



Department of
Parks and Wildlife



Interim Recovery Plan No. 358

Swamp Starflower

Calytrix breviseta subsp. *breviseta*

Interim Recovery Plan
2015–2020



Department of Parks and Wildlife, Western Australia

November 2015

List of Acronyms

The following acronyms are used in this plan:

BGPA	Botanic Gardens and Parks Authority
CALM	Department of Conservation and Land Management
CCWA	Conservation Commission of Western Australia
CFF	Conservation of Flora and Fauna
CITES	Convention on International Trade in Endangered Species
CR	Critically Endangered
DAA	Department of Aboriginal Affairs
DEC	Department of Environment and Conservation
DFES	Department of Fire and Emergency Services
DPaW	Department of Parks and Wildlife (also shown as Parks and Wildlife)
DRF	Declared Rare Flora (also known as Threatened)
EN	Endangered
EPBC	Environment Protection and Biodiversity Conservation
GBW	Greater Brixton Street Wetlands
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
IRP	Interim Recovery Plan
IUCN	International Union for Conservation of Nature
NRM	Natural Resource Management
PEC	Priority Ecological Community
PICA	Public Information and Corporate Affairs
SCB	Species and Communities Branch
SPC	State Planning Commission
SRTFCRT	Swan Region Threatened Flora and Communities Recovery Team
SWALSC	South West Aboriginal Land and Sea Council
TEC	Threatened Ecological Community
TFSC	Threatened Flora Seed Centre
UNEP-WCMC	United Nations Environment Program World Conservation Monitoring Centre
VU	Vulnerable
WA	Western Australia
WAPC	Western Australian Planning Commission

Foreword

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Parks and Wildlife (Parks and Wildlife) Policy Statement No. 35 and Corporate Guideline No. 36 (DPaW 2015). Plans outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened flora or ecological communities, and begin the recovery process.

Parks and Wildlife is committed to ensuring that Threatened taxa are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs, and by ensuring that conservation action commences as soon as possible and, in the case of Critically Endangered (CR) flora, within one year of endorsement of that rank by the Minister.

This plan, which replaces IRP No's. 16 and 180 Swamp Starflower (*Calytrix breviseta* subsp. *breviseta*) (Kershaw *et al.* 1997; Luu and English 2004), will operate from November 2015 to October 2020 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked as CR in Western Australia, this plan will be reviewed after five years and the need for further recovery actions assessed.

This plan was given regional approval on 21 September 2015 and was approved by the Director of Science and Conservation on 6 November 2015. The provision of funds identified in this plan is dependent on budgetary and other constraints affecting Parks and Wildlife, as well as the need to address other priorities.

Information in this plan was accurate at November 2015.

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Summary

Scientific name:	<i>Calytrix breviseta</i> subsp. <i>breviseta</i>	Flowering period:	September–November
Family:	Myrtaceae	DPaW district:	Swan Coastal
DPaW region:	Swan	NRM region:	Swan Catchment Council
Shire:	City of Gosnells	Recovery team:	Swan Region Threatened Flora and Communities Recovery Team
IBRA region:	Swan Coastal Plain		
IBRA subregion:	Perth (SWA02)		
Common name:	Swamp starflower		

Distribution and habitat: *Calytrix breviseta* subsp. *breviseta* is endemic to Western Australia where it is confined to the Kenwick area, growing in seasonally wet sandy-clay soil with *Hypocalymma angustifolium*, *Callitris pyramidalis*, *Kunzea recurva*, *Pericalymma ellipticum*, *Viminaria juncea*, *Burchardia multiflora*, *Meeboldina cana*, *Diuris longifolia*, *Verticordia acerosa*, *V. densiflora* subsp. *densiflora*, *Calothamnus hirsutus*, *Melaleuca osullivanii* and open low sedges.

Habitat critical to the survival of the subspecies, and important populations: It is considered that all known habitat for wild populations is critical to the survival of the subspecies and that all wild populations are important populations. Habitat critical to the survival of *Calytrix breviseta* subsp. *breviseta* includes the area of occupancy of populations, areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators), additional occurrences of similar habitat that may contain undiscovered populations or be suitable for future translocations and the local catchment for the surface and/or groundwater that maintains the habitat of the subspecies.

Conservation status: *Calytrix breviseta* subsp. *breviseta* is specially protected under the Western Australian *Wildlife Conservation Act 1950* and is ranked as Critically Endangered (CR) in Western Australia under International Union for Conservation of Nature (IUCN 2001) criteria B1ab(iii,v)+2ab(iii,v) due to its extent of occurrence being less than 100km²; area of occupancy less than 10km²; populations being severely fragmented and a continuing decline observed in the area and quality of habitat and number of mature individuals. The subspecies is listed as Endangered (EN) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Threats: The main threats to the subspecies are weeds, firebreak maintenance, changed fire regimes, hydrological changes, changes to surrounding land uses, salinization, rabbits, rubbish dumping and recreational use.

Existing recovery actions: The following recovery actions have been or are currently being implemented and have been considered in the preparation of this plan:

1. Land managers have been made aware of the existence of *Calytrix breviseta* subsp. *breviseta* and its locations.
2. There has been extensive survey for *Calytrix breviseta* subsp. *breviseta* over the last 20 years, with comprehensive surveys being undertaken by Parks and Wildlife's Swan Coastal District in 2011.
3. Declared Rare Flora (DRF) markers have been installed along the firebreak at Subpopulation 2a.
4. Dashboard stickers and posters describing the significance of Declared Rare Flora (DRF) markers have been produced and distributed to relevant Shires and other organisations.
5. Private properties containing Subpopulations 1a, 1b, 1c and 2a have been purchased by the Western Australian Planning Commission (WAPC).
6. Research on the reproductive biology, post-fire succession dynamics and population viability analysis of *Calytrix breviseta* subsp. *breviseta* undertaken by Nield, Ladd and Yates was published in 2009.
7. 10,731 seeds collected from *Calytrix breviseta* subsp. *breviseta* are stored in the Threatened Flora Seed Centre (TFSC) at –18°C.

8. The Botanic Gardens and Parks Authority (BGPA) currently have 81 plants of *Calytrix breviseta* subsp. *breviseta* in their gardens and nursery.
9. A Translocation Proposal was approved in 2007 (Jackson and Wright 2007).
10. An A4 sized poster, that provides a description of *Calytrix breviseta* subsp. *breviseta* and information about threats and recovery actions, has been developed.
11. A Fire Management Strategy was developed in January 2002.
12. Shade cloth was erected at Subpopulation 1a in 1997 in an attempt to reduce weed seed blowing in from a nearby paddock. It is not certain whether or not this was successful in reducing weed loads. The shade cloth was then removed in 2015 as it was in complete disrepair.
13. In 1999 and 2000 Subpopulation 1a was sprayed with Fusilade to reduce African Lovegrass (*Eragrostis curvula*) invasion.
14. Two 10 by 10 metre plots were installed for weed control trials (Obbens 1997).
15. A hydrological study of the Greater Brixton Street Wetlands (GBW) area was commissioned by the Friends of Brixton Street in 2001 (V & C Semeniuk Research Group 2001).
16. V & C Semeniuk Research Group has conducted monthly monitoring of groundwater and surface water along a number of transects as per their 2001 report.
17. The City of Gosnells has undertaken two years of monitoring of surface and groundwater in the context of proposed rezoning and development either side of the GBW (Endemic Environmental Consultants 2011).

Plan objective: The objective of this plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term conservation of the subspecies in the wild.

Recovery criteria

Criteria for recovery success: The plan will be deemed a success if one or more of the following occur.

- New populations have been found, increasing the number of known populations from two to three or more over the term of the plan or
- There has been no loss of habitat in which important populations occur and habitat health remains stable or improves over the term of the plan or
- The area of occupancy has increased by >5% over the term of the plan.

Criteria for recovery failure: The plan will be deemed a failure if one or more of the following occur.

- Important populations have been lost or
- There has been a loss of habitat in which the populations occur or habitat health has deteriorated over the term of the plan or
- The area of occupancy has decreased by >5% over the term of the plan.

All populations are considered to be important populations.

Recovery actions

1. Coordinate recovery actions
2. Monitor populations
3. Undertake weed control
4. Maintain fencing
5. Install DRF markers
6. Undertake hydrological monitoring
7. Update the GBW fire management strategy
8. Remove rubbish if required
9. Collect and store additional seed
10. Ensure long-term protection of habitat
11. Develop and implement a translocation proposal
12. Undertake surveys
13. Undertake rabbit control if required
14. Obtain additional biological and ecological information

15. Liaise with land managers and Aboriginal communities
16. Promote awareness
17. Map habitat critical to the survival of *Calytrix breviseta* subsp. *breviseta*
18. Review this plan and assess the need for further recovery actions

1. Background

Review of previous plan

An Interim Recovery Plan (IRP) for *Calytrix breviseta* subsp. *breviseta* was published in 1997 (Kershaw *et al.* 1997) and a review of the plan undertaken in 2001 (Burbidge *et al.* 2001). The review found that the overall threat to the taxon had declined, mainly due to the improved security of land tenure on which some subpopulations occurred. An updated plan was prepared in 2004 (Luu and English 2004). This plan replaces both previous plans.

The criteria for success in the previous plan – the number of individuals within populations and/or the number of populations have increased by 10% or more over the period of the plan's adoption under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), has in principle, been met.

The number of mature individuals in all populations significantly increased from 3,520 in 2003 to 46,548 in 2011/2012. This significant increase was wholly due to a fire response where recruitment of soil-stored seed was substantial. It is expected that plant numbers will decrease considerably within three years post-fire. However, it is possible that given such a large increase, plant numbers may remain above the 2003 baseline figure. In addition, two new subpopulations were located (1e and 2b), which has increased the plant numbers by 2.6% and more importantly increased the known area of occupancy.

Calytrix breviseta subsp. *breviseta* requires ongoing recovery work due to a restricted distribution and a continuing decline in habitat quality.

Table 1: Status of recovery actions listed in the previous plan

Recovery action	Status	Result
Coordinate recovery actions	Ongoing	Recovery actions have been coordinated by the Swan Coastal District with assistance from the Swan Region Threatened Flora and Communities Recovery Team (SRTFCRT).
Map habitat critical to the survival of <i>Calytrix breviseta</i> subsp. <i>breviseta</i>	Not started	To be undertaken.
Transfer care, control and management to Conservation Commission	Mostly complete	Land containing Subpopulations 1a, 1b, 1c and 2a has been purchased by the Western Australian Planning Commission (WAPC) and transferred to the Conservation Commission of Western Australia (CCWA) as an A class reserve for the purpose of Conservation of Flora and Fauna (CFF). Subpopulations 1e and 2b remain in private property.
Undertake weed control	Ongoing	Shade cloth was erected at Subpopulation 1a in 1997 to reduce weed seed blowing in from a nearby paddock. In 1999 and 2000, the area was sprayed with Fusilade to reduce African Lovegrass (<i>Eragrostis curvula</i>) invasion.
Install Declared Rare Flora (DRF) markers	Further action required	Markers require replacement or repositioning at Subpopulations 1a and 1c.
Fence populations	Further action required	Fencing needs to be replaced or repaired at all Subpopulations.
Hydrological monitoring	Ongoing	Monitoring of surface and groundwater is being undertaken.

Redirect drainage and fill in culvert	Not started	The drainage culvert constructed on an adjacent property to Subpopulation 1b to drain into the location was to be redirected and the remaining culvert filled in. Monitoring will be undertaken and the action implemented if necessary.
Remove rubbish	Complete	Rubbish has been removed.
Collect seed and cutting material	Ongoing	10,731 seed collected from <i>Calytrix breviseta</i> subsp. <i>breviseta</i> is stored in the Threatened Flora Seed Centre (TFSC) at -18°C. Some seed has been processed and the germination rate ranged from 19% to 100%.
Develop and implement a Translocation Proposal	Complete	A translocation proposal was developed and approved in 2007. Planting commenced in winter 2007 followed by further plantings in 2008 and 2009. No plants have survived.
Monitor populations	Ongoing	All populations were monitored during the term of the plan and information stored at Parks and Wildlife's Swan Coastal District and Species and Communities Branch (SCB).
Implement a fire management strategy	Complete	A Fire Management Strategy was developed in January 2002.
Stimulate the germination of soil-stored seed	Complete/ongoing	Germination trials using smoke water were conducted in May 2001 with germination significantly enhanced in treated areas compared to non-treated areas. The action is ongoing. With the large number of plants present at most populations, and the frequency with which the area within the GBW are burnt, this recovery action was deemed no longer be necessary.
Conduct further surveys	Ongoing	Extensive surveys have been conducted and include the Bellevue area, Ellen Brook NR, heath near the Mundijong Road-Kargotich Road junction, Tonkin Highway, Railway Marshalling Yard, Guildford Cemetery, Hartfield Country Club in Forrestfield, areas near Forrestdale Lake, Keane Road and Passmore Road in Gosnells, Turner Road in Byford and the junction of High and Nicholson Roads in Canning Vale.
Control rabbits	Not started	Rabbit impacts are low and rabbit control is not currently required.
Maintain disease hygiene	Ongoing	Dieback hygiene has been adhered to where required.
Promote awareness	Done	An A4 sized poster was developed and distributed.
Obtain biological and ecological information	Complete, research undertaken	Research on the post-fire succession dynamics and population viability of the subspecies was published in 2009.
Review the need for a full Recovery Plan	Complete	As Parks and Wildlife no longer produce full recovery plans for flora, this IRP will be reviewed and a revised IRP prepared if necessary.

Ongoing recovery actions shown in Table 1 are included in this revised plan. Additional recovery actions include – 'Liaise with land managers and Aboriginal communities'; and 'review this plan and assess the need for further recovery actions'.

History

The first collection of *Calytrix breviseta* subsp. *breviseta* was made near Bellevue by Cecil Andrews in 1901 with a further collection made from Gosnells in 1915. The taxon was then thought to be extinct until 1990 when rediscovered in the Kenwick area by Parks and Wildlife staff.

Surveys undertaken by Parks and Wildlife staff in other areas of likely habitat have not been successful in locating further populations of this taxon. A plant believed to be *Calytrix breviseta* subsp. *breviseta* was found in Ellis Brook Valley in 2000 by a volunteer. However, it was later identified as *C. variabilis*. Very little suitable habitat for the taxon still exists and the probability of finding new populations is low.

The location containing *Calytrix breviseta* subsp. *breviseta* is a Bush Forever site (Number 387), known as the Greater Brixton Street Wetlands (GBW). It is an area of 'regional significance bushland to be retained and protected forever' (State of Western Australia 2000). At October 2011 the taxon was known from two populations comprising approximately 46,548 mature plants. A full population count has not been conducted since that time.

Description

Calytrix breviseta subsp. *breviseta* is an erect or spreading shrub to 40cm high. The leaves, which are widely spaced, linear to narrowly elliptic and 2 to 10mm long by 0.4 to 1.1mm wide, are arranged alternately along the stem. The taxon has purplish-blue flowers that contain numerous stamens (Brown *et al.* 1998).

Calytrix breviseta subsp. *breviseta* is distinguished from subspecies *stipulosa* (which is found in mallee and heath communities east of the Darling Range) in having longer, usually linear leaves, longer petals, a greater number of stamens, equal rather than unequal bracteoles and a swampy clay-flat habitat (Brown *et al.* 1998).

Illustrations and/or further information

Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, WA; Evans, R., Willers, N. and Mitchell, D. (2003) *Threatened Flora of Swan Region*, Unpublished report to the Department of Conservation and Land Management, and Environment Australia; Curry, S. and Kelly, A. (1993) *Endangered! The Swamp Starflower* *Landscape* 8(4): 27; Western Australian Herbarium (1998–) *FloraBase- the Western Australian Flora*. Department of Parks and Wildlife. <http://florabase.dpaw.wa.gov.au/>.

Distribution and habitat

Although originally recorded from Gosnells and Bellevue *Calytrix breviseta* subsp. *breviseta* now appears to be confined to the Kenwick area where it is found in seasonally wet sandy-clay soil with *Hypocalymma angustifolium*, *Callitris pyramidalis*, *Kunzea recurva*, *Pericalymma ellipticum*, *Viminaria juncea*, *Burchardia multiflora*, *Meeboldina cana*, *Diuris longifolia*, *Verticordia acerosa*, *V. densiflora* var. *densiflora*, *Calothamnus hirsutus*, *Melaleuca osullivanii* and open low sedges.

Table 1. Summary of population land vesting, purpose and manager

Population number & location	DPaW district	Shire	Vesting	Purpose	Manager
1a. Kenwick	Swan Coastal	City of Gosnells	CCWA	CFF	DPaW
1b. Kenwick	Swan Coastal	City of Gosnells	CCWA	CFF	DPaW
1c. Kenwick	Swan Coastal	City of Gosnells	CCWA	CFF	DPaW
1e. Kenwick	Swan Coastal	City of Gosnells	Private property		Landowners
2a. Kenwick	Swan Coastal	City of Gosnells	CCWA	CFF	DPaW
2b. Kenwick	Swan Coastal	City of Gosnells	Private property		Landowners

Biology and ecology

Calytrix breviseta subsp. *breviseta* is an obligate-seeder which exhibits abundant recruitment following fire. The application of a smoke treatment significantly improves germination, with Nield *et al.* (2009) finding smoke treatment seeds producing a greater number of seedlings ($9.3 \pm 1.31 \text{ m}^2$) in comparison to those not treated ($1.1 \pm 0.43 \text{ m}^2$). Nield *et al.* (2009) also found that significant inter-fire recruitment was observed up to 10 years following fire, with a juvenile period of three to four years to first flowering. Population viability analysis predicted that, to maintain viable populations, the optimal fire return interval was dependent on the site quality, competition from invasive species and the number of individuals. If the carrying capacity of the community was high then the optimal fire return interval is approximately 15 to 20 years but with a lower carrying capacity (competition from weeds) frequent fire decreases the likelihood of population survival.

Although dieback disease (*Phytophthora cinnamomi*) has been identified at the site, testing indicates that *Calytrix breviseta* subsp. *breviseta* is not susceptible. In laboratory conditions, none of the 27 individuals that were inoculated with the pathogen died.

Conservation status

Calytrix breviseta subsp. *breviseta* is specially protected under the Western Australian *Wildlife Conservation Act 1950* and is ranked as Critically Endangered (CR) in Western Australia under International Union for Conservation of Nature (IUCN 2001) criteria B1ab(iii,v)+2ab(iii,v) due to its extent of occurrence being less than 100km^2 ; area of occupancy less than 10km^2 ; populations being severely fragmented and a continuing decline, observed in the quality of habitat and number of mature individuals. The subspecies is listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as Endangered (EN).

Threats

- **Weeds.** These include: **Subpopulation 1a** *Oxalis glabra*, *Parentucellia viscosa* (Sticky bartsia), *Romulea rosea* (Guildford grass), *Aira cupaniana* (Silvery hairgrass), *Hypochaeris glabra* (Smooth catsear), *Vulpia myuros* (Rat's tail fescue) and *Sparaxis bulbifera* (Harlequin flower); **Subpopulation 1b** *Briza minor* (Shivery grass), *Aira cupaniana*, *Lotus ?angustissimus*, *Gladiolus caryophyllaceus* (Wild gladiolus), *Briza maxima* (Blowfly grass), *Ehrharta longiflora* (Annual veldt grass) and *Lolium rigidum* (Wimmera ryegrass); **Subpopulation 1c** *Briza maxima*, *Parentucellia viscosa*, *Romulea rosea*, *Lotus ?angustissimus* and *Watsonia meriana* (Bulbil watsonia); **Subpopulation 1e** *Briza maxima* and *Lotus ?angustissimus* and **Subpopulation 2a/b** *Briza maxima* and *B. minor*.
- **Firebreak maintenance.** Subpopulations 1a, 1c, 2a and 2b are threatened by grading and chemical spraying along firebreaks.
- **Altered fire regimes.** *Calytrix breviseta* subsp. *breviseta* requires infrequent fire to promote regeneration from soil-stored seed. Frequent fire is likely to deplete the soil seed bank and conversely a lack of fire will result in poor recruitment. An ecologically appropriate fire regime is required.
- **Hydrological changes.** A report by V. & C. Semeniuk (V. & C. Semeniuk Research Group 2001) states that the hydrology of GBW has been altered by local drains, tracks and possibly land uses in the broader catchment. The V & C Semeniuk Research Group monitors the groundwater and surface water of the GBW. This data has not been available.

- **Change to surrounding land uses.** The Maddington/Kenwick Strategic Employment Area Concept Plan July 2008 indicates the area directly adjacent to the GBW will need adequate buffers to protect the hydrology, fauna and flora of the area. Areas directly adjacent to the *Calytrix breviseta* subsp. *breviseta* populations in part will be left for drainage, and also in part proposed for industry, and therefore may impact on the conservation values of the area.
- **Salinization.** Salinization is a possible future threat to *Calytrix breviseta* subsp. *breviseta*. Salt tolerant species such as *Sarcocornia* sp. have been found on the edge of its habitat.
- **Rabbits.** Rabbit numbers are currently low but may have a future impact on *Calytrix breviseta* subsp. *breviseta* through digging, increased nutrient levels and grazing seedlings.
- **Rubbish dumping.** Rubbish dumping is a continuing threat.
- **Recreational use.** Horse riding and recreational motorbikes have been observed in the habitat of *Calytrix breviseta* subsp. *breviseta*.

The intent of this plan is to provide actions that will mitigate immediate threats to *Calytrix breviseta* subsp. *breviseta*. Although climate change and drought may have a long-term effect on the taxon, direct actions to prevent the impact of climate change and drought are beyond the scope of this plan.

Table 2. Summary of population information and threats

Population number & location	Land status	Year/no. mature plants	Condition	Threats
1a. Kenwick	Nature reserve	1990 100+ 2001 665 2003 2,723 (78) 2011 44,431 (1,639) [81]	Healthy	Weeds, rabbits, firebreak maintenance, altered fire regimes, hydrological changes, land use changes, rubbish dumping, horses
1b. Kenwick	Nature reserve	1992 200+ 1997 321+ 2011 417 [21]	Healthy	Weeds, rabbits, altered fire regimes, hydrological changes, land use changes, rubbish dumping, horses
1c. Kenwick	Nature reserve	1997 50 (20) 2006 357 2011 884 [16]	Healthy	Weeds, rabbits, firebreak maintenance, altered fire regimes, hydrological changes, land use changes, rubbish dumping, horses
1e. Kenwick	Private property	2008 20 2011 93 (5) [6]	Healthy/moderate	Weeds, rabbits, altered fire regimes, hydrological changes, land use changes, rubbish dumping, horses
2a. Kenwick	Nature reserve	1992 100+ 2003 303 2011 719 (25) [27]	Healthy	Weeds, firebreak maintenance, altered fire regimes, hydrological changes, land use changes, rubbish dumping, horses, rabbits
2b. Kenwick	Private property	2012 4	Healthy	Firebreak maintenance, recreational vehicles

Note: Populations in **bold text** are considered to be important populations. Subpopulation 1d is now considered the same Subpopulation as 1c. () = number of juveniles. [] = number of dead plants.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Actions for development and/or land clearing in the immediate vicinity of *Calytrix breviseta* subsp. *breviseta* may require assessment.

Actions that could result in any of the following may potentially result in a significant impact on the subspecies:

- Damage or destruction of occupied or potential habitat.
- Alteration of the local surface hydrology or drainage.
- Reduction in population size.
- A major increase in disturbance in the vicinity of a population.

Habitat critical to the survival of *Calytrix breviseta* subsp. *breviseta* and important populations

Calytrix breviseta subsp. *breviseta* is ranked as CR and it is considered that all known habitat for wild populations is critical to the survival of the taxon, and all wild populations are important populations. Habitat critical to the survival of *C. breviseta* subsp. *breviseta* includes the area of occupancy of populations, areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators), additional occurrences of similar habitat that may contain undiscovered populations of the taxon or be suitable for future translocations, and the local catchment for the surface and/or groundwater that maintains the habitat of the taxon.

Benefits to other species or ecological communities

Recovery actions implemented to improve the quality or security of the habitat of *Calytrix breviseta* subsp. *breviseta* will also improve the status of associated native vegetation, including other rare taxa. Three Declared Rare Flora (DRF) and four Priority flora that occur within 500m of *C. breviseta* subsp. *breviseta* are listed in the table below.

Table 3. Conservation-listed flora taxa found within 500m of *Calytrix breviseta* subsp. *breviseta*

Species name	Conservation status (WA)	Conservation status (EPBC Act)
<i>Diuris purdiei</i>	DRF (EN)	EN
<i>Lepidosperma rostratum</i>	DRF (EN)	EN
<i>Andersonia gracilis</i>	DRF (VU)	EN
<i>Baeckea</i> sp. Perth Region (R.J. Cranfield 444)	Priority 3	-
<i>Drosera occidentalis</i> subsp. <i>occidentalis</i>	Priority 4	-
<i>Grevillea thelemanniana</i> subsp. <i>thelemanniana</i>	Priority 4	-
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	Priority 4	-

For a description of conservation codes for Western Australian flora see http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation_code_definitions_18092013.pdf

Calytrix breviseta subsp. *breviseta* is found within 500m of the Threatened Ecological Communities (TECs) and Priority Ecological Community (PEC) listed in the table below.

Table 4. TECs and PECs within 500m of populations of *Calytrix breviseta* subsp. *breviseta*

TEC/PEC title	Conservation status (WA)	Conservation status (EPBC Act)
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Shrublands on dry clay flats (SCP 10a)	EN	CR
Herb rich saline shrublands in clay pans (SCP 07)	VU	CR
Herb rich shrublands in clay pans (SCP 08)	VU	CR
Low lying <i>Banksia attenuata</i> woodlands or shrubland (SCP 21c)	Priority 3	-

For a description of TEC and PEC categories see Department of Environment and Conservation (2010).

International obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. The species is not listed under Appendix II in the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES), and this plan does not affect Australia's obligations under any other international agreements. Brixton Street and associated wetlands were listed in the Australian Register of Significant Wetlands in November 2000.

Aboriginal consultation

A search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Sites Register revealed six sites of Aboriginal significance adjacent to populations of *Calytrix breviseta* subsp. *breviseta* (see Table 5) and input and involvement has been sought through the South West Aboriginal Land and Sea Council (SWALSC) and DAA to determine if there are any issues or interests with respect to the management of the taxon. Opportunity for future Aboriginal involvement in the implementation of the plan is included as an action in the plan. Aboriginal involvement in management of land covered by an agreement under the *Conservation and Land Management Act 1984* is also provided for under the joint management arrangements in that Act, and will apply if an agreement is established over any reserved lands on which the taxon occurs.

Table 5. Sites of Aboriginal significance near *Calytrix breviseta* subsp. *breviseta*

Site number	Status	Site name	Site type	Restriction	Access
3624	Registered	Boundary Road, Wattle Grove	artefacts	none	open
4342	Registered	Brentwood Road, quarry	artefacts	none	open
4343	Registered	Brentwood Road, swamp	artefacts	none	open
3312	Heritage	Wattle Grove, Perth	artefacts	none	open
4340	Heritage	Edward Grove/Streets	artefacts	none	open
4341	Heritage	Brentwood Road	artefacts	none	open

Social and economic impacts

Social and economic impacts may occur for subpopulations 1e and 2b which occur on private property due to the loss of land available for development. Six sites of Aboriginal significance are also found near populations of *Calytrix breviseta* subsp. *breviseta* and recovery actions may require consideration of Aboriginal interests.

Affected interests

The implementation of this plan has implications for Parks and Wildlife which has management responsibility for reserved areas containing populations of *Calytrix breviseta* subsp. *breviseta* and private landholders on whose land the taxon occurs. *Calytrix breviseta* subsp. *breviseta* is also found near land subject to Aboriginal interests.

Evaluation of the plan's performance

Parks and Wildlife with assistance from the Swan Region Threatened Flora and Communities Recovery Team (SRTFCRT) will evaluate the performance of this plan. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following five years of implementation.

2. Recovery objective and criteria

Plan objective

The objective of this plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term conservation of the subspecies in the wild.

Recovery criteria

Criteria for recovery success: The plan will be deemed a success if one or more of the following occur.

- New populations have been found, increasing the number of known populations from two to three or more over the term of the plan or
- There has been no loss of habitat in which important populations occur and habitat health remains stable or improves over the term of the plan or
- The area of occupancy has increased by >5% over the term of the plan.

Criteria for recovery failure: The plan will be deemed a failure if one or more of the following occur.

- Important populations have been lost or
- There has been a loss of habitat in which important populations occur or habitat health has deteriorated over the term of the plan or
- The area of occupancy has decreased by >5% over the term of the plan.

All populations are considered to be important populations.

3. Recovery actions

Existing recovery actions

Parks and Wildlife, with assistance from the SRTFCRT is overseeing the implementation of recovery actions for *Calytrix breviseta* subsp. *breviseta*.

Land managers have been made aware of *Calytrix breviseta* subsp. *breviseta* and its locations. Notifications detail the current DRF status of the taxon and the associated legal obligations in regards to its protection.

There has been extensive survey for the *Calytrix breviseta* subsp. *breviseta* over the last 20 years including:

- Surveys in the Bellevue area, Ellen Brook Nature Reserve, heath near the Mundijong Road-Kargotich Road junction, Tonkin Highway, Railway Marshalling Yard, Guildford Cemetery, Hartfield Country Club in Forrestfield, areas near Forrestdale Lake, Keane Road and Passmore Road in Gosnells, Turner Road in Byford and the junction of High and Nicholson Roads in Canning Vale.
- Survey of rural lands in the vicinity of GBW in 2008 (Tauss and Weston 2010), resulting in the discovery of Subpopulation 1e.
- Survey of a number of lots containing *Calytrix breviseta* subsp. *breviseta* in 2003 and 2006, following purchase by the WA Planning Commission (WAPC). No new plants were located.
- Surveys in 2011 established the full extent of Subpopulation 1a. The location of plants in other Subpopulations was digitally recorded with a Global Positioning System (GPS).

DRF markers have been installed along the firebreak at Subpopulation 2a.

Dashboard stickers and posters describing the significance of DRF markers have been produced and distributed to Shires and other organisations.

Private properties that contain Subpopulations 1a, 1b, 1c and 2a were purchased by the WAPC and the land transferred to the care, control and management of the Conservation Commission of Western Australia (CCWA).

Research on the reproductive biology, post-fire succession dynamics and population viability analysis of the subspecies was undertaken by Nield, Ladd and Yates and published in 2009.

11,470 fruits, containing approximately 9,357 germinable seed, have been collected from *Calytrix breviseta* subsp. *breviseta* and are stored in the Threatened Flora Seed Centre (TFSC) at -18°C (see table 6).

Table 6. TFSC collection details for *Calytrix breviseta* subsp. *breviseta*

Accession number	Date collected	Population number	Collection type	No. fruit in storage	Estimated germinable seed
00375	27/11/1996	1	B/20, B/20	1,411	255
01293	27/11/2003	1	B/100	1,578	1,512
02300	11/12/2006	2	B/10	216	56
02301	11/12/2006	1	B/10	85	Not tested
02545	21/11/2007	1	B/35	441	417
02546	21/11/2007	1	B/20	661	489
02550	28/11/2007	1	B/29	195	157
02917	12/12/2008	1	I/33	401	320
03625	25/11/2011	1	B/0	6,482	6,151

Note: 'I' = a collection of individuals and the number of plants collected; 'B' = a bulked collection and the number of plants sampled.

The Botanic Gardens and Parks Authority (BGPA) currently have 81 plants of *Calytrix breviseta* subsp. *breviseta* in their conservation garden, nursery and garden beds. Propagation records indicate a 45% success from cuttings and 37.5% success from grafts.

A Translocation Proposal for *Calytrix breviseta* subsp. *breviseta* was approved in 2007 (Jackson and Wright 2007). The aim of this proposal was to establish two additional viable populations at secure locations. Monitoring of the translocated populations was undertaken initially, six monthly after planting, and annually thereafter and to include the number of surviving plants, height and width of crown in two directions, reproductive state, number of flowers and drupes, and general health of plants. Monitoring of the natural populations was also undertaken to provide essential baseline data for assessing the performance of the translocated populations. In June 2007, 61 seedlings were planted, but by December that year all had died. In June 2008, 1,008 seedlings were planted at a second site. Unfortunately, by the end of the year all of these were also dead, possibly from water logging. A further 154 seedlings were then planted at the second site in May 2009. In December 2009 only 14 remained alive and a survey in October 2011 revealed no plants alive.

An A4 sized poster has been prepared that provides a description of *Calytrix breviseta* subsp. *breviseta* and information on threats and recovery actions. It is hoped that the poster will result in the discovery of new populations.

A Fire Management Strategy for the GBW has been developed by Parks and Wildlife in consultation with stakeholders, including Friends Groups, Department of Fire and Emergency Services (DFES) and City of Gosnells. This plan aims to help maintain the high conservation values of the site through controlling fire frequency and using fire control methods that promote regeneration of the bushland.

Shade cloth was erected at Subpopulation 1a in 1997 in an attempt to reduce weed seed blowing in from a nearby paddock. It is not certain whether or not this was successful in reducing weed loads. The shade cloth was then removed in 2015 as it was in complete disrepair. In 1999 and 2000, this area was also sprayed with Fusilade to reduce African Lovegrass (*Eragrostis curvula*) invasion.

Two 10 x 10m plots were installed and monitored in May 1996 (before rain) and again in September/October the same year (after rain). Seedling mortality recorded in the plots in 1996 was 10% and 12.9%. Fruit set was estimated to be above 90% (Obbens 1997).

A hydrological study of the GBW was commissioned by the Friends of Brixton Street in 2001 (V & C Semeniuk Research Group 2001). The study provides preliminary information about the hydrology of the habitat of *Calytrix breviseta* subsp. *breviseta*. V & C Semeniuk Research Group has continued monitoring the GBW and includes monthly monitoring of groundwater and surface water.

The City of Gosnells has undertaken two years monitoring of surface and groundwater in the context of proposed rezoning and future development either side of the GBW (Endemic Environmental Consultants 2011).

Future recovery actions

The following recovery actions are roughly in order of descending priority, influenced by their timing over the term of the plan. However this should not constrain addressing any recovery action if funding is available and other opportunities arise. Where these recovery actions are implemented on lands other than those managed by Parks and Wildlife, permission has been or will be sought from the appropriate land managers prior to actions being undertaken.

1. Coordinate recovery actions

Parks and Wildlife with assistance from the SRTFCRT will coordinate the implementation of this plan and include information on progress in annual reports.

Action:	Coordinate recovery actions
Responsibility:	Parks and Wildlife (Swan Region), with assistance from the SRTFCRT
Cost:	\$8,000 per year

2. Monitor populations

Monitoring of grazing, weed invasion, habitat degradation, hydrology (inundation, drought and salinity), disease presence (*Phytophthora* sp.), population stability (expansion or decline), pollinator activity, seed production, recruitment and longevity is essential. Where possible, populations will be inspected annually.

Action:	Monitor populations
Responsibility:	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT
Cost:	\$10,000 per year

3. Undertake weed control

1. Undertake mapping of the weeds present in the areas containing the *Calytrix breviseta* subsp. *breviseta*.
2. Control weeds by hand removal and/or spot spraying as required.
3. Re-map the weeds present.
4. Monitor the success of weed control and the tolerance of associated native plant species to treatment.
5. Report on the method and success of treatments.

Action:	Undertake weed control
Responsibility:	Parks and Wildlife (Swan Coastal District), private landowners
Cost:	\$10,000 per year, as required

4. Maintain fencing

Fencing around lots containing *Calytrix breviseta* subsp. *breviseta* requires maintenance. Locks and chains are old and some are damaged and should be replaced and breaches in the fence should be repaired.

Action:	Maintain fencing
Responsibility:	Parks and Wildlife (Swan Coastal District), private landowners
Cost:	\$10,000 per year

5. Install DRF markers

DRF markers are needed along firebreaks at Subpopulations 1a and 1c.

Action:	Install DRF markers
Responsibility:	Parks and Wildlife (Swan Coastal District)
Cost:	\$4,000 in year 1

6. Undertake hydrological monitoring

Monthly monitoring of groundwater and surface water of GBW along a number of transects is required. This information will help in the formulation of future recommendations for management of the catchment that will help maintain the wetlands habitat of *Calytrix breviseta* subsp. *breviseta*.

Action:	Undertake hydrological monitoring
Responsibility:	Parks and Wildlife (Swan Coastal District) (coordinators), hydrologist
Cost:	To be determined

7. Update the GBW fire management strategy

A fire management strategy developed for the GBW in 2002 will be updated to include recently acquired lots. An optimal fire return interval of approximately 15 to 20 years, as described by Nield *et al.* (2009), is recommended for the subspecies.

Action:	Update the GBW fire management strategy
Responsibility:	Parks and Wildlife (Swan Coastal District), City of Gosnells, Department of Fire and Emergency Services (DFES)
Cost:	\$10,000 in years 1 and 2, and \$6,000 in years 3–5

8. Remove rubbish if required

Rubbish dumped in the area of populations will be removed.

Action:	Remove rubbish if required
Responsibility:	Parks and Wildlife (Swan Coastal District), City of Gosnells
Cost:	\$5,000 per year

9. Collect and store additional seed

Although numerous seed collections from the subspecies have been made, further collections are required to be used for future research, in particular establishing new populations. It is recommended that seed be collected and stored at the TFSC and BGPA. Collections should aim to sample and preserve the maximum range of genetic diversity possible (which should be determined by an appropriate molecular technique such as genetic fingerprinting if feasible).

Action:	Collect and store additional seed
Responsibility:	Parks and Wildlife (Swan Coastal District, TFSC), BGPA
Cost:	\$10,000 per year

10. Ensure long-term protection of habitat

Ways and means of improving the security of Subpopulations 1e and 2b will be investigated.

Action:	Ensure long-term protection of habitat
Responsibility:	Parks and Wildlife (Swan Region, SCB Nature Conservation Covenant Program and Land Unit)
Cost:	\$4,000 per year

11. Develop and implement a translocation proposal

Translocations may be required for the long term conservation of *Calytrix breviseta* subsp. *breviseta* if natural populations continue to decline. It should be noted that previous translocations were unsuccessful (possibly due to waterlogging) and that any new proposal will need to take this into account. Information on the translocation of Threatened plants and animals in the wild is provided in Parks and Wildlife Policy No. 35 *Conserving Threatened Species and Ecological Communities* (2015) and Corporate Guideline No. 36 *Recovery of Threatened Species through Translocation and Captive Breeding or Propagation* (2015), and the Australian Network for Plant Conservation translocation guidelines (Vallee *et al.* 2004). All translocation proposals require endorsement by Parks and Wildlife's Director of Science and Conservation. Monitoring of translocations is essential and will be included in the timetable developed for the Translocation Proposal.

Action:	Develop and implement a translocation proposal
Responsibility:	Parks and Wildlife (Parks and Wildlife Science and Conservation Division, Swan Coastal District), BGPA
Cost:	\$42,000 in years 1 and 2; and \$26,500 in years 3–5 as required

12. Undertake surveys

Extensive survey has been undertaken for the subspecies. Therefore only opportunistic survey on private properties and pre-development areas remain as avenues where potential new populations may be located. Surveys should be undertaken in areas of potentially suitable habitat. Where feasible, volunteers from landcare groups, wildflower societies and naturalists clubs will be encouraged to participate. All surveyed areas will be recorded and the presence or absence of the subspecies documented to increase survey efficiency and prevent duplication of effort.

Action:	Undertake surveys
Responsibility:	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT
Cost:	\$10,000 per year

13. Undertake rabbit control if required

Rabbit control will only need to be undertaken if monitoring shows the threat to be high. Control programs should be undertaken in liaison with adjacent landowners and, given their close proximity to populations of *Calytrix breviseta* subsp. *breviseta*, alternate methods to baiting with 1080 will be required.

Action:	Undertake rabbit control if required
Responsibility:	Parks and Wildlife (Swan Coastal District), relevant land managers
Cost:	\$4,000 in years 1, 3 and 5

14. Obtain additional biological and ecological information

Research on the reproductive biology, post-fire succession dynamics and population viability analysis of the subspecies has been undertaken by Nield, Ladd and Yates (2009). Further research may be required but not limited to:

1. Identification of pollinators and their habitat requirements.
2. The impact of changes in hydrology.
3. Investigate specific horticultural requirements of the subspecies, such as soil pH, soil nutrition, soil particle size, and their impact on translocation success.

Action:	Obtain additional biological and ecological information
Responsibility:	Parks and Wildlife (Parks and Wildlife Science and Conservation Division, Swan Coastal District)
Cost:	\$50,000 in years 1–3

15. Liaise with land managers and Aboriginal communities

Parks and Wildlife will liaise with land managers to ensure that populations of *Calytrix breviseta* subsp. *breviseta* are not accidentally damaged or destroyed, and the habitat is maintained in a suitable condition for the conservation of the taxon. Consultation with the Aboriginal community will take place to determine if there are any issues or interests in areas that are habitat for the taxon.

Action:	Liaise with land managers and Aboriginal communities
Responsibility:	Parks and Wildlife (Swan Coastal District, Swan Region)
Cost:	\$4,000 per year

16. Promote awareness

The importance of biodiversity conservation and the protection of *Calytrix breviseta* subsp. *breviseta* will be promoted through the print and electronic media and by setting up poster displays. Formal links with local naturalist groups and interested individuals will also be encouraged.

Action:	Promote awareness
Responsibility:	Parks and Wildlife (Swan Region, SCB) and Public Information and Corporate Affairs (PICA), with assistance from the SRTFCRT
Cost:	\$7,000 in years 1 and 2; \$5,000 in years 3–5

17. Map habitat critical to the survival of *Calytrix breviseta* subsp. *breviseta*

Although spatial data relating to habitat critical to the survival of *Calytrix breviseta* subsp. *breviseta* is alluded to in Section 1 it is not yet mapped. If additional populations are located, then habitat critical to their survival will also be mapped.

Action:	Map habitat critical to the survival of <i>Calytrix breviseta</i> subsp. <i>breviseta</i>
Responsibility:	Parks and Wildlife (SCB, Swan Region)
Cost:	\$6,000 in year 2

18. Review this plan and assess the need for further recovery actions

If *Calytrix breviseta* subsp. *breviseta* is still ranked as CR at the end of the five-year term of this plan, the need for further recovery actions, or a review of this plan will be assessed and a revised plan prepared if necessary.

Action:	Review this plan and assess the need for further recovery actions
Responsibility:	Parks and Wildlife (SCB, Swan Region)
Cost:	\$6,000 in year 5

Table 7. Summary of recovery actions

Recovery action	Priority	Responsibility	Completion date
Coordinate recovery actions	High	Parks and Wildlife (Swan Region), with assistance from the SRTFCRT	Ongoing
Monitor populations	High	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT	Ongoing
Undertake weed control	High	Parks and Wildlife (Swan Coastal District), private landowners	Ongoing
Maintain fencing	High	Parks and Wildlife (Swan Coastal District), private landowners	Ongoing
Install DRF markers	High	Parks and Wildlife (Swan Coastal District)	2016
Undertake hydrological monitoring	High	Parks and Wildlife (Swan Coastal District) (coordinators), hydrologist	2020
Update the GBW fire management strategy	High	Parks and Wildlife (Swan Coastal District), City of Gosnells, DFES	Developed by 2016 with implementation ongoing
Remove rubbish if required	High	Parks and Wildlife (Swan Coastal District), City of Gosnells	2020
Collect and store additional seed	Medium	Parks and Wildlife (Swan Coastal District, TFSC), BGPA	2020
Ensure long-term protection of habitat	High	Parks and Wildlife (Swan Region, SCB Nature Conservation Covenant Program and Land Unit)	2020
Develop and implement a translocation proposal	High	Parks and Wildlife (Parks and Wildlife Science and Conservation Division, Swan Coastal District), BGPA	2020
Undertake surveys	Medium	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT	Ongoing
Undertake rabbit control if required	Low	Parks and Wildlife (Swan Coastal District), relevant land managers	Ongoing
Obtain additional biological and ecological information	Low	Parks and Wildlife (Parks and Wildlife Science and Conservation Division, Swan Coastal District)	2018

Liaise with land managers and Aboriginal communities	Medium	Parks and Wildlife (Swan Coastal District, Swan Region)	Ongoing
Promote awareness	Medium	Parks and Wildlife (Swan Region, SCB and PICA), with assistance from the SRTFCRT	2020
Map habitat critical to the survival of <i>Calytrix breviseta</i> subsp. <i>breviseta</i>	Medium	Parks and Wildlife (SCB, Swan Region)	2017
Review this plan and assess the need for further recovery actions	Medium	Parks and Wildlife (SCB, Swan Region)	2020

4. Term of plan

This plan will operate from November 2015 to October 2020 but will remain in force until withdrawn or replaced. If *Calytrix breviseta* subsp. *breviseta* is still ranked CR after five years, the need for further recovery actions will be determined.

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6. Taxonomic description

Calytrix breviseta* subsp. *breviseta

Craven, L.A. (1987) A taxonomic revision of *Calytrix* Labill. (Myrtaceae). *Brunonia* 10: 1–138.

Leaves widely spaced, spreading-ascending; stipules to 1.25mm long; petiole 0.1–0.75mm long; blade linear, linear–lanceolate, lanceolate, or narrowly elliptic, 2–9 mm long, 0.5–1.25mm wide, slightly incurved, or straight or slightly recurved, in transverse section obtriangular. Inflorescences scattered. Cheiridium narrowly funnel-shaped, 7–11mm long; lobes elliptic to obovate, 5–7mm long (the lobes \pm equal in length), the apex rounded and mucronate, recurved. Hypanthium 6.5–10mm long, the ovarian region 0.5–0.6mm wide, the adnate region 0.4 mm wide, the staminal disc slightly prominent. Calyx segments with the blade depressed obovate to shortly ovate, 1.75–2.5mm long, 2–2.8mm wide, the apex produced into an awn to 11mm long, the awn \pm straight to sinuous in bud. Petals (colour unknown) elliptic to lanceolate, 7.25–10mm long, 3–3.8mm wide, the apex acute. Stamens c. 40–65, \pm regularly 3- or 4-seriate (when 3-seriate sometimes partly 2- or 4-seriate in one flower), the filaments (colour unknown) 2–6mm long. Style 4–5mm long.