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Ashfield Flats Flora and Vegetation Report

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Ashfield Flats Flora and Vegetation Report

Species and Communities Program

September 2019

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1 Introduction

This flora and vegetation survey was commissioned to complement a hydrological study by the Department of Biodiversity, Conservation, and Attractions with the aim of better understanding the hydrology and floristics within the site Ashfield Flats, including the Commonwealth listed threatened ecological community “Subtropical and Temperate Coastal Saltmarsh” within the site. The work was supported by Perth Region NRM and then consolidated for multiple projects into a National Landcare Program grant. Findings from the recent surveys are presented in this report.

2 Study Area

2.1 Summary of previous studies

Syrinx (2004) summarised vegetation surveys undertaken within the Ashfield Flats site as part of the "Ashfield Foreshore Restoration Project (2005-2009)"; as follows "The two conservation habitats remaining on site include mixed Melaleuca Wetlands (*Melaleuca viminea* thickets, *Melaleuca rhaphiophylla* Woodland) and Samphire (*Sarcocornia* sp./*Haloscarcia* sp.) Flats…The site also contains many weed species (particularly *Typha orientalis*)". Since that study, *Typha orientalis* has been determined as naturalised in the south-west of Western Australia, and *Sarcocornia* and *Halosarcia* have been taxonomically updated to *Salicornia* and *Tecticornia* respectively.

Syrinx (2004) noted that Pen (1986) recorded flora species present within the site, as did Blair and Blatchford (DEC, 1978) and ATDG (1988) in the following studies;

- APACE WA (1988) - Ashfield Flats Design and Management Plan. Prepared for the Town of Bassendean - Carried out Site investigations
- ADTG - (1988) Ashfield Flats Design and Management Plan
- Pen, L.J. – (1983) Peripheral Vegetation of the Swan and Canning Estuaries (1981)
- The vegetation survey conducted on site (ATDG 1988) identified that 50% of the species at Ashfield Flats were weed species (22 native and 22 weed species were identified).

An environmental photo essay of the Ashfield Flats was also undertaken by Ron Van Delft (1986).

Syrinx (2004) noted that "The most thorough and complete assessment undertaken of vegetation communities at Ashfield Flats was conducted by Pen (1986). ATDG (1988) also developed a comprehensive species list for any restoration works on site. The report produced a list of species specific to particular elevations and landforms. Pen (1986) identified that Bulrush (*Typha orientalis*) and Club Rush (*Bolboschoenus caldwellii*) vegetation represented one of the seven major vegetation zones on Ashfield Flats and occupies a substantial proportion of the reserve (approximately 5%), in the south western corner between the Escarpment and the Kitchener Street Drain."

3 Site Detail

3.1 Description of regional vegetation complex

The soils on site are Pinjarra Plains with alluvial, colluvial deposits, and Bassendean Sands. The vegetation is Swan Complex, consisting of Melaleuca dominated wetlands, Samphire flats and *Eucalyptus rudis* woodlands.

3.2 Overview of Conservation Status

The key conservation, planning and tenure considerations pertinent to Ashfield Flats reserve include;

- Threatened ecological community (*Environmental Protection and Biodiversity Conservation Act 1999*);
- Conservation Category Wetland (*Environmental Protection Act 1986*); *State Planning Policy 2.9 – Water Resources*;
- Bush Forever Site 214 as part of Parks and Recreation reserved under the *Metropolitan Region Scheme (MRS). State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region;*
- Swan Canning Development Control Area (*Swan and Canning Rivers Management Act 2006*); and
- Chapman Street Main Drain – (Owned and management by the Water Corporation)

3.2.1 Threatened Ecological Community

Ashfield Flats contains an occurrence of the Subtropical and Temperate Coastal Saltmarsh community, which is listed as a threatened ecological community (TEC) under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). This TEC is ranked 'vulnerable'. Under section 182 (3)(b) of the EPBC Act, a TEC is listed as vulnerable if it is considered to be, *'facing a high risk of extinction in the wild in the medium-term* future' *(indicative timeframe being the next 50 years)* (https://www.environment.gov.au/biodiversity/threatened/communities/about#ec, extracted 17/04/19). A Recovery Plan is recommended; however, it is understood that no plan has yet been adopted or made for this ecological community.

Adequate protection and appropriate land use practices are important to ensure the ecological community persists to benefit future generations.

The recommended management actions include, but are not limited to, the following:

- Avoid native vegetation clearance and destruction of the ecological community and its buffer zones; including protecting potential areas of natural retreat.

- Undertake surveys to identify areas where natural retreat of Coastal Saltmarsh may be possible and manage those areas to enable natural retreat in the future.
- Undertake community engagement and education to promote the value of the ecological community; also, to highlight the importance of minimising disturbance (e.g. during recreational activities) and of minimising pollution and littering (e.g. through signage).
- Liaise with planning authorities to promote the inclusion of Coastal Saltmarsh protection and projected tidal inundation zones in their planning processes, including consideration of responses to climate change and sea level rise in coastal zone management.

(http://www.environment.gov.au/biodiversity/threatened/communities/pubs/118-conservation-advice.pdf)

The advice below has been extracted from Conservation Advice for subtropical and temperate coastal saltmarsh (DSEWPAC, 2013) as is relevant to the TEC present within the Ashfield Flats site:

Key diagnostic characteristics

The ecological community is the assemblage of organisms including and associated with coastal subtropical and temperate saltmarsh. Key diagnostic characteristics for describing the Coastal Saltmarsh ecological community include but are not limited to:

• occurs on the coastal margin, along estuaries and coastal embayments and on low wave energy coasts

• occurs on places with at least some tidal connection, including rarely-inundated supratidal areas, intermittently opened or closed lagoons, and groundwater tidal influences, but not areas receiving only aerosol spray

• occurs on sandy or muddy substrate and may include coastal clay pans (and the like)

• consists of dense to patchy areas of characteristic coastal saltmarsh plant species (i.e. salt- tolerant herbs, succulent shrubs or grasses, that may also include bare sediment as part of the mosaic) and

• proportional cover by tree canopy such as mangroves, Melaleucas or Casuarinas is not greater than 50%, nor is proportional ground cover by seagrass greater than 50%.

Condition thresholds and survey guidelines

Where the ecological community intergrades with an adjacent community, such as seagrass, mangroves, paperbark (*Melaleuca* spp.) and *Casuarina* spp. swamp, or freshwater marshes, then in this ecotone region, if 50% or more of the groundcover/understorey is comprised of coastal saltmarsh vegetation then it is considered to be the ecological community.

Patch size

Therefore patches of saltmarsh within a mosaic that are within 30 m of each other, and collectively are 0.1 ha or more are considered to be the ecological community (Figure 1b).

Exclusions

The following are excluded from the Coastal Saltmarsh ecological community:

• saltmarsh occurring in seepage zones on sea cliffs and elevated rock platforms above the tidal limit and on elevated headlands subject only to aerosolic salt

• saltmarsh occurring on inland saline soils with no tidal connection

• isolated patches of saltmarsh < 0.1 ha

• patches or areas of saltmarsh that contain > 50% weeds (i.e. patches must be dominated by native saltmarsh plant species to be the ecological community) and

• patches of saltmarsh (possibly senescent) within the coastal margin that are disconnected (either naturally or artificially) from a tidal regime but were once connected. However, should the patch be reconnected to the tidal regime (e.g. via removal of an artificial barrier, or constructing a pipeline under a roadway), then the patch can become part of the ecological community (i.e. if it meets other key diagnostics and condition thresholds).

Buffer zone

It is recommended that an appropriately sized buffer zone of influence be applied from the outer edge of the patch or area (i.e. size to be determined on a case-by-case basis depending on threat type, location and barriers). While the buffer zone is not formally part of the ecological community, it should be taken into account when considering likely 'significant impacts' during EPBC Act decision-making (as should any other areas where an action may have a significant impact on the ecological community).

Area critical to the survival of the ecological community

Of critical importance to the survival of the Coastal Saltmarsh ecological community is an ongoing connection with the adjacent tidal regime (whether regular or irregular).

Areas that meet the key diagnostic characteristics and condition thresholds plus an appropriate buffer zone are considered critical to the survival of the ecological community. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also considered important to the survival of the ecological community.

The Subtropical and Temperate Coastal Saltmarsh community at Ashfield Flats is not listed as a TEC under the *WA Biodiversity Conservation Act 2016*.

3.2.2 Conservation Category Wetland

Ashfield Flats contains portions of conservation category wetlands (UFIs 8563, 8574 and 8575) (CCWs). CCWs are wetlands that support a high level of environmental attributes and function (i.e. highest priority wetlands).

3.2.3 Bush Forever Site 214

Ashfield Flats is also a Bush Forever Site (Site 214 – Ashfield Flats – Bassendean/Ashfield) and is reserved as Parks and Recreation under the *Metropolitan Region Scheme* (MRS). *State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region* states that Bush Forever areas are defined as a *'classification of land in the MRS to protect and manage regionally significant bushland in accordance with this policy'*. The policy also provides a level of intent that Bush Forever Sites are retained for conservation. Further information on Bush Forever Sites can be found on the Department of Planning, Lands and Heritage website: https://www.dplh.wa.gov.au/information-and-services/district-and-regional-planning/region-planning-schemes/metropolitan-region-scheme/bush-forever.

3.2.4 Plantings within Ashfield Flats

Bassendean Preservation Group has historically undertaking planting of native flora within Ashfield Flats, and continues these works, and some weed control. Lists of native species planted within the wider Ashfield Flats area can be found at https://bpginc.info/planting.html.

4 Methodology

4.1 Survey approach

The floristic surveys were undertaken by a botanist and two ecologists from the DBCA Species and Communities Program. Surveys were undertaken from September 2018 to June 2019, and included collection of a range of floristic and vegetation data across the survey area (Figure 1), as detailed below.

4.2 Floristic quadrats

Six 10m x 10m floristic quadrats were established across the samphire flats, to ensure adequate sampling of the samphire community (see Figure 2). Quadrats were established as per EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment, as is appropriate for this area of the state. Data collected includes flora present, vegetation structure, condition and soil types (Appendix B). A field herbarium was also developed to assist in future surveys of the samphire area of the Ashfield Flats.

4.3 Flora and vegetation survey

Vegetation types and condition were mapped and recorded for the wider Ashfield Flats survey area and are provided at Section 5.4 below. Specimens requiring further identification were collected and tagged, pressed and dried according to WA Herbarium hygiene requirements, prior to submission for identification by taxonomic specialists at the WA Herbarium.

Vegetation units and condition were recorded, with dominant species from each stratum recorded as per NVIS level IV, and structure noted. Photographs were also taken throughout the site. Vegetation condition was assessed using the Keighery (1994) scale used in Bush Forever (2000).

Samphire specimens in particular require extra care and photographing when pressing, and require a longer drying period than other specimens, due to the high water content. Samphire specimens collected for this project were dried for several weeks, including at least a week in front of a fan. Appendix D details some collection instructions, prepared by Dr. Kelly Shepherd.

Introduced species (weeds) were recorded, and patches or locations of significant weeds were mapped, to assist in prioritising areas for weed control within the site.

4.4 Tree survey

A survey of trees was undertaken in the ‘parkland cleared’ component of the survey area. The location, species and size of those trees were recorded, to provide a reference for further management decisions for the Ashfield Flats. A list of trees

recorded is presented at Appendix C. Size was recorded on the basis of approximate diameter at breast height (DBH), and grouped into categories of Very Large (~60+cm DBH), Large (~50-60cm DBH), Medium (~10-50 cm DBH), Small (~5-10 cm DBH) and Saplings (smaller than ~5cm DBH). If trees were dead at the time of survey, or exhibiting significant signs of stress, that information was also recorded, as Very Stressed, Stressed, Slightly Stressed.

4.5 Flora identification

Flora identifications were undertaken by Mike Hislop, and samphire specimens were identified by Dr Kelly Shepherd, both from the DBCA State Herbarium. Professor Stephen Hopper also assisted with confirmation of identification of some of the Eucalypt specimens.

5 Results

5.1 Flora

47 native and 65 introduced taxa from 34 families were recorded during the survey (Appendix A) and section 5.3. The families with the greatest representation of taxa were Chenopodiaceae (samphires) with 10 taxa, Cyperaceae with 10 taxa, Myrtaceae with 19 taxa, Fabaceae (peas) with 15 taxa, and Poaceae (grasses) with 17 taxa.

Flora taxa recorded in Appendix A include naturally occurring species, native and introduced, and some species planted by the Bassendean Preservation Group (see https://bpginc.info/planting.html for planting lists). Plantings have taken place more in the eastern side of the Ashfield Flats, in areas that were predominantly cleared, and in some shoreline areas to assist with erosion control.

Plate 1: *Tecticornia pergranulata* subsp. *pergranulata* with flowers indicated

The orange arrow in the photograph above shows the inconspicuous yellow flowers of this specimen of *Tecticornia pergranulata* subsp. *pergranulata.*

Plate 2: *Tecticornia lepidosperma* specimen

DBCA Samphire Herbarium Senior Research Scientist Dr Kelly Shepherd (specialist in the genus *Tecticornia* and *Salicornia*) undertook identification of samphire specimens for the project. Many of the collected specimens were able to be identified, and the following *Tecticornia* and *Salicornia* species were confirmed to occur within the TEC:

- *Tecticornia pergranulata* subsp. *pergranulata*
- *Tecticornia indica* subsp. *bidens*
- *Tecticornia lepidosperma*
- *Tecticornia halocnemoides* (likely part of the species complex)

- *Salicornia quinqueflora*

Three additional specimens require more flowering material to confirm identification. Checks for additional flowering material have been made for these species, however searches for and collection of flowering material in subsequent months are recommended to confirm identification of these taxa, and are discussed in Section 6 below:

- *Salicornia* sp. (collection ASH05-02)
- *Tecticornia* sp. (collection ASH01-03 *Tecticornia* 'lime' – likely part of the *Tecticornia halocnemoides* species complex), and
- *Tecticornia* sp. (collection ASH06-01)

5.2 Flora of Conservation Significance

No flora of conservation significance were located during the survey.

5.3 Introduced flora including priority weeds

Many introduced flora were recorded during the survey, as would be expected in an area adjacent to parkland and subject to high recreational activity that assists movement of seed through the landscape. A list of native and introduced flora occurs at Appendix A, with weeds of highest priority for control mapped (Figures 3a and 3b), to assist in prioritising weed control. These include:

- **Arundo donax* (giant reed)
- **Cortaderia selloana* (pampas grass)
- **Hyparrhenia hirta* (tambookie grass)
- **Ipomoea indica* (morning glory)
- **Rubus laudatus* (blackberry)
- **Rumex crispus* (curled dock)
- **Ricinus communis* (castor oil plant)
- **Melia azedarach* (Cape lilac)
- **Schinus terebinthifolia* (pepper tree)
- **Symphyotrichum squamatum* (bushy starwort)

None of these species, or other introduced species as shown in Appendix A are classified as WONS (Weeds of National Significance), however the species listed above are known for their invasiveness. Many of the species were observed either in or adjacent to the Chapman Street drain, and control of such species in this area will assist in inhibiting their spread.

Control of some of these species has recently commenced, and some weed removal by the Bassendean Preservation Group has also been undertaken, most recently including removal of **Symphyotrichum squamatum* (Bushy Starwort) near the river edge.

Typha orientalis has historically been considered an introduced species, however more recently has been determined as naturalised for the south west of Western Australia. Potential monitoring and management of this species is discussed in Section 6 below.

Casuarina obesa was recorded extensively within the site, and in some areas **Casuarina ?glauca* was observed to occur. *C. glauca* is an introduced sheoak that regenerates through production of root suckers. Stands of trees considered likely to be this species were observed in areas where *C. obesa* also occurred, with differences in morphology observed in the field, (eg clusters of Casuarina trees that are lighter in appearance than the older individual *C. obesa* trees).

Many planted Eucalyptus trees were observed and recorded in the site, and are discussed in Section 5.8 below.

5.4 Vegetation units

20 vegetation units and seven non vegetation units were recorded within the Ashfield Flats survey area. The units marked as # in Table 1 below are considered part of the TEC, as per criteria detailed in Section 3.2.1 above.

Table 1: Vegetation units recorded within the Ashfield Flats survey area

Note: # denotes vegetation units considered part of the Subtropical and Temperate Coastal Saltmarsh TEC

Vegetation Symbol	Vegetation Description
Te #	Low Shrubland to Closed Low Heath of *Tecticornia pergranulata* subsp. *pergranulata*, *Tecticornia indica* subsp. *bidens*, *Tecticornia lepidosperma*, *Tecticornia halocnemoides*, *Salicornia quinqueflora* and *Suaeda australis* on seasonally inundated flats. Dominance of these species varies throughout the community.
MrJkTe #	Previously burnt Low Open Woodland of *Melaleuca rhaphiophylla*, over scattered *Tecticornia* low shrubs spp.
ErMr #	Woodland to Open Forest of *Eucalyptus rudis*, over Low Woodland to Low Open Forest of *Melaleuca rhaphiophylla.*
B	*Bolboschoenus caldwellii* sedgeland

Mr #	Low Woodland to Low Open Forest of *Melaleuca rhaphiophylla,* sometimes over Sedgeland to Open Sedgeland of *Bolboschoenus caldwellii.* Contains some areas of previously burnt *Melaleuca rhaphiophylla.*
Co #	*Casuarina obesa* occasionally with *Casuarina ?glauca*
CoT #	Low Open Woodland (to scattered trees) of *Casuarina obesa* over Low Open Shubland of *Tecticornia* spp. over Grassland of ?*Lolium* sp. (dead). In modified (raised) central area of TEC samphire unit, and small patch to east of 'Te' *Tecticornia* samphire unit
CoJa	Fringing *Casuarina obesa* and *Eucalyptus* sp. trees over scattered *Juncus kraussii* subsp. *australiensis* and *Schoenoplectus tabernaemontani* sedges (including plantings) on river banks.
To	**Typha orientalis* sedgeland
MosMvMrBc #	Mosaic of *Melaleuca viminea*, grasses, previously burnt *Melaleuca* ?*rhaphiophylla*, *Bolboschoenus caldwellii* and *Atriplex prostrata*. Scattered patches of **Typha orientalis*.
Mv #	Tall Shrubland of *Melaleuca viminea* subsp. *viminea*
MrBc #	Low Woodland to Low Open Forest of *Melaleuca rhaphiophylla,* sometimes over Sedgeland to Open Sedgeland of *Bolboschoenus caldwellii.* Contains some areas of previously burnt *Melaleuca ?rhaphiophylla.*
MosMrTe #	Mosaic of *Melaleuca rhaphiophylla* over *Tecticornia* spp.
J1	Closed Sedgeland of *Juncus krausii* subsp. *australiensis* with scattered *Atriplex prostrata* and *Suaeda australis* low shrubs, and scattered emergent *Melaleuca rhaphiophylla* trees. In some areas the *Suaeda australis* is more dominant, and the *Melaleuca rhaphiophylla* is much reduced.
J2	Sedgeland of *Juncus kraussii* subsp. *australiensis*
J3	Closed Sedgeland of *Juncus kraussii* subsp. *australiensis* over scattered *Tecticornia* spp., with occasionally emergent *Casuarina* sp. and *Eucalyptus* sp. saplings.
OW	Open water
SI	Seasonally inundated

Pl	Planted areas (BPG)
PC	Parkland cleared areas with remnant trees and (Pl)
***A**	**Acacia* sp. (Likely *A. podalyriifolia*)
***Rl**	**Rubus laudatus* (Blackberry) under canopy of *Eucalyptus rudis*.
Mod	Modified river bank (reinforced)
DistEr	*Eucalyptus rudis* over *Melaleuca rhaphiophylla* over disturbed understorey of introduced Cyperaceae spp, **Arundo donax* (Giant Reed). A large **Salix babylonica* (Willow Tree) was also recorded in the vicinity.
Dr	Drain
Tracks	Tracks/Paths
CoD	*Casaurina obesa* growing adjacent to drain

Plate 3: Samphire vegetation within the Subtropical and Temperate Coastal Saltmarsh community Threatened Ecological Community

The photograph above shows vegetation unit Te, as described in Table 1 above. The samphire vegetation is subject to inundation here.

5.5 Vegetation of Conservation Significance

The areas comprising the TEC "Subtropical and Temperate Coastal Saltmarsh community" include the samphire areas (Te), and surrounding woodland areas, sedgeland and wetland areas, (vegetation units considered part of the Subtropical and Temperate Coastal Saltmarsh TEC are marked with # in Table 1 above) and are considered to be of conservation

The areas classified as Parkland Cleared and Degraded have reduced conservation significance, however works can be undertaken to improve the quality of vegetation in these areas, as is occurring in areas mapped as 'Parkland Cleared with plantings', and some areas of shoreline where revegetation/rehabilitation is being undertaken by the Bassendean Preservation Group to address continuing erosion.

5.6 Vegetation condition

Vegetation within the survey area ranged from Excellent-Very Good in areas of the samphire community (see Figure 5), to Completely Degraded, in areas of high previous disturbance, and in areas adjacent to pedestrian access, where many weed species were recorded.

Much of the predominant component of the TEC that occurs within the site, the (Te - *Tecticornia/Salicornia/Suaeda*) samphire flats were recorded as being in Very Good to Excellent condition. Relatively few weeds were recorded within this area, with the grass **Polypogon monspeliensis* in most of the floristic quadrats, however with low cover.

Pen (1983) notes for the Swan and Canning Estuaries that "*Typha orientalis* invasion has caused the displacement of many understorey species normally associated within the fringing forest complexes." *Typha orientalis* is now considered naturalised in south western Australia, and does not appear to currently be dominating the Ashfield Flats wetland areas. Pockets of *Typha orientalis* were mapped during this project, and are shown on Figures 4, 4a, 4b and 4c. Consideration of *Typha orientalis* in future management is discussed in Section 6 below.

Pen (1983) also noted that *Bolboschoenus caldwellii* "is another species the distribution of which can be correlated with fresh water flushing originating from drains." The current distribution of vegetation dominated by *Bolboschoenus caldwellii* is shown in Figures 4, 4a, 4b and 4c.

As would be expected in a site subject to historical disturbance in parts, and with adjacent parkland, a high proportion of introduced species were recorded during the survey (Appendix A).

Water quality within the site is likely to be variable, and a review of how current vegetation condition relates to hydrological flows and nutrients is recommended once hydrological studies are completed.

5.7 Vegetation photographs

Photographs of marked vegetation quadrats within the samphire areas of the TEC are shown in Appendix A. Additional photos are shown below.

Plate 4: Samphire vegetation within the TEC

The photo above shows the *Tecticornia* (samphire) vegetation in the north east side of the TEC.

Plate 5: Fringing river vegetation

Casuarina obesa (swamp sheoak) tree, *Eucalyptus* sp. and *Juncus kraussii* subsp. *australiensis* sedges (vegetation unit CoJa) Note the very limited fringing vegetation in this area.

Plate 6: Samphire vegetation within the Ashfield Flats TEC

Samphires in the photo below include *Tecticornia* and *Salicornia* shrubs (foreground) surrounded by tall *Melaleuca* shrubland.

Plate 7: *Juncus kraussii* subsp. *australiensis* (J2 vegetation unit)

The photo above is from the J2 vegetation unit looking east from the path in the western side of Ashfield Flats, that leads to the boardwalk adjacent to the river. The vegetation above is in Good condition.

Plate 8: *Juncus kraussii* subsp. *australiensis* (J3 vegetation unit)

The photo above is from the J3 vegetation unit, to the east of the Ashfield Flats (Te) saltmarsh area and contains vegetation dominated by *Juncus kraussii* subsp. *australiensis* with scattered *Tecticornia* (samphire) shrubs, and scattered emergent Casuarina and Eucalypt saplings.

Plate 9 (left): Degraded vegetation adjacent to Chapman Street drain,

Plate 9 shows **Rumex crispus* (curled dock) and introduced grasses with *Persicaria decipiens* in the foreground, and large stand of **Arundo donax* (giant reed) in the background, adjacent to the Chapman Street drain.

Plate 10 (right): Degraded vegetation in Chapman Street drain

Plate 10 shows stands of **Arundo donax* (giant reed) and a mass of **Ipomoea indica* (morning glory) in the Chapman Street drain. Management of weeds in the drain is required to prevent further spread.

Plate 11: Area designated as higher priority for weed control

This area was recorded adjacent to the path on the western side of Ashfield Flats, and shows introduced Cyperaceae weeds in the understorey

Plate 12: *Typha orientalis*, **Cortaderia selloana* (Pampas Grass)

The photo above shows one of the larger patches of *Typha orientalis, with *Cortaderia selloana* (pampas grass) (lighter green vegetation with emerging flower heads on the right side of the photograph).

The *Eucalyptus rudis*/*Melaleuca rhaphiophylla* (ErMr vegetation unit) shrubland is shown in the background. This area is on the western side of Ashfield Flats, adjacent to cleared parkland which adjoins the nearby residential area.

Plate 12: Degraded vegetation

The photograph above shows planted native Eucalypt trees (foreground) and tall *Melaleuca* shrubs (background) with Degraded understorey of introduced grasses including **Avena barbata* (bearded oat).

5.8 Tree survey

276 individual trees, or small groups of trees were mapped in parkland cleared areas. Methodology for the trees survey is described in Section 4.4 above. Trees in these areas included some that were likely naturally occurring, native species *Eucalyptus rudis*, and a large number of non-local introduced Eucalypt species including *Eucalyptus camaldulensis,* and other hybrids, some *Melaleuca rhaphiophylla* and *M. viminea* trees, and *Casuarina obesa* and *Casaurina ?glauca* trees. An area of trees that appeared were exhibiting signs of stress occurred in the south of the tree survey area (see Appendix C for relevant tree numbers).

6 Recommendations for further investigation

As a result of the recent surveys, flora lists have been updated, and vegetation types and condition have been mapped. Knowledge of the specific samphire species within the TEC at Ashfield Flats has improved, and recommendations for further investigation to inform management can be made.

6.1 Weed control

Priorities for sites for control of significant weeds (see section 5.3) have been recommended, and control works have commenced.

- Areas known to have had weed control works undertaken should be monitored to assess effectiveness of weed control, and inform future weed control works.
- Weed control works to control **Polypogon monspeliensis* within the samphire area should be undertaken, with careful targeting to minimize any impact to the TEC.
- Monitoring of the effectiveness of weed control within the TEC should be established.

6.2 Confirmation of flora

As detailed in Section 5.1 above, *Tecticornia* and *Salicornia* specimen identification was undertaken by Dr Kelly Shepherd. Many of the collected samphires were positively identified, however three specimens require more flowering material for confirmation of identification. Checks for additional flowering material have been made for these species, however searches for and collection of flowering material in subsequent months are recommended to confirm identification of these taxa:

- *Salicornia* sp. (collection ASH05-02)
- *Tecticornia* sp. (collection ASH06-02 Tecticornia 'lime'), and
- *Tecticornia* sp. (collection ASH06-01)

Some samphire taxa were collected and recorded more than once, so the species above may have already been positively identified for the site, however at least one, *Tecticornia* 'lime'(ASH06-02) appears morphologically distinct from other collections, and is not expected to be one of the samphire species recently identified for the site. Searches for more flowering material for this species are recommended.

6.3 Monitoring of *Typha orientalis*

Typha orientalis was historically considered an introduced species, however it is now considered naturalised in the south west of Western Australia.

- Monitoring of the extent of *Typha orientalis* (using the current mapped patches as a baseline) is recommended, to assess whether this species outcompetes other wetland flora.

6.4 Research to fill gaps in data

Survey and flora identification work to date has facilitated commencement of a review of available scientific research literature regarding specific tolerance (of salinity, waterlogging and submergence) of many of the samphire species.

Some of the samphire species present are yet to have data published on them, and future recommendations for research projects to fill these knowledge gaps are described below. This information would support management decisions regarding flow and quality of water within the site.

Data are available particularly for *Tecticornia pergranulata*, and some for *T. indica*/*T. indica* subsp. *bidens*, however some samphire species recorded at the site currently have limited or no available literature on their tolerance thresholds, and further research is required about these taxa to inform management within the site.

- Literature review should be continued to add to existing knowledge of relevant samphire species to inform future management (and develop monitoring) of the TEC.

Discussions with Professor Tim Colmer (UWA), who in collaboration with colleagues/students, has published much of the available information on waterlogging/salinity tolerance for samphire species relevant to this survey have identified potential further research that would assist in management of the TEC. Collection of seed from specific samphires within the site could be undertaken by a suitably qualified botanist/ecologist, for the purposes of germination of plants of the samphire specimens for which there are limited published data. Trials on plants of these species, and on *Tecticornia pergranulata*, could then be undertaken. Outcomes of trials on the species for which there is limited available data could then be undertaken, so that any findings could then be assessed in the context of available data published for *Tecticornia pergranulata.*

Associate Professor Erik Veneklaas from UWA's School of Biological Sciences was consulted regarding his collaborative publication on drought tolerance of *Tecticornia* species (including *Tecticornia indica* subsp. *bidens*). This species occurs within the TEC at Ashfield Flats, and potential collaboration for trials on the tolerance of *Tecticornia* species have been discussed with Associate Professor Erik Veneklaas and Dr Kelly Shepherd (DBCA). Trials on the tolerance of samphire species, in collaboration with experts in this field would be of benefit for future management regarding floristic and hydrological interactions within the site.

In summary, recommended future research work includes:

- Establishing trials on samphire species known to occur in the TEC, to fill current gaps in knowledge

- Assessing flora and hydrological survey data from the recent surveys together, to clarify the relationship between recorded hydrological measurements/electrical conductivity and how they relate to the literature for known tolerance levels of samphire species.

6.5 An integrated monitoring program

Once collection of remaining baseline floristic and hydrological data is complete, establishing monitoring of the TEC is recommended, to be modelled around a well considered monitoring question regarding components of the TEC and anticipated effects of altered hydrology within the site.

Future monitoring recommended:

- Develop a strategic monitoring program once management decisions regarding drains/water flow/water quality within the site have been made.

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Appendices

Appendix A: Flora taxa recorded at Ashfield Flats

Note *denotes introduced species

FAMILY	Floristic Taxa
Anacardiaceae	**Schinus terebinthifolia*
Apiaceae	*Apium prostratum* subsp. *prostratum* *Centella asiatica*
Asteraceae	**Cotula coronopifolia* **Hypochaeris glabra* **Sonchus oleraceus* **Symphyotrichum squamatum* *Polygonum aviculare*
Brassicaceae	**Lobularia maritima*
Caryophyllaceae	*Spergularia marina*
Casuarinaceae	**Casuarina ?glauca* *Casuarina obesa*
Chenopodiaceae	**Atriplex prostrata* Chenopodiaceae sp. *Salicornia quinqueflora* *Salicornia* sp. *Suaeda australis* *Tecticornia halocnemoides* species complex *Tecticornia indica* subsp. *bidens* *Tecticornia lepidosperma* *Tecticornia pergranulata* subsp. *pergranulata* *Tecticornia* sp.
Convolvulaceae	**Ipomoea indica*
Cyperaceae	*Baumea preissii* *Bolboschoenus caldwellii* **Carex divisa* **Cyperus involucratus* **Cyperus polystachyos* **Cyperus tenellus* **Cyperus tenuiflorus* *Isolepis cernua* var. *cernua* *Lepidosperma gladiatum* *Schoenoplectus tabernaemontani*
Dennstaedtiaceae	*Pteridium esculentum*

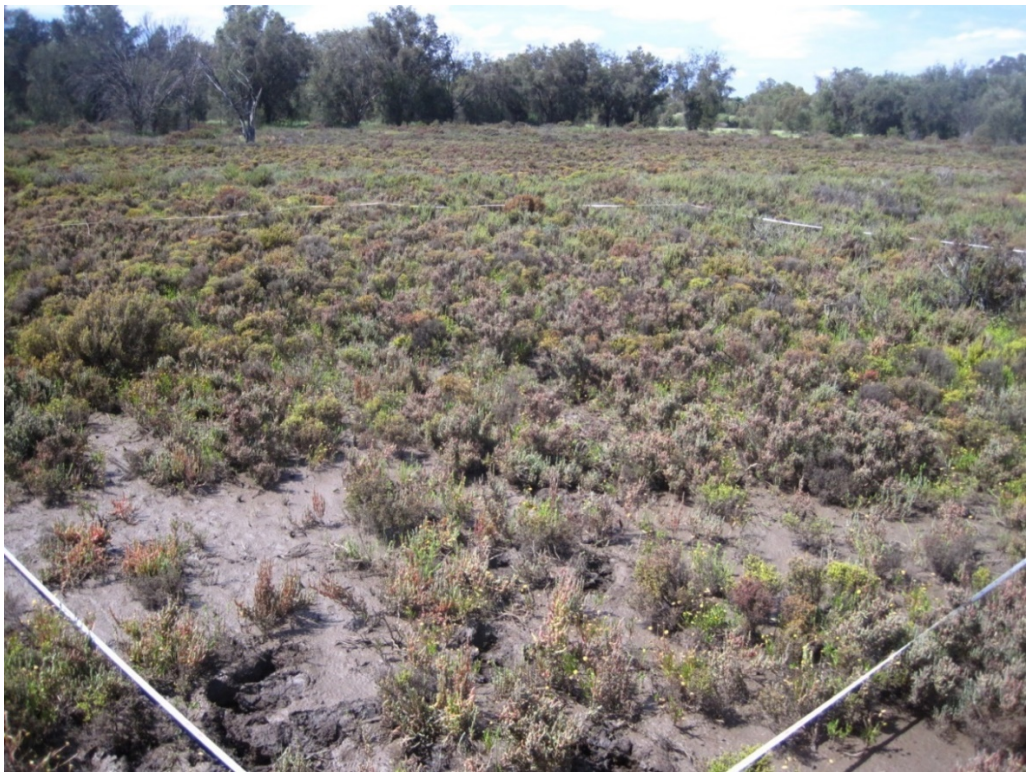
FAMILY	Floristic Taxa
Euphorbiaceae	**Ricinus communis*
Fabaceae	**?Acacia dentifera* **Acacia longifolia* **Acacia podalyriifolia* *Acacia pulchella* *Acacia saligna* *Gastrolobium ebracteolatum* *Hardenbergia comptoniana* *Jacksonia furcellata* **Lotus subbiflorus* **Melilotus indicus* **Trifolium fragiferum* var. *fragiferum* *Paraserianthes lophantha* subsp. *lophantha* **Vicia hirsuta* **Vicia sativa* subsp. *nigra* *Viminaria juncea*
Frankeniaceae	*Frankenia pauciflora* var. *pauciflora*
Gentianaceae	**Centaurium tenuiflorum*
Goodeniaceae	*Lobelia anceps*
Iridaceae	**Gladiolus undulatus* **Sparaxis bulbifera*
Juncaceae	**Juncus bufonius* *Juncus kraussii* subsp. *australiensis*
Juncaginaceae	*Triglochin mucronata*
Loranthaceae	*Amyema linophylla* subsp. *linophylla*
Meliaceae	**Melia azedarach*
Moraceae	**Ficus carica*
Myrtaceae	*Agonis flexuosa* **Callistemon* sp. **Corymbia calophylla* x *Corymbia ficifolia* *Corymbia calophylla* **Eucalyptus camaldulensis* s. lat. **Eucalyptus* sp. Sect. Bisectae **Eucalyptus* sp. *Eucalyptus rudis* **Eucalyptus rudis* x *Eucalyptus camaldulensis* **Eucalyptus ?utilis* *Melaleuca cuticularis* *Melaleuca lateritia* **Melaleuca leucadendra*

FAMILY	Floristic Taxa
Myrtaceae continued	**Melaleuca nesophila*
	Melaleuca preissiana
	Melaleuca rhaphiopylla
	**Melaleuca radula*
	Melaleuca teretifolia
	Melaleuca viminea subsp. *viminea*
	Taxandria linearifolia
Oleaceae	**Olea europa*
Oxalidaceae	**Oxalis pes-caprae*
Papaveraceae	**Fumaria capreolata*
Plantaginaceae	**Plantago lanceolata*
Poaceae	**Arundo donax*
	**Avena barbata*
	**Briza maxima*
	**Briza minor*
	**Bromus diandrus*
	**Cortaderia selloana*
	**Cynodon dactylon*
	**Ehrharta calycina*
	**Eragrostis curvula*
	**Hordeum marinum*
	**Hyparrhenia hirta*
	**Lolium multiflorum*
	**Lolium perenne* x *rigidum*
	**Paspalum dilatatum*
	Paspalum vaginatum
	**Polypogon monspeliensis*
	**Stenotaphrum secundatum*
Polygonaceae	*Persicaria decipiens*
	**Rumex crispus*
Primulaceae	**Lysimachia arvensis*
	Samolus repens var. *repens*
Proteaceae	*Hakea prostrata*
	Hakea varia
Rosaceae	**Rubus laudatus*
Salicaceae	**Salix babylonica*
Solanaceae	**Solanum nigrum*
Typhaceae	**Typha orientalis*

Appendices

Appendix B: Floristic Quadrat Data for Ashfield Flats

Quadrat 1:



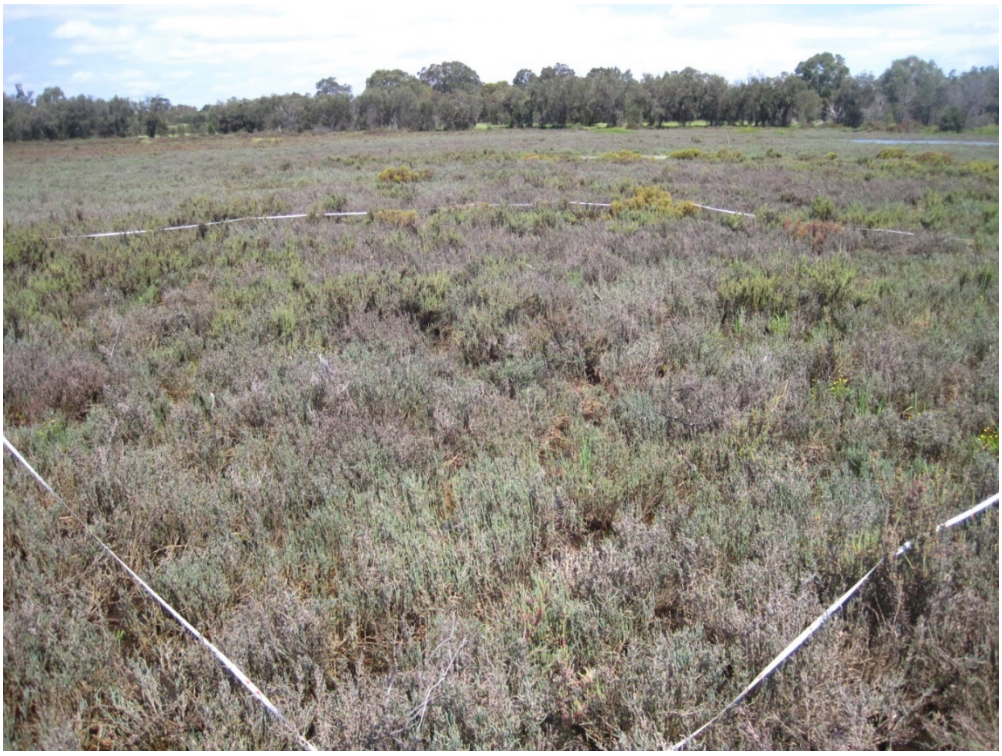
Site	Ash01
Date	11-Oct-18
Location	Ashfield Flats
Described by	CH WH
Topography	Wet flats, seasonal wetland
Observation Type	Quadrat
Site Dimension	10x10m quadrat
Vegetation condition	Excellent-Very good
Fire notes	Fire has been observed in other parts of the occurrence
Observation notes	Algal mats, waterlogged, some older *Tecticornia* shrubs seem to be senescing, one large *Tecticornia* (0.5mHx1,2mW) dead. Dead 4m ?*Casuarina* outside south east corner of quadrat
NW Corner coordinate	400353mE, 6468032mN
Photo Number	100-0098, 100-0099
Litter Cover (leaf)	2%
Soil Colour	Dark Brown
Surface soil	Clay (mud)
Bare ground	5%

Flora Taxa recorded in ASH01

**Cotula coronopifolia* (Waterbuttons)
Poaceae sp.
Tecticornia indica subsp. *bidens*
Tecticornia lepidosperma
Tecticornia pergranulata subsp. *pergranulata* (Blackseed Samphire)
Tecticornia sp.
Triglochin mucronata

Shrubs under 1m (*Tecticornia* spp 30-70%), Herbs 10-30% (*Cotula coronopifolia*, *Triglochin mucronata*).

Quadrat 2:



Site	Ash02
Date	11-Oct-18
Location	Ashfield Flats
Described by	CH WH
Topography	Wet flats, seasonal wetland
Observation Type	Quadrat
Site Dimension	10x10m quadrat
Vegetation condition	Excellent
Observation notes	Inundated to 5cm
NW Corner coordinate	400282mE, 6468123mN
Photo Number	100-0013, 100-0012
Soil Colour	Dark Brown
Surface soil	Clay
Bare ground	5%

Flora taxa recorded in ASH02

**Cotula coronopifolia* (Waterbuttons)
**Polypogon monspeliensis* (Annual Beardgrass)
Salicornia quinqueflora (Beaded Samphire)
Suaeda australis (Seablite)
Tecticornia lepidosperma

Tecticornia sp.
Triglochin mucronata

Shrubs under 1m 30-70% (*Sarcocornia quinqueflora, Tecticornia lepidosperma*)

Quadrat 3:

Site	Ash03
Date	26-Nov-18
Location	Ashfield Flats
Described by	CH SM
Topography	Wet flats, seasonal wetland
Observation Type	Quadrat
Site Dimension	10x10m quadrat
Vegetation condition	Excellent
Fire notes	Fire has been observed in other parts of the occurrence
Observation notes	Located near existing boardwalk
NW Corner coordinate	31.91947, 115.94251
Photo Number	100-0110, 100-0011
Litter Cover (leaf)	1%
Soil Colour	Dark Brown
Surface soil	Clay (mud)
Bare ground	1%

Flora taxa recorded in ASH03

Apiaceae sp.
**Atriplex prostrata* (Hastate Orache)
Bolboschoenus caldwellii (Marsh Club-rush)
Casuarina obesa (Swamp Sheoak)
**Cotula coronopifolia* (Waterbuttons)
Juncus kraussii subsp. *australiensis*
**Lolium multiflorum* (Italian Ryegrass)
Samolus repens var. *repens*
Sarcocornia quinqueflora (Beaded Samphire)
Poaceae sp.
Suaeda australis (Seablite)

Trees under 10m (*Casuarina obesa* 6m, 6% (overhang)), shrubs under 1m (*Suaeda australis* 75%), Sedges (*Bolboschoenus caldwellii* 7%, *Juncus kraussii* subsp. *australis* 12%)

Quadrat 4

Site	Ash04
Date	26-Nov-18
Location	Ashfield Flats
Described by	CH SM
Topography	Wet flats, seasonal wetland
Observation Type	Quadrat
Site Dimension	10x10m quadrat
Vegetation condition	Excellent
Observation notes	Cracking clay at surface, well drained. Tyre tracks through south west corner.
NW Corner coordinate	31.91941, 115.94379
Photo Number	100-0112, 100-0113
Litter Cover (leaf)	0.5%
Soil Colour	Brown
Surface soil	Clay
Bare ground	0.5%

Flora taxa recorded in ASH04

**Atriplex prostrata* (Hastate Orache)
Bolboschoenus caldwellii
**Cotula coronopifolia* (Waterbuttons)
**Lolium multiflorum* (Italian Ryegrass)
Poaceae sp.
**Polypogon monspeliensis* (Annual Beardgrass)
Salicornia quinqueflora (Beaded Samphire)
Suaeda australis (Seablite)

Shrubs under 1m (*Salicornia quinqueflora* and *Suaeda australis* 95%), Sedges (*Bolboschoenus caldwellii* 2.5%)

Quadrat 5

Site	Ash05
Date	26-Mar-19
Location	Ashfield Flats
Described by	CH SM
Topography	Wet flats, seasonal wetland
Observation Type	Quadrat
Site Dimension	10x10m quadrat
Vegetation condition	Very Good
Observation notes	Dead *Melaleuca* standing but not resprouting (previously burnt). Soil surface quite greasy.
NW Corner coordinate	400317mE, 6468295mN
Photo Number	SM 9.26
Litter Cover (leaf)	4%
Soil Colour	Dark Brown
Surface soil	Clay (mud)
Bare ground	12%

Flora taxa recorded in ASH05

Isolepis cernua var. *cernua*
**Juncus bufonius* (Toad Rush)
**Polypogon monspeliensis* (Annual Beardgrass)
Salicornia sp.
Suaeda australis (Seablite)
Tecticornia lepidosperma

Shrubs under 1m (*Salicornia* sp. 65%, *Tecticornia lepidosperma* 10%)

Quadrat 6

Site	Ash06
Date	26-Mar-19
Location	Ashfield Flats
Described by	CH SM
Topography	Wet flats, seasonal wetland
Observation Type	Quadrat
Site Dimension	10x10m quadrat
Vegetation condition	Very Good
Observation notes	Seasonal wetland, gentle slope, slight south westerly aspect, soil colour brown/orange, winter/spring wet, 2% litter cover, 20% bare ground. Dead 4m *Casuarina* ?*obesa* outside SE corner
NW Corner coordinate	31.91798, 115.94749
Photo Number	CH 950 x2
Litter Cover (leaf)	2%
Soil Colour	Brown/orange
Surface soil	Clay
Bare ground	20%

Flora taxa recorded in ASH06

Poaceae sp.
**Polypogon monspeliensis* (Annual Beardgrass)
Tecticornia sp. (likely *halocnemoides* species complex)
Triglochin mucronata

Shrubs under 1m (*Tecticornia* sp. 50%), Grasses (**Polypogon monspeliensis* and Poaceae sp.) 2%, Herbs (*Triglochin mucronata* 1%).

Appendices

Appendix C: Trees recorded in Parkland Cleared areas of Ashfield Flats

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
1	52	*Eucalyptus rudis* x 5	M		
2	53	*Eucalyptus rudis*	L		
3	54	**Acacia podalyriifolia*	S		
4	55	**Corymbia calophylla* x *C. ficifolia*	M		
5	56	*Eucalyptus rudis*	M		
6	57	*Eucalyptus rudis*	Sapling		
7	58	*?*Eucalyptus* sp.	L		
8	59	*Eucalyptus* sp.	L		
9	60	*Corymbia calophylla*	M		
10	61	**Eucalyptus* sp.	L		
11	62	*Corymbia calophylla*	M		
12	63	*Corymbia calophylla*	S		
13	64	*Eucalyptus rudis*	VL		
14	65	*Corymbia calophylla*	M		
15	66	*Corymbia calophylla*	M		
16	67	*Corymbia calophylla*	M		
17	68	*Corymbia calophylla*	M		
18	69	*Corymbia calophylla*	L		
19	70	*Corymbia calophylla*	M		
20	71	*Corymbia calophylla*	M		
21	72	*Corymbia calophylla*	S		
22	73	*Corymbia calophylla*	S		
23	74	*Eucalyptus rudis*	M		
24	75	*Corymbia calophylla*	M		
25	76	*Eucalyptus rudis*	L		*Eucalyptus* sp. seedlings within trees in patch, some dead
26	77	*Corymbia calophylla*	M		
27	78	*Corymbia calophylla*	M		
28	79	*Corymbia calophylla*	M		
29	80	?*Corymbia calophylla* (mixed seedlings - see other species)	Seedlings		Also *Hakea prostrata*, *Hakea* spp. Seedlings
30	81	**Corymbia calophylla* x *C. ficifolia*	M		
31	82	*Eucalyptus rudis*	M		
32	83	*Eucalyptus rudis*	M		

Tree Number (refer to Figure 6)	Field Way point	*Species*	Size	Ranking (if stressed/ dead)	Comments
33	84	*Eucalyptus rudis*	S		
34	85	*Eucalyptus rudis*	M		
35	86	*Eucalyptus rudis*	M		
36	87	*Eucalyptus rudis*	M		
37	88	*Eucalyptus rudis*	S		
38	89	*Eucalyptus rudis*	M		
39	90	*Eucalyptus* sp.	S		
40	91	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
41	92	**Eucalyptus* sp.	L		
42	93	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	S		
43	94	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	S		
44	95	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	S		
45	96	*Eucalyptus rudis*	Sapling		
46	97	*Eucalyptus rudis*	Sapling		
47	98	*Eucalyptus rudis*	Sapling		
48	99	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	S		
49	100	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
50	101	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
51	102	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
52	103	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
53	104	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
54	105	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
55	106	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
56	107	*Eucalyptus rudis*	M		
57	108	*Melaleuca rhaphiophylla*	M		
58	109	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
59	110	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	S		
60	111	*Corymbia calophylla*, **Casuarina ?glauca*	Saplings		
61	112	*Eucalyptus rudis*	L		

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
62	113	*Eucalyptus rudis*	S		
63	114	*Eucalyptus rudis*	M		
64	115	*Eucalyptus rudis*	L		
65	116	*Eucalyptus rudis*	S		
66	117	*Eucalyptus rudis*	S		
67	118	*Eucalyptus rudis*	S		
68	119	*Eucalyptus rudis*	M		
69	120	*Eucalyptus rudis*	L		
70	121	*Eucalyptus rudis*	S		
71	122	*Corymbia calophylla* + 4 x *Corymbia calophylla* saplings	S		
72	123	*Eucalyptus rudis*	M		
73	124	*Corymbia calophylla* + 3 x *Eucalyptus rudis* saplings	M		
74	125	*Corymbia calophylla*	S		
80	155	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	S		
81	156	*Eucalyptus rudis*	S		
82	157	**Eucalyptus rudis* x *E. camaldulensis*	S		
83	158	*Eucalyptus* ?*rudis*	Sapling		
84	159	**Eucalyptus rudis* x *E. camaldulensis*	S		
85	160	**Eucalyptus rudis* x *E. camaldulensis*	S		
86	161	**Eucalyptus rudis* x *E. camaldulensis*	M		
87	162	*Eucalyptus* ?*rudis*	M		
88	163	*Eucalyptus* ?*rudis*	Sapling		
89	164	**Eucalyptus rudis* x *E. camaldulensis*	M		
90	135	*Eucalyptus* sp. + *Corymbia calophylla* saplings	L		
91	142	**Eucalyptus rudis* x *E. camaldulensis*	L		
92	174	**Eucalyptus rudis* x *E. camaldulensis*	M		
93	175	**Eucalyptus rudis* x *E. camaldulensis*	S		
62	176	**Eucalyptus rudis* x *E. camaldulensis*	M		
63	177	C*orymbia calophylla* + *Melaleuca rhaphiophylla*	M		Also *Agonis flexuosa* here.

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
94	178	**Eucalyptus rudis* x *E. camaldulensis* + *Eucalyptus rudis* saplings	L		
95	179	*Eucalyptus* sp. (dead)	M	Dead	
96	180	*Eucalytus* sp.	M		
97	181	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
98	182	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
99	183	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	Sapling		
100	184	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
101	185	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
102	186	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
103	187	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
104	188	*Eucalyptus* sp. (dead)	S	Dead	
105	189	*Eucalyptus rudis*	M		
106	190	*Eucalyptus rudis*	M		
107	191	*Eucalyptus rudis*	M		
108	192	*Eucalyptus rudis*	S		
109	193	*Eucalyptus rudis*	S		
110	194	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
111	195	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
112	196	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
113	197	*Eucalyptus rudis*	S		
114	198	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
115	199	*Eucalyptus rudis*	S		
116	200	*Melaleuca rhaphiophylla*	M		On edge of bush patch
117	201	*Acacia saligna*	M		
118	202	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		Dead *Melaleuca viminea* x 2
119	203	*Eucalyptus rudis*/**E. rudis* x *E. camaldulensis*	M		
120	204	*Melaleuca viminea* x 20	M		
121	205	*Casuarina obesa*	M		
122	206	*Eucalyptus rudis*	S		
123	207	*Eucalyptus rudis*	M		

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
124	208	*Eucalyptus rudis/*E. rudis x E. camaldulensis* x 2	M		
125	209	*Eucalyptus rudis/*E. rudis x E. camaldulensis* (dead)	M	Dead	Surrounded by *Melaleuca viminea, Melaleuca rhaphiophylla, Hakea prostrata*
126	210	*Eucalyptus rudis*	L		
127	211	*Eucalyptus rudis/*E. rudis x E. camaldulensis*	M		
128	212	*Eucalyptus rudis /* E. rudis x E. camaldulensis*	M		
129	213	*Casuarina obesa*	M		
130	214	*Corymbia calophylla*	S		
131	215	*Casuarina ?glauca*	M		
132	216	*Meleleuca viminea, Melaleuca rhaphiophylla*	M		also *Casuarina* ?glauca, *Eucalyptus* ?*rudis* saplings
133	217	*Eucalyptus rudis/*E. rudis* x *E. camaldulensis* x 2 L, 4 medium	L/M		
134	218	*Melaleuca teretifolia, Melaleuca rhaphiophylla*	M		
135	219	*Eucalyptus rudis/*E. rudis* x *E. camaldulensis*	M		
136	220	*Corymbia calophylla*	M	Very Stressed	
137	221	*Casuarina ?glauca* x 2	M		
138	222	*Eucalyptus* sp. (dead)	M	Dead	
139	223	*Eucalyptus rudis*	M		
140	224	*Corymbia calophylla* x 2	Saplings		
141	225	*Eucalyptus rudis*	M		Surrounded by *Melaleuca rhaphiophylla*
142	226	*Corymbia calophylla*	M	Dead	
143	227	*Casuarina ?glauca*	M		
144	228	*Casuarina obesa* x 2, 2 x *Corymbia calophylla* seedlings	M		

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
145	229	*Eucalyptus rudis/*E. rudis* x *E. camaldulensis* x 2 medium, 5 small	M/S		
146	230	Planted *Corymbia calophylla* x 4	S/M		3 *Corymbia calophylla* S, 8 *E. rudis* x *E. camaldulensis* S, scattered *Melalecua viminea* and *Viminaria juncea*, 2 *Paraserianthes lophantha* seedlings (planted)
147	232	*Eucalyptus rudis/*E. rudis* x *E. camaldulensis* x 2	L		
148	233	*Casuarina obesa*	L		
149	234	*Casuarina obesa*	VL		
150	235	*Casuarina obesa* x 7	M		2 *Casuarina* ?*glauca* M
151	497	*Eucalyptus rudis*	VL		
152	498	*Eucalyptus rudis*	M		
153	499	*Eucalyptus rudis*	L		
154	500	*Eucalyptus rudis* x 11	Saplings		
155	501	*Eucalyptus rudis*	S		
156	502	*Eucalyptus rudis*	M		
157	503	*Eucalyptus rudis*	M		
158	504	*Eucalyptus rudis*	Saplings		
159	505	*Eucalyptus rudis*	VL		
160	506	*Eucalyptus rudis*	VL		
161	507	*Eucalyptus rudis* X 4	M		
162	508	*Eucalyptus rudis*	S		
163	509	*Eucalyptus rudis*	VL		
164	510	*Eucalyptus rudis*	VL		
165	511	*Eucalyptus rudis*	L		
166	512	*Eucalyptus rudis*	L		
167	513	*Eucalyptus rudis*	M		
168	514	*Eucalyptus rudis* x 32	S		Saplings, small trees at edge of swamp
169	515	*Eucalyptus rudis*	Sapling		
170	516	*Eucalyptus rudis*	M		
171	517	*Eucalyptus rudis*	M		
172	518	*Eucalyptus rudis*	M		

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
173	519	*Eucalyptus rudis*	1 M, 1 S		
174	520	*Eucalyptus rudis*	L		
175	521	*Eucalyptus rudis*	M		
176	522	*Eucalyptus rudis*	M		
177	523	*Eucalyptus rudis*	L		
178	524	*Eucalyptus* ?*rudis*	M		
179	525	*Eucalyptus rudis*	M + Saplings		
180	526	*Eucalyptus rudis*	M		
181	527	*Eucalyptus rudis*	M		
182	528	*Eucalyptus rudis*	S		
183	529	*Eucalyptus rudis +* 13 saplings	S, Saplings		
184	530	*Eucalyptus rudis*	M		
185	531	*Melaleuca* ?*viminea* subsp. *viminea* x 3	M		28 Saplings
186	532	*Melaleuca rhaphiophylla*	S		
187	533	*Eucalyptus rudis*	M		
188	534	*Melaleuca rhaphiophylla*	M		
189	535	*Melaleuca preissiana*	1 M, 5 S		
190	536	*Melaleuca rhaphiophylla* x 2	L, M		
191	537	*Eucalyptus rudis*	M		
192	538	*Eucalyptus rudis*	M		
194	540	*Melaleuca rhaphiophylla* x 4	M, L		
195	541	*Melaeuca cuticularis* x4	M		
196	542	*Melaleuca rhaphiophylla*	M		
197	543	*Casuarina obesa* and *C.* ?*glauca* scattered	M		
198	544	*Eucalyptus rudis*	S		*Melaleuca rhaphiophylla* and *Casuarina glauca*
199	545	*Melaleuca teretifolia*	S		
200	546	*Acacia saligna*	S		
201	547	*Eucalyptus rudis* x 10	M		
202	548	*Viminaria juncea*	M		
203	549	*Melaleuca cuticularis*	M		
204	550	*Eucalyptus rudis*	++		*Melalecua* ?*preissii* (scattered)
205	551	*Eucalyptus rudis* x 27	S-M		

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
206	552	*Paraserianthes lophantha*	1 L, 15 S		
207	557	*Eucalyptus camaldulensis*	M		*Casuarina obesa*
208	559	*Eucalyptus rudis* x 4	M		
209	560	*Eucalyptus rudis* x 2	M		
210	561	*Eucalyptus rudis*	S		
211	562	*Eucalyptus rudis*	S		
212	563	*Eucalyptus rudis*	S		
213	564	*Eucalyptus rudis*	M		
214	565	*Eucalyptus rudis/*E. rudis* x *E. camaldulensis*	L		
215	566	*Eucalyptus rudis*	VL		
216	567	*Eucalyptus rudis* + 6 saplings (likely planted)	S, Saplings		
217	568	**Eucalyptus rudis* x *E. camladulenis* x2	S		
218	569	*Eucalyptus rudis*	S		
219	570	*Eucalyptus rudis* x 4	M		
220	571	*Eucalyptus rudis*	M		
221	572	**Eucalyptus rudis* x *E. camladulenis*	M		
222	573	*Eucalyptus rudis*	M		
223	574	*Eucalyptus rudis*	M		
224	575	*Eucalyptus rudis*	M		
225	576	*Eucalyptus rudis*, *Casuarina obesa* x 7, *E. rudis* sapling 1m(alive)	M	Dead *E. rudis* Sapling	
226	577	*Eucalyptus rudis*	S		*Casuarina* ?*glauca* x 30 M, 1 x *Casuarina obesa L*, *Eucalyptus rudis* x 2 saplings, 3 *Melaleauca preissiana* M
227	578	*Casuarina obesa*	S		
228	579	*Eucalyptus rudis* x 26	S/M		**Eucalyptus rudis* x *E. camaldulensis* M
229	580	*Casuarina obesa*	S		
230	581	*Casuarina obesa*	S		
231	582	*Casuarina obesa*	S		
232	583	*Eucalyptus rudis*	Sapling		
233	584	*Casuarina obesa*	M		
234	585	**Eucalyptus rudis* x *E. camaldulensis*	M		
235	586	**Eucalyptus rudis* x *E. camaldulensis*	M		

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
236	587	**Eucalyptus rudis* x *E. camaldulensis*	M		*Casuarina ?glauca* S
237	588	*Eucalyptus rudis*	S		*Acacia saligna*
238	589	**Eucalyptus camaldulensis*	L		
239	590	**Eucalyptus* sp. Sect. Bisectae x 2 (including one at river edge)	M		
240	591	**Eucalyptus rudis* x *E. camaldulensis*	M		
241	592	**Eucalyptus camaldulensis*	M/L		
242	593	*Eucalyptus rudis*	M		
243	594	*Eucalyptus rudis*	S		
244	595	**Eucalyptus rudis* x *E. camaldulensis*	L		
245	596	*Casuarina ?glauca* x 2	M		
246	597	*Eucalyptus rudis*	M		
247	598	*Casuarina glauca*	S		
248	599	*Eucalyptus rudis*	M		
249	600	*Casuarina ?glauca*	S		
250	601	*Casuarina ?glauca*	S		
251	602	*Casuarina ?glauca*	S		
252	603	*Eucalyptus rudis*	S	Dead (recent)	
253	604	*Eucalyptus rudis*	S	Dead (recent)	
254	605	*Eucalyptus rudis*	S	Very Stressed	
255	606	*Eucalyptus rudis*	M	Slightly stressed	
256	607	*Eucalyptus rudis*	S	Stressed	
257	608	*Eucalyptus rudis*	M		
258	609	*Eucalyptus rudis/*E. rudis x E. camaldulensis*	M	Slightly stressed	
259	610	*Eucalyptus rudis*	M		
260	611	*Eucalyptus rudis*	S	Stressed	
261	612	*Eucalyptus rudis*	M		
262	613	*Eucalyptus camaldulesis*	M		
263	614	*Eucalyptus rudis*	S	Stressed	
264	615	*Eucalyptus rudis*	S/M	Stressed	
265	616	*Eucalyptus rudis*	S	Slightly Stressed	
266	617	E*ucalyptus rudis* x 5 , 1 *E. rudis* Sapling (very stressed)	S	Stressed, Very Stressed	
267	618	**Casuarina ?glauca* x 4	S		
268	619	*Eucalyptus rudis*	S/M	Stressed	

Tree Number (refer to Figure 6)	Field Way point	Species	Size	Ranking (if stressed/ dead)	Comments
269	620	*Casuarina ?glauca* x 25, 6 x *E. rudis* dead, older - stags	M	1 dead *E rudis*, recent	
270	621	*Melaleuca cuticularis*	M		
271	622	*Casuarina obesa* x 8	M		
272	623	*Eucalyptus rudis* x 4	M	2 dead, 2 Very Stressed	1 x *Eucalyptus rudis* sapling - (Very stressed), 2 x *Casuarina ?glauca*
273	624	*Casuarina ?glauca* x 4	S/M	1 Dead *E. rudis*	2 X *Melaleuca rhaphiophylla*, 1 X *Melaleuca viminea*, 1 x *Eucalyptus rudis* (dead)
274	625	*Melaleuca cuticularis* x 3	M	2 Dead, 1 Stressed	
275	626	*Eucalyptus rudis/*E. rudis x E. camaldulensis*	L		
276	627	*Eucalyptus* sp. ('CHSM' to be identified)	L		4 x *Eucalyptus* sp. saplings
277	628	*Eucalyptus rudis*	S		
278	629	*Eucalyptus rudis*	S	Very Stressed	
279	630	*Eucalyptus rudis*	S	Epicormic	
280	631	*Eucalyptus rudis* x *E. camaldulensis* hybrid	M		
281	632	*Eucalyptus rudis* x *E. camaldulensis* hybrid	VL		

Appendices

Appendix D: Samphire identification

Please note: a flora collecting licence is required for all flora collection.

Specimens of *Tecticornia* and *Salicornia* (previously known as *Sarcocornia*) submitted collected during the recent surveys at Ashfield Flats were submitted through the Herbarium Identification Service and were identified by Herbarium Senior Research Scientist Dr Kelly Shepherd who is a specialist in the genus.

Particular attention was made to adhere to collection protocols for *Tecticornia* and *Salicornia* specimens, including the following:

- Ensure the specimens have completely **dried**, because of their succulent nature this process will take quite a bit longer than regular plants.
- Ensure the specimens are **well pressed**; 3D specimens break up and make very poor Herbarium specimens. Ideally trim one side off a branch before pressing.
- Retain all parts which fall off in the drying process, particularly the seeds which are the best diagnostic feature.

Appendix E: References for review of Samphire Tolerance of Salinity, Waterlogging and Submersion

A review of available published data for tolerance of samphire species relevant to the study area has commenced, and a table of findings is currently in preparation. Relevant references reviewed are as follows.

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