INTERIM RECOVERY PLAN NO. 197

# SHRUBLANDS AND WOODLANDS ON PERTH TO GINGIN IRONSTONE

## INTERIM RECOVERY PLAN 2005-2010

by

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Photo: Val English

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DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

Natural Heritage Trust
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## FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos 44 and 50

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered ecological communities are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by CALM's Director of Nature Conservation.

This Interim Recovery Plan replaces plan number 61 – 'Shrublands and woodlands on Perth to Gingin Ironstone', Interim Recovery Plan 2000-2003, by V. English and J. Blyth.

This Interim Recovery Plan will operate from 17 November 2005 but will remain in force until withdrawn or replaced. It is intended that, if the ecological community is still ranked Critically Endangered, this IRP will be replaced by a full Recovery Plan after five years.

The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at November 2005.


### ACKNOWLEDGMENTS

Environment Australia (now Department of Environment and Heritage) funded the 1994-1996 project entitled 'Identifying and conserving threatened ecological communities in the south west botanical province'. The community was listed as threatened as a result of that project. The Commonwealth Government in partnership with the Swan Catchment Council through the National Heritage Trust funded the 2003-2005 project entitled 'Nine Critically Endangered Threatened Ecological Communities of the Swan Coastal Plain'. Recovery actions have been implemented through this project for the 'shrublands and woodlands on Perth to Gingin ironstone' community.

The following people provided valuable advice and assistance in the preparation of this Interim Recovery Plan:

| | |
|---|---|
| Neil Gibson and Greg Keighery | CALM, Wildlife Research Centre, Woodvale |
| David Hodby | Landowner |
| Bronwen Keighery and Natalie Thorning | Department of Environment |
| David Mitchell | CALM Swan Region |
| Leigh Sage and Paul Brown | CALM Swan Coastal District, Wanneroo |
| Henry Smolinsky | Department of Agriculture |

**SUMMARY**

**Name**: Shrublands and woodlands on Perth to Gingin ironstone

**Description**: Plant community located on seasonally inundated ironstone and heavy clay soils. The community occurs on the eastern side of the Swan Coastal Plain. Typical and common native species are the shrubs *Melaleuca viminea*, *Dryandra sessilis*, *Acacia saligna*, *Grevillea curviloba* subsp. *incurva*, *Kunzea* aff. *recurva*, *Jacksonia furcellata* and the herbs *Rhodanthe manglesii*, *Tribonanthes australis* and *Isotropis cuneifolia* subsp. *glabra*. The following exotic species are also currently common: *Romulea rosea*, *Briza maxima*, *Trifolium dubium*, *Spergula arvensis* and *Hesperantha falcata*.

**CALM Region**: Swan

**CALM District**: Swan Coastal

**Shire**: Gingin

**Recovery Team**: Swan Region Threatened Flora and Communities Recovery Team (SRTFCRT). Membership: representatives from CALM's Swan Region (Chair), Swan Coastal District, Perth Hills District, Species and Communities Branch (SCB) and Science Division; and City of Gosnells, Botanic Gardens and Parks Authority (BGPA) and World Wide Fund for Nature (WWF).

**Current status**: Assessed 21 November 1995 as Critically Endangered. Also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

**Habitat requirements**: The community is located on skeletal soils developed over massive ironstones and undergoes seasonal inundation with fresh water. Many of the plant species present are specifically adapted to this shallow seasonal inundation. Specifically, the herb layer present in late winter and early spring, which is a major distinguishing characteristic of this community, relies on inundation in winter. This daisy dominated herb layer does not occur on deeper soils adjoining the ironstone areas.

**Habitat critical to the survival, and important occurrences**: The habitat that is critical for the survival of the Perth to Gingin Ironstone community is the area of occupancy of known occurrences, areas of similar habitat within 200 metres of known occurrences, and the local catchment for the surface and groundwaters that maintain the winter-wet habitat of the community. Given that the community is listed as Critically Endangered, it is considered that all known occurrences of the community, and the catchments for the surface and groundwater that support this wetland habitat are critical to the survival of the community.

**Benefits to other species/ecological communities**: The Declared Rare Flora *Grevillea curviloba* var. *incurva* occurs in the community. Five priority listed taxa also occur in the community, as follows: *Isotropis cuneifolia* subsp. *glabra* (Priority 2), *Grevillea evanescens* (P1), *Haloragis tenuifolia* (P3), *Myriophyllum echinatum* (P3) and *Stylidium longitubum* (P3).

**International obligations:** This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity and will assist in implementing Australia's responsibilities under that Convention. This community is not specifically listed under any international treaty and therefore this plan does not affect Australia's obligations under any other international agreements.

**Role and interests of indigenous people**: An Aboriginal Sites Register kept by the Department of Indigenous Affairs lists no sites within this Ironstone community and no indigenous interests have yet been identified for the areas that contain the community. Implementation of recovery actions under this plan includes consideration of the role and interests of indigenous communities in the region.

**Social and economic impacts**: Two occurrences occur on private land and negotiations will continue with the land managers with respect to the future management of these occurrences. The implementation of this recovery plan has the potential to have some limited social and economic impact, where occurrences are located on private property. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

**Affected Interests**: Occurrences of the Perth to Gingin Ironstone community occur within the local government authority of the Shire of Gingin. They occur on land managed by the Shire of Gingin, CALM, and on land managed by one private land owner.

**Evaluation of the Plan's Performance**: CALM, in conjunction with the Swan Region Threatened Flora and Communities Recovery Team, will evaluate the performance of this Interim Recovery Plan. The plan is to be reviewed within five years of its implementation. Any changes to management / recovery actions will be documented accordingly.

**IRP Objective**: To maintain or improve the overall condition of the wetlands and the associated plant community in the known locations and reduce the level of threat, with the aim of reclassifying it from Critically Endangered to Endangered.

**Criteria for success**:

- An increase in the number of occurrences held within the conservation estate and being managed for conservation.
- Maintenance in terms of diversity and basic composition of native plant taxa (as described in Department of Environmental Protection 1996; Ecoscape Pty Ltd 2004) taking account of natural change in the community over time. This will be measured as a loss of no more than 10% of the native plant taxa in any occurrence over the life of the plan.
- Improvement in the condition of the habitat, in terms of reduction of numbers of exotic species. This will be measured as a reduction of 10% or more in the cover of exotic plant taxa in any occurrence.
- Groundwater levels and quality maintained within the parameters expected as a consequence of natural change, by comparison with monitoring results for the Gnangara Mound in areas remote from development.

**Criteria for failure:**

- A decrease of 10% or more in the area covered by the community, and/or decline in the area and/or number of occurrences of this community under conservation management.
- A decline in terms of diversity and basic composition of native plant taxa (as described in as described in Department of Environmental Protection 1996; Ecoscape Pty Ltd 2004) taking account of natural change of the community over time. This will be measured as a loss of more than 10% of the native plant taxa in any one occurrence over the life of the plan.
- Decline in the condition of the habitat, in terms of increase in numbers of exotic species. This will be measured as an increase in the cover of exotic plant taxa of more than 10% in any occurrence of the community.
- Groundwater levels and quality not maintained within the parameters expected as a consequence of natural change, by comparison with monitoring results for the Gnangara Mound in areas remote from development.

**Recovery Actions**:

| | | | |
|---|---|---|---|
| 1. | Coordinate recovery actions | 8. | Implement program for monitoring flora |
| 2. | Monitor boundaries and condition of occurrences | 9. | Monitor weed populations |
| 3. | Map habitat critical to survival | 10. | Implement weed control, and replanting |
| 4. | Seek to exclude stock from occurrences | 11. | Monitor water levels and water quality |
| 5. | Liaise with relevant land managers and other groups | 12. | Design and conduct research |
| 6. | Develop a Fire Management Strategy | 13. | Report on success |
| 7. | Ensure hygiene conditions | | |

## 1. BACKGROUND

### 1.1 History, defining characteristics of ecological community, conservation significance and status

Ironstone soils are extremely restricted in distribution on the Swan Coastal Plain. These soils may have been historically associated with bogs - the iron being deposited by water percolating through the soil (H. Smolinsky[1], personal communication). Restricted areas of ironstone soils associated with unusual plant communities occur in a number of areas in the southwest of Western Australia; near Kalbarri (A. Brown[2], personal communication.), near Eneabba (Griffin *et al.* 1983), at Gingin and Busselton (Department of Environmental Protection (DEP) 1996; Gibson *et al.* 1994), the Scott River (Gibson *et al.* 2000) and near Albany (G. Keighery[3] personal communication). Each of these areas contain plant communities that are characterised by different taxa.

The Perth to Gingin ironstone soil type occurs on the eastern side of the Swan Coastal Plain. This area contains heavy soils that are particularly useful for agricultural purposes and are around 97% cleared (Department of Conservation and Land Management (CALM) 1990; Keighery and Trudgen 1992). Churchward and McArthur (1980) mapped the Yanga fluviatile landform that contains these ironstone soils. The unit is described as "poorly drained plain with grey sandy benches and intervening swamps; also areas of bog iron ore, marl or solonetzic soils" (Churchward and McArthur 1980). The scale of mapping was 1:250,000, which is not sufficiently detailed to indicate the individual small areas of bog-ironstone on the Swan Coastal Plain.

On the 1:50,000 scale Urban/Environmental Geology series (Anon 1976 and 1977; Gozzard 1982) ironstone areas are noted as "bog-iron or iron-rich laterite" within the Guildford Formation, which consists mainly of alluvial clays. The original extent of the community is not known as boundaries of the soil type are not specified on these maps, but symbols occur where patches of the type occur. It is evident however, that the soil type is extremely restricted and that most of the original community has been cleared (B. Keighery[4] and G. Keighery, personal communication; Gibson *et al.* 1994).

The Perth to Gingin ironstone soils are associated with shallow seasonal inundation with fresh water. This inundation may be from surface water that accumulates due to the impermeable nature of the ironstone and the associated heavy soils. In addition, groundwater may come very close to or may reach the surface in the wetter months.

The plant community on these ironstone soils is the only one in the Perth area that is characterised by massed everlastings (*Rhodanthe* spp.) in the understorey (English *et al.* 1996). Floristic analyses of plots on this soil type link to 'herb rich shrublands in clay pans' (community type 8) as described by Gibson *et al.* (1994), reflecting the clays in the soil (DEP 1996). Typical and common native species in the community are the shrubs *Kunzea* aff. *recurva*, *Grevillea curviloba* subsp. *incurva*, *Melaleuca viminea*, *Acacia saligna*, *Jacksonia furcellata*, *Grevillea obtusifolia* and *Dryandra sessilis* and the herbs *Rhodanthe manglesii*, *Tribonanthes australis* and *Isotropis cuneifolia* subsp. *glabra*. A full list of plant taxa currently known from plots in Occurrence 1 is provided at Appendix 1.

There is one taxon listed as rare flora under the *Wildlife Conservation Act* 1950, and several priority flora that occur in the Perth to Gingin Ironstone community. The largest known population of *Grevillea curviloba* subsp. *incurva* is present at Occurrence 1a (B. Keighery personal communication) and the taxon is listed as threatened (i.e. Declared Rare Flora). There is an Interim Recovery Plan for *Grevillea curviloba* subsp. *incurva* (Phillimore and English 2000). There are five priority species that

[1] Henry Smolinsky, Department of Agriculture
[2] Andrew Brown, Threatened Flora Coordinator, CALM Species and Communities Branch
[3] Gregory Keighery, Senior Principal Research Scientist, CALM Science Division
[4] Bronwen Keighery, Department of Environment

occur within the community, or adjacent to the occurrence (refer to the Glossary for definitions of Priority status): *Isotropis cuneifolia* subsp. *glabra* (Priority 2), *Grevillea evanescens* (P1), *Haloragis tenuifolia* (P3), *Myriophyllum echinatum* (P3 ) and *Stylidium longitubum* (P3).

The species composition of the community is likely to have been altered by grazing, as the occurrences have been grazed by stock intermittently. It is not known to what extent fire has influenced the present structure or composition of the community. The grazing would almost certainly have increased the invasion of exotic species such as *Arctotheca calendula, Ursinia anthemoides, Vulpia* spp., *Romulea rosea* and *Briza major* into the community.

The only known occurrences of the community originally located were on private land adjacent to Airfield Road in the Shire of Gingin. The largest of these was acquired with funding from the Commonwealth National Reserve System Program and the Western Australian Government in February 1999 and is now a Nature Reserve.

Very small, degraded areas of the community occur on road reserves in the Gingin area. All of the road side occurrences except the road side portion of Occurrence 1 (refer Table 1) are considered totally destroyed as few of the taxa that were likely to have inhabited the community remain, and occurrences have been severely degraded by weeds (Gibson *et al.* 1994; DEP 1996).

The major threats to the community are weed invasion, grazing, inappropriate fire regimes, clearing, and possibly changes to hydrology such as salinisation and altered patterns of inundation. A recent assessment of dieback disease caused by *Phytophthora* spp. recorded this community as 'uninterpretable', as there are few if any susceptible indicator species present.

**Table 1: Extent and location of occurrences**

| Occurrence Number | Location | Estimated area |
|---|---|---|
| Occurrence 1a | Nature Reserve 46373, Shire of Gingin | 35 ha |
| Occurrence 1b | Road reserve (contiguous with 1a) | Approximately 0.25 ha |
| Occurrence 2 | Private property, Shire of Gingin | 1.6 ha |
| Occurrence 3 | Private property, Shire of Gingin | 2 ha |

**Table 2. Vesting , purpose and tenure of all occurrence of the Perth to Gingin Ironstone community**

| Occurrence Number | Vesting | Purpose | Tenure |
|---|---|---|---|
| Occurrence 1a | Conservation Commission | Conservation of Flora and Fauna | Nature Reserve |
| Occurrence 1b | Shire of Gingin | Road reserve | Non-CALM Act Reserve |
| Occurrence 2 | Private Freehold | Freehold, purpose not listed | Non-CALM Act Freehold |
| Occurrence 3 | Private Freehold | Freehold, purpose not listed | Non-CALM Act Freehold |

**Description of Occurrences**

The ironstone community type as described by Gibson *et al.* (1994) and DEP (1996) was located on only one privately owned property, and adjoining road reserve, in the Shire of Gingin. Subsequently three occurrences of the community have been located on this property, and the largest, Occurrence 1a, has now been purchased by Government and is gazetted as a Nature Reserve.

Occurrence 1a consists of a shrubland dominated by *Kunzea* aff. *recurva* (swamp kunzea) and *Melaleuca viminea* over mixed herbs and low sedges (DEP 1996 - see Appendix 1 for species list). The herbs *Rhodanthe manglesii* (pink sunray) and *Tribonanthes australis* are noticeable in the herb layer in spring. Areas of *Banksia* woodland occur on sandy soils immediately adjacent to the western side of the occurrence. A creek line with pasture under remnant trees occurs in the north east, and pasture under remnant trees also occurs to the south. Occurrence 1a is now fenced on all sides. This occurrence is located on the shallowest soils of all the known occurrences and is associated with the greatest dominance of daisies in the understorey.

This occurrence was burnt in a hot wildfire in January 2003. Some of the overstorey vegetation was killed outright, and the remainder is resprouting from root stock. Since the fire there has been an increase in grassy and pasture weeds (L. Sage[5], personal communication).

Occurrence 1b is the portion of Occurrence 1 that extends onto an adjacent road reserve, where the community has been degraded in terms of a decline in floristic diversity, and subsequent dominance by weeds. This road reserve portion of Occurrence 1 was historically slashed. Pasture-land occurs on the opposite side of the road.

Occurrence 2 is about a kilometre north of Occurrence 1. The shrub layer in both Occurrences 2 and 3 consists of a thicket dominated by *Kunzea* aff *recurva* and *Melaleuca viminea*. The herb layer in these two areas contains a similar suite of species to Occurrence 1. Occurrence 2 covers about two hectares within a 12 ha remnant. The remainder of the area is *Banksia* woodland and a densely wooded wetland. The land owner had erected an electric fence around the perimeter of the entire remnant, as he recognized the vegetation as significant. In 2004, CALM re-fenced the whole 12 ha remnant with standard ringlock fence, in consultation with the landholder.

Occurrence 3 is within a larger remnant that is surrounded by an electric fence and utilised as a bull paddock. The surrounding area consists of remnant trees over pasture. This occurrence is about 750 m south of the northern edge of Occurrence 1, and about 500 m east of that occurrence. It is proposed that this area will also be fenced, in liaison with the landholder.

Ironstone soils occur elsewhere in the vicinity of this occurrence, but are either totally cleared or support a community that has been so modified as to be considered totally destroyed (Gibson *et al.* 1994; DEP 1996).

Data on all known occurrences of threatened ecological communities are held in the threatened ecological community database at CALM, kept at the Wildlife Research Centre, Woodvale.

**Biological and ecological characteristics**

The ironstone soils near Gingin are seasonally inundated (surface water in wetter months). Many of the plant species present are specifically adapted to this shallow seasonal inundation, eg., *Kunzea* aff. *recurva* (swamp kunzea) and the herb layer that appears in late winter and early spring. This herb layer is a major distinguishing characteristic of this community.

The daisy-dominated herb layer that is characteristic of this community does not occur on adjacent deeper soils This is likely to be because species that reproduce by means other than annual seed production may have a competitive advantage (G. Keighery, personal communication). Indeed, the herb assemblages on the ironstone soils where the topsoil is deepest are not dominated by daisies, although daisies still occur (Occurrences 2 and 3; V. English, J. Blyth[6], personal observation).

**Hydrology**

Local hydrogeology is likely to be very important in maintaining the shrublands and woodlands of the Perth to Gingin Ironstone community. The hydrology of the occurrences is most likely to be influenced by the interactions of regional and local groundwater flows, and surface flows. There is little information available about these hydrological interactions, however, some information can be gleaned from data held in the literature, and from direct observations.

[5] Leigh Sage, CALM Swan Coastal District
[6] John Blyth, previously CALM, Wildlife Research Centre, Woodvale

Long term observations (G. Keighery and B. Keighery; landholder, personal communication) indicate that seasonal inundation is limited to very shallow surface water during the winter months. Inundation usually persists for a period of around three months, with the soils drying out at the surface in summer. The surface waters may be linked to the water table as the groundwater is close to the surface in September - October (Davidson 1995). Surface water would also originate from rainfall runoff in the wetter months of the year and be retained by the impervious substrata of heavy soils and rock. If there are connections between the surface and groundwater through the ironstone, then both these sources would affect the quantity and quality of water on the surface of the site.

Occurrences of the community are all located on the north Gnangara Mound, an unconfined groundwater aquifer. The height of the groundwater table is 60-70 metres above sea level (m AHD) where the community occurs. Occurrences are also located in a low point adjacent to a peak in the water mound (a 'col') and adjacent to a flow channel in the groundwater mound (Davidson 1995).

A trend of falling water tables in the general area is evident since around 1976 (Greay 1993). As there is a corresponding decline in annual rainfall this general fall in the water table may be presumed to be at least partly as a result of this decline. It is possible that draw-down of the superficial aquifer - the Gnangara Mound - could also have had an effect. The hydrology of specific areas of the eastern side of the Swan Coastal Plain has also been altered through the construction of drains to lower the water table (Keighery and Trudgen 1992). Conversely, the area is characterised by much valued heavy soils, which were historically highly cleared for agriculture, and for the Gingin Airfield immediately to the west. Clearing is likely to have increased surface runoff and recharge of the groundwater in the local area. Despite a likely increase in recharge due to clearing, drainage has probably resulted in an overall lowering of the water table in localised areas (B. Keighery personal communication). Altered surface flow and/or alteration of the height of the local water table may change the length of the period or the depth of ponding.

The shallow groundwater in the vicinity has a salinity of around 250-500 milligrams per litre total dissolved solids (mg/L TDS) (Davidson 1995), which is quite fresh. Areas of fresh groundwater are generally associated with relatively low risk of salinisation on the Swan Coastal Plain (Davidson 1995). However, samphire, which is vegetation associated with saline areas, was recorded very close to Occurrence 2 (J. Blyth, N. Gibson[7], V. English, personal observation).

The Central Coast Regional Strategy (WA Planning Commission 1996) indicates there is unlikely to be significant urbanisation in the area due to the proximity to the airfield. Additional water table rise in the superficial aquifer or increased surface flows due to further clearing in the catchment therefore seem unlikely. This issue is discussed further under threatening processes.

**Habitat critical to survival, and important occurrences**

The habitat critical to the survival of the Perth to Gingin Ironstone community comprises:

- the area of occupancy of known occurrences;
- areas of similar habitat within 200 metres of known occurrences, ie poorly drained flats, depressions or winter wet flats with shallow red brown sands and loams over massive ironstone
- remnant vegetation that surrounds or links occurrences (this is to provide habitat for pollinators or to allow them to move between occurrences); and
- the local catchment for the surface and groundwaters that maintain the winter-wet habitat of the community (the plant community would be dependent on maintenance of the local hydrological conditions).

Given that the community is listed as Critically Endangered, it is considered that all known occurrences, and the catchments for the surface and groundwater that support the community, are critical to the survival of the community.

**Benefits to other species/ecological communities**

The largest known population of *Grevillea curviloba* subsp. *incurva* is present at Occurrence 1a (B. Keighery personal communication) and is listed as threatened (i.e. rare flora) under the *Wildlife*

[7] Neil Gibson, CALM Wildlife Research Centre, Woodvale

*Conservation Act 1950*. There is an Interim Recovery Plan for *Grevillea curviloba* subsp. *incurva* (Phillimore and English 2000). There are five priority species that occur in the community (Atkins 2005, refer to the Glossary for definitions of Priority status): *Isotropis cuneifolia* subsp. *glabra* (Priority 2), *Grevillea evanescens* (P1), *Haloragis tenuifolia* (P3), *Myriophyllum echinatum* (P3 ) and *Stylidium longitubum* (P3).

Recovery actions implemented to improve the quality or security of the community are likely to improve the status of any species within the community.

**International obligations**

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity and will assist in implementing Australia's responsibilities under that Convention. This community is not specifically listed under any international treaty and therefore this plan does not affect Australia's obligations under any other international agreements.

**Role and interests of indigenous people**

An Aboriginal Sites Register kept by the Department of Indigenous Affairs lists no sites within these Ironstone occurrences and no indigenous interests have yet been identified for these areas. Implementation of recovery actions under this plan includes consideration of the role and interests of indigenous communities in the region.

**Social and economic impacts**

Two occurrences occur on private land, and part of one occurrence is managed by the Shire of Gingin. Negotiations will continue with the land managers with respect to the future management of these occurrences.

The implementation of this recovery plan has the potential to have some limited social and economic impact, where occurrences are located on lands that are not specifically managed for conservation. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

**Affected Interests**

Occurrences of the Perth to Gingin Ironstone community occur within the local government authority of the Shire of Gingin. They occur on land managed by the Shire of Gingin, CALM, and on land managed by one private land owner.

**Historical and current threatening processes**

**Clearing**

Clearing for agriculture has been extensive on the heavy soils on the eastern side of the Swan Coastal Plain, with some 97% of all vegetation in the area cleared historically (Keighery and Trudgen 1992; CALM 1990). The vegetation on the ironstone soils near Perth occur on this portion of the plain and has suffered almost total destruction.

The largest remnant of the community (Occurrence 1), adjacent to Airfield Road, was apparently rolled and fertilised in 1969. However, the attempt to convert the area to more useable pasture was not successful as the soils were too shallow (landowner, personal communication).

**Grazing**

Grazing of the community is likely to have caused alterations to the species composition, by the selective grazing of edible species, the introduction of weeds and nutrients, trampling, and general disturbance.

Occurrence 1 was grazed by livestock for many years prior to the land becoming a conservation reserve. The shallow soils are not very productive and the area was historically only lightly grazed as a consequence. Grazing was reduced when the area became a nature reserve and ceased with the erection of the subsequent permanent fencing in 2004. Kangaroos and rabbits still have access onto the reserve for grazing, and this may affect regeneration.

The most northerly remnant (Occurrence 2) was permanently fenced from stock by CALM in 2004. Fencing was very difficult in the ironstone soils. Occurrence 3 is basically fenced within a larger area that is used as pasture and is currently lightly grazed as a bull-paddock (landowner, personal communication). CALM will seek to fence this remnant in consultation with the landholder.

**Altered fire regimes**

As this community is not well studied, little is known of its requirements in terms of fire regime to maintain species composition. The current study of the 2003 wildfire impacts on species composition and regeneration will provide data about the community's response to fire.

Mediterranean ecosystems are usually fire responsive and indeed may require a particular fire regime to assist regeneration (Abbot and Burrows 2003). If an appropriate fire frequency is exceeded, however, species that are obligate seeders may not have sufficient time to flower and produce seed. If the time between fires is too long, obligate seeders may senesce and be unable to regenerate. Therefore, wildfires or prescribed burns must occur at appropriate intervals, and possibly at the appropriate season and intensity, to sustain the integrity of plant communities.

Too frequent fire can increase the risk of invasive weeds establishing within small bushland remnants such as this community (Abbot and Burrows 2003). Following the hot wildfire in January 2003, there was an observable increase in grass and pasture weeds (L. Sage, personal communication).

**Weed invasion**

Grazing alters species composition through increased nutrient levels and weed invasion. Other disturbances, such as fire and disturbance of the vegetation also result in increased weed invasion. The pollution of the surface waters with droppings from stock is likely to cause increased nutrient levels and, hence, to favor weed species, which are generally adapted to higher levels of nutrients than local species.

A weed control program would be necessary to maintain or improve the current condition of occurrences of the community in the long term. Brown and Brooks (2002) state that the generic aims of weed control are to maintain the pre-invasion condition of the habitat (prevention), control or arrest ongoing weed invasion (intervention), and reverse the degraded condition of the habitat where applicable (rehabilitation). A generic weed control program would involve the following steps (adapted from Brown and Brooks 2002):

1. Accurately mapping the boundaries of weed populations.
2. Selecting an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling weeds that pose the greatest threat to the community in the early stages of invasion where possible, e.g. invasive perennial grasses, *Watsonia*.
4. Rehabilitation through reintroduction of local native species where areas are no longer capable of regenerating following weed control.

**Hydrological changes**

Increased clearing would be expected to result in increased runoff and an increase in recharge to the groundwater table. Alternatively, drainage of the area and uncontrolled abstraction from irrigation bores may lower groundwater levels, especially in summer. Altered periods or depths of ponding may impact the timing of growth of herbs in the understorey, and may also affect the species composition of the community by favoring different plant species.

**Salinisation**

Salinisation may pose a threat to this ironstone community as it occurs on very low-lying, seasonally inundated sites. Samphire, which is vegetation associated with saline areas, was recorded very close to Occurrence 1 and Occurrence 2 (Ecoscape 2004; J. Blyth, N. Gibson, V. English, personal observation). It is not known if this is a result of natural salinity arising from the annual drying out and concentration of small amounts of salt in rain water, or secondary salinity as a consequence of clearing in the catchment.

The levels of salinity in the community will ideally be monitored to determine if salinisation poses a major threat to the community. Remedial actions such as replanting with deep rooted vegetation in strategic parts of the catchment may be indicated if monitoring shows that secondary salinisation is a problem.

**Erosion by wind and water**

Erosion by wind and water may also occur following removal of vegetation by clearing, grazing or fire, although it may not be significant for this community, which is located on heavy soils.

**Disease introduction**

This plant community is believed not to be susceptible to dieback from *Phytophthora cinnamomi* as there are very few dieback indicator species within the community. In 2004 this community was recorded as ‘uninterpretable’ in a dieback assessment. However, even if it is likely to be affected the occurrences should be treated as uninfested.

Another plant community that occurs on ironstone soils in the Busselton area (‘shrublands on southern ironstones’ - community 10b as identified by Gibson *et al.* 1994) is extremely susceptible to dieback, but the species composition of the two ironstone communities is very different.

Risk of introduction of disease in this community should be minimised by undertaking the appropriate hygiene procedures. This would involve wash-down of any equipment used adjacent to the community, and restricting access by vehicles and machinery to dry soil conditions.

**Evaluation of the Plan's Performance**

CALM, in conjunction with the Swan Region Threatened Flora and Communities Recovery Team, will evaluate the performance of this Interim Recovery Plan. The plan is to be reviewed within five years of its implementation. Any changes to management / recovery actions will be documented accordingly.

## 1.2 Conservation status

The community meets the criteria for Critically Endangered (CR) as follows (from CALM 2005):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and** the following applies:

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, **and** the following applies:

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

### 1.3 Strategy for recovery

To identify, and influence the management of, the areas in which the community occurs, so maintaining natural biological and non-biological attributes of the sites and the current area covered by the community.

To conduct appropriate research into the ecological characteristics of the community to develop further understanding about the management actions required to maintain or improve its condition.

## 2. RECOVERY OBJECTIVE AND CRITERIA

### 2.1 Objective

To maintain or improve the overall condition of the wetlands and the associated plant community in the known locations and reduce the level of threat, with the aim of reclassifying it from Critically Endangered to Endangered.

### 2.2 Criteria for success

- An increase in the number of occurrences held within the conservation estate and being managed for conservation.

- Maintenance in terms of diversity and basic composition of native plant taxa (as described in Department of Environmental Protection 1996; Ecoscape Pty Ltd 2004) taking account of natural change in the community over time. This will be measured as a loss of no more than 10% of the native plant taxa in any occurrence over the life of the plan.

- Improvement in the condition of the habitat, in terms of reduction of numbers of exotic species. This will be measured as a reduction of 10% or more in the cover of exotic plant taxa in any occurrence.

- Groundwater levels and quality maintained within the parameters expected as a consequence of natural change, by comparison with monitoring results for the Gnangara Mound in areas remote from development.

### 2.3 Criteria for failure:

- A decrease of 10% or more in the area covered by the community, and/or decline in the area and/or number of occurrences of this community under conservation management.

- A decline in terms of diversity and basic composition of native plant taxa (as described in as described in Department of Environmental Protection 1996; Ecoscape Pty Ltd 2004) taking account of natural change of the community over time. This will be measured as a loss of more than 10% of the native plant taxa in any one occurrence over the life of the plan.

- Decline in the condition of the habitat, in terms of increase in numbers of exotic species. This will be measured as an increase in the cover of exotic plant taxa of more than 10% in any occurrence of the community.

- Groundwater levels and quality not maintained within the parameters expected as a consequence of natural change, by comparison with monitoring results for the Gnangara Mound in areas remote from development.

## 3. RECOVERY ACTIONS

Note: The responsible authority is frequently listed as the relevant CALM District (Swan Coastal District). This refers largely to initiating and guiding actions. However, in general the relevant CALM District, the Species and Communities Branch (SCB) and the Recovery Team share the primary responsibility for securing resources for recovery actions.

## Future Actions

### 3.1 Coordinate recovery actions

The Swan Region Threatened Flora and Communities Recovery Team (SRTFCRT) encompasses all threatened ecological communities and threatened species in CALM's Swan Region. The recovery team will continue to coordinate recovery actions for the Perth to Gingin Ironstone community in Swan Region. They will include information on progress in their annual reports to CALM's Corporate Executive and funding bodies.

**Responsibility**: Swan Region Threatened Flora and Communities Recovery Team
**Cost**: $1,000 pa
**Completion date**: Ongoing

### 3.2 Monitor boundaries and condition of occurrences

The extent of the three known occurrences have been mapped and boundaries determined. The boundary of occurrences will be monitored every two years and changes identified to determine if the 'criteria for success/failure' have been met.

**Responsibility**: CALM (SCB, Swan Coastal District) through the Recovery Team
**Cost**: $1,000 every second year
**Completion date**: Ongoing

### 3.3 Map habitat critical to survival

Although habitat critical to survival is described in Section 1, the areas as described have not yet been mapped and that will be done under this action. If any additional occurrences are located, then this habitat will also be determined and mapped for these locations.

**Responsibility**: CALM (Swan Coastal District; SCB) through the Recovery Team
**Cost**: $1000
**Completion date**: Year 1

### 3.4 Seek to exclude stock from occurrences

Occurrences 1 and 2 have been entirely fenced and stock are now excluded from these areas. Negotiations are continuing with the private land holder to fence the southern occurrence (Occurrence 3) and remove grazing pressure from this area. Monitoring and maintenance of the existing fencing will be ongoing.

**Responsibility**: CALM (Swan Coastal District) in liaison with adjacent landowner, through the Recovery Team
**Cost**: $8,000 for fencing of Occurrence 3
**Completion date**: Fencing Occurrence 3 – Year 1; other issues ongoing

### 3.5 Liaise with relevant land managers and other groups

Where occurrences of the community are privately owned or managed by authorities other than CALM, the involvement of these land managers in the recovery of the community wherever possible and practical is therefore essential to the recovery process. Input and involvement will also be sought

from any Indigenous groups that have an active interest in areas of the Perth to Gingin Ironstone community.

CALM staff will provide information to the landholder who manages Occurrences 2 and 3, with regard to accessing incentives for protection. This will include information about the Land for Wildlife scheme and other funding sources, to help ensure long term protection of the community.

**Responsibility**: CALM (Swan Coastal District; SCB)
**Cost**: Total costs of all liaison $500 pa
**Completion date**: Ongoing

### 3.6 Develop a Fire Management Strategy

#### 3.6.1 Develop and implement fire management and response plans as follows (3.6.1-3.6.3):

Currently, a draft fire response plan is being implemented, however, the full response plan will be completed by the end of 2005.

Prescribed burning within occurrences will not be carried out until the results of the fire response research is complete (L. Sage, personal communication). Therefore the TEC will be listed as a 'no plan burn' area in the interim. Liaison with the landholder and the Shire of Gingin will be maintained relating to prescribed burning.

CALM is responsible for fire management on land managed by CALM outside the Metropolitan Gazetted Fire District, while Fire and Emergency Services Authority (FESA) and the Local Authority (Shire of Gingin) is responsible on non-CALM-land. A CALM District 'Fire Emergency Availability' officer will be present at wildfires that may potentially threaten the TEC, with additional staff and/or crews dispatched as required.

Use of heavy machinery to create new fire breaks within the community will be avoided as additional disturbance would encourage further weed invasion, and fire retardant chemicals that may be toxic to the community will not be used. CALM District staff and local volunteer brigades will be provided with the fire response plan for the TEC so that the importance of not constructing new tracks during wildfires is recognised.

**Responsibility**: CALM (Swan Coastal District); liaison with local Bush Fire Brigades (and Fire and Emergency Services if necessary) through the Recovery Team
**Cost**: $900 for preparation of plan; additional funds for CALM District staff to attend fires in the community $1000 pa
**Completion date**: Ongoing

#### 3.6.2 Ensure maintenance of strategic firebreaks

Maintenance of existing firebreaks is appropriate where firebreaks are already constructed, unless maintenance is likely to cause further degradation of the community. Local CALM staff will ideally be involved in planning the construction and maintenance of firebreaks for all occurrences of the community.

No new firebreaks should be constructed or existing breaks upgraded around occurrences of this community on CALM-managed lands unless they are provided for in the fire response plan and approved by the Recovery Team.

**Responsibility**: CALM (Swan Coastal District) through the Recovery Team
**Cost**: Firebreak maintenance $1000 pa; through the Recovery Team
**Completion date**: Ongoing

### 3.6.3 Determine the community's response to wildfire

Research into recovery of the community from fire is being undertaken following the fire in January 2003. The findings will be used to determine future fire management for the community. As the fire in January 2003 burnt all occurrences, the fuel age of all the occurrences is the same. As little is known of the response of the community to fire, no planned burn will be implemented for the life of this IRP, unless results of future studies suggest fire is required to enhance regeneration.

**Responsibility**: CALM (Swan Coastal District) through the Recovery Team
**Cost**: Additional funds for CALM District staff for research and monitoring $2,500 pa
**Completion date**: Year 1 and 2

### 3.7 Ensure hygiene conditions

This plant community is believed not to be susceptible to dieback caused by *Phytophthora cinnamomi* as there are very few dieback indicator species within the community. In 2004, the community was recorded as 'uninterpretable' in a dieback assessment. However, even if it is likely to be affected the occurrences should be treated as uninfested. Good hygiene procedures can reduce the risk of introduction of disease and limit the impact of the disease if introduced. This will involve wash-down of any equipment used adjacent to the community, and restricting access by vehicles and machinery to dry soil conditions.

No vehicle access will be allowed onto bushland areas within Occurrence 1.

**Responsibility**: CALM (Swan Coastal District); all personnel operating machinery on site, including during fire control operations
**Cost**: To be underwritten by user of machinery; costs of liaison included in 3.5
**Completion date**: Ongoing

### 3.8 Implement program for monitoring flora

Ten monitoring transects were established in Timaru Nature Reserve (Occurrence 1) following the January 2003 fire (L. Sage, personal communication). Each transect consists of a 10m point intercept transect that measures diversity and cover of all species, including weed taxa. These transects have been sampled for the last 2 years in spring and will continue to be monitored bi-annually.

In addition to the transects, two floristic plots occur in Occurrence 1 (DEP 1996) and all native and weeds species have been recorded. There is a need for a floristic survey of the two private property occurrences. Pending landholder permission, plots will be established in Occurrences 2 and 3. These will be monitored every fifth year, or following any major disturbance, such as fire.

The floristic list from Occurrence 1 is relatively detailed and is from plot data (DEP 1996), a floristic survey (Ecoscape 2004) and the post fire transects (L. Sage, personal communication) (see Appendix 1).
Data will be entered on a database program such as that used by Gibson *et al.* (1994) and unknown plant species will be collected, identified and lodged with the WA Herbarium.

**Responsibility**: CALM (Swan Coastal District; SCB)
**Cost**: $3000 annually for point intercept transects; $2000 to establish additional permanent plots in Occurrences 2 and 3 in Year 1
**Completion date**: Ongoing

### 3.9 Monitor weed populations

In 2003, CALM commissioned Ecoscape Pty Ltd to conduct a survey of weeds within the Timaru Nature Reserve (Occurrence 1). Post-wildfire monitoring transects established by CALM District staff in Occurrence 1 complemented this work. As a consequence a comprehensive list of weeds species, cover values and their distribution within the reserve was obtained. This has helped to determine weeds that pose the greatest threat in Occurrence 1. The weeds that are highest priority for control in this community include *Romulea rosea, Sparaxis bulbifera, Lupinus cosentinii* and *Zantedeschia aethiopica.*

Weed control has been undertaken in the heavily infested areas of the reserve. Weed levels will be monitored in conjunction with flora monitoring and weed control (refer Action 3.8 and 3.10). Mapping of the boundaries of weed species that are high priority for control will be undertaken.

As part of the weed monitoring program, weed control trials will being undertaken by Swan Coastal District with assistance from staff from CALM's Urban Nature program. Trials will also include research into seed rain from adjacent pasture land.

**Responsibility**: CALM (Swan Coastal District) through the Recovery Team
**Cost**: $2000 every second year for mapping of high priority weeds
**Completion date**: Ongoing

### 3.10 Implement weed control, and replanting where necessary

The first stage in protecting Occurrences 1 and 2 was the erection of the fencing in 2004 to prevent stock entering the sites. In addition, a 2m high shadecloth fence was erected along the western boundary of Occurrence 1. This will help to slow the spread of weed seed fall on the prevailing winds from the west-southwest in the adjoining paddocks.

The next stage of rehabilitation will involve control of perennial weeds and their replacement with local species, where appropriate. Initial weed control was undertaken in the south west corner of the reserve, where a high density of weeds occurs. The highest priority will be controlling weeds that pose the greatest threat to the community in the early stages of invasion where possible, eg, invasive perennial grasses and *Watsonia*. Rehabilitation through reintroduction of local native species may be necessary if areas are no longer capable of regenerating following weed control.

Seed has been collected from the main overstorey species within Occurrence 1 and is being grown as tubestock (L. Sage, personal communication). The seed was collected from within the reserve and only seed from the same occurrence will be used for rehabilitation. No seed from other areas will be introduced into occurrences.

**Responsibility**: CALM (Swan Coastal District) through the Recovery Team
**Cost**: $2,000 pa for weed control; costs of replanting and rehabilitation to be determined
**Completion date**: Ongoing

### 3.11 Monitor water levels and water quality

There is little information available about the local hydrology and interactions with regional groundwater for this winter inundated, freshwater dependent community. Regional groundwater levels and water quality are routinely monitored by the Department of Environment (DoE), and in specific areas by the Department of Agriculture and local Landcare District Committees (LCDCs). There is some opportunity for local hydrological studies to be undertaken and data for areas close to the ironstone community will be assessed as they may indicate that remedial measures are required.

**Responsibility**: CALM (Swan Coastal District); in liaison with the Department of Agriculture, DoE and LCDCs, through the Recovery Team
**Cost**: $1,000 pa
**Completion date**: Ongoing

### 3.12 Design and conduct research

Research will be designed to increase the understanding of the biological and ecological characteristics of the community to assist future management decisions. Such research will ideally include:

1. The impact of weeds on the community

2. The role of disturbance such as fire and grazing in regeneration or maintenance of the community.
3. Investigation of significant biological processes in the community, eg, pollination biology, germination requirements, longevity and time taken to reach maturity of important plant taxa in the community.
4. Monitoring of water depth, timing and depth of inundation, and water quality in ironstone occurrences.
5. Research on hydrogeology of the community.
6. Seed rain experiment to determine the impact of wind blown weed seeds

**Responsibility**: CALM (Science Division; Swan Coastal District; SCB, Urban Nature) through the Recovery Team
**Cost**: $10,000 pa to initiate research
**Completion date**: To be determined

### 3.13 Report on success of management strategies

Reporting on the success of management strategies will be part of annual reports prepared by the Recovery Team for CALM's Corporate Executive. A more detailed analysis of results as measured against the success criteria will be undertaken at the completion of the five years of implementation of this plan.

**Responsibility**: CALM (Swan Coastal District; SCB)
**Cost**: $1,000 in Year 1-4, $5,000 in Year 5
**Completion date**: Year 5

## 4. TERM OF PLAN

This Interim Recovery Plan will operate from November 2005 to October 2010 but will remain in force until withdrawn or replaced.

**Table 3: Summary of costs for each recovery action**

| Recovery Action | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|---|---|---|---|---|---|
| Coordinate Recovery Actions | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Monitor boundaries and condition of occurrences | 1,000 | | 1,000 | | 1,000 |
| Map habitat critical to survival | 1,000 | | | | |
| Seek to exclude stock from occurrences | 8,000 | | | | |
| Liaise with relevant land managers and other groups | 500 | 500 | 500 | 500 | 500 |
| Develop Fire Management Strategy | 1,900 | 1,000 | 1,000 | 1,000 | 1,000 |
| Ensure maintenance of strategic firebreaks | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Determine community's response to wildfire | 2,500 | 2,500 | | | |
| Ensure hygiene conditions | - | - | - | - | - |
| Implement program for monitoring flora | 5,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Monitor weed populations | | 2,000 | | 2,000 | |
| Implement weed control, and replanting where necessary | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Monitor water levels and water quality | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Design and conduct research | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| Report on success of management strategies for this ironstone community | 1,000 | 1,000 | 1,000 | 1,000 | 5,000 |
| | | | | | |
| **Total** | 36,900 | 26,000 | 22,500 | 23,500 | 26,500 |

Total cost over five years $135,400 (costs of rehabilitation not included)

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**APPENDIX 1**

**Vascular Plants recorded in Occurrence 1 (DEP 1996, Ecoscape 2004, L. Sage unpublished data)**

| | Taxon | Status |
|---|---|---|
| | **Aizoaceae** | |
| * | *Carpobrotus edulis* | |
| | **Asphodelaceae** | |
| * | *Asphodelus fistulosus* | |
| | *Bulbine semibarbata* | |
| | **Asteraceae** | |
| | *Agrostis capillaris* | |
| * | *Arctotheca calendula* | |
| | *Brachyscome iberidifolia* | |
| | *Cotula australis* | |
| | *Cotula coronopifolia* | |
| * | *Hypochaeris glabra* | |
| | *Myriocephalus helichrysoides* | |
| | *Podolepis gracilis* | |
| | *Podotheca gnaphaliodes* | |
| | *Rhodanthe manglesii* | |
| * | *Ursinia anthemoides* | |
| | **Callitrichaceae** | |
| * | *Callitriche stagnalis* | |
| | **Caryophyllaceae** | |
| * | *Silene gallica* | |
| * | *Spergula arvensis* | |
| | **Centrolepidaceae** | |
| | *Centrolepis aristata* | |
| | *Centrolepis glabra* | |
| | **Crassulaceae** | |
| * | *Crassula alata* var. *alata* | |
| | *Crassula* ?*decumbens* | |
| * | *Crassula natans* | |
| | **Cyperaceae** | |
| * | *Cyperus tenellus* | |
| * | *Isolepis marginata* | |
| | *Schoenus odontocarpus* | |
| | **Dilleniaceae** | |
| | *Hibbertia racemosa* | |
| | **Droseraceae** | |
| | *Drosera rosulata* | |

**Geraniaceae**
* *Geranium molle*

**Goodeniaceae**
*Goodenia micrantha*
*Dampiera coronata*

**Haemodoraceae**
*Haemodorum laxum*
*Haemodorum simplex*
*Tribonanthes australis*

**Haloragaceae**
*Haloragis tenuifolia* P3
*Haloragis brownii*

**Hydatellaceae**
*Trithuria bibracteata*

**Iridaceae**
* *Hesperantha falcata*
* *Romulea rosea*
* *Sparaxis bulbifera*

**Juncaceae**
* *Juncus bufonius*
*Juncus holoschoenus*

**Juncaginaceae**
*Triglochin centrocarpa*

**Lentibulariaceae**
*Utricularia multifida*

**Lobeliaceae**
* *Monopsis* ?*debilis*

**Loranthaceae**
*Nuytsia floribunda*

**Marsileaceae**
*Pilularia novae-hollandiae*

**Menyanthaceae**
*Villarsia capitata*

**Mimosaceae**
*Acacia saligna*

**Myrtaceae**
*Kunzea* aff. *recurva*

*Melaleuca viminea* ssp. *viminea*
*Verticordia densiflora* var. *densiflora*

**Orchidaceae**
*Prasophyllum* sp.
*Thelymitra antennifera*

**Papilionaceae**
*Isotropis cuneifolia* subsp. *glabra* P2
*Jacksonia furcellata*
*Ornithopus* sp.
* *Trifolium angustifolium*
* *Trifolium campestre*
* *Trifolium dubium*

**Poaceae**
*Aira cupaniana*
*Amphibromus nervosus*
* *Briza maxima*
* *Briza minima*
* *Ehrharta longiflora*
* *Vulpia bromoides*

**Proteaceae**
*Dryandra sessilis* var. *sessilis*
*Grevillea curviloba* var. *incurva* DRF
*Grevillea obtusifolia* P1
*Hakea varia*

**Scrophulariaceae**
*Glossostigma drummondii*

**Stylidiaceae**
*Stylidium ecorne*
*Stylidium inundatum*
*Levenhookia leptantha*

* Introduced

**GLOSSARY**

Alluvial: made up of sediments deposited by flowing water
Fluviatile: found in or near rivers
Marl: compact impure limestone
Solonchak: pale saline soils typical of certain poorly drained semi-arid regions
Solonetzic: dark alkaline soils formed from solonchak by leaching

STATUS OF FLORA TAXA (Atkins 2005)

Declared Rare Flora (DRF) ‘taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such pursuant to the *Wildlife Conservation Act 1950*.’

Priority 1 (P1) ‘taxa which are known from one or a few populations which are under threat.’

Priority 2 (P2) ‘taxa which are known from one or a few populations, at least some of which are not believed to be under immediate threat.’

Priority 3 (P3) ‘taxa which are known from several populations, at least some of which are not believed to be under immediate threat.’