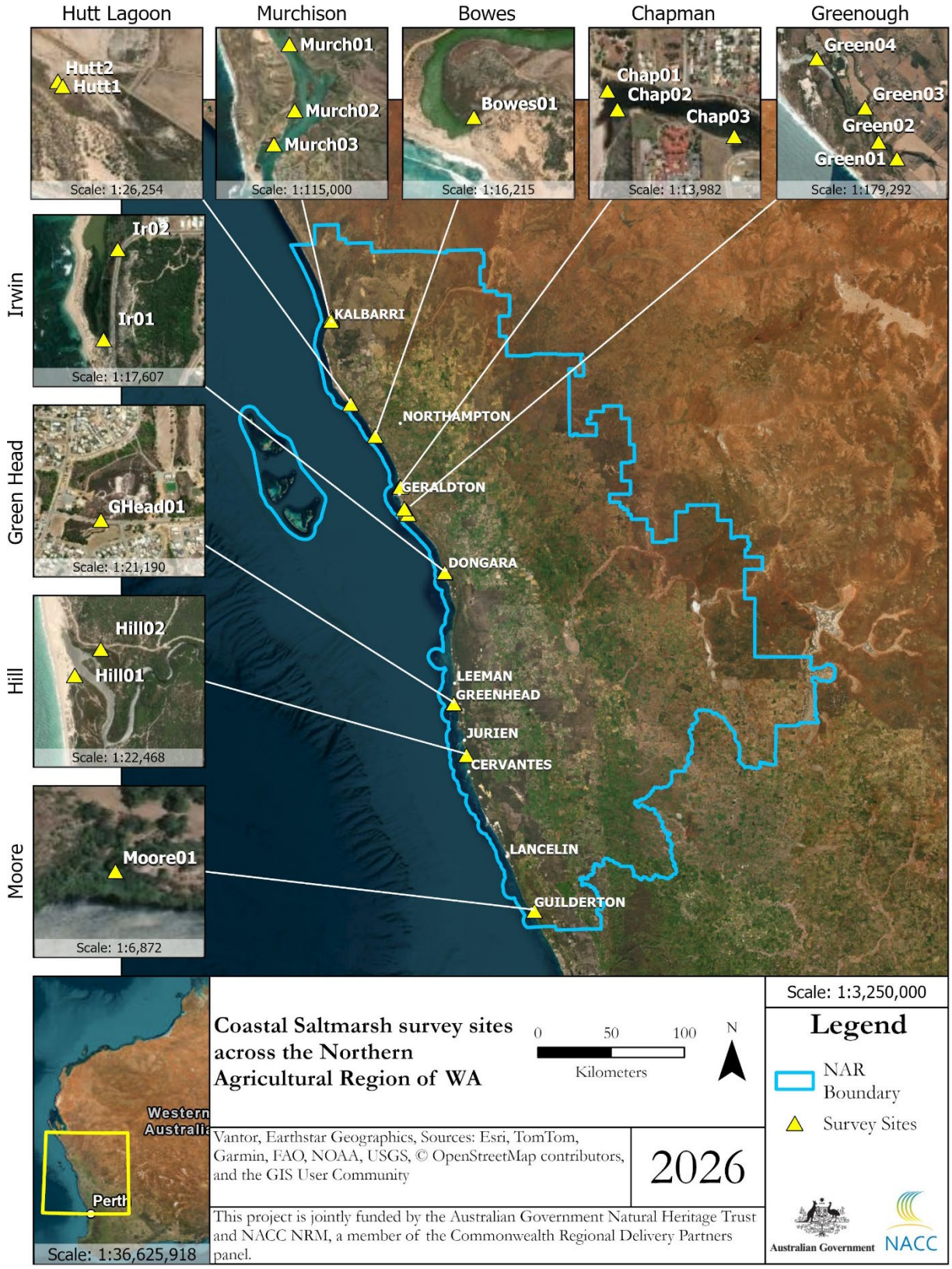



Figure 1. The coastal zone of the Northern Agricultural Region. Coastal Saltmarsh occurs intermittently along the entire coastline of this region and on some islands. Areas surveyed as part of this project are indicated by yellow triangles.

## SALTMARSH SITE SELECTION

Information on potential Coastal Saltmarsh areas was gathered from the following sources:

- Existing Coastal Saltmarsh maps held by the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA)
- Identification of all major estuary systems
- Identification of major land-locked coastal lagoons
- Extensive corporate and personal knowledge of the natural assets of the region held by NACC NRM and its staff.

Coastal Saltmarsh communities have been identified by DBCA in the following locations:

- Bowes
- Chapman
- Greenough (as a single point observation)
- Irwin
- Moore

A total of seven larger rivers with estuary systems and three large coastal lagoons were selected as areas of Coastal Saltmarsh for further investigation:

Estuaries

1. Murchison
2. Bowes
3. Chapman
4. Greenough
5. Irwin
6. Hill
7. Moore.

Coastal Lagoons

1. Hutt Lagoon
2. Leeman Lagoon
3. Green Head wetlands.

It is important to note that additional areas of Coastal Saltmarsh likely exist in the NAR, and that these areas will require further resources to ensure that they are mapped and protected.

## SALTMARSH SITE ASSESSMENTS

Potential Coastal Saltmarsh areas, as identified above, were surveyed to determine whether they met Coastal Saltmarsh TEC requirements. This section provides a general description and prioritisation considerations for each location. Further information on each location can be found in Appendix A. Mapped Coastal Saltmarsh extents are provided in Appendix B, with invasive weed distributions at the time of survey included for those locations at risk from this threat.

# Murchison

## Location description

The Murchison estuary is the only permanently open river mouth in the NAR, although the estuary mouth is dredged periodically to ensure the channel is navigable for the commercial fishing fleet and recreational boats. This estuary also experiences the largest tidal range in the NAR. In combination, these two factors contribute to extensive areas of Coastal Saltmarsh within the riparian zone of the estuary system and its islands.

The township of Kalbarri is located at the river mouth, and the estuary is a popular site for boating, fishing and swimming. Substantial numbers of recreational boats use the estuary, especially during holiday periods. Four-wheel drive (4WD) vehicles can access all areas on the eastern estuary bank, with many tracks traversing through areas of Coastal Saltmarsh. Vehicle access to the west bank is restricted due to restricted access via Murchison House station further upstream, yet historic and current vehicle tracks are still evident in Coastal Saltmarsh on this side of the river. Previous attempts to manage 4WD access in this area have failed.

Goats are common along both banks and their regular walking tracks are very evident. Annual weeds are also evident, although no perennial weeds were found during these surveys.

The estuary banks are currently managed by the Shire of Northampton, however there is a proposal for a Joint Management Body, comprising Nanda Aboriginal Corporation and DBCA representatives, to take over management duties.

## Prioritisation considerations

- The extensive Coastal Saltmarsh that is currently unrecognised makes this a high priority location for mapping.
- Impacts from four-wheel driving is very evident, although this activity will be difficult to manage given the high value placed on “wilderness four-wheel driving” by local residents and visitors alike. Also, the large management area makes restricting vehicle access difficult.
- The impact of goats, via grazing, trampling and spread of weeds, requires assessment.
- It is likely that Coastal Saltmarsh is poorly understood in the local township of Kalbarri hence awareness-raising activities would be beneficial, including the identification of and monitoring for potential invasive weed species not currently present, particularly Sharp Rush, *Juncus acutus*.





# Bowes

## Location description

The Bowes River rises around 10km northeast of Northampton, and flows southwest, discharging just south of Horrocks. A carpark north of the river mouth is popular with surfers and a beach access track crosses the normally closed sand bar at the mouth of the estuary.

A well-used 4WD track cuts through the southwestern side of the Coastal Saltmarsh, and large areas of low-lying *Salicornia quinqueflora* appeared dead during a recent site visit, possibly following prolonged periods of freshwater inundation.

Over half of the Coastal Saltmarsh extent is on private property, whilst the balance is managed by the Shire of Northampton. It appears that the Coastal Saltmarsh extends past the current boundaries however, permission from private landholders is required for further mapping to take place.

Few weeds were observed in the Coastal Saltmarsh area, however extensive weeds were observed in adjacent areas, particularly private property and likely road reserves. Marine debris was evident around the sand bar.

## Prioritisation considerations

- Establishing contact with the private landowner is an important step towards conservation of this Coastal Saltmarsh and possible extension of its boundaries.
- A follow-up site visit in summer (drier conditions) is required to determine if the *S. quinqueflora* has recovered.
- 4WD track management is likely to be difficult due to the historical use of the area by 4WDs and the flat nature of the landscape and vegetation making it easy to bypass any barrier.
- Clean up events will reduce the pollution load on the system. Weed monitoring is also required to prevent adjacent weeds invading the Coastal Saltmarsh.





# Chapman

## Location description

The Chapman River is a small urban Coastal Saltmarsh system located within the town boundaries of the City of Greater Geraldton. The catchment has very little native vegetation cover due to agricultural clearing. The river surrounds, incorporated in the Chapman River Regional Park, is a popular recreational asset for activities such as fishing, walking, dog exercise, bird watching and water sports.

Chapman River Friends is a community group that is very active in promoting conservation of the river. The Local Government Authority is similarly active in managing the river for conservation purposes.

The estuary bar is often opened artificially by people wishing to fish or surf, with unknown consequences for Coastal Saltmarsh. Invasive weeds are prevalent at the location, particularly in the southern and western areas. Marine debris is conspicuous in this small estuary system. Conversely, the eastern area of Coastal Saltmarsh is fenced and in very good condition. Although, anecdotal evidence confirms occasional breaching of this barrier by community members.

### Prioritisation considerations

- The high profile, urban setting of this conservation asset, as well as the active management by community and local government, make this Coastal Saltmarsh system a high conservation priority. On-ground works would provide an opportunity unique amongst coastal saltmarsh systems of the NAR to promote saltmarsh conservation to a large regional community.
- Invasive weeds and pedestrian access are obvious threats requiring attention.
- Indigenous engagement will clarify the cultural heritage values of this site.
- This estuary provides an ideal location to investigate the effects on Coastal Saltmarsh of artificial opening of the bar.
- Regular clean up events will reduce the impacts of marine debris. The impact of contamination by stormwater runoff from surrounding roads is unknown.





## Greenough

### Location description

The Greenough Estuary is a peri-urban system located within the town boundaries of the City of Greater Geraldton. The river catchment has experienced major loss of native vegetation cover, mainly due to agricultural clearing. The river mouth, located at Cape Burney, 10km south of Geraldton, is a popular recreational asset for activities such as fishing, walking, dog exercise, bird watching, four-wheel driving and water sports.

Greenough River Friends and Birdlife Midwest are community groups that are active in promoting conservation of the river environment. The Local Government Authority is similarly active in managing the river for conservation purposes.

The Coastal Saltmarsh vegetation that is not impacted by 4WDs and walking trails is in good condition. The presence of invasive grass was noted at some sites.

## Prioritisation considerations

- The Greenough Estuary includes significant areas of Coastal Saltmarsh that have not been formally identified or mapped. This fact, along with the high profile, peri-urban setting of this conservation asset, and the active management by community and local government, make this coastal saltmarsh system a high conservation priority.
- Indigenous engagement will clarify the cultural heritage values of the location.
- 4WD and pedestrian access management will likely be conservation priorities.





# Irwin

## Location description

The Irwin River is another peri-urban system located within the town boundaries of Dongara/Port Denison in the Shire of Irwin. The river mouth and surrounds, located southwest of the town centre, is a popular recreational asset. Located close to multiple tourist parks, it is a scenic natural asset to the town, with well-used boardwalks significantly reducing impacts on vegetation. The area is popular mostly for walking, dog exercise and bird watching.

Several invasive weed species were recorded, and anecdotal evidence suggests the bar is artificially opened periodically. Marine debris significantly impacts this small Coastal Saltmarsh area.

## Prioritisation considerations

- The popularity of the river mouth, given its established walking path and coastal location within a tourist town, award this area of Coastal Saltmarsh significant conservation value.
- Extensive weed infestation by the perennial grass *Paspalum vaginatum* threatens the classification of this site as a TEC which cannot consist of more than 50% weeds. Prioritisation should be placed on controlling this, and other, weeds recorded at the location.
- Other on-ground works, particularly public awareness raising activities, would provide an opportunity to showcase a thriving TEC to local community members and tourists alike.
- Indigenous engagement will clarify the cultural heritage values of the location.
- Like the Chapman, this estuary provides an ideal opportunity to investigate the effects of artificial bar openings on estuary health, particularly Coastal Saltmarsh.
- Clean up events will mitigate some of the pollution caused by marine debris. The impact of contamination by stormwater runoff from surrounding roads is unknown.




# Hill

## Location description

Hill river flows west from Badgingarra, and discharges into the Indian Ocean about 10km south of Jurien Bay in the Shire of Dandaragan. Of all the estuary systems in the NAR, Hill has experienced the least amount of clearing in its catchment and can be considered relatively pristine. There is substantial fresh groundwater flow into the system year-round (Dept of Water, 2011) and, as a result, the vegetation is different from other Coastal Saltmarsh locations in the NAR. Elsewhere, salt-loving samphires dominate but here the primary understory is sea rush, *Juncus kraussii*, which prefers lower saline environments.

Nesting colonies of Fairy terns (*Sternula nereis nereis*), listed as “vulnerable” under the Environmental Protection and Biodiversity Conservation Act (1999), have been recorded at the estuary mouth.

Coastal Saltmarsh occurs on land actively managed by the Shire of Dandaragan, with volunteer management from the Jurien Bay Regional Herbarium Group. Remaining Coastal Saltmarsh occurs on private land owned by Ardross Estate PL, who do not currently engage in active management but are supportive of management actions.

The estuary mouth is normally closed and utilised illegally as a camping destination, accessed through 4WD tracks. Despite this, 4WD impacts are limited to the southern boundary of the system and do not cause widespread damage. Invasive weeds are very evident, as is marine debris at the estuary mouth.

## Prioritisation considerations

- Coastal Saltmarsh vegetation is in good condition at this location, although invasive weeds, in the form of *Juncus acutus* and *Paspalum vaginatum*, pose significant threats. There is an opportunity to maintain this unique and somewhat remote estuary system in its relatively pristine condition through appropriate weed management.
- The Shire of Dandaragan takes an active role in managing illegal camping, which helps address 4WD impacts to the system.
- The estuary mouth would benefit from regular clean up events.

# Moore

## Location description

The Moore River estuary is a peri-urban system with the inlet reaching the coast at the town of Guilderton within the Shire of Gingin. Areas of native vegetation along the catchment have been extensively cleared for agricultural development. The river and surrounds are a popular recreational asset for activities such as fishing, walking, bird watching and water sports.

Community groups such as Friends of Moore River Estuary and the Lower Moore River Working Group are very active in promoting the health and conservation of the river and estuary. Significant effort has been given to restoring areas of native vegetation growing along sections of the riverbank that were previously subject to grazing by livestock. The small Coastal Saltmarsh area is difficult to access although there are plans to repair a boardwalk which will provide access to the site.

Extensive invasive weeds were recorded, and the area has been fenced to exclude stock.

## Prioritisation considerations

- The high profile, peri-urban setting of the Moore River estuary, as well as proactive community groups, make this an important Coastal Saltmarsh area for conservation. A boardwalk system, currently under repair, provides the opportunity to showcase this Coastal Saltmarsh area.
- Extensive infestation with *Paspalum vaginatum* and other perennial weeds, along with its small size reduces the current value of this conservation asset.
- Discussions with local community will help determine the value placed on this area, and therefore the level of priority for interventive actions.
- Indigenous engagement will further clarify the cultural heritage values of the location.





# Hutt Lagoon

## Location description

Hutt Lagoon is a shallow, evaporitic basin covering an area of 3000ha, located near the town of Port Gregory in the Shire of Northampton. Highly saline lakes and marshlands are separated from the Indian Ocean by a narrow stretch of coastal sand dunes. No surface link between the sea and the lagoon is evident. The lagoon hydrology is reportedly driven by three main components: an influx of subsurface sea water from the Indian Ocean on the western side, influx from groundwater on the eastern side, and water loss through evaporation (Arakel

1980). The endemic algal species *Duneliella salina* gives the lagoon a vibrant pink colour which makes it a popular tourist attraction in the region.

The chemical company BASF operates a commercial beta-carotene cultivation operation over a 500ha lease and manipulates brine concentrations within the lagoon system without apparent adverse impacts to the surrounding natural environment.

The area is also a known hotspot for migratory and resident shore birds, with the area hosting a successful breeding colony of Fairy Terns (*Sternula nereis nereis*) which are listed as "vulnerable" by the Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth) and Biodiversity Conservation Act 2016 (WA).

## Prioritisation considerations

- The popularity of the Hutt Lagoon area, with tourists and 4WD users, and its possibly significant Coastal Saltmarsh extent, of which only a small proportion is currently mapped, make this coastal saltmarsh system a high conservation priority for further investigation.
- Tidal connection has been confirmed for the southern section (Figure 2); further groundwater surveys are required to determine connectivity with the sea for the remaining lagoonal area. If connection is confirmed, further site assessments will be required, including Coastal Saltmarsh condition and threats.
- On-ground works to help improve Hutt Lagoon Coastal Saltmarsh could include public awareness-raising activities such as signage and events like rubbish clean-ups that provide an opportunity to showcase a thriving TEC to local community and visitors.
- Engagement with local indigenous groups relevant to the area will further clarify the cultural heritage values of the location.





## Hutt groundwater survey

One groundwater survey has been undertaken in this extensive system. The procedure is as follows:

1. Permissions from land managers obtained.
2. Bore hole locations are selected with the aim of limiting vegetation disturbance - open mudflat areas will be preferred. Bore locations are indicated on the Hutt saltmarsh map in Appendix B.
3. A small petrol auger is used to sink two shallow bore holes less than 2 m deep and around 10 m apart (two sample holes provide redundancy in case of failure).
4. Slotted 50mm PVC is inserted into the holes and coarse, clean gravel used to backfill.
5. Pressure sensors are suspended in the ground water in both bore pipes.

6. An atmospheric sensor is fitted in the headspace of one of the bore holes.
7. Sensors are left in place for a week, then retrieved and data downloaded.
8. Proprietary software is used to calculate water levels, correcting for atmospheric pressure. Water levels are correlated with concurrent local tide predictions.

Figure 2 below indicates a regular diurnal fluctuation in near-surface ground water levels that correlate closely to tidal data for nearby Port Gregory. Peaks in bore water levels occurred approximately 5 hours after each high tide, indicating delayed infusion of groundwater from the sea to the bore locations. This demonstrates a clear influence of tides on shallow groundwater and confirms that vegetation in the southern Hutt Lagoon can be classified as Coastal Saltmarsh.

However, it must be noted that Hutt Lagoon is an extensive system, at least 20 km in length, which requires further groundwater surveys to determine groundwater tidal influence across the entire system.

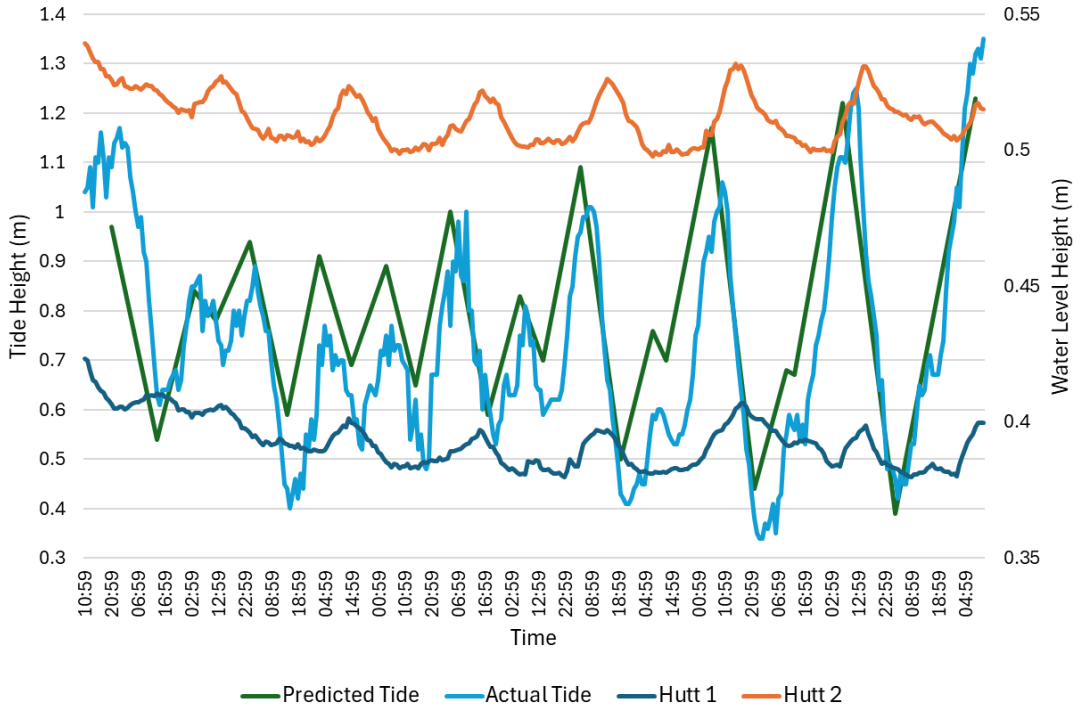



Figure 2. Shallow groundwater fluctuations (orange and dark blue) in response to predicted and actual tide heights (green and light blue) at the southern end of Hutt Lagoon. Data collection period 23-30 April 2025.

# Leeman Lagoon

## Location description

Leeman Lagoon is a shallow, evaporitic basin covering a length of 21km parallel to the coast just north of Leeman, Western Australia, spanning the Shires of Carnamah in the north and Coorow in the south. The lagoon is separated from the Indian Ocean by a stretch of coastal sand dunes with no surface link between the sea and the lagoon evident. The lagoon hydrology is reportedly driven by three main components: an influx of subsurface sea water from the Indian Ocean, influx from groundwater from dune sand aquifers and rainfall, and water loss through evaporation (Arakel 1980).

The lagoon is currently mainly a recreational resource for locals and visitors. The lagoon area is recognised as an important refuge for migratory birds.

Much of the lakes systems falls within Beekeepers Reserve, which is jointly managed by DBCA and Traditional Owners. The Shire of Coorow manages much that remains. Commercial sand and gypsum mining occurs in and around the system.

### Prioritisation considerations

- A groundwater survey has failed to definitively confirm the Coastal Saltmarsh status of the Leeman Lagoon system. Heavy rainfall during this survey may have obscured any tidal effect in groundwater, hence, the survey will be repeated during dry weather.
- The system predominantly falls within conservation reserve managed by DBCA and Traditional Owners, thus is already afforded some level of protection. 4WD tracks are evident but would be difficult to manage due to the ease of bypassing any access restriction structures.

## Green Head Wetlands

### Location description

A sizeable area of coastal saltmarsh persists in the centre of the small coastal township of Green Head, in the Shire of Coorow. The area has faced development attempts in the past with hopes to convert the land for future growth of community services. Strong opposition from concerned and passionate community members has been able to keep development works at bay, with revegetation efforts allowing the site to flourish.

The area has been recorded to support many bird species and provides a thriving area of natural beauty for locals and tourists to admire. The local community continues to monitor the health of this area and work to preserve and protect its place in the town's heart.

Numerous interconnected tracks have been formed by extensive BMX bike riding, likely the primary current impact on the site. Rubbish and weeds were not prevalent.

### Prioritisation considerations

- The area of Coastal Saltmarsh at Green Head is significant and has been formally mapped. Tidal connection to the area is implied via confirmation of the TEC in the DBCA database.
- There have been previous attempts to infill this saltmarsh for development, and this threat remains.
- The popularity of the area for local BMX bicycle use in drier conditions also adds to the need for protection.
- Further survey data will inform on-ground works to help improve the condition of saltmarsh at the site, namely through public education and signage to reduce human intrusion, and possible weed and rubbish clean-ups.
- Engagement with local indigenous groups relevant to the area will further clarify the cultural heritage values of the location.




## THREAT PRIORITISATION

For each location, the consequence and the likelihood of each threat were estimated and allocated a threat level according to the 3x3 threat assessment matrix below. Threat assessments were conducted by estimating the threat level (Low, Medium or High) for each individual threat at each location using the four criteria below. Averaging the results of the four criteria determined the over-all rating for that threat at that location (Table 1).

- Threat ranking during site assessments (with most evident threats ranked highest – Appendix A)
- Extent of current impacts and the level of damage (Appendix B)
- Impact on cultural heritage value of the location
- Irreversibility of the threat by management actions (higher levels of irreversibility were considered a higher impact).

| | Low impact | Medium impact | High impact |
|---|---|---|---|
| Almost certain | Med | High | High |
| Likely | Low | Med | High |
| Unlikely | Low | Low | Med |

An aggregated list of threats to Coastal Saltmarsh in the NAR is provided below.

- Pedestrian access
- 4WD access
- Invasive weed species
- Rubbish/Pollution
- Grazing/trampling by stock/invasive species
- Earthworks that destroy vegetation or alter hydrology
- Climate Change
- Insufficient information to enable assessment

These threats have been cross-referenced with the Priority Conservation Actions in the *Subtropical and Temperate Coastal Saltmarsh Conservation Advice* (p. 23-27). Additional threats listed in the Conservation Advice are either not applicable to Coastal Saltmarsh in the NAR or are considered beyond the scope of this Management Plan.

For the threat of "Climate Change", several potential impacts are listed in the Conservation Advice (p. 51), including:

- Landward or seaward migration (with landward the most likely)
- Shifts in native species distributions
- Shifts in invasive species distributions
- Altered hydrology and sedimentation.

For the purposes of this Management Plan, only the potential for landward migration of Coastal Saltmarsh will be considered as this is dependent on surrounding landforms at each site. For example, extensive floodplains surrounding the Murchison estuary will allow Coastal Saltmarsh to migrate landward as sea levels rise, hence has been allocated a "low" threat score (Table 1). In contrast, the Chapman estuary is contained by relatively steep riverbanks that extend upstream beyond the estuary; therefore, the Coastal Saltmarsh is prevented from landward migration in response to sea level rise and has been given a "high" rating for the threat of climate change.

It is acknowledged that the impact of climate change on Coastal Saltmarsh is very complex, requiring independent assessment of collective impacts across a range of potential climate scenarios. Further studies will be essential to facilitate effective planning for Coastal Saltmarsh conservation in the face of our rapidly changing climate.

A discrepancy between the list above and that provided in the Conservation Advice is the threat of "Insufficient information". The Conservation Advice recommends conducting surveys to identify and assess Coastal Saltmarsh as a Research Priority (p. 23). The current project lists "insufficient information" as a threat as unmapped areas may not receive the same protections from development as mapped Coastal Saltmarsh.

**Table 1**. Ranked threats (first column) to Coastal Saltmarsh at different locations (first row) in the NAR. Blank cells indicate that a threat does not apply to that location. Note: Leeman Lagoon has not been confirmed as Coastal Saltmarsh hence blank cells for all threats except “Insufficient information” which highlights the need for further investigation into this system.

| | Murchison | Bowes | Chapman | Greenough | Irwin | Hill | Moore | Hutt Lagoon | Leeman Lagoon | Green Head | Summary (threat) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pedestrian/bike access** | Low | Low | Med | Med | Low | Low | | | | High | Low |
| **4WD access** | Med | Med | | Med | | Low | | Med | | | Med |
| **Invasive weed species** | Low | Med | High | Low | High | High | High | Low | | Low | Med |
| **Rubbish/pollution** | Low | Med | High | Low | Med | Med | Low | Low | | Low | Low |
| **Grazing/trampling by feral animals** | Med | Low | Low | Low | Low | Low | Low | Low | | Low | Low |
| **Earthworks** | Low | Low | Med | Med | Med | Low | Med | Med | | Low | Low |
| **Climate change** | Low | Med | High | Med | High | Med | High | Low | | Med | Med |
| **Insufficient information** | High | Med | Low | Low | Low | Low | Low | High | High | Low | Med |
| **Summary (location)** | Low | Low | Med | Low | Med | Low | Low | Low | High | Low | |

# CONSERVATION STRATEGIES

Table 2 lists conservation strategies for observed threats to Coastal Saltmarsh in the NAR (see *Threat Prioritisation*). Corresponding threats from the *Subtropical and Temperate Coastal Saltmarsh Conservation Advice* (p. 20-21) are also listed. Strategies have been developed to address threats specific to the NAR and are cross-referenced with Priority Conservation Actions listed in the Conservation Advice (p. 23-27). Note: additional threats listed in the Conservation Advice are either not applicable to Coastal Saltmarsh in the NAR or are considered beyond the scope of this plan.

**Table 2**. Conservation actions for Subtropical and Temperate Coastal Saltmarsh in the NAR.

| Threat | Description | Corresponding threat listed in Conservation Advice | Project-specific strategies, cross-referenced with actions listed in Conservation Advice |
|---|---|---|---|
| **Pedestrian/bike access** | Coastal Saltmarsh often occurs in areas with high recreational activity, particularly those in urban settings. Both walking and bike riding over Coastal Saltmarsh can kill vegetation and prevent recolonisation leaving bare trails. | • Recreation | • Hard exclusion barriers such as fences.<br>• Soft exclusion barriers such as brushing and revegetation.<br>• Awareness-raising publications such as signage, articles and brochures.<br>• Awareness-raising public events such as workshops and guided walks. |
| **4WD access** | Away from urban centres, Coastal Saltmarsh often occurs in areas that fulfill the “wilderness” experience sought by many 4WDers. Relatively flat riverbanks with low vegetation provide little barrier to 4WDers seeking to gain access to the water. Repeated vehicle incursions kill vegetation and compact the substrate preventing recolonisation. | • Recreation | • Hard exclusion barriers such as fences, bollards and concrete blocks.<br>• Soft exclusion barriers such as brushing and revegetation.<br>• Awareness-raising publications such as signage, articles and brochures.<br>• Awareness-raising public events such as workshops and guided walks. |

| | | | |
|---|---|---|---|
| **Invasive weed species** | Few weeds tolerate the saline conditions of Saltmarsh TEC however, those that do are often highly invasive and require substantial intervention to prevent habitat loss. | • Invasive species | • Targeted treatment with herbicides that are safe for off-target flora and wetland fauna.<br>• Physical exclusion barriers to prevent spreading weeds, such as perennial grasses, through access.<br>• Promotion of biosecurity messages via publications such as signage. |
| **Rubbish/Pollution** | Rubbish, particularly plastics, contaminate all ecological systems on the planet, including Coastal Saltmarsh. Rubbish sources include both the land and sea. Micro- and Nano-plastics are known carcinogens and endocrine disruptors and will impact Coastal Saltmarsh biota. Lost or discarded fishing gear directly impacts birds. Water-borne pollutants, such as excess fertilisers, herbicide residues and hydrocarbons from road run off, will similarly impact the health of Coastal Saltmarsh residents, sometimes resulting in fish kills. | • Pollution/Litter | • Awareness-raising publications on littering such as signage, articles and brochures.<br>• Sufficient placement of rubbish bins in urban settings, including “Reel it in” bins for fishing line.<br>• Public clean-up events to remove rubbish, including data collection and recording on appropriate databases, such as Tangaroa Blue’s Australian Marine Debris Initiative.<br>• Promote rapid alerts by community to authorities for fish kill events or other observations of potential contamination.<br>• Ensure best-practise treatment of stormwater runoff through filtration systems and/or avoid discharge near or into Coastal Saltmarsh altogether. |
| **Grazing/trampling by stock/invasive species** | In general, Coastal Saltmarsh in the NAR does not overlap with commercial grazing activities. However, feral goat impacts are evident, predominantly via trampling along regular water access paths. Rabbits likely graze vegetation, although the | • Grazing | • Promote/support feral animal eradication programs, such as rabbit baiting/biocontrol.<br>• Implement control measures to restrict access of terrestrial invasive animals, such as fencing, to reduce impact on Coastal Saltmarsh.<br>• Plan for the inclusion of rabbit exclusion strategies, such as fencing or tree guards, in any revegetation projects. |

| | | | |
|---|---|---|---|
| | cumulative impact on Coastal Saltmarsh is unknown. | | |
| **Earthworks that destroy vegetation or alter hydrology** | Perhaps the most common example of this threat is the artificial opening of river mouth bars for "fun" or to create good fishing or surfing conditions. The effect of this activity on saltmarsh, as well as the rest of the estuary ecosystem, is unknown. It is possible that this action prevents the estuary draining to its fullest extent and therefore does not flush properly. Conversely, prolonged inundation with freshwater is detrimental to samphires (Frood 2002) and regular flushing may be beneficial. In some locations, earthmoving equipment has been used to infill Coastal Saltmarsh or collect substrate, possibly for road base. | • Altered hydrology/tidal restriction<br>• "Land claim" or infilling<br>• Clearing and fragmentation | • Ensure that all Coastal Saltmarsh in the NAR is recorded and therefore protected under State and Federal environmental law.<br>• Promote reporting by community of illegal clearing of Coastal Saltmarsh to authorities.<br>• Awareness-raising publications such as signage, articles and brochures, explaining the harm of artificially opening river mouth bars.<br>• Promote research into the effects of artificial bar openings. |
| **Climate Change** | Climate Change brings with it a range of different threats, of which sea level rise is considered the most harmful for Coastal Saltmarsh communities with nowhere to retreat as the sea rises. | • Climate change | • Promote all actions to mitigate climate change.<br>• Build Coastal Saltmarsh resilience to climate change by reducing the impact of other pressures.<br>• Identify potential refuge areas (including buffer zones) for future Coastal Saltmarsh migration.<br>• Advocate for a climate change risk management and adaptation study on Coastal Saltmarsh to better understand the impacts and potential mitigation strategies available. |

| | | | |
|---|---|---|---|
| **Insufficient information** | Three extensive Coastal Saltmarsh areas in the NAR (Murchison estuary, Hutt Lagoon and Leeman Lagoon) have not yet been fully mapped. Additional smaller areas are also likely to occur in the NAR (including islands) and require investigation, and mapping, if necessary. | No equivalent threat, however, the Conservation Advice recommends conducting surveys to identify and assess Coastal Saltmarsh as a Research Priority (p. 23). The current project lists insufficient information as a threat as unmapped areas may not receive the same protections from development as mapped Coastal Saltmarsh. | • Seek resources to complete Coastal Saltmarsh surveys, including groundwater surveys, in locations currently unmapped (including islands).<br>• Maintain a list of possible locations (including islands) for future Coastal Saltmarsh surveys. |

# STRATEGIC ACTION PLAN 2025 – 2035

This action plan is separated into two parts:

- actions that will be delivered by NACC NRM's current project, "Improving Subtropical and Temperate Coastal Saltmarsh in the Northern Agricultural Region", and
- actions that are outside the scope of the current project but are considered priorities for Coastal Saltmarsh improvement in the NAR for which further resources are required.

This Plan supports the following Vision and Goals of the "Natural Resource Management Vision (NARvis) for the Northern Agricultural Region of Western Australia";

- Coastal and Marine Vision: "Coastal and marine biodiversity, landforms and ecosystem integrity are valued, maintained, improved and restored across the whole system".
- Coastal and Marine Goal 1: Conservation status of all coastal and marine threatened and priority plants, animals and ecological communities is maintained or improved, and no extinctions occur, by 2030.
- Coastal and Marine Goal 3: 25 research or monitoring projects implemented to increase scientific knowledge and community awareness of coastal and marine biodiversity conservation in the region by 2030.
- Community Capacity Goal 1: 200 community events delivered to build natural resource management knowledge, ability and willingness in the local community by 2030.

## Strategic actions for the project "Improving Subtropical and Temperate Coastal Saltmarsh in the Northern Agricultural Region".

This Management Plan addresses the on-ground actions specific to NACC NRM's aforementioned project which has funding available from 2025 to 2028. Specified on-ground actions are as follows:

- Control of invasive weeds – e.g. physical removal, spraying.
- Access control measures (applicable to vehicles, bikes and pedestrians) – e.g. signage, bollards, fences and/or barriers.
- Community engagement events – e.g. rubbish clean-ups, awareness-raising forums.
- Communication material – e.g. articles, brochures and signs that promote saltmarsh conservation.

Table 3 provides proposed locations for aforementioned on-ground actions based on threat priority ratings in Table 1. Additional to these on-ground actions are non-site-specific actions, such as community forums and various publications, that are necessary to raise awareness of Coastal Saltmarsh conservation across the entire NAR.

## Strategic actions outside the scope of the current project.

On-ground actions to improve Saltmarsh TEC in the NAR that are beyond the scope of the current project are provided in Table 4. "High" threat actions are the priority for efforts to secure further resources from 2026 to 2035. It should be noted that the need for awareness-raising actions that elevate the importance of Saltmarsh TEC conservation is ongoing and should be delivered in addition to, and filter through, all other on-ground actions.

**Table 3**. On-ground actions for the project "Improving Subtropical and Temperate Coastal Saltmarsh in the Northern Agricultural Region" which has funding available from 2025 to 2028. These actions address high, medium and low-level threats (see *Threat Prioritisation*) at all Coastal Saltmarsh locations. High and Medium threat locations are recommended for priority on-ground actions.

| Project Action | Threat addressed | High threat locations | Medium threat locations | Low threat locations | Comments |
|---|---|---|---|---|---|
| Control of invasive weeds | Invasive weed species | Chapman<br>Irwin<br>Hill<br>Moore | Bowes | Murchison<br>Greenough<br>Hutt Lagoon<br>Green Head | Few invasive weeds can survive in highly saline Coastal Saltmarsh environments, however those that can, such as *Juncus acutus* and *Paspalum vaginatum*, are highly invasive and are a priority for control. |
| Access control measures | Pedestrian/bike access | Green Head | Chapman<br>Greenough | Murchison<br>Bowes<br>Irwin<br>Hill | BMX bikes are the highest priority threat to Green Head Coastal Saltmarsh, whereas the urbanised areas of Chapman and Greenough are impacted by pedestrian traffic. Irwin has a well-used boardwalk that greatly reduces pedestrian impacts. |
| Access control measures | 4WD access | | Murchison<br>Bowes<br>Greenough<br>Hutt Lagoon | Hill | 4WDs are unable to access most smaller areas of Saltmarsh, and their impact on larger areas does not represent a high threat. Most 4WD users will avoid salty muddy substrates. |
| Community engagement – clean-up events | Rubbish/pollution | Chapman<br>Irwin | Bowes<br>Hill | Murchison<br>Greenough<br>Moore<br>Hutt Lagoon<br>Green Head | Smaller Coastal Saltmarsh areas are at risk from contamination from significant amounts of marine debris (relative to their small size) entering when the bars are open. Chapman and Irwin are at risk from contamination from stormwater run-off from urban roads. |
| Communication material – signs discouraging artificial opening of bars | Earthworks that destroy vegetation or alter hydrology | | Chapman<br>Irwin<br>Hutt Lagoon<br>Greenough<br>Moore | Murchison<br>Bowes<br>Hill<br>Green Head | All the normally-closed estuaries in the NAR are likely subject to artificial bar openings, however, those closer to population centres are more likely to be affected. The impact of this activity on Coastal Saltmarsh is not fully understood and requires further study. |

**Table 4**. Strategic actions requiring further resources to address higher priority threats to Saltmarsh TEC in the NAR.

| Required On-ground Action | Threat addressed | High threat locations | Medium threat locations | Low threat locations | Comments |
|---|---|---|---|---|---|
| Saltmarsh surveys and mapping | Insufficient information | Murchison<br>Hutt Lagoon<br>Leeman Lagoon | Bowes | Chapman<br>Greenough<br>Irwin<br>Hill<br>Moore<br>Green Head | As part of the current project, areas of Coastal Saltmarsh in the NAR have already been surveyed and mapped (Appendix B). Three areas of potential Coastal Saltmarsh remain predominantly unsurveyed and are considered highly threatened by insufficient information about their extent and condition. Hutt Lagoon and Leeman Lagoon require further groundwater surveys to confirm tidal connection throughout these systems. In addition, the Bowes system requires investigation as it likely extends further onto private property. |
| Control of invasive weeds | Invasive weed species | Chapman<br>Irwin<br>Hill<br>Moore | Bowes | Murchison<br>Greenough<br>Hutt Lagoon<br>Green Head | Despite weed control actions in the current project, it is unlikely that targeted weeds will be eradicated. Further weed treatments will likely be required in high priority locations. In addition, monitoring programs will be necessary to ensure locations remain free of highly invasive species. |
| Access control measures | Pedestrian/bike/4WD access | Green Head | Murchison<br>Bowes<br>Chapman<br>Greenough<br>Hutt | Irwin<br>Hill | Coastal Saltmarsh areas occur along the coast where people wish to recreate, hence requirements for access impact management will be ongoing. Maintenance and impact assessments of project-specific access control structures will also be required. |
| Community engagement – clean-up events | Rubbish/pollution | Chapman<br>Irwin | Bowes<br>Hill | Murchison<br>Greenough<br>Moore<br>Hutt Lagoon<br>Green Head | On-going clean up events are the most effective option for removal of marine debris pollution that continues to wash into these systems when bars are open. Continued education campaigns to reduce the impacts of rubbish, through signs and dedicated placement of bins, including “Reel it in” bins for fishing gear, is required. Support for strategies to reduce the prevalence of marine debris should also be prioritised. |
| Urban stormwater management | Rubbish/pollution | Chapman<br>Irwin | | | Best-practise stormwater management, such as biofiltration systems, will reduce the risk of pollution from this source for the urbanised Coastal Saltmarsh systems. Wherever possible, stormwater infrastructure should be constructed to avoid discharging into or near Coastal Saltmarsh. |
| Investigate effects of | Earthworks that destroy vegetation or alter hydrology | | Chapman<br>Irwin<br>Greenough | | Artificially opening the sand bar to drain the estuary for purposes of human recreation (surfing, fishing, fun) has an unknown effect on Coastal Saltmarsh. It is possible that |

| | | | | | |
|---|---|---|---|---|---|
| artificial bar opening | | | Hill | | opening the bar before the estuary has filled up enough to break the bar naturally will reduce the volume of the flushing event, thus reducing the removal of sediment and nutrients. In contrast, prolonged inundation appears to cause some samphire species to die off, in which case more regular draining will reduce this inundation. More study is required on this topic. |
| Climate change study | Climate change | Chapman<br>Irwin<br>Moore | Bowes<br>Greenough<br>Hill<br>Green Head | Murchison<br>Hutt Lagoon | The impact of climate change on Coastal Saltmarsh in the NAR is essentially unknown. The current study assumes that the primary impact will be the capacity for landward TEC boundary expansion in response to rising sea levels. Other impacts likely include altered saltmarsh community structure with changing conditions. A dedicated study would improve the conservation of this TEC under various climate change scenarios and assess impacts and mitigation strategies for other climate change-induced pressures. |

# CONCLUSIONS

The current project has added significantly to the total area recognised as Coastal Saltmarsh through the detailed mapping of previously unidentified areas. Further investigation is essential to recognise yet more Coastal Saltmarsh which remains unidentified, namely, around the Murchison estuary, Hutt Lagoon and Leeman Lagoon. This Management Plan has identified priority actions to maximise conservation of Coastal Saltmarsh areas in the NAR, both within the scope of this project and beyond.

It is evident that coordinated management is best suited to address the identified priority actions for Coastal Saltmarsh in the NAR. Consultation between all relevant stakeholders - State and Local governments, NRM organisations, private land holders, Traditional Owners and community groups and/or members – is required to deliver effective conservation of this TEC.

# REFERENCES/FURTHER INFORMATION


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# APPENDIX A: SALTMARSH LOCATION ATTRIBUTES

The following tables provide site assessment summary information for all Coastal Saltmarsh areas surveyed as part of NACC NRM's project, "Improving Subtropical and Temperate Coastal Saltmarsh in the Northern Agricultural Region". Leeman Lagoon is not included as surveys to confirm tidal groundwater influence were inconclusive.

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Murchison** | >50 | Surface - permanently open bar | 10227. 10224.7186- Creation / Dreaming Narrative.10222 10235- Artefacts / Scatter. 0169- Artefacts / Scatter.10223- Artefacts / Scatter. | Shire of Northampton - Likely transition to joint management | None | Nanda Aboriginal Corporation |

| | | | |
|---|---|---|---|
| **Survey Site Names** | **Murch01** | **Murch02** | **Murch03** |
| **Dominant plant spp <u>Weeds underlined</u>** | *Sporobolus virginicus*<br>*Casuarina obesa*<br>*Salicornia quinqueflora*<br>*Tecticornia spp.*<br>*Juncus kraussii*<br>*Samolus repens*<br>*Enchylaena tomentosa*<br>*<u>Reichardia tingitana</u>* | *Salicornia quinqueflora*<br>*Tecticornia indica*<br>*Juncus spp.*<br>*Casuarina obesa*<br>*Atriplex spp.* | *Tecticornia indica*<br>*Atriplex spp.*<br>*Casuarina obesa*<br>*Salicornia quinqueflora*<br>*<u>Reichardia tingitana</u>*<br>*Juncus spp*. |
| **Condition** | Average | Good | Good |
| **Threat 1** | 4WD access | Rubbish/pollution | Invasive weeds |
| **Threat 2** | Rubbish/pollution | Trampling (Feral goats) | Trampling (Feral goats) |
| **Threat 3** | Invasive weeds | - | 4WD access |
| **Previous on ground management** | Limited unsuccessful attempts to manage 4WDs. | | |
| **Comments** | Riverside patches of saltmarsh seemed to have relatively low biodiversity. South-eastern patch located further inland had greater biodiversity of saltmarsh plant species. Average condition awarded due to the high impact of 4WD activity in the area, including tracks driven through patches of saltmarsh vegetation. Recent flooding has seen areas of samphire (*S. quinqueflora*) die-back. | Limited vehicle access to this site means that man-made tracks from 4WDs are reduced. Large area of continuous saltmarsh vegetation. *Juncus spp*. to be identified (no flowerheads present hence not believed to be *J. kraussii*). Potentially freshwater species as it is located on a small rise that sits at the base of a hill. Unlikely that tidal influence would reach these plants. Possible threats from trampling and weed invasion due to presence of feral goats in area. | Overall condition considered good. Evidence of recent flooding has impacted *S. quinqueflora* vegetation at centre of southern patch (where small lake is present). Evidence of weeds around sandy margins with some intrusion into saltmarsh vegetation present and more likely in the future. Feral goats likely main threat to saltmarsh due to trampling of vegetation and spreading of weeds. Little 4WD impact observed at area of assessment, however, it is likely to occur on the western margins at the base of the hill and can be seen throughout northern areas of saltmarsh on satellite imagery. |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Hutt** | >100 | Groundwater | None registered | Shire of Northampton | Birdlife Midwest-Geraldton | Nanda Aboriginal Corporation |
| **Survey Site Names** | **Hutt01** | | | | | |
| **Dominant plant spp <u>Weeds underlined</u>** | *Salicornia quinqueflora*<br>*Tecticornia halocnemoides*<br>*Juncus kraussii*<br>*Samolus repens*<br>*Wilsonia humilis*<br>*Atriplex spp.*<br>*Threlkeldia diffusa*<br>*Frankenia spp,*<br>*Tecticornia spp 1*<br>*Tecticornia spp 2*<br>*WIlsonia backhousei*<br>*Sporobolus virginicus* | | | | | |
| **Condition** | Good | | | | | |
| **Threat 1** | 4WD access | | | | | |
| **Threat 2** | Earthworks (likely extraction for road base) | | | | | |
| **Threat 3** | Rubbish/pollution | | | | | |
| **Previous on-ground management** | The surveyed area is a small part of a much larger coastal lagoon system that is largely unmanaged. A beta-carotene farm exists within the system – their internal monitoring has indicated no impacts on potential Coastal Saltmarsh vegetation. | | | | | |
| **Comments** | High Coastal Saltmarsh plant diversity. Small amount of litter/debris along road side (due to traffic) – does not appear to be present throughout the saltmarsh area.4WD tracks are evident in the area. Most appear to be well-worn indicating drivers stick to existing tracks. However, anecdotal knowledge of 4WDs accessing the area pose a threat for future damage from creation of new tracks (and use of existing). Tracks from dirt bikes also present. Area is known for offroad activity opportunities and so these could become a risk to saltmarsh health if users not made aware on the importance of preserving the TEC. Evidence of historic earthworks present where several mounds of sediment have been created. Plants have re-vegetated these mounds indicating it has been some time since activities. Unlikely to occur in the future but have changed the landscape. Very few weeds observed at site although annuals noted on margins and in dune vegetation communities. Monitoring should be undertaken to ensure these species do not encroach Coastal Saltmarsh, although, the saline conditions and soil type are likely to exclude most weeds from invading. | | | | | |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Bowes** | 1.5 | Surface - normally closed bar | 5558- Artefacts / Scatter; Camp. 24416- Creation / Dreaming Narrative; Landscape / Seascape Feature. 4940- Burial; Artefacts / Scatter; Camp; Midden; Other.5749- Burial. 17464- Burial. | Shire of Northampton | None | Nanda Aboriginal Corporation |
| **Survey Site Names** | **Bowes01** | | | | | |
| **Dominant plant spp <u>Weeds underlined</u>** | *Salicornia quinqueflora*<br>*Tecticornia indica*<br>*Atriplex cinerea*<br>*Sporobolus virginicus* | | | | | |
| **Condition** | Average | | | | | |
| **Threat 1** | 4WD access | | | | | |
| **Threat 2** | Rubbish/pollution | | | | | |
| **Threat 3** | Trampling (sheep) | | | | | |
| **Previous on-ground management** | Unmanaged. | | | | | |
| **Comments** | Overall condition is good apart from large areas of *S. quinquefolia* die off, most likely a result of prolonged inundation, requiring further investigation. Weeds were observed in areas adjacent to the Coastal Saltmarsh, requiring further surveys. Sheep were also observed in the area but grazing is not evident. Low Coastal Saltmarsh plant diversity. | | | | | |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Chapman** | 1.1 | Surface - normally closed bar | 30063 - Birthplace; Creation/Dreaming Narrative; Historical; Water Source. 5561 - Burial | City of Greater Geraldton | Chapman River Friends, Birdlife Midwest-Geraldton | Yamatji Southern Regional Corporation |

| **Survey Site Names** | **Chap01** | **Chap02** | **Chap03** |
|---|---|---|---|
| **Dominant plant spp Weeds underlined** | *Paspalum vaginatum*<br>*Causarina obesa*<br>*Juncus kraussii*<br>*Tecticornia indica*<br>*Salicornia quinqueflora*<br>*Juncus acutus* | *Sporobolus virginicus*<br>*Atriplex cinerea*<br>*Salicornia quinqueflora*<br>*Tecticornia indica*<br>*Casuarina obesa*<br>*Juncus kraussii*<br>*Melaleuca rhaphiophylla*<br>*Wilsonia humilis*<br>*Paspalum spp* | *Salicornia quinqueflora*<br>*Tecticornia indica*<br>*Casuarina obesa*<br>*Juncus kraussii*<br>*Atriplex cinerea*<br>*Melaleuca rhaphiophylla*<br>*Paspalum spp*. |
| **Condition** | Average | Average | Good |
| **Threat 1** | Invasive weeds | Invasive weeds | Pedestrian access |
| **Threat 2** | Pedestrian access | Pedestrian access | Pollution/ rubbish |
| **Threat 3** | Altered hydrology | Pollution/ rubbish | Invasive weeds |
| **Previous on-ground management** | City of Greater Geraldton has developed the Chapman River Action Plan (2022) which is guiding investment in signage, boxthorn control, revegetation etc | | |
| **Comments** | Urban location, significant impact from weeds (*P. vaginatum, J. acutus*) and pedestrians. Remaining saltmarsh vegetation generally in good condition. Artificial opening of the bar is not uncommon, with unknown consequences for saltmarsh | Average condition awarded due to considerate amount of threats facing site, notably damage from man-made tracks and weeds. Existing saltmarsh vegetation appears to be in good condition. Limited observed occurrence of *W. humilis* suggests improving health of saltmarsh community at this site may help this species persist in the area. | Condition of saltmarsh at this site was considered good due to the high rate of coverage of saltmarsh species. Limited threats in the form of previously observed human interference at the site are likely easily managed. Recently installed fencing and thick vegetation growth likely inhibit the site from further human-induced damage. A weedy *Paspalum sp*. was noticed at Charles St (near public bench along fencing) but no further weeds were observed in the fenced area. |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Greenough** | 10 | Surface - normally closed bar | 24761-Creation / Dreaming Narrative; Landscape / Seascape Feature.17964-Shell | City of Greater Geraldton | Birdlife Midwest | Yamatji Southern Regional Council |

| **Survey Site Names** | **Green01** | **Green02** | **Green03** | **Green04** |
|---|---|---|---|---|
| **Dominant plant spp** **Weeds underlined** | *Salicornia quinqueflora* *Tecticornia indica* *Juncus kraussii* *Casuarina obesa* *Threlkeldia diffusa* *Paspalum spp.* | *Juncus kraussii,* *Tecticornia pergranulata* *Salicornia quinqueflora* *Threlkeldia diffusa* *Casuarina obesa* *Tecticornia indica* | *Sporobolus virginicus* *Tecticornia indica* *Salicornia quinqueflora* *Casuarina obesa* *Juncus kraussii* | *Salicornia quinqueflora* *Tecticornia indica* *Casuarina obesa* *Sporobolus virginicus* *Juncus kraussii* *Paspalum spp*. |
| **Condition** | Good | Good | Good | Average |
| **Threat 1** | Pedestrian access | 4WD access | Pedestrian access | Pedestrian access |
| **Threat 2** | Rubbish/pollution | Rubbish/pollution | - | Rubbish/pollution |
| **Threat 3** | | Invasive weeds | - | Invasive weeds |
| **Previous on-ground management** | City of Greater Geraldton is actively seeking funding for a management plan. Some 4WD track management and boxthorn control is underway | | | |
| **Comments** | Strong, healthy community of saltmarsh vegetation. Limited threats other than walking tracks along the inland margins and main track stemming from maintained walking track. Limited pollution, that was present was old. No major weeds observed, although attention should be given to unidentified *Paspalum spp*. growing on inland margin of saltmarsh. No flowers/seed heads were present to identify whether the species has potential to invade the saltmarsh vegetation. | Good condition other than damage and patchiness created by vehicle tracks at site. Litter one of the other main threats including damage to surrounding vegetation (potential removal of a dead tree for purpose of firewood). This site is clearly used often by people either visiting or camping. Annual weeds present. | Good condition overall. Vegetation with very minimal observed threats. Man-made tracks mostly present in vegetation outside of saltmarsh boundary. No other major threats observed. | Relatively good condition however there are obvious threats as outlined above. A very well established walk track exists and a small amount of Paspalum sp. was observed |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Irwin** | 5.3 | Surface - normally closed bar | 18907- Camp; Creation / Dreaming Narrative; Historical; Landscape / Seascape Feature; Water Source. 632- Traditional Structure. | Shire of Irwin | None | Yamatji Southern Regional Council/ Wattandee Littlewell Aboriginal Corporation |

| **Survey Site Names** | **Ir01** | **Ir02** |
|---|---|---|
| **Dominant plant spp <u>Weeds underlined</u>** | *Salicornia quinqueflora*<br>*Atriplex cinerea*<br>*Tecticornia indica*<br>*<u>Paspalum vaginatum</u>*<br>*Juncus kraussii*<br>*<u>Lycium ferocissimum</u>*<br>*Threlkeldia diffusa*<br>*Sporobolus virginicus*<br>*Bolboschoenus caldwellii*<br>*Samolus spp.* | *Juncus kraussii*<br>*Tecticornia indica*<br>*Threlkeldia diffusa*<br>*<u>Lycium ferrocissimum</u>*<br>*<u>Schinus terebinthifolia</u>*<br>*Casuarina obesa*<br>*<u>Cynodont dactylon</u>*<br>*<u>Tetragonia decumbens</u>*<br>*<u>Symphiotrichum subulatum</u>*<br>*<u>Tamarix aphylla</u>* |
| **Condition** | Poor | Average |
| **Threat 1** | Invasive weeds | Invasive weeds |
| **Threat 2** | Rubbish/pollution | Rubbish/pollution |
| **Threat 3** | Altered hydrology | Altered hydrology |
| **Previous on-ground management** | Various management plans but little on-ground investment, extensive boxthorn removal previously. An aging board walk protects vegetation from trampling. | Various management plans but little on-ground investment, extensive boxthorn removal previously. An aging board walk protects vegetation from trampling. |
| **Comments** | The urban-based system provides opportunity to raise awareness of Coastal Saltmarsh to local residents and visitors. Significant weed invasion by *Paspalum vaginatum* such that it threatens the saltmarsh classification as TEC. Anecdotal records of artificial opening of the bar by local residents. Marine debris enters the system when the bar is open. | *P. vaginatum* at this site not as extensive as "Ir01". Other mid storey weeds present at site including pepper trees and boxthorn. Ground storey plant diversity stronger. Appropriate weed management should be undertaken to preserve diversity. Rubbish present in vegetation and at water's edge. |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Green Head** | 4.4 | Groundwater | None registered | Shire of Coorow | Green Head Coastcare | Kwelena Mambakort Aboriginal Corporation |
| **Survey Site Names** | **GHead01** | | | | | |
| **Dominant plant spp** **<u>Weeds underlined</u>** | *Casuarina obesa*<br>*Salicornia quinqueflora*<br>*Tecticornia indica*<br>*Threlkeldia diffusa*<br>*Sueda australis*<br>*Atriplex spp.*<br>*Tecticornia spp.*<br>*Frankenia pauciflora*<br>*Melaleuca rhaphiophylla* | | | | | |
| **Condition** | Good | | | | | |
| **Threat 1** | Earthworks | | | | | |
| **Threat 2** | Bike access | | | | | |
| **Threat 3** | Invasive weeds | | | | | |
| **Previous on-ground management** | Saltmarsh has been illegally cleared previously, currently damage is being repaired via Conservation Vegetation Notice, no other on-ground investment is evident. | | | | | |
| **Comments** | Very good area of saltmarsh vegetation with good diversity of species observed. Area has known history of attempted development works which were stopped by concerned community members. Community members have records of area being important habitat for various bird species. Bicycle use during drier conditions has impacted vegetation, causing a network of bare tracks. Possible old piles of rubbish that have been dumped in the area. It was noted that weeds/weed species were not greatly encroaching saltmarsh vegetation given presence along verge/roadside margins of saltmarsh patch, excusing a few small, isolated patches growing in bare areas in the centre of the saltmarsh patch. | | | | | |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Hill** | 9 | Surface - normally closed bar | None registered | Shire of Dandaragan, Ardross Estate PL | Jurien Bay Regional Herbarium Group | Kwelena Mambakort Aboriginal Corporation |
| **Survey Site Names** | **Hill01** | | | **Hill02** | | |
| **Dominant plant spp <u>Weeds underlined</u>** | *Juncus kraussii*<br>*Sporobolus virginicus*<br>*Atriplex spp.*<br>*<u>Paspalum vaginatum</u>* | | | *Juncus kraussii*<br>*Sporobolus virginicus*<br>*<u>Juncus acutus</u>*<br>*Melaleuca lanceolata* | | |
| **Condition** | Good | | | Good | | |
| **Threat 1** | Invasive weeds | | | Invasive weeds | | |
| **Threat 2** | Rubbish/pollution | | | Rubbish/pollution | | |
| **Threat 3** | 4WD access | | | - | | |
| **Previous on-ground management** | Limited attempts to manage 4WD access. Sharp Rush control works commenced. | | | | | |
| **Comments** | Dense *J. kraussii* with *S. virginicus* and *Atriplex spp*. observed at this site. Large patches of *Paspalum vaginatum* present, including on the small island. An infestation of *J. acutus* occurs nearby and its spread should be closely monitored. Litter and marine debris, especially close to the river mouth, represents another threat to overall health of the saltmarsh vegetation. Some 4WD access around the margins. | | | Dense *J. kraussii* stands with *S. virginicus* at margins. *J. acutus* along margins, parallel to walking trail with dense growth of *J. kraussii* possibly hindering further encroachment. Other grassy/broad leaf annual weed species observed just off from walking trail on what appears to be a firebreak. | | |

| Location | Total Area ha | Connection to the sea | Aboriginal Heritage values for Location (ID - Description) | Land Manager | Active Community groups | Active Aboriginal groups |
|---|---|---|---|---|---|---|
| **Moore** | 5.1 | Surface - normally closed bar | 20008-Camp; Creation / Dreaming Narrative; Historical; Hunting Place; Plant Resource; Water Source. 20749- Creation / Dreaming Narrative. 21620-Creation / Dreaming Narrative. 21616-Creation / Dreaming Narrative. 21617- Creation / Dreaming Narrative. 20650-Creation / Dreaming Narrative; Landscape / Seascape Feature; Other; Water Source. 21618- Creation / Dreaming Narrative. 21619- Creation / Dreaming Narrative. | Shire of Gingin | Friends of Moore River Estuary, Lower Moore River Working Group | Yued Aboriginal Corporation, Kwelena Mambakort Aboriginal Corporation |

| | |
|---|---|
| **Survey Site Names** | **Moore01** |
| **Dominant plant spp <u>Weeds underlined</u>** | *Juncus kraussii*<br>*Juncus spp.*<br>*<u>Gahnia trifida</u>*<br>*Machaerina juncea*<br>*<u>Paspalum spp.</u>*<br>*Melaleuca rhaphiophylla* |
| **Condition** | Good |
| **Threat 1** | Invasive weeds |
| **Threat 2** | Rubbish/pollution |
| **Threat 3** | - |
| **Previous on-ground management** | Stock exclusion by land holder, boardwalk reconstruction underway. |
| **Comments** | Overall low vegetation diversity at site, with dense stands of *J. kraussii* making up most of the saltmarsh vegetation. Site has opportunity for significant weed management works to mitigate threat of weeds encroaching from the margins. Some litter was observed at the site, likely washed in from river or left by walkers in the area. There is an unmarked track which is sometimes used (not as often as previous as a boardwalk at the beginning of the track is currently being repaired). Historically, the area was open to cattle grazing – fenced off in the last 15-20 years. As such, dense pasture grasses (*<u>Paspalum spp</u>*.) present between the riverbank and saltmarsh vegetation. |

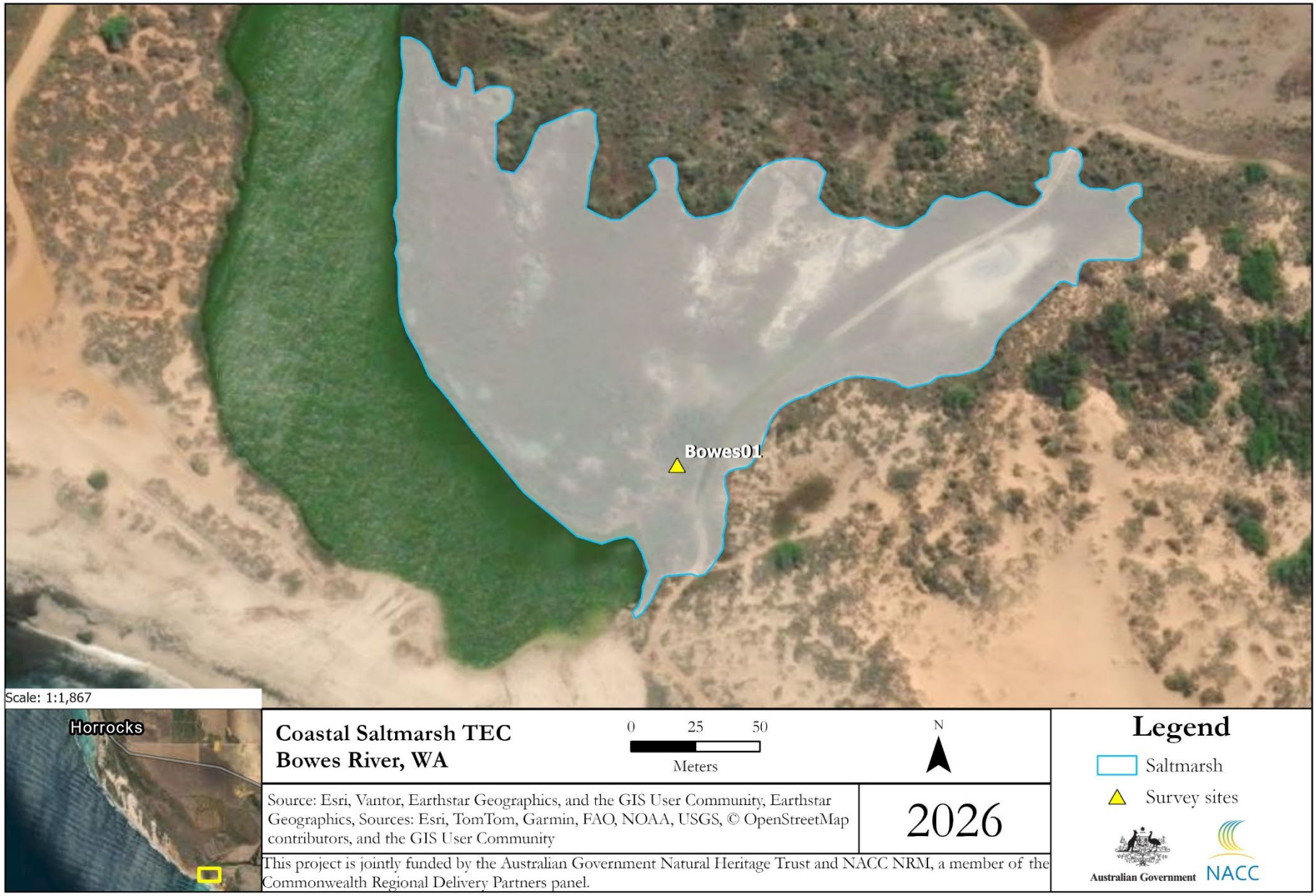
# APPENDIX B. COASTAL SALTMARSH DISTRIBUTION MAPS

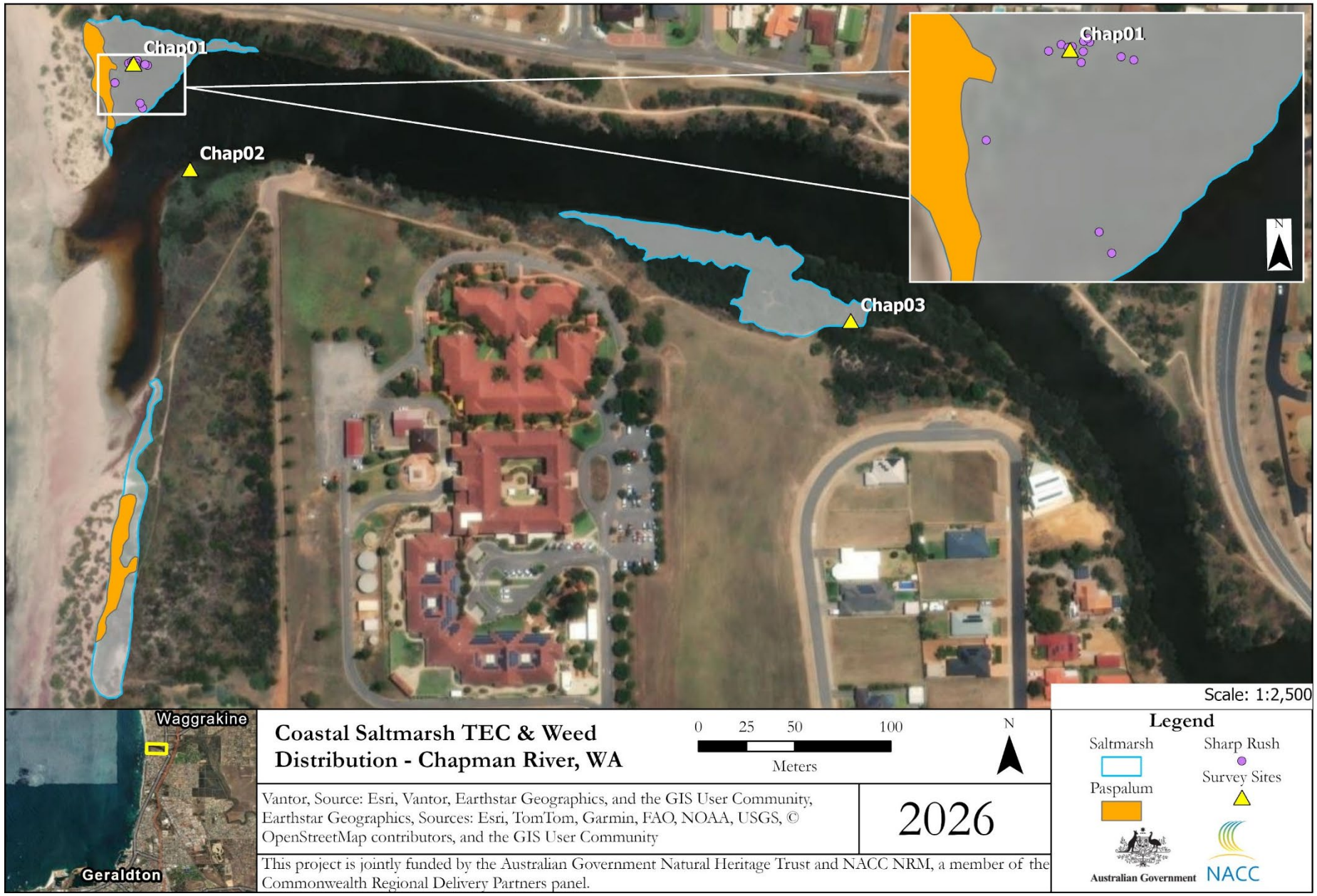


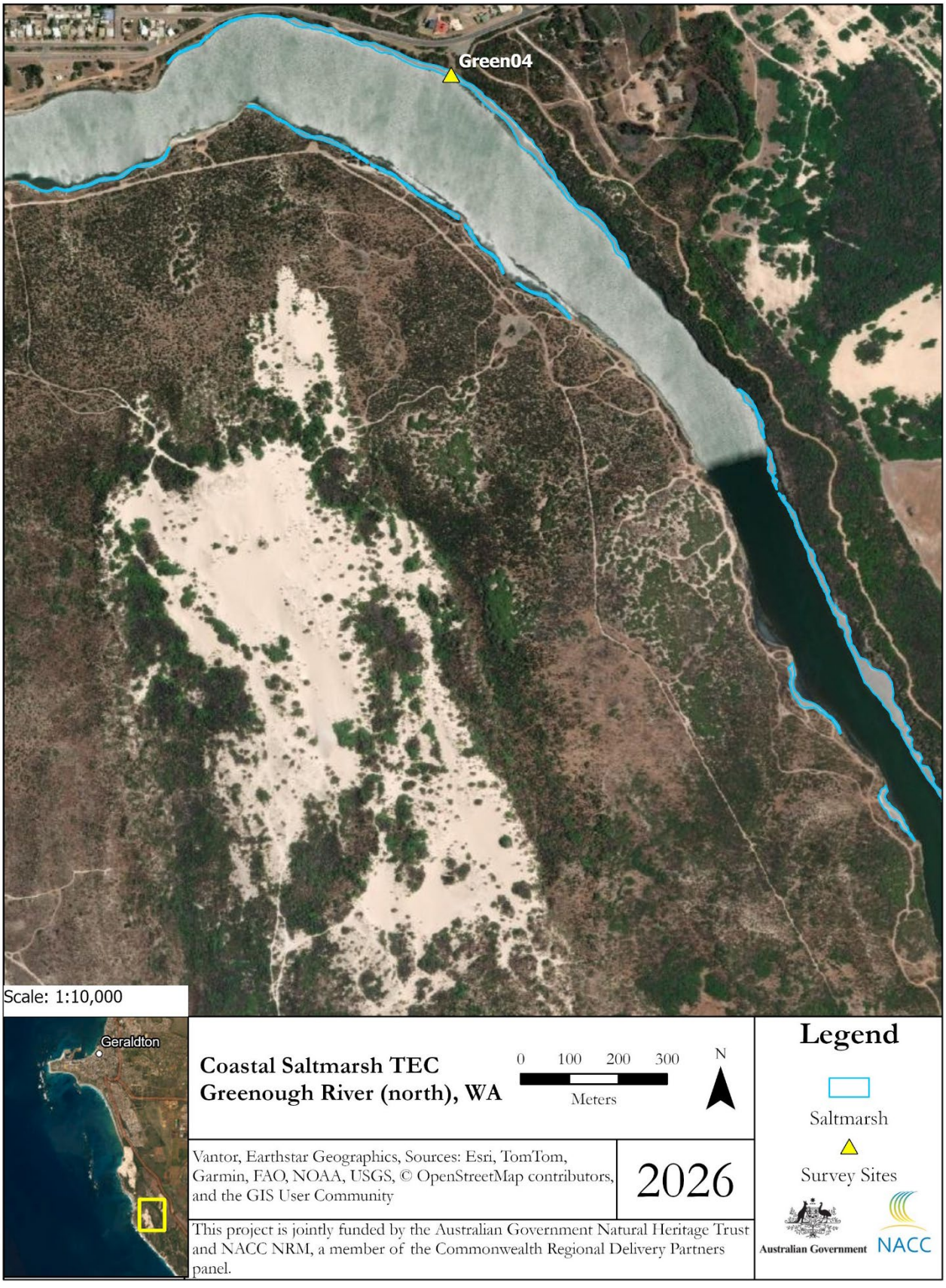

Murch02
Murch03
Scale: 1:9,000
Kalbarri
Coastal Saltmarsh TEC
Murchison River (lower),
WA
0 100 200
Meters
N
Vantor, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
2026
This project is jointly funded by the Australian Government Natural Heritage Trust and NACC NRM, a member of the Commonwealth Regional Delivery Partners panel.
Legend
Saltmarsh
Survey Sites
Australian Government
NACC



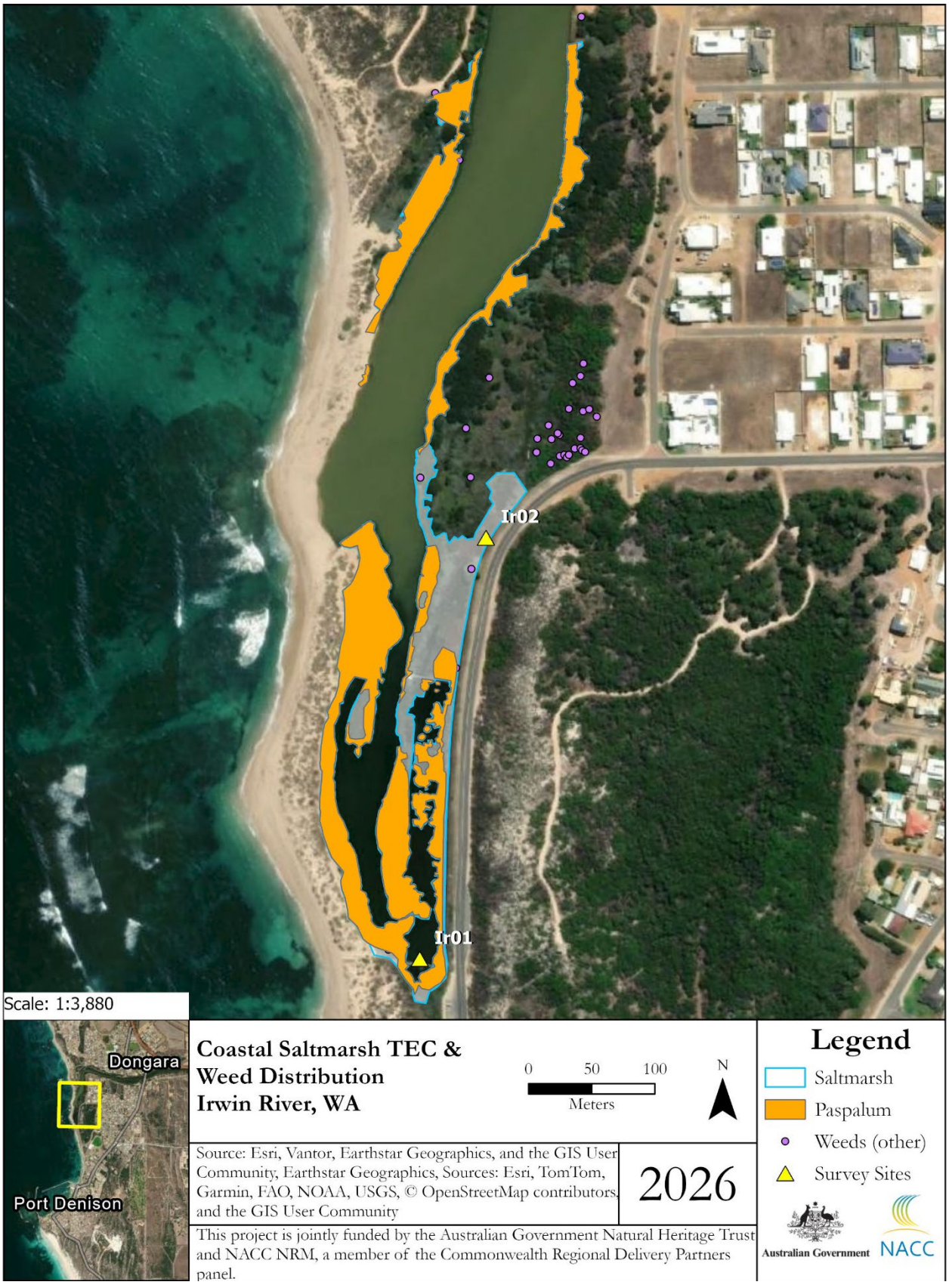

Note: The site assessment conducted at Hutt Lagoon (Appendix A) was conducted at the survey site “Hutt2”, depicted above.


Bowes01
Scale: 1:1,867
Horrocks
Coastal Saltmarsh TEC
Bowes River, WA
0 25 50
Meters
N
Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
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Legend
Saltmarsh
Survey sites
Australian Government
NACC

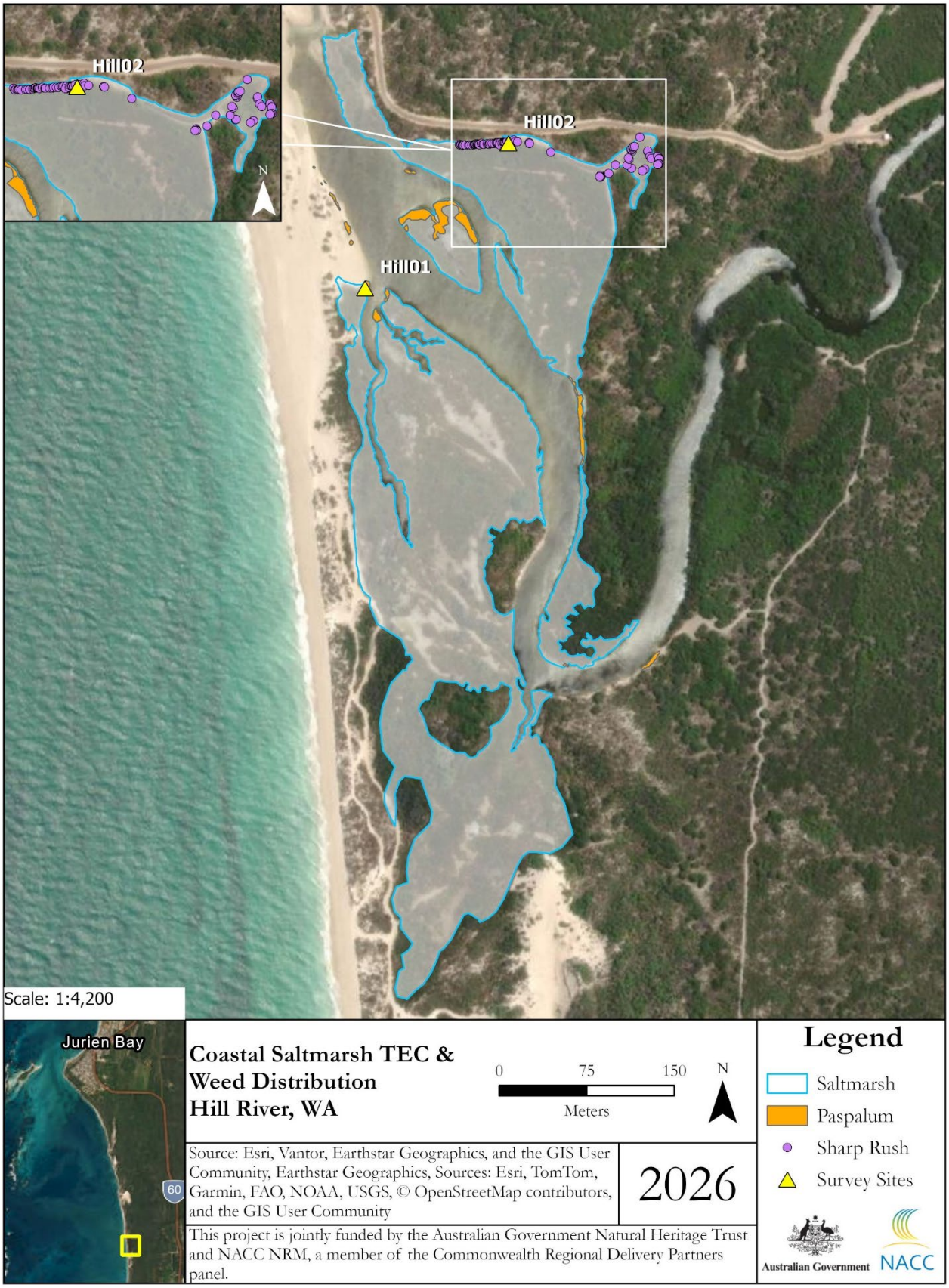

Chap01
Chap02
Chap03
Chap01
N
Waggrakine
Geraldton
Coastal Saltmarsh TEC & Weed Distribution - Chapman River, WA
0 25 50 100
Meters
N
Scale: 1:2,500
Legend
Saltmarsh
Sharp Rush
Survey Sites
Paspalum
Vantor, Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
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Australian Government
NACC

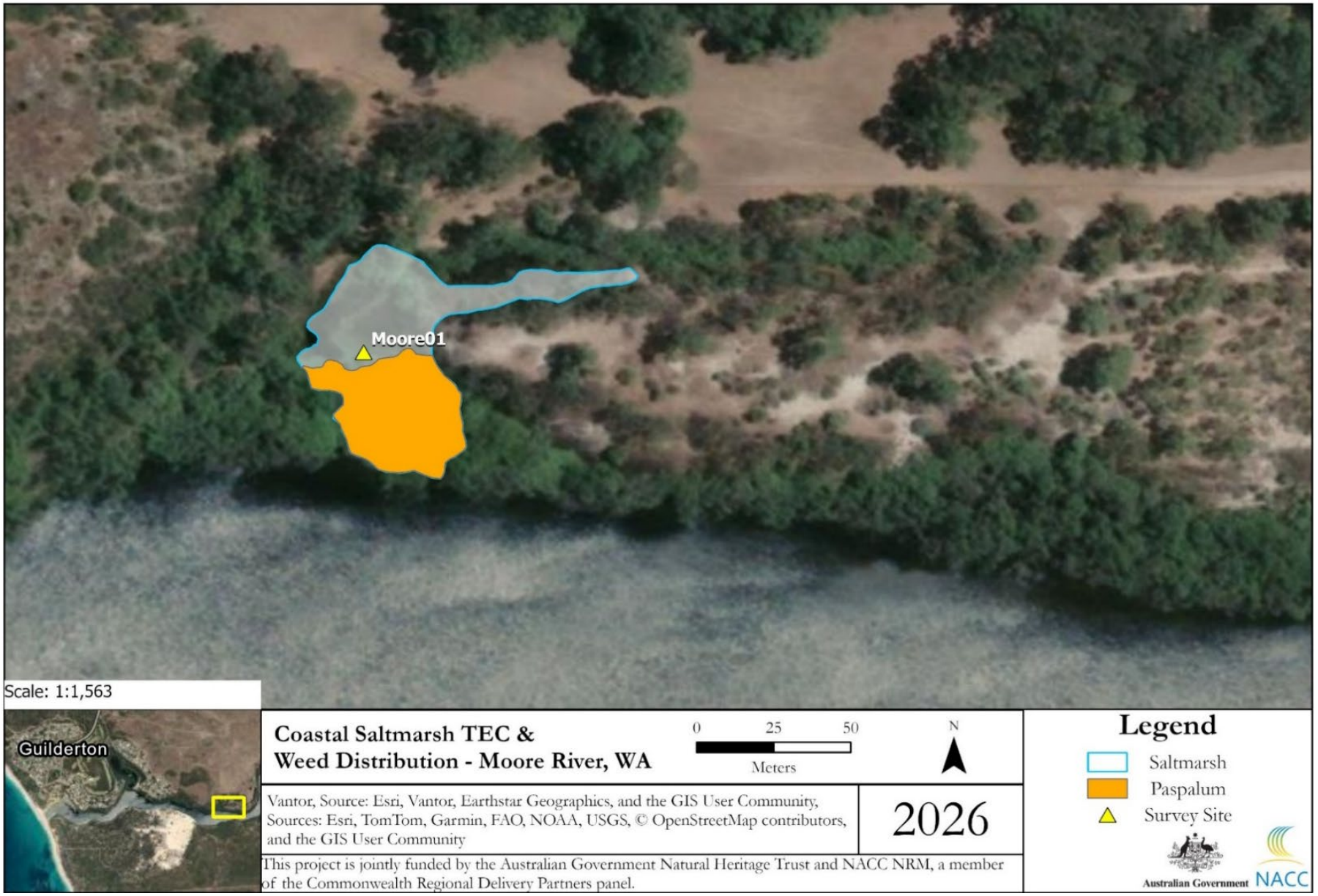

Green04
Scale: 1:10,000
Geraldton
Coastal Saltmarsh TEC
Greenough River (north), WA
0 100 200 300
Meters
N
Legend
Saltmarsh
Survey Sites
Vantor, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
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Australian Government
NACC


Green03
Green02
Green01
Scale: 1:16,000
Geraldton
Coastal Saltmarsh TEC
Greenough River (south), WA
0
250
500
Meters
N
Vantor, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
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Legend
Saltmarsh
Survey Sites
Australian Government
NACC


Ir02
Ir01
Scale: 1:3,880
Dongara
Port Denison
Coastal Saltmarsh TEC &
Weed Distribution
Irwin River, WA
0
50
100
Meters
N
Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
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Legend
Saltmarsh
Paspalum
Weeds (other)
Survey Sites
Australian Government
NACC


GHead01
Scale: 1:2,839
Green Head
Coastal Saltmarsh TEC
Green Head, WA
0 25 50
Meters
N
Vantor, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
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Legend
Saltmarsh
Survey sites
Australian Government
NACC


Hill02
Hill02
Hill01
N
Scale: 1:4,200
Jurien Bay
60
Coastal Saltmarsh TEC &
Weed Distribution
Hill River, WA
0
75
150
Meters
N
Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community, Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
2026
This project is jointly funded by the Australian Government Natural Heritage Trust and NACC NRM, a member of the Commonwealth Regional Delivery Partners panel.
Legend
Saltmarsh
Paspalum
Sharp Rush
Survey Sites
Australian Government
NACC


Moore01
Scale: 1:1,563
Guilderton
Coastal Saltmarsh TEC &
Weed Distribution - Moore River, WA
0
25
50
Meters
N
Vantor, Source: Esri, Vantor, Earthstar Geographics, and the GIS User Community, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
2026
This project is jointly funded by the Australian Government Natural Heritage Trust and NACC NRM, a member of the Commonwealth Regional Delivery Partners panel.
Legend
Saltmarsh
Paspalum
Survey Site
Australian Government
NACC