

Serpentine Sports Reserve Management Plan



[Final January 2012 Version 2 – March 2020](#)

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1. Executive Summary

1.1. Introduction

The Serpentine Sports Reserve covers a total area of 68 hectares. It is located about 60 km south of Perth on the eastern edge of the Swan Coastal Plain, near the Serpentine River, the Perth to Bunbury rail line and the townsite of Serpentine. The reserve includes recreational facilities, consisting of a golf club, pony club and polocrosse club, and regionally significant areas of remnant vegetation.

The Serpentine Sports Reserve (SSR) consists of two land parcels, one on each side of Karnup Road. Unless otherwise specified, the terms *Serpentine Sports Reserve*, *SSR* or ~~just-reserve~~, ~~all~~ refer to the combined areas of both the northern and southern land parcels.

1.2. ~~Vision~~ Objectives

Vision for the Serpentine Sports Reserve

~~To provide a family orientated recreation and conservation area that provides casual, golf and equine organized quality sport and recreation facilities amid well-managed regionally significant bushland.~~

The objectives of this management plan are to:

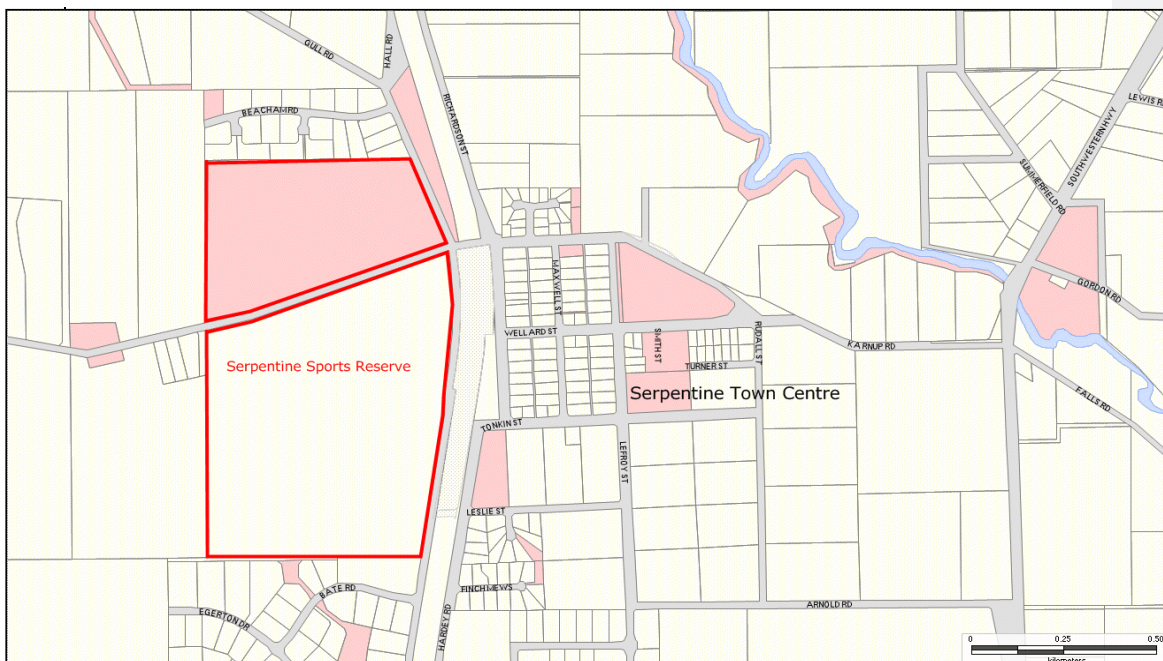
- Provide the necessary background information and site descriptions for informed management of the reserve;
- Define specific management objectives for maintaining and improving the conservation values of the reserve:
 1. Define areas that may require different management methods (e.g. conservation versus active recreation);
 2. Assess the vegetation quality and potential for rehabilitation;
 3. Assess the major problems affecting safety, aesthetics and public enjoyment, such as fire management and weed control;
 4. Assess the types and degree of environmental degradation and possible ways to address these issues; and
 5. Provide a plan for the user groups to follow when managing and regenerating the area;
- Document the actions required to successfully manage the reserve;
- Identify any management constraints and possible ways to overcome them;
- Ensure consistent management into the future, so that the goal or focus is clearly defined and easy to follow despite change of position holders; and
- Provide the community with the opportunity to become involved in the decision-making process for management of the reserve.

1.3. Location and Description

The Serpentine Sports Reserve consists of two land parcels, one on each side of Karnup Road. On the southern side, Lot 778 Karnup Road is over 46 hectares and was ~~ceded-given~~ to the Shire as a “Crown Grant in Trust” in 1925. ~~While t~~This transferred ownership ~~of the land~~ to the Shire, ~~but the land~~ it is still considered part of the Crown Reserves System administered by the State Government. It ~~includes~~ ~~contains~~ club houses for the golf club and equestrian sports clubs, the first nine holes of a golf course, the David Buttfield Equestrian Park, the John Lyster Polocrosse Ground and a small area leased for a communications tower. It also includes regionally significant areas of remnant vegetation in the Paul Robinson Reserve and nearby banksia woodland.

Lot 870 covers 21 hectares and lies to the north of Karnup Road. It is Crown Land and was vested in the ~~Serpentine Jarrahdale~~ Shire in 1965 for the purpose of ~~R~~recreation and ~~S~~show-grounds. This reserve (R27453) contains holes 10 to 18 of the golf course.

Figure 1 shows the location of Serpentine Sports Reserve, and Figure 2 shows the land uses current on the two land parcels.



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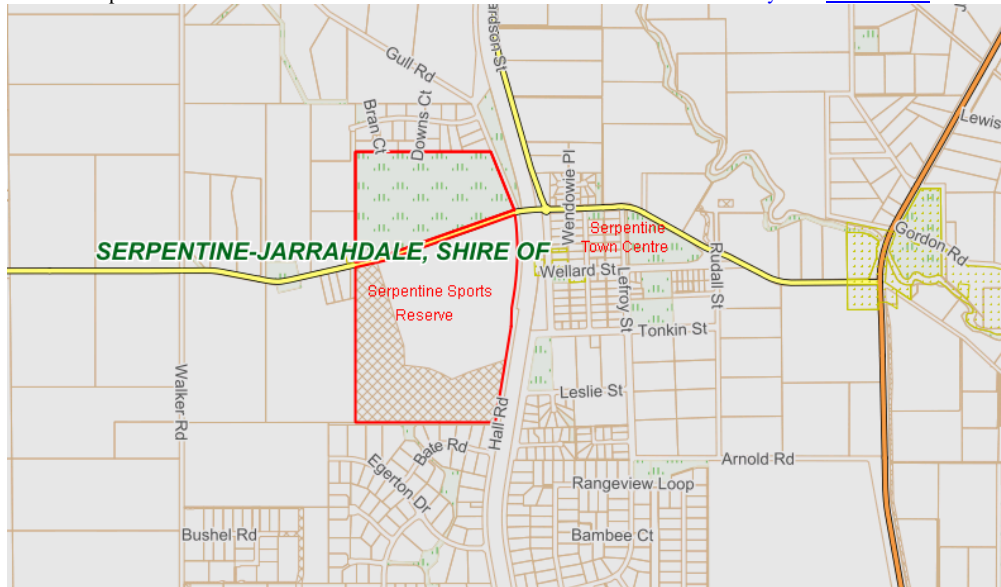


Figure 1 – Site Location of Serpentine Sports Reserve

Prior to European settlement, ~~mixed~~ woodlands and swamps provided ~~abundant~~ resources for ~~Indigenous-Aboriginal~~ people. In the early 1920s, land was made available for settlers, leading to clearing of bush and draining of swamps, ~~significantly altering the landscape~~. The ~~small patches of remnant vegetation found within the~~ reserve ~~now~~ provides important examples of ~~the~~ vegetation complexes which once covered much of the eastern side of the Swan Coastal Plain.

The settlement of Serpentine was originally located one kilometre to the east but moved to its current location ~~adjacent to the reserve~~ when the railway line was built in 1893. The town serviced the rural community and a timber mill operated on the southern portion of the reserve. Recreational ~~activities commenced~~ ~~began~~ on the reserve at this time ~~and have continued to the present day~~.

~~In recent years, the community of~~ Serpentine ~~now~~ has an increasing number of ~~members-residents~~ who commute to Perth. Many of the broad-acre farms have been subdivided, and ~~today~~ the land to the north, south and west of the reserve is small-holdings, hobby farms and lifestyle blocks, many of which ~~house-keep~~ horses.

As more people move into the area, the conservation and recreation values of the reserve are ~~being placed~~ ~~coming~~ under increasing pressure. This plan seeks to sustainably manage the increasing pressures in view of the environmental, social and economic values of the reserve.

~~The Serpentine Sports Reserve Management Committee (SSRMC) is a community group with membership from local recreational and bushcare groups. This committee has provided a focus for community consultation in relation to the development of this plan. In addition, input from the broader community, including Government agencies, has been sought.~~

~~The Shire Reserves Planning and Management Framework stipulates the need for Council endorsement of management plans. In addition, as the SSR is a regional reserve within the Metropolitan Region Scheme, this management plan must also be endorsed by the State Government.~~

~~This management plan is expected to remain current for ten years commencing from the time the final draft is endorsed by Council, and will remain operational until such time as it is reviewed. Any review process will involve broad community consultation.~~

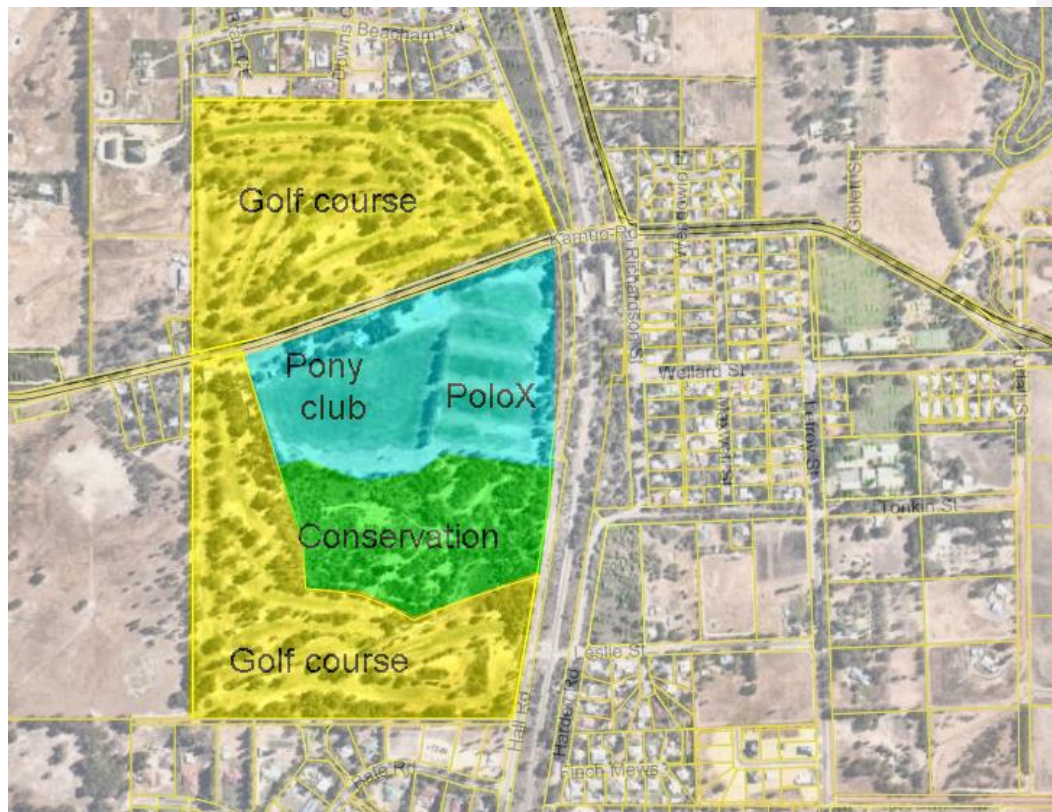


Figure 2 – Land Uses of Serpentine Sports Reserve

1.4. Report Structure

This management ~~plan has been prepared in accordance with the Shire Reserves Planning and Management Framework. The report~~ is structured into the following sections:

- Governance:
 - *Identifies the existing legislation and policies that apply and therefore have management implications for the reserve. The management plan has been prepared within this framework.*
- Environmental characteristics:
 - *Analyses landform, land, water and biodiversity features on the reserve. Threats to these features have also been considered.*
- Social and economic characteristics:
 - *Identifies the main human uses of the reserve, with consideration given to issues such as tenure, access, recreation and heritage.*
- Implementation:
 - *Provides guidance to Council and the community on implementation mechanisms for each management recommendation. Priorities, responsibilities and potential costs and partners are identified.*

1.5. Key ~~Strategies~~ Priority Actions

Table 1 – Key ~~Strategies~~ Actions for the Management of Serpentine Sports Reserve
(Long Term actions and Business as Usual)

No.	Strategy
8.	a) Install meters and monitor water extraction from bores. b) Prepare an inventory of all water consumption on the reserve.
9.	a) Prepare a plan to reduce consumption and reuse water by for example: <ul style="list-style-type: none"> Storing and reusing rain water; Reducing evaporation from dams and irrigation; Reviewing the extent and standard of turf; Using and reusing surface water; b) Applying best management practices for water use on turf surfaces as follows: <ul style="list-style-type: none"> Installing automatic sprinkler systems; Adjusting the quantity of water applied in accordance with evaporation and turf conditions; Adjusting the timing of water application to minimise evaporation and wastage; Monitoring soil infiltration rates and applying wetting agents and other amendments as required.
10.	a) Design and implement a monitoring program for water quality: <ul style="list-style-type: none"> Entering and leaving the reserve; Adjacent to and downstream of potential nutrient hotspots; Entering and leaving the existing constructed wetland. b) Maintain joint records of fertilizer and animal waste applications (as equivalent horse hours per hectare and management techniques) and maintain levels below target amounts (150kg/ha/year N and 15kg/ha/year P). c) Distribute educational material about minimal impact equine management and the impacts of nutrient pollution. d) Minimise nutrient export by implementing best management practices including: <ul style="list-style-type: none"> Adjust fertilizer application for turf condition. Establish vegetated buffers between all nutrient sources and surface water features. Pick up manure and export it within 12 hours. If horse pens are exporting significant quantities of nutrients, provide and frequently renew temporary absorbent surfaces in horse pens and/or construct covered pens with sealed floors. Develop and implement procedures to ensure that manure is not stored on the reserve, even for short periods, unless in appropriate covered containers with impermeable bases. Develop and implement procedures to ensure that fertilizers and other chemicals are transported, stored and used in such a manner that the risk of spillage and pollution is minimal. e) Maximise nutrient stripping from flowing surface waters by reviewing, and where possible implementing, best management practices (e.g. planting native rushes, sedges and other vegetation along drains, treatment trains and artificial wetlands). f) If the existing constructed wetland is not effectively stripping nutrients: <ul style="list-style-type: none"> Adjust its design and management (e.g. in relation to its size, shape, planting, flow rates and vegetation and sediment removal programs); and. Investigate constructing additional wetlands.
15.	a) Map dieback distribution within the bushland areas, zone dieback free areas as high conservation, and manage any tracks through dieback free areas (where they cannot be closed) without unreasonably impacting on existing uses. b) Treat vegetation for dieback by spraying and injecting vulnerable plants at 3 to 5 year intervals. c) Raise community awareness (such as by provision of signs, club newsletters, event briefings etc.). d) Raise the awareness of staff, volunteers and contractors of appropriate dieback hygiene procedures and ensure they are adhered to. e) Minimise risks of disease spread by: <ul style="list-style-type: none"> Where practical, reconciling the alignment of tracks with dieback fronts; and Otherwise, ensuring tracks are constructed with appropriate materials and suitable buffer zones maintained on either side by spraying with a dieback treatment and trimming vegetation at recommended intervals.

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No.	Strategy
	f) Liaise directly with Shire Officers for identification, protection and management of important flora. g) Construct barriers where necessary to prevent pedestrian and stock traffic from crossing dieback fronts or important areas of flora. h) Minimise risks of disease spread by adopting dieback hygiene processes including: <ul style="list-style-type: none"> Construction and maintenance work to be undertaken in dry conditions only; Wash down of vehicles and footwear prior to commencing construction or maintenance work in the bushland area; No material (e.g. soil and pathway surfaces) to be introduced into the bushland area unless guaranteed dieback free.
17.	a) Map weed distribution within the bushland, and compare with previous maps. b) Prepare a weed control program by identifying and prioritising weed affected areas, including sources of weed seed outside the bushland area. c) Remove weeds with physical and chemical treatments in accordance with the weed control program. Mulch, brush, seed, or plant treated areas with local native plants. d) Minimise disturbance and weed introduction and actively remove weeds from the bushland area through: <ul style="list-style-type: none"> Maintaining the number and width of tracks but disallowing the development of new tracks without prior approval; Diverting nutrient rich surface drainage away from bushland areas; Picking up all traces of manure by stock owners in the bushland area within 12 hours of deposition; Picking up all traces of bedding and stock feed from the bushland area within 12 hours of use; Raising the awareness of all users of the importance of minimising weed spread (by event briefings etc.); Removing all <i>Eucalyptus camaldulensis</i> saplings and regrowth plants.
28.	a) Negotiation, agreement and preparation of current lease and licence use of the reserve.
29.	a) Review applications from the equine clubs for normal event camping. b) Impose additional approvals for camping outside the conditions set for normal event camping. c) Review current camping practices in relation to health and other statutory requirements, and where necessary rearrange or move traditional camp sites to locations which better comply with health and other regulations.
30.	a) Continue to maintain the turf area and analyse and document the needs, benefits, carrying capacity and cost sharing associated with budgeting to maintain the turf area at an acceptable standard including estimating the costing for raising the height of the polo/crosse ground. b) Submit this document to Shire staff for assessment and to Council to seek endorsement and allocation of funds to bring the turf area up an acceptable standard for equine purposes and for ongoing annual maintenance. c) Review potential solutions to flooding on the golf course. d) Seek expert advice regarding feasibility and impacts of solutions, and submit preferred proposals and any requests for Shire funds to Shire staff for assessment and Council for endorsement.
31.	a) Minimise environmental impact in bushland by raising the awareness of club members and developing a code of practice with a detailed process for its implementation. b) Formalise and designate tracks and jumps to limit expansion, and adjust the cross-country course if current use causes further degradation of the bushland. c) Constraints and approval requirements: <ul style="list-style-type: none"> No tree/vegetation in bush areas to be removed without a DEC Clearing Permit; Any proposal for the trimming of trees/vegetation to go through the RWG's Reserve Improvement Application Form Process; Camping to be restricted to turf areas on the edge of the bush area and not occur in any bush areas; Ongoing vegetation monitoring in the bush area will result in recommendations for the demarcation and protection of vegetation from use of tracks by horses; Access for horses in the bush area to be restricted to demarcated tracks; The Pony Club to always possess a map showing the designated horse tracks in the bush areas; Any horse manure to be removed by stock owners within 12 hours in any part of the reserve.

No.	Action	Priority & Status	Implementation	Responsibility	Requirements
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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
1	<u>An appropriate application is to be submitted and assessed prior to improvement, development or requests for works.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u>
3	<u>Periodically monitor and review leases and licence use of the reserve.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Infrastructure Services</u>	<u>Staff time</u>
6	<u>Audit water use, prepare a water conservation and reuse plan, and apply best management practices for water use on turf surfaces.</u>	<u>Key Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services, Parks and Gardens</u>	<u>Staff time</u>
7	<u>Design and implement a water quality monitoring program, including nutrient export targets, and develop and monitor nutrient stripping features.</u>	<u>Key Long Term</u>	<u>Implemented in Part</u>	<u>Natural Reserves Coordinator, User Groups</u>	<u>Staff time Funding for monitoring and nutrient stripping</u>
12	<u>Map and treat dieback every three years, according to best management practice.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time Funding for dieback mapping and treatment</u>
15	<u>Map and monitor weed distribution, and prepare and implement a weed control program.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time Funding for weed mapping and control</u>
22	<u>Identify and protect threatened and priority flora and vegetation communities.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Environmental Services</u>	<u>Staff time Funding for signage</u>
30	<u>An appropriate application is to be submitted and assessed prior to any event camping.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Environmental Health, Development Services</u>	<u>Staff time</u>
31	<u>Maintain the turf areas at an acceptable standard.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Parks and Gardens</u>	<u>Staff time Funding for turf maintenance</u>

1.6. Short Term Actions

Table 2 – Short Term Actions for the Management of Serpentine Sports Reserve

<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
2	<u>Change vesting purpose to recognise "conservation" as a purpose for the southern section of the reserve.</u>	<u>Medium Short Term</u>	<u>Not Yet Implemented</u>	<u>Environmental Services</u>	<u>Staff time</u>
9	<u>Liaise with Emergency Services to prepare/update and implement a Fire Management Plan that prioritises conservation alongside people and property.</u>	<u>High Short Term</u>	<u>Not Yet Implemented</u>	<u>Emergency Services, Environmental Services</u>	<u>Staff time Funding for fire management plan preparation</u>
10	<u>Carry out mosaic burns if any control burning is required, allowing habitat restoration before burning the next area.</u>	<u>Medium Short Term</u>	<u>Not Yet Implemented</u>	<u>Emergency Services, Environmental Services</u>	<u>Staff time</u>
13	<u>Adopt and implement dieback hygiene procedures for all users.</u>	<u>High Short Term</u>	<u>Not Yet Implemented</u>	<u>Natural Reserves Coordinator,</u>	<u>Staff time Funding for hygiene</u>

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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
				<u>User Groups</u>	<u>procedures</u>
<u>20</u>	<u>Monitor track width within bushland and adjust access through demarcation and barrier installation as appropriate.</u>	<u>High Short Term</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u> <u>User Groups</u>	<u>Staff time</u> <u>Funding for barriers</u>
<u>34</u>	<u>Consider and document access issues, and develop and implement an access policy.</u>	<u>High Short Term</u>	<u>Implemented in Part</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u> <u>Funding for signage</u>

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2. Governance

2.1. Vesting and Land Tenure

The SSR consists of two land parcels which are zoned for Parks and Recreation in both the *Metropolitan Regional Scheme* and the *Serpentine Jarrahdale Town Planning Scheme No. 2*. The northern parcel (Lot 870) is crown land vested in the Shire of Serpentine Jarrahdale in 1965 for the purpose of Recreation and Showground. The southern parcel (Lot 778) was given to the Shire as a “Crown Grant in Trust” in 1925. While this transferred ownership of the land to the Shire, it is still considered part of the Crown Reserves System administered by the State Government and use must comply with conditions placed on the grant. Table 32 shows the locations and uses of the land parcels.

Table 32 – Serpentine Sports Reserve Locations and Uses

Location Number	Reserve Number	Area (ha)	Land transfer date	Purpose	Current Use
Cockburn Sound 870	27453	21.8	19/03/1965	Recreation and Showground	Golf course
Cockburn Sound 778	19134	46.4	04/12/1925	Recreation, Racecourse and Showground	Golf course, pony club, polocrosse club and <u>nature</u> conservation

Under both forms of tenure the Shire is able to lease the land or licence its use, provided the use is consistent with the reserve purpose. The Shire has responsibility for management of the equestrian ovals and the bushland on the southern section of the reserve, while the remainder of the southern and all of the northern sections are leased to the Serpentine and Districts Golf Club (SDGC), which has responsibility for the management and improvement of the recreation values of the land.

The Shire has overall responsibility for the management, use and protection of the values of all these lands. This includes ensuring that the management and use of the land complies with relevant State and Commonwealth legislation, regulations and policies, as well as local government legislation and strategic policy frameworks.

The SSR is located lies within the catchment of the Peel Harvey Estuary, the area presided over by the Peel Harvey Catchment Council and its parent body, the South West Catchment Council. These catchment councils administer much of the Commonwealth funding for natural resource management. The Water Corporation is responsible for two rural drains through the Serpentine Sports Reserve and therefore has a vested interest in the development, use and management of the reserve in relation to both surface and ground water drainage. Any, within which any works undertaken in a Water Corporation drain require priors approval before any work can be commenced.

This management plan requires the endorsement of Council, and thereafter any significant departures from the endorsed plan, or additional development proposals, also require Council endorsement. The Shire Reserves Planning and Management Framework details the required format for reserve management plans, and the processes for developing and reviewing them. This policy sets out requirements for community consultation, including the establishment and support of two community forums: the Reserves Advisory Group (RAG), and the Reserves Working Group (RWG).

Many of the works on Shire reserves are undertaken by community members, and must comply with legislation, Shire policies and approved plans, and be coordinated ~~under the guidance of~~by the Natural Reserves Coordinator. ~~The Shire Policy for Reserve Improvement/Development by the Community outlines the process for undertaking works, including an application form to note recommendations and proposals for developments and improvements.~~

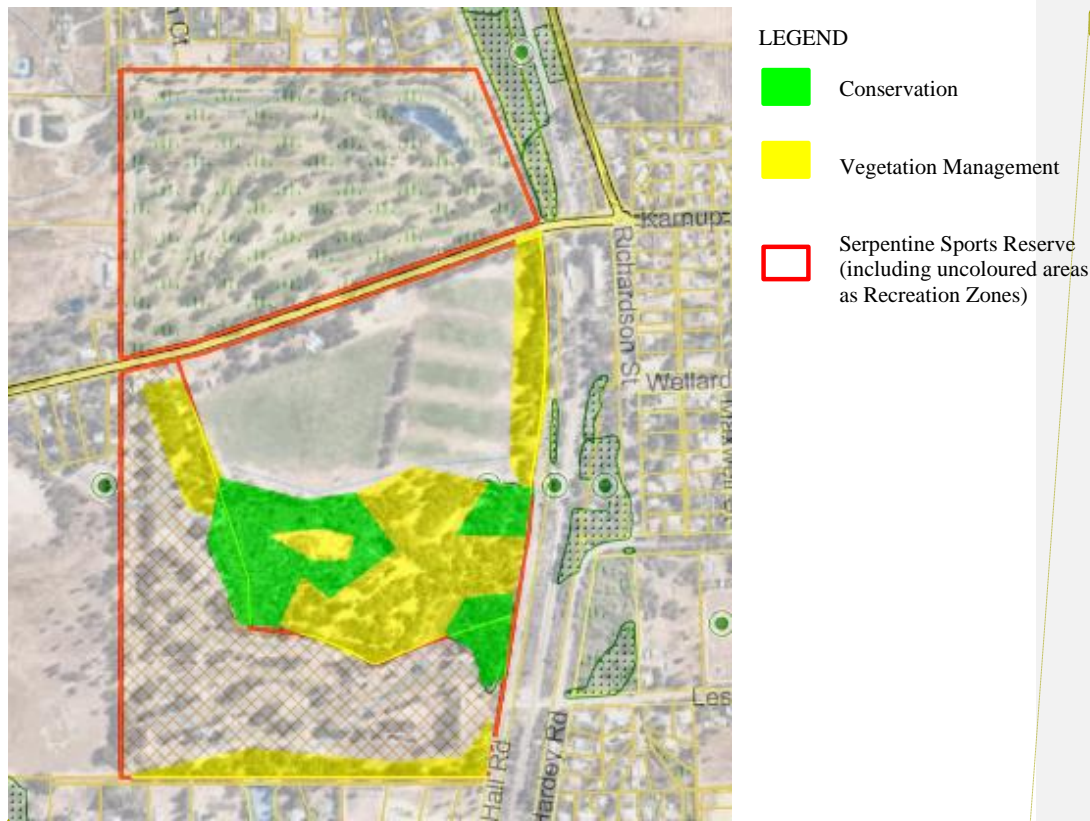
The reserve has been divided into ~~four~~three different management zones: ~~High Conservation~~, Conservation, Vegetation Management and Recreation. Figure 3 shows the location and extent of each of the management zones. Each zone has a range of activities that can or cannot occur there.

~~High Conservation Zone:~~ ~~Areas of remnant vegetation of high biodiversity and scientific reference value which are dieback free and largely weed free. This zone has no planned burn, no dieback treatment and minimal revegetation requirements. Should revegetation or any type of access for scientific or other purposes be proposed within this zone, extreme care is to be taken to not introduce any soil particles which may bring dieback into the zone.~~

Conservation Zone: Areas of remnant vegetation of high biodiversity and scientific reference value which are ~~Threatened Ecological Communities and include both~~ not dieback free ~~and dieback infected areas~~. This zone ~~has no planned burn, but~~ includes dieback treatment, ~~seeding, weeding and planting operations~~weed control and revegetation where required. Access within this area must ~~utilise dieback hygiene procedures such as clean-down and take extreme care to prevent spread of dieback from infected to uninfected areas consider movement and reduce spread of dieback from infected to uninfected areas through clean-down procedures.~~

Vegetation Management Zone: Areas of remnant vegetation of biodiversity and scientific reference value which are not dieback free, ~~and may be disturbed by recreation or weed infested~~. This is a buffer zone and ~~has burning prescribed for protection of people, property and conservation values, but also~~ includes dieback treatment, ~~seeding, weeding and planting operations~~. ~~Access within this area must consider movement and reduce spread of dieback from infected to uninfected areas through clean-down procedures.~~weed control and revegetation where required.

Serpentine Sports Reserve Recreation Zone (remaining uncoloured): Areas with little remnant vegetation which are largely ~~for use~~used for active and passive recreational activities, where management relates to reticulation, horse ~~trails~~grounds, golf course or other active recreational pursuits.



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Figure 3 – Management Zones of Serpentine Sports Reserve

2.2. Community Consultation and Participation

Community input is essential for the protection of the high conservation or recreation values of many reserves the SSR. There are three The main community forums which are involved in the management of the SSR – the Reserves Working Group (RWG), is the Reserves Advisory Group (RAG), and the Serpentine Sports Reserve Management Committee (SSRMC) – as well as four main stakeholder groups.

The Reserves Working Group (RWG) consists of staff from the Shire and the Community Landcare Centre and two community members (nominated respectively by the Land Conservation District Committee and the Roadside Care Volunteers). It coordinates and assesses the progress of on-ground works and considers management issues relating to biodiversity and recreation values within Shire vested reserves. The RWG considers recommendations from the SSRMC in accordance with the Policy for Reserve Improvement/Development by the Community, and records of RWG meetings are forwarded to the SSRMC and RAG. The RWG may request advice from community groups.

The Reserves Advisory Group (RAG) consists of up to 8-eight community members, supported by Shire staff, Landcare SJ representatives and a Council delegate, and appointed by Council for renewable terms of three years. Members have a high level of relevant knowledge, expertise or experience in biodiversity and conservation, natural resource management, sport and recreation, indigenous and other cultural values, equine activities, and/or commercial tourism, wildflower and

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~~seed-picking. The combined knowledge, expertise or experience of all group members covers all of these topics. Members and~~ are expected to participate in a non-representative manner ~~rather than protecting the interests of individual stakeholder groups.~~

~~On Thursday the 15th 2011, 5:00pm at the Shire Offices, a workshop was held with the Serpentine Sports Reserve Committee.~~

~~An overview of Shire reserves management and management plan issues was presented by the Manager of Environmental and Sustainability Services. Biodiversity implications and requirements for approvals were discussed. The workshop mostly involved brainstorming and participants prioritizing listed items which are summarized below:~~

~~PRIORITY VALUES~~

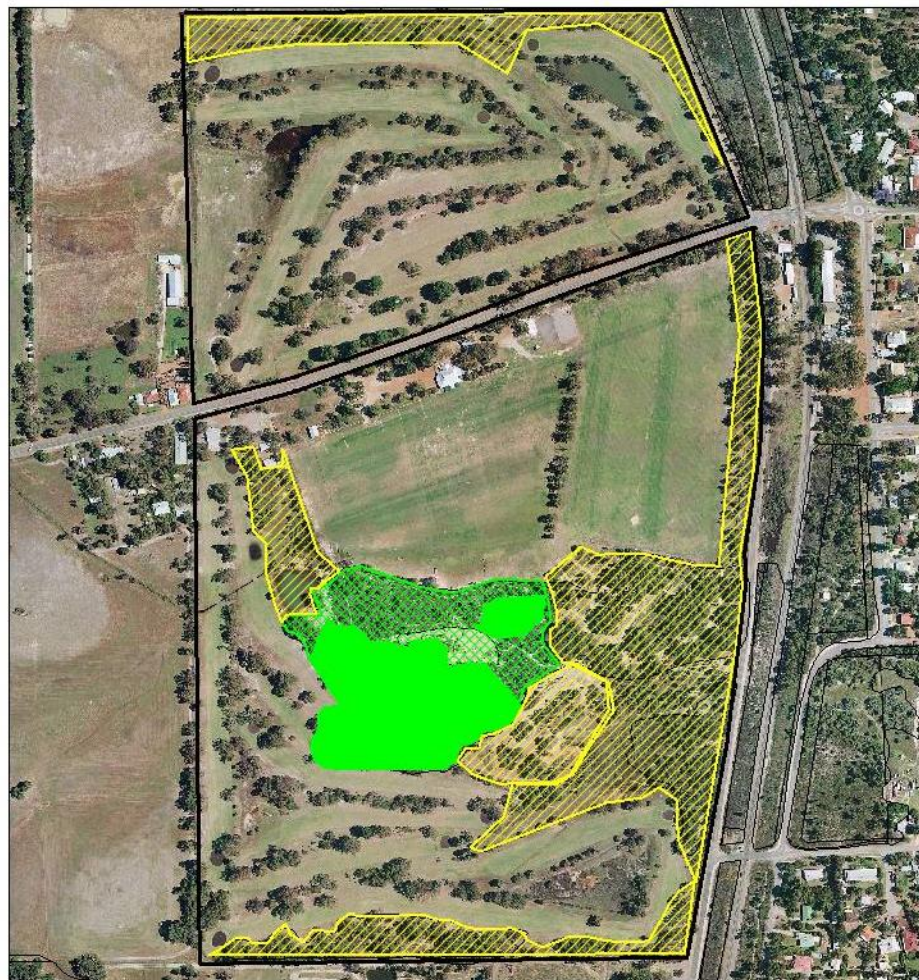
- ~~1. Polo Crosse Ground~~
- ~~1. Pony Club Ground~~
- ~~2. Golf Cub Ground~~
- ~~3. Other Equestrian Groups~~
- ~~4. Bush Forever Site Conservation of DRF and TECS & Education and Scientific Study for DEC~~
- ~~5. Area for General Community Facility Uses and other Casual Users~~
- ~~6. Playgroup, Cross Country Run, Bike Club and Use by Schools~~
- ~~7. Cultural Heritage and History~~
- ~~8. Recreation Use including for Spotlighting Animals~~
- ~~9. Catchment Water Collection~~

~~PRIORITY ISSUES / THREATS / CONSTRAINTS~~

- ~~1. Carrying Capacity of Turf Area and its Management~~
- ~~1. Running Costs – Expenditure and Income and Available Resources~~
- ~~2. Bush Management Dieback/Weeds/Special Species~~
- ~~3. Competing Uses and Facility Use Clashes~~
- ~~4. Public Liability and Risk Management~~
- ~~5. Infrastructure Management and Whole of Life Cost~~
- ~~6. Drainage and Water/Nutrient Management~~
- ~~7. Camping Event Management and Crowd Parking Planning~~
- ~~8. Signage and Education Programs~~
- ~~9. Use of Paths in the Bush, Security Locks, Gates, Dogs, Horses Conflicts and Motorbikes~~
- ~~10. Public Perceptions, History and Planning for the Future~~
- ~~11. External Neighbourhood Expansion~~

~~FUTURE LONG TERM POSSIBLE OPPORTUNITIES~~

- ~~1. Improvements in Surfaces and Sustainability and Capacity Management~~
- ~~1. Improvement in Club House Facilities, Parking Expansion & Longer Term Plan 15 to 20 Years~~
- ~~2. Other Potential Regional Underutilised Alternative Locations ie Web Road or Whitby Falls~~
- ~~3. Turf Upgrade with Underground Reticulation and Redeveloping Drainage and Irrigation~~
- ~~4. Higher Profile Varied Events ie Enclosed Arenas~~
- ~~5. Bush Education Awareness Raising – Establishing Bush Walks with Interpretive Information~~



LEGEND

	High Conservation
	Conservation
	Vegetation Management
	Serpentine Sport Reserve (including uncoloured areas as Recreation Zones)

Figure 3—Management Zones of Serpentine Sports Reserve

The roles of the RAG are to:

- Provide advice to Council on reserve values, threats, management targets and strategies to protect ecological and social values and take account of community aspirations;
- Provide advice to Council ~~and RWG~~ about on-ground management programs and issues; and
- Undertake audits of reserve management plans and report the results to Council.

~~The SSRMC remains the primary focus for community discussion in relation to activities on the SSR. The RAG will maintain an interest by referring to minutes, providing advice to Council and liaising with the SSRMC and RWG, as well as periodically auditing implementation of this management plan.~~

~~The **Serpentine Sports Reserve Management Committee** (SSRMC) provides a forum for the four main stakeholder groups to discuss issues relating to the management of the reserve. SSR is one of a very small number of Shire reserves where there is intensive commitment and involvement of community groups in the use and management of the land. It is also unusual in having an established and active management committee with representation from each of the user groups.~~

~~The SSRMC includes representatives from each of the Serpentine Horse and Pony Club, the Serpentine/Foothills Polocrosse Club, the Serpentine Bushland Group and the Serpentine and Districts Golf Club; two Council delegates; representation from the Land Conservation District Committee and Landcare; and Shire staff members.~~

~~The SSRMC, rather than the RAG, provides the focus for community input into planning and the provision of advice to Council on day-to-day management for SSR. The SSRMC should continue to liaise with Shire staff and the RAG. The implementation of recommendations made by the SSRMC that are not specifically within this plan must be referred to the Natural Reserves Coordinator under the *Policy for Reserve Improvement/Development by the Community*.~~

~~Each of the four stakeholder groups involved in the use and management of the SSR are the Serpentine Horse and Pony Club, the Serpentine/Foothills Polocrosse Club, the Serpentine Enviro Group (previously Serpentine Bushland Group) and the Serpentine and Districts Golf Club. Each is an incorporated body affiliated with a State body. All of the community groups that operate on the SSR are entirely voluntary. is an incorporated body with a defined decision-making structure. Each group holds an annual general meeting, has a constitution and an active committee and holds regular meetings. The three recreation groups are all affiliated with State bodies and need to abide by their conditions for competitions and day-to-day management. The pony club is affiliated with the Pony Club Association of Western Australia, the polocrosse club with the Polocrosse Association of Western Australia, and the golf club with the Darling Range Association and the WA Golf Association.~~

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~~The *Shire Reserves Planning and Management Framework* sets out processes for the preparation and review of management plans, including two rounds of public participation: during the development of the draft plan, and when the draft plan is made available for public comment during a submission period. For the development of this management plan, SSRMC undertakes the usual role of RAG.~~

~~A clear understanding of the processes of Council planning and decision-making, the roles and responsibilities of participants in the planning and management process, and the mechanisms for community input will lead to effective short and long term management and protect the sense of community ownership.~~

~~Consultative planning and management is time consuming and potentially frustrating. This can be minimised by raising awareness and understanding about planning and management processes, and the development of achievable expectations. The endorsement of this management plan should provide a step forward in decision-making and articulate roles, responsibilities and decision-making processes.~~

~~All of the community groups that operate on the SSR are entirely voluntary, but must administer and manage their groups to a high standard. This significant burden often falls on the shoulders of just a few dedicated members, and while the groups may currently have access to considerable expertise and experience in governance, there is no guarantee that this will be the case in the future. To maintain good governance, it is essential that all participating groups are kept informed of available training,~~

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~~and where groups identify the need for additional skills amongst their office bearing members, they should be encouraged to attend relevant training.~~

2.3. Governance: Actions

Table 4 – Governance Actions for Management of Serpentine Sports Reserve (Short Term actions and Business as Usual)

<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
<u>Governance</u>					
<u>1</u>	<u>An appropriate application is to be submitted and assessed prior to improvement, development or requests for works.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u>
<u>2</u>	<u>Change vesting purpose to recognise “conservation” as a purpose for the southern section of the reserve.</u>	<u>Medium Short Term</u>	<u>Not Yet Implemented</u>	<u>Environmental Services</u>	<u>Staff time</u>
<u>3</u>	<u>Periodically monitor and review leases and licence use of the reserve.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Infrastructure Services</u>	<u>Staff time</u>

2.3. Governance Strategies

Issue	Target	Priority	Strategy	Responsibility
1. Many statutes and government policies relate to SSR.	Compliance with all Commonwealth, State and Local Government legislation and policy frameworks.	Medium	a) Develop and implement a process to inform and advise SSMC, RAG and RWG members of current legislation. b) Make reserve users aware of the <i>Policy for Reserve Improvement/Development by the Community</i> . c) All community recommendations and requests for works received under the above policy are to be referred by the Natural Reserves Coordinator to the RWG, and thence to the Council if it is of sufficient magnitude or involves the construction of new infrastructure.	Shire in partnership with all stakeholders
2. Independent auditing provides accountability and ensures appropriate implementation as resources are made available.	Independent audits of this plan to be undertaken and reported to Council by the RAG at a minimum frequency of every 3 years from the date of endorsement of this plan.	Medium	a) RAG meetings to be conducted with broad membership as required in the <i>Shire Reserves Planning and Management Framework</i> . b) Provide assistance and support to RAG members to ensure that proper independent audits are undertaken and reported to Council at a minimum frequency of every 3 years from the date of endorsement of this plan. c) Facilitate a review and debate relating to audit results and the endorsed management plan.	Shire staff with Council, community groups and the broader community
3. Community groups manage a significant administrative and management burden, often without governance expertise.	Community groups which regularly use the SSR to be made aware of appropriate governance training opportunities.	Medium	a) Maintain a record of relevant governance training opportunities and communicate this to SSR community groups.	Shire

3. Environmental Characteristics

3.1. ~~Geology, Geomorphology and Soils~~ Land Resources

3.1.1. Description

~~The apparent stability and eroded appearance of Australia's landforms belie an ancient geological history of spectacular turmoil. A general drift north resulted in climatic changes, and ice and snow gave way to a warm climate.~~ The exceptional biodiversity in the SSR is due to long-term geological instability activity, resulting in variations in soil types within relatively short distances.

Today, the SSR is situated on the eastern side of the Swan Coastal Plain. ~~About 2.5 km further east is the Darling Range, underlain by some of the oldest rocks in the world. Historical erosion from the range accumulated as sediments up to 15 km thick, forming the underlying bedrock of the Swan Coastal Plain.~~

~~The,~~ where the surface ~~deposits on the eastern side of the Swan Coastal Plain~~ soils originate from two sources.

~~The first source is recent~~ Firstly, erosion of the Darling Range ~~to-form~~ ed the Pinjarra Plain soil complex. ~~These are~~ characterised by grey sandy duplex soils, clays, loams and gravels. ~~Effective agricultural use has relied on a network of drains to remove winter water.~~

~~Agriculture WA soil maps indicate that there are two soil types from the Pinjarra complex within the SSR. Pinjarra 8 lies beneath the pony club and polo/crosse fields, and beneath the northern and eastern sectors of the golf course. This soil type is described as:~~

~~Moderately deep to deep sands over mottled clays; acidic or less commonly alkaline grey and yellow duplex soils to uniform bleached or pale brown sands over clay.~~

~~Pinjarra 1b is located beneath the south west corner of the golf course and is described as:~~

~~Deep acidic mottled yellow duplex soils. Moderately deep pale sand to sandy loam over clay.~~

~~The~~ Secondly, ~~source of surface deposits on the eastern side of the Swan Coastal Plain is coastal processes. Massive~~ sea level fluctuations formed a series of sand dunes on top of the plain, the oldest of which lies to the east. Soils from this dune system belong to the Bassendean complex ~~and are~~, characterised by deep, pale siliceous sands ~~which are leached and often waterlogged.~~

Agriculture WA soil maps indicate that there are two soil types from the Pinjarra and two from the Bassendean ~~this~~ complex within the SSR (Table 5). ~~Bassendean 1 soil lies beneath the remnant bushland and under much of the central and south west portion of the northern sector of the reserve. This soil type is described as:~~

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~~Deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than two meters.~~

~~Bassendean 3 is located under the golf course in the south-east corner of the reserve, and is described as: Moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil; surfaces are dark grey sand or sandy loam.~~

Table 5 – Landform and Soil Classifications

Soil type	Location	Description	Land Quality Considerations
Pinjarra 8 phase	Pony club and polocrosse fields, northern and eastern parts of golf course	Moderately deep to deep sands over mottled clays; acidic or less commonly alkaline grey and yellow duplex soils to uniform bleached or pale brown sands over clay.	Wind erosion, waterlogging in low-lying areas
Pinjarra 1b phase	South-west corner of golf course	Deep acidic mottled yellow duplex soils. Moderately deep pale sand to sandy loam over clay.	Moderately susceptible to salinity, soil water storage
Bassendean 1 phase	Remnant vegetation; central and south-west portion of northern sector of reserve	Deep bleached grey sands, sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than two meters.	Wind erosion
Bassendean 3 phase	Golf course in south-east corner of reserve	Moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil; surfaces are dark grey sand or sandy loam.	Waterlogging, phosphorus export, acidity

The SSR has a low relief landscape, with the ~~Bassendean 1~~ soils forming ~~shallow~~ sandy rises and the ~~Pinjarra~~ soils low-lying and poorly drained flats. These natural contours have been altered by excavation in some areas and the addition of soils to others. Soil ~~was excavated~~ from several locations within the northern and southern sections ~~was used~~ during the 1970s to elevate ~~some of the~~ fairways, with the excavations helping drainage.

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~~Excavations have revealed more details of the Bassendean 1 soil profiles can be seen in these. The sand pit within the bushland, which shows very deep, uniformly-grained yellow sand with a shallow grey surface layer enriched by organic matter. Re-establish in the sand pit has been slow, and erosion has undermined adjacent bushland. Further north, adjacent to the southern boundary of near the pony club grounds, the excavated sands have clay subsoil.~~

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~~Bassendean 1 sand from the bushland was used to level, elevate and assist with drainage on the polocrosse grounds. To level the grounds, the sand layer was being spread thicker in the south than the north. The pony club grounds underwent major works to the pony club grounds during in 1999, when the area was levelled the area and replaced the top 200 mm of soil replaced with 300 mm of imported sand.~~

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~~Agriculture WA has prescribed the maximum numbers of stock that various soils can support. The sand layers on both ovals form a thin cover over Pinjarra 8 soils, which have a stocking rate equivalent to two horses permanently on one hectare of irrigated land, or 17,500 horse hours per hectare per year. The current usage for both ovals is within this limit, and the minor soil erosion that occurs during major events recovers quickly.~~

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The pony club ~~also~~ uses a cross-country track which passes through the bushland. About 300 m of this ~~has been~~ was covered with ~~crushed~~ bluemetal ~~finer~~ to help prevent erosion, compaction, ~~and the~~ formation of ruts ~~and the spread of dieback, in the underlying fragile Bassendean 1 soil. The bluemetal is now wearing, with ruts, hollows and side banks becoming evident.~~ The rest of the cross-country trail has a natural surface of Bassendean 1 soil.

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Little is known about the current condition of SSR soils ~~in terms of changes to chemical and microbial composition.~~ Surface salinity is evident ~~along some drainage lines and in low-lying~~ in some areas in the northern section, and there is ~~the~~ potential for ~~changes associated with~~ nutrient build-up and acidification. ~~These issues are discussed under threats and pressures, and in the water section of this management plan.~~

~~The risk characteristics of the four soil types present in the SSR are shown in Table 3.~~

Table 3—Risk Characteristics of Soils of Serpentine Sports Reserve

Soil type	Characteristics
Bassendean 1	Wind erosion
Bassendean 3	Water logging, phosphorus export, acidity
Pinjarra 8	Wind erosion, water logging in low-lying areas
Pinjarra 1b	Moderately susceptible to salinity, soil water storage

Source: Agriculture WA

3.1.2. Threats and Pressures

Water logging is characteristic of the soils over much of the SSR. ~~These impacts are considered in the water and recreation sections of this management plan.~~

Wind erosion ~~is preventable if soils retain~~ occurs when vegetation cover ~~is removed, and.~~ Wind has been the primary cause of continued erosion following the extraction of ~~Bassendean 1~~ soil from the sand pit ~~for the polorosse grounds.~~ The native vegetation ~~in this area~~ is slowly recovering.

Phosphorus export occurs ~~because different soil types possess differing ability to retain nutrients. The from the~~ addition of fertilisers to soils which export nutrients ~~is more, which is~~ likely to result in surface- and ground-water pollution ~~than application to soils which retain nutrients.~~ Excess fertilisers and manure ~~pose a threaten to the soil's~~ chemical balance and microbial communities ~~within soil. Nutrient management is discussed further in the water section of this management plan.~~

Surface salinity can ~~result from two causes, and it is likely that both are operating in the SSR. The be~~ caused by either the evaporation of shallow pools ~~causes water to become increasingly saline through which~~ concentration of salts, ~~or.~~ Salt may also be introduced by rising saline groundwater. Surface salinity can be managed by drainage ~~to ensure that evaporation cannot concentrate salt in standing water. R,~~ while rising groundwater can be controlled through the planting of deep-rooted perennial plants. Increased salinity causes changes to the chemical composition of soils, ~~but is.~~ However, ~~the impacts of salinity are~~ most evident in ground- and surface-water resources, ~~and this topic is therefore discussed further in the water section of this management plan.~~

Soil compaction refers to the crushing of soils to a point where the physical structure is altered, creating layers that are almost impenetrable, ~~which affecting~~ fertility and the soil microbial community. ~~Little is known about the extent of any soil compaction on the reserve. However,~~ The protection of fragile soils

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by a surface material that holds its structure helps to minimise ~~the potential for soil~~ compaction and erosion.

~~The SSR is within a medium risk area for a~~acid sulphate soils, which contain chemicals that, when exposed to oxygen, form sulphuric acid, ~~which is highly toxic and corrosive~~. The ~~component~~ chemicals form in swamps, where constant inundation ~~by stagnant, anoxic water~~ prevents ~~the acid~~ formation of acid. ~~However, if~~ If these soils are ~~disturbed and~~ exposed to air, or ~~water is pumped from them to lower~~ the water table lowered, sulphuric acid forms. This ~~not only~~ alters the chemical nature of the soils ~~themselves~~ but has the potential to and can cause severe pollution of ground and surface water.

The ~~Department of Environment has defined the~~ acid sulphate soil risk within the SSR as:

~~Moderate to high risk of acid sulphate or potential acid sulphate soils occurring greater than three meters from the soil surface; no risk of occurrence less than three meters from the soil surface is moderate to high, occurring more than three metres from the soil surface.~~

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~~The a~~Acidification of soils within the SSR can be prevented by ensuring that there is no soil disturbance or dewatering below a depth of three meters from the surface. ~~Any proposal that might cause or mobilize acid sulphate soils should be investigated in accordance with DEC guidelines and referred to that Department for assessment and advice.~~

3.1.3. Environmental Characteristics: Geology, Geomorphology and Soils Strategies

Issue	Target	Priority	Strategy	Responsibility
4. Soil erosion of sandpit.	Sand pit wall profiles to be stabilised and soil erosion stopped.	Medium	a) Monitor the profile of the sand pit wall and determine whether soil erosion remediation is required.	Shire
5. Potential erosion of polocrosse and pony club ovals.	Ovals to have adequate cover of pasture and/or mulch at all times.	Medium	a) Pasture and mulch cover to be monitored and managed adaptively to ensure management target.	Shire with pony club and polocrosse club
6. Acid sulphate soils.	All members of community groups who make management decisions and/or undertake construction or maintenance works to be aware of acid sulphate soil risks. No acid sulphate soils to be exposed within the SSR.	High	a) The potential risks of acid sulphate soils are to be communicated to all community groups that use the reserve, taking place frequently enough to ensure the management target when club members change. b) No excavation or dewatering is to take place without consultation with DEC.	Shire and all other stakeholders

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3.2. Water Resources

3.2.1. Description

Water resources of the SSR consist of drains, natural and artificial wetlands, ~~plus and~~ superficial and artesian groundwater. The area has a Mediterranean climate with hot, dry summers and cool, wet winters. About 70% of annual rain falls from May to August; these winter rains recharge the ground and surface water.

Surface Water

Much of the reserve is low-lying and originally formed part of a dampland (a ~~winter-waterlogged~~ basin-shaped wetland ~~which was waterlogged in winter~~) with no natural drainage off-site ~~and slow surface flows~~. From the 1920s, a network of drains was constructed to ~~remove excess surface water and~~ reduce inundation, ~~opening the region for and enable~~ agriculture. ~~Later extensions passed through the SSR, removing excess water and draining surrounding areas.~~ The drains flow west to the Serpentine River and the Peel Inlet.

The Peel Harvey Estuary is of regional, national and international significance, and is protected by Commonwealth legislation. ~~It is listed on the Register of the National Estate, as a Ramsar site of international significance for water birds, and supports migratory birds protected under agreements with Japan and China. However, the~~ The estuary has been severely degraded by ~~high concentrations of~~ nutrients from the catchment ~~via the drainage network~~ which cause ~~nutrient enrichment and~~ algal blooms. The Dawesville Channel ~~was constructed in 1994 to increase~~ estuarine flushing, ~~and w-~~ Water quality was also improved through better land management to reduce nutrient inputs ~~into, and increase nutrient stripping from, surface waters.~~

Catchment land use is subject to policies that set nutrient export targets: ~~the Environmental Protection (Peel Inlet Harvey Estuary) Policy 1992 (EPP) and the Statement of Planning Policy No.2 (SPP). The EPP sets~~ These include a maximum phosphorus load from the Serpentine River, ~~while the SPP requires~~ water management plans for recreation facilities, ~~and. The DEC position statement New Conventional Sprinkle Irrigation Agricultural Proposals in the Swan Coastal Plain Catchment of the Peel Harvey Estuary sets~~ maximum nutrient application rates at 150 kg of nitrogen and 15 kg of phosphorus per hectare per year.

~~The SSR is in a proclaimed catchment under the Rights in Water and Irrigation Act 1914, so a license is required to take water from waterways. Works that interfere with watercourse beds or banks also require a licence, although the differentiation between natural and artificial watercourses is unclear.~~

A dampland of 1.8 hectares, ~~on the~~ south-east ~~edge~~ of Paul Robinson Reserve, is a ~~regionally significant~~ "Conservation ~~C~~category" wetland. The primary management objective is to preserve wetland attributes and functions, ~~and;~~ State ~~Government~~ policies require land uses to be compatible. ~~It is protected under the Water and Rivers Water Quality Protection Guideline No. 13 Environmental Guidelines for Horse Facilities and Activities, and the Rights in Water and Irrigation Act 1914 which prohibits taking water that affects wetland water levels.~~ The remaining low-lying areas are ~~R-~~resource ~~E~~enhancement" wetlands.

Runoff from the SSR empties into three Water Corporation drains, which also carry runoff from upstream (see Appendix 2 for a drainage map). The ~~first~~ drain ~~runs~~ along the southern ~~and western~~ boundaries ~~of~~

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the south sector ~~and~~ carries runoff from south of the townsite and ~~a subdivision south of the reserve, passing north along the western boundary to join a~~ The second drain which bisects the south section, carrying water from the townsite, ~~the southeast portion of the golf course, the pony club arena and part of the polocrosse grounds and most of the reserve, and.~~ This flows through an artificial nutrient stripping wetland before crossing two fairways to the western boundary, where the ~~two~~ drains ~~unite~~ join and flow towards the Serpentine River. Runoff from the north sector ~~origin~~ discharges into a third drain running along its northern boundary, which later joins this combined drain.

In 1999 ~~a major project improved the drainage of, and reduced nutrient export from, the pony club arena's drainage was improved, and nutrient export reduced.~~ The drain carrying runoff from the townsite was diverted through an artificial nutrient stripping wetland. The arena surface was reshaped and covered with a deep layer of sand, draining half of the runoff towards a central channel and half into a subsurface channel to the north, which both discharge into the artificial wetland. During peak flow, water backs up from the wetland, ~~covering the outlet pipes;~~ water levels approach the surface and local flooding occurs, ~~caused by limited discharge from the downstream drain.~~

The polocrosse field has ~~also~~ been raised slightly. The ~~surface~~ soils ~~still~~ have low infiltration rates, and the northern section is often ~~inundated and~~ waterlogged throughout winter. The grounds drain ~~slowly~~ towards channels in the north and east and the ~~southern~~ drain ~~in the south~~. Polocrosse carnivals are held in autumn and spring when drainage is not an issue. ~~Use by other activities would require improved drainage.~~

A dam constructed by the golf club provides ~~irrigation~~ water ~~to irrigate all 18 fairways~~. It is filled from a bore, and receives runoff from the equine areas and fairways. It is next to the artificial wetland, but connectivity ~~between dam, wetland and groundwater flows~~ is uncertain. During winter the dam overflows.

The fairways are mounded to drain sideways, ~~using soil from between the fairways and some shallow excavations. In both sections, water collects between the fairways. In the south section, Runoff collects in the channels, along with subsurface flows through the deep duplex soils or deeper sands, accumulating south of the natural wetland and slowly discharging via a~~ the water discharges by a drain through the ~~natural~~ wetland and bushland to join the central Water Corporation drain. ~~In the north section, water collects in shallow drains between the fairways.~~ Drainage is slow, with localised flooding, particularly south of the club house where the central drain crosses the first fairway. ~~Over time t~~ This drain ~~has~~ gradually filled, ~~so so that the base level is above that of the drain upstream. On the western edge of this fairway the two Water Corporation drains meet and,~~ after heavy rain, water flooded ~~eds~~ back ~~along and~~ across the fairway, lasting for several days and ~~causing the high~~ raising water levels in the artificial wetland, which backed ~~sed~~ up and flooded ~~eds~~ the equine arenas. ~~More recently work has been carried out to mitigate flooding and improve outflows from the reserve.~~

Information on surface water quality is limited. ~~The Department of Water has coordinated monitoring in~~ Along the Serpentine River, ~~catchment since 2001. No differences occur in total phosphorus or nitrogen levels at the discharge point of the river, but 57% of the sites (not those closest to the reserve) exceed ANZECC trigger values for water quality in streams. The Serpentine River community group sampled nutrient levels along the Serpentine River in 2001. T~~ total phosphorus levels ~~along the river~~ increased moving downstream, ~~but n~~ No difference ~~was has been~~ detected between the sampling sites up- and down-stream of the ~~junction with the~~ main Water Corporation drain from the SSR and surrounding areas.

Salt-affected land occurs in the north section of the reserve and on the northern edge of the polocrosse field, ~~on clay soils with slow drainage due to low slope and infiltration.~~ The largest area is near the western boundary of the north section, where deep-rooted perennial vegetation appears to have reduced

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the severity ~~of the salt problem~~. On the polocrosse field it is not clear whether salt or water logging is the problem, but salt- and water-tolerant couch grass (*Cynodon dactylon*) has replaced the other turf species.

Groundwater

The SSR is in the Serpentine Groundwater Area. Extensive supplies are contained in superficial aquifers ~~within surface sediments throughout the Swan Coastal Plain~~. In general, Bassendean sands, ~~due to higher porosity and ease of infiltration~~, store more water than Pinjarra soils. ~~Because~~ ~~†~~ The reserve lies on the boundary between these two sediment types, so supplies from the superficial aquifer are likely to be erratic.

The older underlying sediments contain substantial quantities of groundwater (the Leederville Aquifer) in form ~~confined (artesian) aquifers that contain substantial quantities of groundwater, known as the Leederville Aquifer~~. Water leaks downwards and upwards between the two aquifers. Groundwater movement is generally from east to west, but ~~the patterns of~~ flows close to the Serpentine River are more complex. ~~Here~~ ~~†~~ The superficial aquifer discharges to the river (and the artificial surface drains) and water leaks upward ~~from the underlying aquifer~~ to recharge the superficial aquifer.

Groundwater extraction is controlled and licensed by the Department of Water and Environmental Regulation. The Shire holds a license to extract water from the Leederville Aquifer, ~~covering two bores~~, as does the golf club.

The Leederville Aquifer in this subregion is more than 50% allocated. Sustainable levels of extraction, and ~~therefore~~ water allocations, are limited as it is a discharge zone ~~where~~ ~~†~~. The aquifer is not being replenished ~~by rainfall but is instead losing water. Groundwater allocation is guided by the Serpentine Groundwater Area—Leederville Aquifer Recharge and Discharge Zones Policy—1999 (confined aquifer policy)~~. A deeper artesian water resource could be accessed if the allocation was sustainable.

The SSR is within a proposed *Public Drinking Water Source Area (PDWSA) Priority Level 3* (~~Proposed Karnup Dandalup Underground Water Pollution Control Area, UWPCA~~), extending from the Serpentine River south to the Dandalup-Murray System. The purpose of the PDWSA is to protect the quality of water in the superficial aquifer from overuse and pollution, ~~and land use planning and management must reflect this~~. In Priority 3 areas, land use and recreation ~~activities~~ are permitted provided that threats to water quality can be adequately managed, ~~as stated in the Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land~~.

Water Use and Management

Regulation of surface water flow and extraction of groundwater have impacts on the environment ~~and ecological communities~~. People expect ~~almost unlimited~~ access to water ~~to service high demands~~, but resources are limited and costs high. ~~Water use efficiency is an important environmental, social and economic issue. Providing amenities for the community is fundamental to social health, but w~~ Where the needs of community and environment conflict, a balance must be reached or alternatives sought.

The State and many local governments are increasing water use efficiency. ~~In 2003 the State Government released the State Water Strategy and the State Sustainability Strategy, which ensure sustainability of water supplies and manage environmental impacts. Thirteen local governments in the Peel Harvey catchment, including the Serpentine Jarrahdale Shire, are participating in the International Council for Local Environmental Initiatives (ICLEI) Water Campaign, to increase water use efficiency and reduce environmental impacts of Council operations and local communities.~~

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Over three quarters of the reserve is turfed and irrigated from the Leederville Aquifer. Shire staff ~~manage irrigation of the pony club and polocrosse fields (16.5 hectares), using two travelling irrigators applying about 15 mm of water once per week. Best management practices suggest applying around 70% of weekly evaporation (up to 38 mm per week), divided between 3 or 4 applications at times of low wind and evaporation. Currently, less water is applied, in one extended application irrespective of wind and evaporation. More efficient sprinkler systems for equine areas are now available and installation would improve water efficiency and require much less staff time to operate, with generally less water applied than is best practice.~~

The golf course fairways are irrigated via a pump on the dam, which is filled from a bore and receives runoff from the horse grounds. The system is owned and managed by the club. ~~Evaporation is recorded and water inputs calculated accordingly. Fairways are watered every second day at rates of up to 35 mm per week, wetting only the top 200 mm of the soil profile. Irrigation levels are in line with recommended best management practice, but only the centres of the fairways are irrigated, totalling about 30 hectares.~~

3.2.2. Threats and Pressures

Water Quality

The most critical water quality issue is nutrient management, which on the SSR is well within the recommended maximum rates of 150 kg/ha/year nitrogen (N) and 15 kg/ha/year phosphorus (P).

~~The polocrosse field receives about 40 kg/ha N once a year, and no P. The animal waste input is calculated at about 0.6 kg/ha/year P and 6.7 kg/ha/year N. Total inputs are of 46.7 kg/ha/year N and 0.6 kg/ha/year (40 kg/ha N once a year from fertiliser, plus about 6.7 kg/ha/year N and 0.6 kg/ha/year P from animal waste).~~ The animal waste is not evenly distributed ~~in space or time~~ and there may be significant ~~nutrient~~ export from high concentration points ~~such as horse pens, particularly on porous sandy soils.~~

~~Nitrogen is applied on~~ The pony club arena ~~receives total inputs of 108.3 kg/ha/year N and 1 kg/ha/year P (fertilised twice a year at 46 kg/ha and 51 kg/ha N, plus animal waste inputs of about 1 kg/ha/year P and 11.3 kg/ha/year N), twice a year, at rates of 46 kg/ha and 51 kg/ha. Calculated animal waste inputs are 1 kg/ha/year P and 11.3 kg/ha/year N. Total inputs are 108.3 kg/ha/year N and 1 kg/ha/year P.~~ The nutrient loads are not even ~~in space or time~~ and may be exported from high use hot spots. Runoff drains into the artificial wetland where nutrients and sediments can be removed.

Nutrient input ~~levels~~ on the golf fairways ~~are is~~ about 25 kg/ha/year N ~~in two applications~~. This is much lower than professional advice (100 kg/ha/year N ~~per year, in 6 or 7 applications~~) for semi-active turf. Fairway shaping and tree planting ~~between fairways in channels~~ creates the basis for a “treatment train” ~~consistent with water sensitive urban design practices~~. Water travels slowly along shallow channels and collects in artificial sumps, allowing in-stream processes to occur, removing nutrients and sediment.

Water is also used to operate toilets and catering facilities. The toilets at the Eric Senior Pavilion use a Biomax system, while the golf club ~~toilets have~~ has a septic system on a deep sandy ~~profile~~ with high infiltration. The ~~estimated~~ household equivalents, ~~based on estimated use~~, are 1.6 for the Pavilion and 0.3 for the golf club, ~~well within the guidelines for environmentally sensitive areas.~~

Climate Change

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Local impacts of global climate change include significant changes to rainfall patterns. Recent dry conditions are predicted to continue, ~~and may become~~ more distinct and associated with warming and more frequent extreme events. Less rainfall provides fewer water resources and increased pressure for conservation and reuse. ~~SSR managers will have little direct impact on global weather patterns, but~~ Pressure is growing to reduce energy use and greenhouse gas emissions. Low energy and water consumption Initiatives at a public facility provide the additional benefit of community education.

Water Pollution

Nutrient export is a significant threat to water flowing into, through and from the reserve. The main sources are fertilisers and animal wastes, but water from upstream may already be poor quality. Fertiliser use is well within recommended rates, but small amounts can cause pollution if large proportions are exported. Effective application relies on nutrient penetration to root depth at a rate plants can assimilate.

Best management practices to minimise nutrient export from turfed surfaces include: r

- ~~Repeated application of small amounts of fertiliser rather than infrequent applications of large amounts, with amount and time managed by monitoring nutrient levels in soil; and water, use of~~
- ~~Applying soil conditioners and wetting agents, to ensure absorption rather than runoff;~~
- ~~Repeated application of small amounts of water to maintain dampness in surface layers, with amount and time managed by monitoring soil water content and evaporation rates;~~
- ~~Avoidance of applying fertiliser before very heavy rain or just prior to inundation;~~ and
- ~~Maintenance of healthy vegetation over fertilised areas to maximise nutrient uptake.~~

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Horse manure and urine ~~are nutrient sources that~~ require careful management. Total inputs ~~for the grounds from horse excreta~~ are currently well within allowable limits, but only assuming that it is spread evenly. In practice, the horses spend far more time in some parts of the grounds, particularly the horse pens, than in others. ~~Any~~ Most of these nutrients ~~not assimilated by plant roots~~ are exported ~~to surface or ground water. Healthy plant material in the horse yards varies, often being dense during spring but limited for much of the year.~~

Removal of manure from horse pens could reduce levels at these “hot spots”, but large proportions of nutrients are in urine, ~~so 84% N and 36% P remains even when manure is picked up.~~ Sand or other absorptive material ~~in the pens~~ would absorb some of the urine, and subsequent removal ~~would~~ reduce the likelihood of ~~nutrient export as long as rain does not wash nutrients through prior to collection.~~ Covered pens with sealed floors would guarantee the confinement of nutrients.

Best management practice prevents export of nutrients from the source, but nutrients in water can be removed if ~~the water~~ passes slowly ~~enough for assimilation~~ through areas where plant roots can absorb the nutrients. Effective nutrient stripping requires ~~establishment of~~ vegetation with roots at appropriate depths and the slowing down of nutrient-rich water ~~through these areas.~~ The

~~Constructing an~~ artificial nutrient-stripping wetland ~~to strip nutrients and sediments from surface flows~~ improved nutrient management, but ~~it~~ was only designed to process runoff from the pony club grounds. The ~~addition of the~~ much larger flows from the Serpentine townsites puts the system under pressure, and the residence times may be inadequate. ~~The redesign of this wetland and construction of others may be appropriate.~~

Chemicals such as pesticides, herbicides, cleaning agents and petrochemicals can also ~~present the threat of~~ pollute water ~~pollution.~~ A precautionary approach should be taken when transporting, storing and using chemicals, and manufacturers’ instructions must be adhered to at all times.

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Water Quality in the Conservation Category Wetland

Inflows to the wetland could ~~significantly alter/disrupt~~ its ecological balance. The ~~golf course~~ drain ~~from the golf course~~ may import nutrients, weeds and disease, and affect water levels. Ideally, there should be no hydraulic connection between a damland and surrounding land uses. ~~Flooding of the adjacent fairways has been mitigated by digging drainage reservoirs and raising the fairways.~~ Water quality deterioration could be minimised by redirecting and ~~perhaps~~ reusing water from the golf course, or by installing a nutrient stripping wetland ~~to remove pollutants prior to entering the wetland.~~ The wetland is an expression of the water table, and any activities that affect the water table impact on it, including alteration of water levels and leaching of nutrients and other pollutants into the groundwater.

Unsustainable Use of Water Resources

Groundwater is a limited resource under increasing demand. Knowledge of aquifers is incomplete, but license allocation helps to keep usage ~~of ground water resources~~ within sustainable limits. There is significant pressure to increase water use efficiency and maintain natural ~~water~~ flow regimes. Originally, very little water would have left the SSR, ~~evaporating, transpiring or infiltrating to the groundwater.~~ Water sensitive ~~urban~~ design aims to keep most if not all of the water on site and maximise infiltration.

A wide range of best management practices can be adopted to:

- ~~Minimise water demand, by efficient irrigation, application as required, and improved infiltration;~~
- ~~Collect, store and reuse water, via collection dams or tanks and reused waste water;~~
- ~~Reduce evaporation, and wastage via lined dams, sealed tanks, and irrigation during cooler hours;~~
- ~~Slow the passage of water, by meandering or infiltration;~~ and
- ~~Increase transpiration by establishing vegetation that absorbs water.~~

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Salinity

Salinity alters soil structure and limits plant growth. Secondary impacts include bare sealed surfaces with low infiltration and increased runoff, ~~increasing~~ erosion, and nutrient and sediment transport. Saline waters ~~impact-affect~~ the health of freshwater ecosystems. On the Swan Coastal Plain the primary cause ~~of salinity~~ is ~~secondary salinity where~~ salt accumulates ~~from evaporation of standing water on clay soils with low infiltration. This is known as secondary salinity and, which~~ differs from the salinity caused by rising groundwater. Management includes reducing flood time through drainage, increasing surface water use on site and upstream, and reducing evaporation by shading.

Acid Sulphate Soils

Acid sulphate soils occur in the region, and when exposed to oxygen, release sulphuric acid that directly impacts ~~terrestrial and aquatic~~ ecosystems and has serious indirect impacts by liberating ~~ion~~ of heavy metals and acid compounds ~~to surface and ground water.~~ Hydrological ~~s~~ystems for detaining and treating storm water must identify and avoid creating an acid sulphate ~~soils~~ problem.

3.2.3. Environmental Characteristics: Water Strategies

Issue	Target	Priority	Strategy	Responsibility
7. Climate change is reducing rainfall in the Peel Harvey catchment.	Zero net contribution to greenhouse gases.	Medium	a) Prepare an energy consumption and emissions audit of all operations and activities on SSR, including methane production, carbon sinks and carbon trading contingencies. b) Establish vegetation as required to offset emissions.	Coordinated by Shire with involvement of all stakeholders & partners
8. Current water use is uncertain and needs to reflect license conditions.	Compliance with all groundwater license allocation and other conditions.	Key	a) Install meters and monitor water extraction from bores. b) Prepare an inventory of all water consumption on the reserve.	Coordinated by Shire with involvement of all stakeholders & partners
9. Large quantities of water are being used within a catchment subject to water consumption reduction policies and targets.	Decrease water consumption by 15% of 1999/2000 levels within one year from the date of endorsement of this plan.	Key	a) Prepare a plan to reduce consumption and reuse water by for example: <ul style="list-style-type: none"> Storing and reusing rain water; Reducing evaporation from dams and irrigation; Reviewing the extent and standard of turf; Using and reusing surface water; b) Applying best management practices for water use on turf surfaces as follows: <ul style="list-style-type: none"> Installing automatic sprinkler systems; Adjusting the quantity of water applied in accordance with evaporation and turf conditions; Adjusting the timing of water application to minimise evaporation and wastage; Monitoring soil infiltration rates and applying wetting agents and other amendments as required. 	Coordinated by Shire with involvement of all stakeholders & partners
10. Excess nutrients in the catchment are causing down stream algal blooms and ecological collapse in the Peel Harvey estuary.	Surface waters leaving the reserve to be of equal or improved water quality compared with surface waters entering reserve. Total nutrients from fertilizers and animal wastes to be applied to turfed areas at rates no greater than 150kg/ha/year N and 15kg/ha/year P.	Key	a) Design and implement a monitoring program for water quality: <ul style="list-style-type: none"> Entering and leaving the reserve; Adjacent to and downstream of potential nutrient hotspots; Entering and leaving the existing constructed wetland. b) Maintain joint records of fertilizer and animal waste applications (as equivalent horse hours per hectare and management techniques) and maintain levels below target amounts (150kg/ha/year N and 15kg/ha/year P). c) Distribute educational material about minimal impact equine management and the impacts of nutrient pollution. d) Minimise nutrient export by implementing best management practices including: <ul style="list-style-type: none"> Adjust fertilizer application for turf condition. Establish vegetated buffers between all nutrient sources and surface water features. Pick up manure and export it within 12 hours. 	Coordinated by Shire with involvement of all stakeholders

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Issue	Target	Priority	Strategy	Responsibility
			<ul style="list-style-type: none"> • If horse pens are exporting significant quantities of nutrients, provide and frequently renew temporary absorbent surfaces in horse pens and/or construct covered pens with sealed floors. • Develop and implement procedures to ensure that manure is not stored on the reserve, even for short periods, unless in appropriate covered containers with impermeable bases. • Develop and implement procedures to ensure that fertilizers and other chemicals are transported, stored and used in such a manner that the risk of spillage and pollution is minimal. <p>e) Maximise nutrient stripping from flowing surface waters by reviewing, and where possible implementing, best management practices (e.g. planting native rushes, sedges and other vegetation along drains, treatment trains and artificial wetlands);</p> <p>f) If the existing constructed wetland is not effectively stripping nutrients:</p> <ul style="list-style-type: none"> • Adjust its design and management (e.g. in relation to its size, shape, planting, flow rates and vegetation and sediment removal programs); and • Investigate constructing additional wetlands. 	
11. Groundwater reserves under the reserve are currently used for domestic and agricultural purposes and are proposed as a major drinking water source.	Comply with legislative and policy requirements associated with groundwater protection.	High	<p>a) Establish a mixture of deep and shallow rooted vegetation to absorb nutrients as they seep down to groundwater resources.</p> <p>b) Seek advice from the Department of Water on meeting the total target of 150kg/ha/year N and 15kg/ha/year P within the reserve.</p>	Coordinated by Shire with involvement of all stakeholders
12. Saline water is causing salt scalds in turf.	Salt scalds to be eliminated.	High	<p>a) Lower the water table and reduce evaporation by establishing a mixture of deep and shallow rooted vegetation in areas where surface water occurs.</p>	Coordinated by Shire with involvement of all stakeholders
13. Surface water draining the golf course flows through the conservation category wetland, and is likely to add nutrients and degrade the wetland ecosystem.	Water draining into or through the conservation category wetland to be free of pollution, with levels no higher than 0.1 mg/L of total P and 0.75 mg/L of total N.	High	<p>a) Monitor water quality entering the conservation category wetland.</p> <p>b) Reduce runoff and filter water from the golf course by, for example:</p> <ul style="list-style-type: none"> • Establishing a mixture of deep and shallow rooted vegetation throughout the golf course area; • Constructing a nutrient stripping wetland within the drain prior to water entering the wetland. <p>c) If water quality entering the wetland is above target levels (0.1 mg/L total P and 0.75 mg/L total N), review and implement options to isolate golf course runoff from the wetland (e.g. by diverting the drain to a storage dam which drains to the south).</p>	Shire in partnership with the golf club

3.3. Biodiversity

3.3.1. Description

The SSR has about nine hectares of remnant vegetation of three community types, generally in good condition, not well represented elsewhere ~~on the Swan Coastal Plain~~, and ~~of enhanced value by being~~ well connected with each other and with ~~significant vegetation~~ remnants on adjacent rail and nature reserves. Small ~~vegetation areas~~, isolated plants and revegetation contribute to ~~the biodiversity values~~.

~~Biodiversity is the variety of life, including species, their genetic material and ecosystems. The Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC) 1999 defines it as: "...the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems."~~

~~Australia has signed a global agreement to protect biological diversity, ensure its sustainable use and the fair and equitable sharing of its benefits (Convention on Biological Diversity, 1996). Commonwealth legislation (EPBC 1999) provides a framework for protecting of biodiversity, particularly threatened or endangered species and ecosystems. The south west of Western Australia is a world biodiversity hotspot.~~

~~At a State level the Wildlife Conservation Act 1950~~legislation protects ~~species of~~ plants and animals that are listed as ~~T~~"threatened". ~~The responsible agency, DEC, maintains a list of p~~Priority species, ~~which are not listed as threatened but~~ have uncertain status and ~~require need~~ further research, and depend on active ~~conservation strategies to ensure for~~ long-term survival. There are four ~~declared rare~~Threatened flora (DRF) species in the SSR and ~~another~~ seven priority species. ~~There is currently no~~ State legislation ~~that also~~ protects ~~threatened~~ ecological communities ~~or unique assemblages of plants and animals. At present, threatened ecosystems are listed by the State Government and some are afforded protection under by~~ Commonwealth legislation ~~(EPBC 1999)~~.

~~Bush Forever is T~~the State's ~~Government has a~~ strategic plan to conserve bushland on the Swan Coastal Plain, ~~Bush Forever, which establishes a representative system of protected areas under the 1996 National Strategy for the Conservation of Australia's Biodiversity.~~ It identifies areas of regionally significant bushland and strategies for their protection. The SSR bushland is mapped, ~~with adjacent bushland,~~ as ~~Bush Forever Site 375, grouped with two other sites as the Byford to Serpentine Rail/Road Reserves and Adjacent Bushland, to~~ forming a corridor to other significant areas, ~~including the Serpentine River and Mundijong Road. It is part of a network of small sites whose connectivity increases their opportunity for long term survival.~~

~~The Bush Forever implementation guidelines for local government or Crown Reserves include:~~

- ~~• (having) reserve purpose amended to include conservation~~
- ~~• (preparing) management plans for local reserves to protect bushland and ensure that any proposed development (in accordance with the reserve's existing purpose) is compatible with Bush Forever conservation objectives and achieves a reasonable outcome.~~

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3.3.2. Flora

~~Australia has been divided into 85 "Biogeographic Regions" for the purpose of conservation planning and natural resource management.~~ The SSR ~~is lies~~ in the Swan Coastal Plain ~~Interim Biogeographic Region of~~

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Australia (IBRA), which lies west of the Darling Fault line and extends from Jurien Bay to Dunsborough. The Swan Coastal Plain biogeographic region is described as:

Low-lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, Allocasuarina obesa on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrust Mesozoic sediments dominated by Jarrah woodland. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by A. obesa-marri woodlands and Melaleuca shrublands, are extensive only in the south.

AIBRA region, within which a variety of plant communities occur within this IBRA region and were defined and described by Heddle *et al.* in 1980 (Government of Western Australia 2000). The Heddle vegetation classification is based on soil types and landforms with some survey data. A vegetation complex contains an array of different plant communities that are associated with a single geomorphic element or soil landscape system.

The SSR is on the boundary of two elements, between the Pinjarra Plain and Bassendean Dunes, an interzone of greater diversity with elements from both systems. Heddle lists the vegetation as Guildford Complex, associated with Pinjarra Plain soils: open to tall open forest of *Corymbia calophylla* (marri), *Eucalyptus wandoo* (wandoo), *E. marginata* (jarrah) and woodland of *E. wandoo* (with rare *E. lane-poolei*). Minor components include *E. rudis* (flooded gum) and *Melaleuca rhaphiophylla* (freshwater paperbark).

The bushland in the center of the reserve, on the low sandy dune, is more typical of the Southern River Complex which is transitional between Pinjarra Plain and Bassendean Dune elements and is described as: Open woodland of *Corymbia calophylla* *Eucalyptus marginata* *Banksia* species with fringing woodland of *Eucalyptus rudis* *Melaleuca rhaphiophylla* along creek beds.

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The Gibson analysis of communities on the Swan Coastal Plain (Gibson *et al.* 1994) used the presence or absence of particular species in standard sample areas to define floristic groupings. The Gibson study also investigated the total areas of each community and defined some as Vulnerable, Endangered or Critically Endangered. Three Gibson floristic communities are represented in the remnant vegetation in SSR. They are Banksia Woodland (community type-20b), Marri Woodland (community type-3b) and Wetland Heath (community 8).

Banksia Woodland (community type 20b)

"*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain" covers an area of about 4.5 hectares. The community is listed as Endangered by the Threatened Species and Communities Unit of DEC, but is not listed under both State and Commonwealth legislation.

This community is found on the most western side of the bushland community, occurring on a low dune of grey Bassendean sand. The central section was excavated more than 50 years ago, leaving a pit scar. West and south is about two hectares of woodland with small areas of degraded open woodland, dominated by firewood banksia (*Banksia menziesii*) and candlestick banksia (*B. attenuata*) with scattered jarrah (*Eucalyptus marginata*) and bull banksia (*B. grandis*). The understorey is diverse, dominated by balga (*Xanthorrhoea preissii*).

About half of the woodland is in very good condition with little structural alteration apart from numerous tracks fragmenting the habitat. A substantial cross-country horse track bisects the woodland, about 1.5 m wide and surfaced with granite blue metal fines. It enters from the north-west corner and travels south and east to the sand pit, traversing bushland in very good condition with few weeds and a healthy understorey. Most was assessed as dieback free in 2000, but the track also traverses dieback-infected bushland.

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The banksia-jarrah woodland south of the sand pit and towards the southwest corner is more disturbed. ~~There is with~~ evidence of historical clearing, ~~grazing and/or trampling, and near the golf course are infestations of and~~ weeds, particularly African lovegrass (*Eragrostis curvula*), veldtgrass (*Ehrharta calycina*) and wild oats (*Avena barbata*), which require regular treatment. The condition varies, with healthy diverse understorey mixed with areas where the understorey is highly disturbed ~~or absent. Many small tracks fragment and disturb the area.~~

The dune sands north of the pit and along the northwest boundary have a structurally distinct community. The lower slopes are open woodland of firewood banksia (*Banksia menziesii*) and swamp banksia (*B. littoralis*) with scattered jarrah (*Eucalyptus marginata*) and Christmas trees (*Nuytsia floribunda*). Further upslope the community grades into dense low shrubs with *B. menziesii* and *E. marginata* emergents. It may be a distinct community, or the result of past disturbance or the ongoing disruption of dieback. This community is very diverse and resembles a sandplain heath, ~~with. There are very~~ few weeds and ~~the~~ healthy vegetation ~~appears healthy, although highly fragmented by tracks.~~ Dieback is evident, particularly upslope north of the pit. A small area in the open woodland ~~was assessed as~~ free of dieback. The horse track continues through this community from the eastern edge of the pit, ~~and more incised as the soils are lighter and more fragile. This section is dieback infected and a few grass weeds are evident.~~

Marri Woodland (community type 3b)

“*Corymbia calophylla* - *Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain” is recorded on the east and north-east section of the bushland. The community is listed as Vulnerable by DEC under State legislation, but is not listed ~~under by the~~ Commonwealth ~~legislation~~.

The ~~community is~~ marri (*Corymbia calophylla*) woodland ~~with has~~ an understorey of sedges and balga (*Xanthorrhoea preissii*). It occurs on the lower slopes ~~in the soil transition~~, covering about 2 hectares ~~(including several clearings)~~ in the north-east and a little less than one hectare in the southeast near Hall Road. There are other small patches of marri on the western edge of the bushland near the golf club dam. All ~~of the marri woodland~~ is infected with dieback.

The ~~condition of the~~ northeast section is in “good” on the Keighery condition scale. ~~It has been despite~~ significantly ~~disturbed~~ anced, with localised ~~aggressive~~ weeds and ~~highly fragmenting~~ tracks, but retains much of the original structure and the potential to regenerate ~~with good management.~~ Extensive e cleared areas for old, ~~unused~~ horse pens have ~~heavy~~ infestations of African lovegrass (*Eragrostis curvula*), which is beginning to invade the small wetland heath and require frequent treatment. The track from the pens to the polocrosse field has some localised ~~dense infestations of~~ lovegrass. A healthy, if fragmented, understorey on the eastern side has weeds confined largely to the tracks and clearings. A severe infestation of watsonia (*Watsonia* sp.) lies ~~along the eastern boundary in and adjacent~~ in and next to the road reserve. The western part, including the horse pens, is completely degraded in places, but retains patches with fairly healthy understorey. There are many tracks, including two horse tracks passing through the cleared western edge and ~~through~~ the woodland on the eastern side, up to 10 m wide. The condition of this community has degraded rapidly over the last ten years.

The smaller marri woodland to the south is in very good to good condition, linked by revegetation in the Paul Robinson Reserve. An area within and near the Paul Robinson Reserve is degraded ~~to completely degraded~~, with ~~heavy~~ weed infestations and few native plants in the understorey. Immediately south is an area of woodland in very good condition with diverse, healthy understorey, lying on each side of the fence and extending west towards the wetland. ~~It is particularly important as the only intact area of this understorey within the bushland and as a healthy transitional community between two distinct ecosystems.~~ The woodland remnant narrows along ~~the~~ Hall Road ~~boundary~~ towards the golf course. ~~The~~

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~~condition of this area has declined with higher levels of weed infestation, but generally there is a healthy understorey.~~ There are patches of watsonia along the tracks and the fairway edges.

Wetland Heath (community type 08)

~~Wetland heath "Herb rich shrublands in clay pans" occurs in the southeast of the reserve and belongs to the Bennett Brook Suite, found in the Serpentine River area, originating in depressions intersecting the water table within the Bassendean Dune system. The wetland covers just over 1 one hectare and supports a low closed heath dominated by swamp teatree, *Pericalymma ellipticum*, and *Melaleuca viminea*. The community is listed as Vulnerable by DEC and has been submitted for listing under State legislation and as Critically Endangered under the Commonwealth legislation. It is a Cconservation Category wetland, which has implications for management and activities which affect its health and function. The Rights in Water and Irrigation Act prohibits the drawing of water or construction of dams that affect its hydrology.~~

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The condition of the wetland vegetation is very good to excellent. There is some weed invasion along the western boundary and ~~vigorous weeds along~~ the artificial drain, ~~probably due to increased nutrients~~. This is a low nutrient environment and any increase affects the vigour of the native plants and delivers a competitive advantage to introduced plants.

Other Vegetation

Outside the remnant bushland the natural vegetation is limited to ~~one a linear~~ vegetation unit area along the southern boundary plus scattered trees and clumps ~~of vegetation~~ elsewhere in the southern section. The bushland along the southern boundary is marri woodland on duplex soils, covering about 1.4 hectares. ~~The woodland e~~Condition is good, ~~being significantly altered by high density aggressive weeds~~ and partial clearing but retaining its basic structure, and could be regenerated ~~with good management. The understorey retains a range of plant species including balga (*Xanthorrhoea preissii*), scattered grass trees (*Kingia australis*) and a number of sedges.~~

Small clumps or narrow lines of native vegetation have been retained between the southern fairways, mostly overstorey species ~~such as marri and banksias~~ with some ~~balga and other~~ understorey. This includes some very large trees with significant aesthetic and habitat values. In the ~~shallow~~ basins, native sedges and other wetland plants have regenerated. Some trees have been planted, ~~including large pine trees near the bushland and non local species on the lower slopes.~~ A small area of sedges occurs between the polocrosse field and Hall Road. ~~It is currently weed free but significant infestations of watsonia nearby pose a threat to its long term survival.~~

Some local vegetation fringes the equestrian fields and club houses, and there are stands of marri and flooded gums on the eastern edge of the polocrosse field, including some large flooded gums with significant aesthetic and habitat value. At the corner of Hall and Karnup Roads the remnant marris have a scattered understorey ~~of *Acacia pulchella*, with watsonia and African love grass.~~ Small groups of marri occur around the equestrian and ~~the golf club rooms, providing shade and habitat.~~

The northern section was almost completely cleared when the golf course was established. ~~Only five or six native trees were retained as the course was and~~ revegetated with mostly non-local trees.

Revegetation has occurred at two sites within and near the remnant bushland. ~~The Paul Robinson Reserve, between the northern and southern marri woodland, was revegetated with a variety of Western Australian plants over 20 years ago. T and the decommissioned go-kart track has been revegetated with, using a range of mostly non-local species. A high level of weed infestation occurs in both revegetation~~

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areas, particularly African lovegrass (*Eragrostis curvula*), veldtgrass (*Ehrharta calycina*) and wild oats (*Avena barbata*). All of these weeds thrive in disturbed and open environments and require regular and intensive management.

Until recently, local provenance plants (grown from local seed) were not available. The Serpentine Bushland Group planted native non-local species that were not found in the reserve in order to avoid polluting the gene pool. Now that local provenance plants are available, there is a greater opportunity to rehabilitate and expand the local ecosystems. More recent revegetation has used local species. The ongoing fauna studies conducted by the SBG since 2001 provide evidence of the value of this revegetation as habitat that linking and expanding the natural bushland.

A line of swamp mahogany (*Eucalyptus robusta*) separates the equestrian grounds and continues along the southern boundary of the polocrosse field. Trees have been planted along the eastern boundary, including *E. maculata* and *E. robusta*, and some local trees retained. Along the northern edge a line of trees was planted on either side of the cross-country track. These are, river red gums (*E. camaldulensis*), which are now considered an environmental weed because it seeds prolifically and invades bushland, and can cross breed with the local flooded gum (*E. rudis*). The trees are well established and have significant amenity value, particularly during summer. However, many saplings occur along the fenceline and the road reserve which could be removed. There are also stands of weedy Victorian teatree (*Leptospermum laevigatum*) and isolated plants near horse jumps should be removed and that can spread into new areas if not controlled.

A range of non-local trees were planted by the golf club between the fairways in the northern section of the reserve, including *Eucalyptus grandis*, *E. robusta*, *E. camaldulensis* and *Pinus radiata*, recommended and supplied by Alcoa Australia. The local species *Casuarina obesa* was used in the original plantings and more recent revegetation along the northern edge of the course. All of the trees are now very large and well established. Where shallow drains were created between the fairways, some rushes and sedges have become established, including local species as well as the introduced bulrush (*Typha orientalis*) which is a targeted wetland weed for removal in many areas.

Conservation Listed Flora

The diverse flora within the remnant bushland is diverse because the area encompasses three community types and a range of habitats. Four plant species are listed under the State Wildlife Conservation Act 1950 legislation as Declared Rare Threatened Flora and are also protected by Commonwealth legislation in the EPBC Act 1999. The disturbance of DRF Threatened flora requires the permission of the Minister. Seven species on the reserve are listed as priority species by DEC the State. The conservation listed plant species are shown in Table 64.

Table 64 – Conservation Listed Plant Species of Serpentine Sports Reserve

Conservation Category	Species Name
Declared Rare Flora	<i>Synaphea stenoloba</i> <i>Tetragia australiensis</i> <i>Verticordia plumosa</i> ssp. <i>pleiobotrya</i> <i>Verticordia plumosa</i> ssp. <i>ananeotes</i>
Priority 1	<i>Synaphea odocoileops</i>
Priority 2	<i>Johnsonia pubescens</i> ssp. <i>cygnorum</i>
Priority 3	<i>Acacia oncinophylla</i> ssp. <i>oncinophylla</i> <i>Isopogon drummondii</i> <i>Lambertia multiflora</i> ssp. <i>australiensis</i>

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Priority 4	<i>Anthotium junciforme</i> <i>Drosera occidentalis</i> ssp. <i>occidentalis</i>
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3.3.3. Fauna

Fauna ~~have been~~ surveyed by the Serpentine Bushland Group and Birds Australia. The Serpentine Bushland group conducted fauna surveys in the Paul Robinson Reserve, ~~to investigate the effectiveness of replanting, twice a year in early summer and autumn between 2001 and 2004. Species recorded during these surveys are listed in~~ Table 7)5. ~~Had s~~ Surveys ~~been conducted~~ throughout the remnant bushland in the more intact ecosystems, ~~it is would~~ likely ~~that have expanded~~ the fauna list ~~would be more extensive~~.

Table 75 – Amphibian, Reptile and Mammal Species Recorded in Paul Robinson Reserve (May 2001 – May 2004)

Fauna Group	Common Name	Species Name
Frogs	<i>Crinia glauerti</i>	Glauerts Froglet
	<i>Crinia insignifera</i>	Sandplain Froglet
	<i>Heleioporus eyrei</i>	Moaning Frog
	<i>Lymnodynastes dorsalis</i>	Pobblebonk
	<i>Tiliqua rugosa</i>	Bobtail
Reptiles	<i>Bassiana trilineata</i>	SW Cool Skink
	<i>Hemiergis quadrilineata</i>	Two Toed Earless Skink
	<i>Menetia greyii</i>	Common Dwarf Skink
	<i>Notechis scutatus</i>	Tiger Snake
	<i>Lialis burtonis</i>	Burton's Legless Lizard
	<i>Varanis gouldii</i>	Goanna
	<i>Cryptoblepharus plageocephalus</i>	Fence Skink
	<i>Ramphotyphlops australis</i>	Southern Blind Snake
	<i>Isodon obesulus</i>	Southern Bandicoot
Mammals	<i>Mus musculus</i> *	House Mouse*
	<i>Rattus sp.</i> *	Rat*

*Introduced species

In 1998, a bird survey conducted by Ninox Wildlife Services recorded 18 species of birds within the remnant bushland, ~~(shown in Table 8)6~~. Three are listed as significant under the *Bush Forever* classification system, ~~which includes four categories of significance for bird species: Category 1 species are listed under the Wildlife Conservation Act 1950; Category 2 species are listed under international treaties with Japan and China for the protection of migratory birds; Category 3 species are habitat specialists with a reduced distribution on the Swan Coastal Plain; and Category 4 species are wide-ranging species with reduced populations on the Swan Coastal Plain.~~

Table 86 – Bird Species Recorded at the Serpentine Sports Reserve (December 1998)

Species	Category of Significance
Common Bronzewing	3
Galah	
Red-capped Parrot	
Port Lincoln Ringneck	
Laughing Kookaburra	

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Rainbow Bee-eater	
Shining Bronze-Cuckoo	
Grey Fantail	
Rufous Whistler	
Black-faced Cuckoo-shrike	
Western Gerygone	
Yellow-rumped Thornbill	3
Splendid Fairy Wren	3
Silvereye	
Brown Honeyeater	
Singing Honeyeater	
Australian Magpie	
Australian Raven	

All ~~fauna (all native animal species)~~ are protected throughout the State ~~under the Wildlife Conservation Act 1950~~. However, some species ~~have been identified as~~ are listed as rare or likely to become extinct, including the Baudin's ~~and~~ Carnaby's and Forest Red-Tailed Black Cockatoos which occur in SSR. These birds are ~~also listed under the EPBC Act 1999 and are therefore~~ protected under Commonwealth legislation as well as State legislation. ~~A second category of species in need of special protection includes the carpet python, which is likely to occur in the SSR.~~ The disturbance, or taking, of these scheduled species attracts higher penalties.

The Southern Bandicoot is listed as a Priority 4 species ~~by DEC~~, meaning that it is in need of monitoring. Until 2004, fauna surveys in the SSR regularly trapped bandicoots, including young animals, suggesting a viable population, but the 2004 data indicated a population crash. The reason is unclear, although a harsh summer may have contributed. The surveys indicate that the area is rich in reptile species.

Black Cockatoos have been recorded in the Serpentine area and are known to feed on local species such as marri and banksia. Cockatoo breeding has been recorded on the Swan Coastal Plain, especially of Carnaby's Black Cockatoo in marri woodland. ~~Whilst b~~ Breeding of black ~~cockatoo~~ species may has not ~~have been recorded in the bushland on SSR, it is a possibility that~~ but cannot be discounted.

Rabbits are a major problem ~~in the bushland~~ and need ~~to be~~ periodical ~~controlled periodically~~. Feral cats and foxes have also been observed ~~in the area~~.

3.3.4. Threats and Pressures

~~The biodiversity values of the SSR vegetation have been degrading for some years, indicated by anecdotal data and a recent review of satellite images by the Peel Harvey Catchment Council. The continuation of current usage plus inadequate management is unsustainable and will lead to irreversible degradation.~~

Dieback (*Phytophthora* ~~spp~~ cinnamomi)

The spread of dieback is a critical threat to much of Western Australia's bushland. Dieback is a disease ~~that affects the roots of many species, usually leading to their death. It is~~ caused by ~~several fungi of the genus water mould~~ *Phytophthora*, ~~most commonly~~ *P. cinnamomi*. Susceptible plants include jarrah (*Eucalyptus marginata*), the banksia family (Proteaceae), heath family (Epacridaceae), pea family (Fabaceae), hibbertia family (Dilleniaceae), balga (*Xanthorrhoea* spp.) and zamia (*Macrozamia* spp.), ~~while~~ Marri (*Corymbia calophylla*), kangaroo paws (*Anigozanthos* spp.), sedges (Cyperaceae) and rushes (Juncaceae and Restionaceae) are not affected.

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The ~~fungus-water mould~~ is spread by the movement of water or soil from infected sites, or directly between plant roots. The most common means for ~~moving the fungus~~ transport to new areas ~~are-is~~ human activities, particularly on vehicles, ~~t-~~ Tyres, shoes and horse hooves (which can pick up divots of soil) ~~are recognised as vectors~~.

There is no known way to eliminate dieback once it has been introduced. Dieback control therefore involves minimising its spread by controlling the movement of vehicles, people and stock from affected areas into dieback free areas. It is standard management practice to:

- ~~R~~oute pathways to avoid crossing boundaries, ~~between dieback infected and non infected areas;~~
- ~~P~~rovide wash-down or other hygiene facilities for vehicles and pedestrians, footwear prior to entering dieback free areas;
- ~~P~~rovide education ~~for visitors;~~ and
- Avoid transporting soil and plant material into dieback free areas ~~unless guaranteed disease free.~~

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~~There are chemical treatments available to mitigate the intensity of dieback. The application of p~~Phosphite (phosphoric acid), ~~by sprayed on ing~~ vegetation and injected ~~into ing~~ trees ~~is an intensive management technique which only~~ mitigates the intensity of disease ~~and can delay onset, not eradicate it.~~ The SSR bushland is ~~ideal for treatment, usually mapped and treated~~ at three ~~to five~~ year intervals. ~~The highest priority areas for treatment are mapped dieback fronts.~~

Fire

~~Fire is important for stimulating regrowth and regeneration in native ecosystems, but if uncontrolled can damage property and vegetation and cause high fauna mortality. Small remnants are vulnerable to local extinctions from single catastrophic fires which burn the whole area. Although the SSR bushland is linked to other bushland nearby, community 20b, banksia woodland, is not connected to other areas of the same community. Regeneration at this site is therefore likely to lack components of the original community.~~

~~Reducing the risk of catastrophic wildfire involves maintaining fire breaks and/or controlled burning to reduce fuel loads. Direction on time of year and intensity of burns for vegetation management will be guided by advice from DEC.~~

Weeds

Introduced weeds ~~comprise up to 11% of the plants in Western Australia and~~ pose a significant threat to native plants through competition for limited resources, ~~particularly space, light and water.~~ Weeds flourish in disturbed sites and often out-compete the native understorey. ~~D~~The displacement of native plant species leads to loss of habitat for ~~dependent~~ fauna, but in some cases fauna still use weeds for habitat.

The primary means of controlling weeds in remnant vegetation is to avoid disturbance, ~~either direct disturbance by trampling or grazing or indirectly by increased nutrient levels, particularly in wetlands.~~ Fire is also a disturbance that causes vulnerability to weed invasion. The second ~~essential~~ strategy is to reduce the ~~vectors or~~ carriers of weed seed, including horse manure and other introduced materials ~~such as soil. It also includes~~ and excluding vectors such as storm-water runoff that can introduce nutrients and other pollutants, ~~which is especially important in wetlands.~~

~~Many of the SSR weeds are grasses with wind distributed seeds. Each plant is the potential source of many others, so it is important to control the seed source. The most effective strategy is to remove weeds~~

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~~from areas of light infestation first (called the Bradley method), then heavily infested areas that are adjacent to healthy areas. Other priorities include heavy infestations upwind of less infested sites.~~

Techniques to control the spread of seed and weed plants range from selective seed head removal to physical or chemical plant removal. Large-scale weed ~~removal control~~ must be integrated with revegetation, otherwise the bare areas will be recolonised by weeds. The ~~removal control~~ of weeds that provide significant habitat values also needs to be carefully planned and integrated with revegetation, ~~including the removal of watsonia, which is commonly used by the Southern Brown Bandicoot.~~

Fragmentation

Fragmentation is the process of creating smaller disconnected populations of plants and/or animals. Smaller, more disconnected and poorer condition habitats will contain smaller populations with less genetic diversity and less ability to adapt to ~~environmental pressures such as climate change. Areas of bushland can be separated by major roads, paddocks or cleared land, while tracks, fences and other barriers within bushland can interfere with fauna movement.~~ Fragmentation also creates more edges, which are ~~more~~ vulnerable to disturbance, ~~s such as erosion, nutrient and pathogen incursions and weed invasion.~~ Overall it decreases resilience and sustainability, reducing the chance of long term survival.

Management to minimise fragmentation requires the maintenance and/or establishment of buffers and corridors around and among remnant patches of vegetation.

Loss of Rare and Threatened Species

~~The SSR bushland is regionally significant in preserving several species of threatened flora, whose small and vulnerable populations are threatened by individuals who may trample plants or pick flowers. The locations and health of individual plants needs to be regularly monitored. In line with DEC management but the State requires that locations not be practice, this information cannot become common knowledge as this introduces further threats from plant collectors or those who might see the occurrence of threatened species as an obstacle to development. Any plans to create pathways or other for activities that impact on the bushland should be referred to the Threatened Species Unit at DEC relevant State agencies for assessment and/or advice. In particular, tracks should be located away from threatened plants, and maintenance of the cross-country track must avoid disturbance to the threatened plants on its edge. Operators of equipment need to be aware that they are required to remain on the track and not use the bush as a turning circle.~~

Trampling

Foot, stock and vehicle movement on plant communities causes breakage, root damage and habitat disruption, ~~and if prolonged, frequent and/or intense trampling causes degradation; such activities could widen tracks and open out dense thicket communities.~~ Management of trampling involves keeping walkers, stock and vehicles on designated tracks, and not creating new tracks.

Erosion

Wind erosion and ~~colluvial~~ movement of soil on the walls and floor of the sand pit could erode the surrounding communities and prevent or suffocate natural regeneration. ~~The sand pit area requires mulch or brush cover to would reduce erosion and provide better conditions for regeneration or revegetation.~~

Acid Sulphate Soils

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The exposure of acid sulphate soils by excavation or lowering the water table results in plumes of sulphuric acid moving through the groundwater. ~~If this occurred in the SSR it would affect~~ the vegetation, particularly wetlands ~~connected to the groundwater table, and impact on~~ and aquatic communities. The acid reacts with clay ~~soils~~ to release heavy metals that ~~can~~ impact ~~directly~~ on surrounding ecosystems and can be transported through ground and surface waters ~~to impact on ecosystems further afield~~. Management of potential acid sulphate soils focuses on avoiding their exposure to air ~~as a result of excavation or lowering the water table~~.

Drainage and Drawdown

Lowering ~~of~~ the water table ~~as a result of bore usage in and adjacent to the SSR could affect~~ all plant communities, particularly the wetland community, ~~which is dependent on hydrological balance~~. Groundwater extraction and water course modification requires State Government assessment and approval ~~to ensure regulation and minimal impact~~.

Feral Animals

Feral animals are an ongoing threat to ~~the flora and fauna of~~ bushland remnants. Rabbits ~~colonies can seriously~~ disturb vegetation, ~~and~~ limit regeneration, and ~~impact on~~ compete with local fauna ~~through competition for food and habitat removal~~. Foxes and cats ~~(feral and domestic)~~ pose a direct threat ~~to~~ predate small birds and mammals ~~such as the Bandicoot~~. Feral rodents ~~such as the house mouse~~ thrive in adjacent ~~agricultural and equine~~ properties, ~~and most likely also occur in the SSR bushland where they would compete with native fauna~~. Feral honey bees compete with native bees, ~~in some cases preventing the pollination of specialized plants, and take over the~~ nesting hollows ~~of native birds and other animals~~.

Feral animal control relies on a variety of techniques, including trapping and poisoning. Current reserve usage and proximity to populated areas limits management options. ~~Feral animals pose a threat to the biodiversity values of the SSR, and monitoring and quick response is the best way to deal with outbreaks~~.

Appreciation, Awareness and Understanding

A lack of appreciation of the importance of protecting biodiversity, and a lack of understanding of threatening processes, ~~is a significant threat to~~ undermines good management. ~~Awareness-raising programs for~~ Education programs for all user group members, through (for example) newsletters, guided walks and presentations, should be extended to all users of the reserve ~~could~~, ~~using~~ techniques such as ~~sporting event briefings and~~ interpretive signage.

Climate Change

To cope with the stresses of climate change, vegetation must remain healthy and support a large and diverse population. This requires careful management of threatening processes, and positive action to increase ecosystem resilience. Climate change is likely to cause a general southerly shift in species distribution, ~~and significant southerly extensions to the distributions of some species have already been recorded~~. ~~The availability of~~ Ecological linkages will play a vital role in facilitating this shift ~~are essential to enable this movement of species~~.

Fire Management

Fire is important for stimulating regrowth and regeneration in native ecosystems, but if uncontrolled can damage property and vegetation and cause high fauna mortality. Small remnants are vulnerable to local

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~~extinctions from single catastrophic fires which burn the whole area. Reducing the risk of catastrophic wildfire involves maintaining fire breaks and/or controlled burning to reduce fuel loads. Direction on time of year and intensity of burns for vegetation management will be guided by best practice fire ecology.~~

Fire is important in conjunction with herbicide usage to control weeds. Controlled burns ~~within the Vegetation Management Zone will be, if necessary at all, should be~~ planned to affect small areas at a time ~~(200—300 m²)~~ in a mosaic pattern. Specific biodiversity values ~~(i.e. DRF or TECs) will must~~ be taken into consideration, ~~utilising advice from DEC. DEC supports a 12 to 13 year minimum inter fire interval. DEC and the Shire have flora lists which will also be considered.~~ The Shire's Emergency Services Manager is responsible for coordinating controlled burns in conjunction with Environmental Services in significant local natural areas.

~~In many cases the management areas will be delineated by existing tracks to avoid further disturbance. In order to achieve mosaic burning, minor existing tracks will be utilised wherever possible. Alternatively, least impact tracks such as 'kangaroo tracks' will be chosen, with rake hoe tracks (hand trails) being reinforced with wet lines, as currently used by local government and DEC as best management practice.~~

Fire intervals will be determined by fuel load and interval between burns, ~~with the aim being intervals of at least 12 years and/or fuel levels between 8 and 12 tonnes per hectare.~~ Only small areas will be burned at any one time, and ~~seasonality of burning will be done in a variety of seasons determined,~~ within safe limits, ~~using spring and autumn burns by best practice fire ecology.~~ Factors such as weather conditions, wind and soil moisture availability will ultimately determine the timing of prescribed burns. A Fire Management Plan for the reserve is presented in Appendix 3.

3.4. Environmental Characteristics: Actions

Table 9 – Environmental Actions for Management of Serpentine Sports Reserve (Short Term actions, Long Term actions, and Business as Usual)

<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
<u>Land Resources</u>					
<u>4</u>	<u>Monitor the profile of the sand pit wall, determine whether soil erosion remediation is required, and take action if required.</u>	<u>Medium Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services</u>	<u>Staff time Funding for erosion action</u>
<u>5</u>	<u>Monitor turf cover, and manage adaptively to meet appropriate targets.</u>	<u>Medium Business as Usual</u>	<u>Ongoing</u>	<u>Parks and Gardens</u>	<u>Staff time</u>
<u>Water Resources</u>					
<u>6</u>	<u>Audit water use, prepare a water conservation and reuse plan, and apply best management practices for water use on turf surfaces.</u>	<u>Key Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services, Parks and Gardens</u>	<u>Staff time</u>
<u>7</u>	<u>Design and implement a water quality monitoring program, including nutrient export targets, and develop and monitor nutrient stripping features.</u>	<u>Key Long Term</u>	<u>Implemented in Part</u>	<u>Natural Reserves Coordinator, User Groups</u>	<u>Staff time Funding for monitoring and nutrient stripping</u>
<u>8</u>	<u>Monitor water quality entering the conservation category wetland, and filter or redirect golf course runoff if water quality exceeds target</u>	<u>High Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services</u>	<u>Staff time Funding for monitoring and</u>

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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
	<u>levels.</u>				<u>runoff diversion</u>
<u>Fire</u>					
<u>9</u>	<u>Liaise with Emergency Services to prepare/update and implement a Fire Management Plan that prioritises conservation alongside people and property.</u>	<u>High Short Term</u>	<u>Not Yet Implemented</u>	<u>Emergency Services, Environmental Services</u>	<u>Staff time Funding for fire management plan preparation</u>
<u>10</u>	<u>Carry out mosaic burns if any control burning is required, allowing habitat restoration before burning the next area.</u>	<u>Medium Short Term</u>	<u>Not Yet Implemented</u>	<u>Emergency Services, Environmental Services</u>	<u>Staff time</u>
<u>11</u>	<u>Follow up any burning with weed control measures.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time Funding for weed control</u>
<u>Dieback</u>					
<u>12</u>	<u>Map and treat dieback every three years, according to best management practice.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time Funding for dieback mapping and treatment</u>
<u>13</u>	<u>Adopt and implement dieback hygiene procedures for all users.</u>	<u>High Short Term</u>	<u>Not Yet Implemented</u>	<u>Natural Reserves Coordinator, User Groups</u>	<u>Staff time Funding for hygiene procedures</u>
<u>14</u>	<u>Surface tracks with appropriate materials, as required.</u>	<u>Medium Long Term</u>	<u>Implemented in Part</u>	<u>Natural Reserves Coordinator User Groups</u>	<u>Staff time Funding for track materials</u>
<u>Weeds</u>					
<u>15</u>	<u>Map and monitor weed distribution, and prepare and implement a weed control program.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time Funding for weed mapping and control</u>
<u>16</u>	<u>Minimise disturbance and weed introduction through maintaining the number and width of tracks.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator, User Groups</u>	<u>Staff time</u>
<u>17</u>	<u>Pick up all traces of manure, bedding and stock feed from all parts of the reserve within 12 hours.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>User Groups</u>	<u>Staff time Funding for signage</u>
<u>Revegetation</u>					
<u>18</u>	<u>Prepare and implement a bushland rehabilitation and revegetation plan.</u>	<u>High Long Term</u>	<u>Implemented in Part</u>	<u>Natural Reserves Coordinator Landcare SJ Inc User Groups</u>	<u>Staff time Funding for revegetation</u>
<u>19</u>	<u>Continue to prohibit use of marri woodland for stock yards, camping and parking, and establish alternative overflow facilities for polocrosse club.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u>
<u>Biodiversity</u>					
<u>20</u>	<u>Monitor track width within bushland and adjust access through demarcation and barrier</u>	<u>High Short</u>	<u>Ongoing</u>	<u>Natural Reserves</u>	<u>Staff time Funding for</u>

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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
	<u>installation as appropriate.</u>	<u>Term</u>		<u>Coordinator</u> <u>User Groups</u>	<u>barriers</u>
<u>21</u>	<u>Review all fencing and replace if necessary with a design that will not form a barrier to wildlife.</u>	<u>Medium Long Term</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u> <u>Funding for fencing</u>
<u>22</u>	<u>Identify and protect threatened and priority flora and vegetation communities.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Environmental Services</u>	<u>Staff time</u> <u>Funding for signage</u>
<u>Fauna</u>					
<u>23</u>	<u>Review fauna surveys, gather additional information, and monitor Black Cockatoos' usage of the reserve.</u>	<u>Medium Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services</u>	<u>Staff time</u>
<u>24</u>	<u>Monitor feral animals and undertake control programs as required, while complying with all safety and accreditation procedures.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u> <u>Landcare SJ Inc</u>	<u>Staff time</u> <u>Funding for feral animal control</u>

3.3.5. Environmental Characteristics: Biodiversity Strategies

Issue	Target	Priority	Strategy	Responsibility
14. Conservation values are very high within the Bush Forever area of the reserve.	Investigate and implement the inclusion of "conservation" as a purpose for the bushland area of southern section of reserve.	Medium	a) Investigate potential options and seek Council advice toward recognising "conservation" as a purpose for the southern section of the reserve.	Shire to coordinate with input from SSRMC and RAG
15. Dieback disease is already present within the bushland area, and has the potential to cause local extinctions and significantly alter community structures.	No increase in the area of bushland infected by dieback.	Key	a) Map dieback distribution within the bushland areas, zone dieback free areas as high conservation, and manage any tracks through dieback free areas (where they cannot be closed) without unreasonably impacting on existing uses. b) Treat vegetation for dieback by spraying and injecting vulnerable plants at 3 to 5 year intervals. c) Raise community awareness (such as by provision of signs, club newsletters, event briefings etc.). d) Raise the awareness of staff, volunteers and contractors of appropriate dieback hygiene procedures and ensure they are adhered to. e) Minimise risks of disease spread by: <ul style="list-style-type: none"> Where practical, reconciling the alignment of tracks with dieback fronts; and Otherwise, ensuring tracks are constructed with appropriate materials and suitable buffer zones maintained on either side by spraying with a dieback treatment and trimming vegetation at recommended intervals. f) Liaise directly with Shire Officers for identification, protection and management of important flora. g) Construct barriers where necessary to prevent pedestrian and stock traffic from crossing dieback fronts or important areas of flora. h) Minimise risks of disease spread by adopting dieback hygiene processes including: <ul style="list-style-type: none"> Construction and maintenance work to be undertaken in dry conditions only; Wash down of vehicles and footwear prior to commencing construction or maintenance work in the bushland area; No material (e.g. soil and pathway surfaces) to be introduced into the bushland area unless guaranteed dieback free. 	Shire to coordinate with involvement of all stakeholders
16. The level of knowledge in relation to the biodiversity values is low.	Databases of biodiversity values to be established.	Medium	a) Review fauna surveys and gather additional information. b) Liaise with Birds Australia in relation to continuing bird surveys. c) Maintain a limited access inventory of declared and priority	Shire in partnership with DEC, WA Museum, bushland and bird groups

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Issue	Target	Priority	Strategy	Responsibility
			plant species, with annual inspections of plants. d) Monitor Black Cockatoos' usage of the reserve.	
17. Many weeds out-compete indigenous plants, causing significant changes to species compositions and habitat structure.	All bushland currently free of weeds to remain so. No weeds to occur within the northern and western sections of the banksia woodland. At least 50% of bushland infected with weeds to be weed free within two years from the date of endorsement of this plan, rising to 75% within four years and 80% within six years.	Key	a) Map weed distribution within the bushland, and compare with previous maps. b) Prepare a weed control program by identifying and prioritising weed affected areas, including sources of weed seed outside the bushland area. c) Remove weeds with physical and chemical treatments in accordance with the weed control program. Muleh, brush, seed, or plant treated areas with local native plants. d) Minimise disturbance and weed introduction and actively remove weeds from the bushland area through: <ul style="list-style-type: none"> • Maintaining the number and width of tracks but disallowing the development of new tracks without prior approval; • Diverting nutrient rich surface drainage away from bushland areas; • Picking up all traces of manure by stock owners in the bushland area within 12 hours of deposition; • Picking up all traces of bedding and stock feed from the bushland area within 12 hours of use; • Raising the awareness of all users of the importance of minimising weed spread (by event briefings etc.); • Removing all Eucalyptus camaldulensis saplings and regrowth plants. 	Shire to coordinate with involvement of all stakeholders
18. Feral animals predate native species, compete with them and destroy their habitat.	All nests of feral bees and rabbit warrens to be eradicated from the southern section of reserve and thereafter excluded.	High	a) Maintain records of feral animal sightings and monitor southern section of reserve annually for rabbit warrens. b) Destroy rabbit warrens and feral bees' nests where required. c) Raise awareness among surrounding landowners about the damage done by feral cats and other animals and encourage owners to restrain pets and control pests on their land. d) Disallow the placement of bee hives anywhere on the reserve.	Shire to coordinate with the participation of all stakeholders
19. Disturbance to and fragmentation of bushland areas results in loss of biodiversity and vulnerability to local extinction.	Compliance with State and Commonwealth legislation, policies and recommended procedures for biodiversity protection. No loss of remnant vegetation. No tracks through the bushland area to increase in width.	High	a) Prepare and implement a bushland rehabilitation plan, including weed management and rehabilitation criteria. b) Map locations of listed flora and maintain records of health of individual plants or clumps. c) Raise stakeholder awareness of the requirements for approvals under State and Commonwealth legislation and policies. d) Map bushland condition periodically and compare with previous maps. e) Monitor track width within banksia woodland and adjust access to achieve target of no vegetation loss in bush areas	Shire to coordinate with DEC and all stakeholders

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Issue	Target	Priority	Strategy	Responsibility
	<p>Prepare and implement a bushland rehabilitation plan, including weed management and rehabilitation criteria.</p> <p>All areas previously or to be rehabilitated to be managed adaptively to approximate the community structures of natural reference communities.</p>		<p>through demarcation and barrier installation.</p> <p>f) Review tracks through marri woodland and narrow to a minimum safe width for cross-country riding events.</p> <p>g) Rehabilitate all but essential designated tracks through the bushland, the sand pit, previously weed-infested areas, Paul Robinson Reserve, old go-kart track, vacant areas where remnant vegetation abuts cleared or weed-infested land, and the banks of water courses and artificial wetlands, including some of the golf course swales.</p> <p>h) Recreate the dominant species, growth forms and community structure of identified natural reference communities.</p> <p>i) Limit collection of indigenous seeds and cuttings to propagation of plant material for local rehabilitation only.</p> <p>j) Disallow use of marri woodland community for stock yards, camping and parking and establish alternative overflow stockyards, camping and parking facilities for polo/crosse club.</p> <p>k) Work with neighbouring land managers to encourage responsible management of ecological linkages.</p> <p>l) Review all fencing and replace if necessary with a design that will not form a barrier to wildlife.</p>	
20. Fire management, including suppression and controlled burning, are planned in the context of a reserve fire management plan for protecting people, property and conservation values as well as managing to conserve biodiversity.	Fire to be used as a management tool to enhance the reserve's biodiversity values and to reduce fuel loads to reduce risk and damage associated with unplanned fires.	High	<p>a) Update and seek approval for a Reserve Fire Management Plan in conjunction with relevant State agencies (including TEC experts from DEC) and Commonwealth Departments.</p> <p>b) Ensure all burning in the reserve conforms to this plan.</p>	Shire to coordinate with the participation of all stakeholders

4. Social and Economic Characteristics

4.1. ~~Indigenous~~ Aboriginal Heritage

4.1.1. ~~Description~~

Local Aboriginal people are part of the Noongar community, whose territory covers the area southwest of a line from Geraldton to Esperance. Prior to European settlement, family groups in the Serpentine region were part of the Whadjug tribe. During the post-European settlement period, forced migration to Aboriginal settlement camps or into areas where labour was required resulted in a shift of tribal groups.

Noongar family groups did not have permanent places of habitation and generally moved along major river systems, such as the Serpentine and Murray ~~River systems~~, or chains of freshwater bodies. The family groups would camp ~~for short periods of time~~ at favoured points ~~along these trails~~, where food and water ~~resources~~ were reliable, ~~for short periods of time~~. ~~The use of food from these systems still occurs today.~~

The water systems are spiritual places for Aboriginal people. Local tradition records that Waugal, the dreaming ancestor, created the Murray and Serpentine river systems. The Waugal is a spiritual force with a physical serpentine manifestation that is widespread throughout the southwest region. Most of the major rivers that drain the Darling Range, and many creeks, springs, pools, swamps and lakes within the Swan Coastal Plain, are associated with the Waugal belief.

The SSR lies on a level to undulating plain, much of which ~~was used to be~~ inundated swamp land during ~~the winter months~~. The wetland areas ~~within~~ the reserve would have been ~~used as~~ a source of food and may have held spiritual meaning for the local Aboriginal people. ~~Aboriginal people maintain a responsibility to care for their country, but information relating to the nature of any specific spiritual connection with the SSR area was not available for this management plan.~~

The Swan Coastal Plain has a high density of Aboriginal archaeological sites, associated with the richness of food resources. The ~~State government Department of Indigenous Affairs, under the Aboriginal Heritage Act 1972~~, currently has ~~46-23~~ heritage sites ~~listed within~~ registered in the Shire, ~~and an additional 63 sites are not (or not yet) registered's boundaries~~. ~~Under this Act, a~~ All places and objects of Aboriginal importance are protected by State legislation.

The Serpentine River is listed on the register of mythological and ceremonial sites, ~~but the exact locations of areas of particular value along and near the river remain unpublished to assist with their protection~~. ~~Instead, registered sites~~ and includes a wide ~~enough~~ buffer to ~~encompass cover~~ all the Aboriginal values ~~that occur~~ in the vicinity. ~~It is through this process that~~ The SSR is encompassed within the buffer and therefore formally listed as a Heritage site ~~under the Aboriginal Heritage Act 1972~~.

A Native Title Claim currently exists over land ~~extending from Garden Island south to a point due west of Capel, east to Kojonup, north to Corrigin and west back to Garden Island, encompassing an~~

~~area of 30,424.531 square kilometres. T~~including the Shire of Serpentine Jarrahdale ~~is included in this Claim area. Native Title, which~~ enables local Aboriginal people to have their rights and interests ~~in land and waters under traditional laws and customs~~ recognised under Australian law.

~~The Gnaala Karla Booja claim which resides over the Shire was submitted to the National Native Title Tribunal for registration on 17 September 1998, and passed the registration test the following year. With the Gnaala Karla Booja Claim having passed registration into mediation, this gives the claimants the right to negotiate in relation to land management issues on lands subject to the claim. However, in 2002 a determination was made that Native Title is extinguished on Crown Lands that were vested prior to December 1996, and this is the case with the northern section of the reserve. It is also likely that Native Title has been extinguished over the freehold land which constitutes the southern section of the reserve. Administration of the Gnaala Karla Booja Land Claim is being co-ordinated by the South West Aboriginal Land and Sea Council, and although Native Title has been extinguished over the reserve, the Shire is required to notify this body of any intended public works and to give claimants the opportunity to document their concerns.~~

To date no formal consultation has occurred with either the South West Aboriginal Land and Sea Council or local Noongar people regarding management of the SSR, ~~nor is there any Indigenous representation on the current Serpentine Sports Reserve Management Committee.~~

A lack of effective consultation with Noongar people and their representatives ~~may result in management practices not guided by traditional laws and customs. This~~ could lead to poor management decisions, conflict of use on the reserve and the degradation of Aboriginal values.

4.1.2. Social and Economic Characteristics: Indigenous Heritage Strategies

Issue	Target	Priority	Strategy	Responsibility
21. Aboriginal people have a right to be informed of public works on the reserve, but there are no Indigenous representatives currently involved in reserve management.	Establish and implement an effective process for ongoing Aboriginal liaison.	High	a) Administrate the RAG with membership of at least one person who can speak for local Indigenous people as required. b) Ensure that minutes from SSRMC and RAG meetings are exchanged. e) Consult the South West Land and Sea Council and South West Catchment Council for advice on other appropriate liaison processes and implement as appropriate.	Shire to coordinate with involvement of SSRMC and RAG members
22. Aboriginal names have not been used for places or events on the reserve.	When naming a place, structure or event give consideration to Aboriginal names.	Medium	a) When naming a place, structure or event give consideration to Aboriginal names, seek advice from Aboriginal representatives and obtain approval for the use of appropriate names from the South West Land and Sea Council and the Shire Council.	Shire and stakeholders
23. Reserve visitors generally do not know about Indigenous perspectives on areas in and around the SSR.	Provide interpretive material for visitors to the reserve about Indigenous perspectives.	High	a) Develop an interpretation plan for the reserve that takes account of Aboriginal heritage values.	Coordinated by Shire with involvement of all stakeholders

4.2. European Heritage

4.2.1. Description

In March 1827, Captain James Stirling arrived in the Swan River, ~~and pronounced that the land possessed great natural attractions. This led to the foundation of~~ the Swan River Settlement ~~was founded~~ in June 1829. ~~Soon after, i~~In 1830, Mandurah was established and settlers ~~started to moved~~ up the Murray River in search of agricultural land. Remnant bushland ~~on the reserve~~ provides a glimpse of what the settlers encountered.

~~Around this time e~~Explorers ~~also~~ ventured up the Serpentine River, but ~~due to~~ navigational difficulties ~~delayed~~, settlement ~~was delayed~~. The area was ~~initially~~ part of a massive 250,000 acre land grant to Thomas Peel, stretching from Wungong ~~(near Armadale)~~ to Pinjarra and out to the coast. However, the nature of the land and vegetation, and the availability of good agricultural land elsewhere, ensured that much of the Peel Estate remained in its natural state for many years.

Some ~~small~~ farms, ~~the largest only a few hundred hectares~~, were established along the Serpentine River ~~between below~~ the scarp ~~and the present town~~ in 1865. ~~These were smallholdings, the largest only a few hundred hectares. At this time T~~he Serpentine settlement was ~~established on the river~~ at the foot of the scarp, about 1 km east of its present location, but in 1893, with the ~~Perth to Bunbury~~ railway almost complete, the present ~~Serpentine~~ townsite was gazetted.

Major agricultural development ~~of the area~~ occurred with the ~~implementation of the~~ group settlement scheme in the early 1920s. Land from the Peel Estate was bought by the Government ~~and made available to for~~ settlers from England. ~~They were organised into groups and paid a small allowance while they developed their land for agriculture.~~ The sandy soil and persistent winter inundation ~~of much of the area~~ made the transition ~~from native bushland~~ to farmland particularly difficult.

A program to drain the group settlement areas ~~of the Peel Estate~~ began in 1922. Large drains were cut with the aid of horse-drawn carts and finished by hand, ~~a challenging task as they were dug during the middle of summer to avoid inundation~~. By 1925, 540 km of drains had been completed. The drainage network was later expanded, and the administration and management of most of the drains was taken over during the 1950s by the Public Works Department, later to become the Water Corporation.

During the early 1920s, horse racing was held ~~for three or four years~~ on the southern section of the reserve. ~~The race track was located on the eastern edge of the reserve, with the track, extending over what is now the John Lyster Polocrosse Ground and part of the David Buttfield Equestrian Park. The grandstand and finishing post was located near the current railway station. Horse racing lasted for 3 to 4 years.~~

In 1925, Lot 778 Karnup Road, ~~(which is the southern section of the SSR)~~, was vested as a reserve for the purposes of Recreation, Racecourse and Showgrounds (R19134). ~~It is likely that it had been used for recreation prior to vesting, but no records exist.~~ In 1925 Reserve 19134 was transferred to the Serpentine Jarrahdale Road Board by the State ~~Government~~, and is still owned by the Council. The northern section was vested in the Shire as a reserve for the purposes of Recreation and Showground in 1965.

In 1934 the Serpentine Agricultural Show began ~~when interest in the race meetings waned. This was organised by the local agricultural community and well patronised.~~ The show was originally split between

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the SSR and the ~~grounds at the~~ RSL club house ~~in the town of Serpentine. However, but,~~ all show activities were located on the SSR from 1950, and ~~this arrangement~~ continued until 1960 when the Serpentine Agricultural Society disbanded and the Show was replaced by a rodeo ~~which used the grounds until 1969.~~

~~There was a~~ scout and guide camp site ~~was located~~ at the western end of the bushland ~~adjacent to~~ near the dam. Some years ago, leaders were ~~requested-asked~~ to move to a more degraded section ~~of the bush~~ further south, but the area has not ~~since~~ been used ~~by the scouts and guides since.~~

The Whittaker's Brothers Timber Company built a steam-driven mill in the southern section of the reserve, where the remains of the go-cart track are located ~~today,~~ opening in 1944. ~~It had an average intake of 2200 cubic feet of raw wood a day, producing about 800 cubic feet of sawn timber, primarily for the housing industry and railway sleepers.~~ Logs were delivered to the mill by trucks from ~~the extensive Whittaker's Bros.~~ timber leases in the jarrah forest. After milling, the timber was transported to Subiaco and Midland by rail. The railway spur line entered the reserve where the Hall Road entrance is today, ~~and~~ ~~relicts of this old line can occasionally be found.~~

The mill was a major part of the post-war rejuvenation of Serpentine and a major employer, providing jobs for 40 local men. However, in 1964, sawmill technology changed dramatically ~~and the Serpentine mill became inefficient and unproductive by comparison.~~ Whittaker's Bros. built a new mill in Kewdale in 1964/5, employing only ~~6-six~~ local men. ~~As a result, and~~ the local mill was closed and dismantled. Whittaker's Bros. had built 10 houses and the State Housing Commission 8 duplexes along Lefroy Street, ~~to provide accommodation for mill employees. Many of these houses are still lived in today, representing an important part of the built heritage of the Serpentine townsite.~~

The SSR was ~~initially~~ managed by the Greater Sports Ground Committee from 1949. In 1953 the committee became the Serpentine Sportsman's Council, ~~which was the key-organising body for events at the reserve. This group and~~ ~~coordinating~~ the development of football, cricket and the equestrian clubs ~~at the reserve until its lease expired in 1976. Even then the Sportsman's Council remained the only organised body to coordinate activities at the reserve.~~

Organised ~~sporting activities~~ began at the reserve in 1947 when the Serpentine Football Club cleared an area for a football field, covering parts of ~~what is now~~ the John Lyster Polocrosse Grounds and David Buttfield Equestrian Park. The football club continued to use the grounds until the mid-1980s. In 1963 the local cricket club ~~was granted permission by the Serpentine Sportsman's Council to construct~~ ~~ed~~ a pitch on the reserve, which was used until the mid-1980s.

Both polo and polocrosse ~~used to be~~ ~~were~~ played on the SSR, ~~but polo found another site several decades ago. However, the reserve has not been used for polo for over 10 years.~~ Polocrosse has been played in the district since the late 1930s ~~when, introduced by~~ local farmers Jim Henderson and Ivan Elliott ~~introduced the sport. The sport was and~~ initially played on suitable paddocks ~~in the locality,~~ but players ~~began to use moving to~~ the SSR in the 1970s. In the 1980s the club became the Serpentine/Foothills Polocrosse Club, ~~using. The club uses the Ivan Elliott Pavilion, named in honour of Ivan Elliott who volunteered his time and money to the promotion of the sport. The club also uses the and~~ John Lyster Ground, ~~which was named in the 1990s in memory of a~~ ~~for~~ longstanding and active members.

The Serpentine Horse and Pony Club was initiated and affiliated with the Western Australian Pony Club Association in 1964 and ~~a request ed was made to the Serpentine Sportsman's Council~~ to use the reserve for events and training. They held their first event in 1967 and remain ~~a thriving club~~ at the reserve today. In 2003 the ~~Horse and Pony Club~~ grounds were named the David Buttfield Equestrian Park in memory of ~~a~~ Councillor ~~David Buttfield~~ who supported the club and the upgrading of their facilities.

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~~In 1955, the Serpentine and Districts Golf Club (SDGC) was formed with the aim of developing an 18-hole golf course, disbanded in 1958, and reformed in 1967. The first nine holes were constructed by members and competition started in 1972. At this stage, the course was not irrigated. In 1976 holes 10 to 18 were developed on the northern section of the reserve with the assistance of Alcoa.~~

~~In 1964, the Serpentine and Districts Golf Club (SDGC) was formed as an incorporated organisation with the aim of developing an 18 hole golf course at the SSR. The first nine holes were constructed by members between 1964 and 1970 in the southern section of the reserve. Competition started in 1971. At this stage, the course was not irrigated and it was quite dry in the summer months. In 1976 holes 10 to 18 were developed on the northern section of the reserve with the assistance of the mining company Alcoa.~~

During 1971 the Serpentine Go-Kart Club developed a high-quality bitumen track on the old mill site ~~in the southern section of the reserve. This track, which~~ was used regularly for practice and competition. However, ~~by the end of in~~ 1986 the track ~~had closed down~~ after numerous requests by residents and a public meeting about noise and relocating the facility. ~~Council has no further records regarding this activity.~~

In 1971, the Netball Association ~~also began searching for a suitable site to holding seasonal competitions on the. The SSR hard courts were used for regular competition by the club,~~ with lights ~~being installed for~~ night games and a playground ~~for children.~~ Netball was played at the SSR until the mid 1990s, but the club is now part of the Serpentine Jarrahdale Netball Association which uses alternative grounds ~~in the district.~~

The Paul Robinson Reserve, ~~located in the southern section,~~ was named after a ~~local~~ Serpentine volunteer fire-fighter who was just 22 when he lost his life ~~whilst fighting a bushfire in the area.~~ Paul Robinson had helped to revegetate ~~this section of~~ the reserve as part of the Landcare and Environmental Action Program. The Serpentine Bushland Group Inc. ~~is still was~~ actively involved ~~for many years~~ in the Paul Robinson Reserve and other bushland areas, ~~both on the SSR and in other areas around Serpentine. They undertake through weed control, -and revegetation works, and promote biodiversity through educational sessions. The group has been operating in the reserve for over ten years. The Serpentine Enviro Group has now taken the place of the SBG.~~

~~Whilst compiling this section of the management plan it became evident that records had been lost and this has inevitably reduced accuracy. To ensure that this does not occur in the future, comprehensive and accurate records of activities and developments need to be maintained from now on.~~

There are no obvious historical remains on the reserve. ~~However, if, but~~ visitor experience ~~is to could~~ be enriched by ~~knowledge and understanding of cultural heritage, it could be interpreted through~~ signage on site, displays at the local museum, school programs and other publications. The names of buildings and grounds, plus the sawmill site, would provide interesting focal points ~~for interpretive signage. A historic trail through the town site and reserve could also be given consideration.~~

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4.2.2. Social and Economic Characteristics: European Heritage Strategies

Issue	Target	Priority	Strategy	Responsibility
24. Historical records relating to the SSR are scarce and scattered.	All developments and activities to be documented and archived from the date of endorsement of this plan.	Medium	a) All stakeholders to provide a summary of their developments and activities for SSRMC meetings. b) Stakeholder summaries of developments and activities to be incorporated in formal minutes of meetings, and files maintained and archived.	Coordinated by Shire with involvement of all stakeholders
25. Reserve visitors generally do not know of the European history of the SSR and surrounding areas.	Raise visitor awareness of local European history.	Medium	a) Develop an interpretation plan for the reserve that takes account of European heritage values.	Coordinated by Shire with involvement of all stakeholders

4.3. Recreation

4.3.1. Description

Sport, recreation and active lifestyles are vital for individual and community health and well-being. The social, emotional, psychological and physical benefits of sport and recreation are well known.

The State Government document *Strategic Directions for Western Australian Sport and Recreation 2003–2005* provides a vision for the sport and recreation industry:

Lifelong physical activity and sport and recreation participation is valued as a cultural trademark of Western Australian society.

It also provides a state-wide perspective on sport and recreation outcomes, shown in Table 7.

Table 7—Sport and Recreation Key Areas and Outcomes

Key Focus Areas	Outcomes
Industry development	A cohesive industry that provides a framework to optimise the social, economic and health benefits of sport and recreation
Organisational development	Organisations that provide sport and recreation services that are effective viable and responsive to their stakeholders
Participation	A more physically active society in which sport and recreation maintains and increases its contribution to community well-being
High performance	Excellence is achieved in sporting performance
People development	All providers of sport and recreation in Western Australia are well informed, skilled and resourced
Infrastructure	All Western Australians, regardless of the level at which they participate, their means or geographical location, have access to quality sport and recreation facilities.

Source: *Strategic Directions for Western Australian Sport and Recreation*

The document also recognises the following issues as some of the key challenges for the next few years:

- Implementing legislative reforms to address the public liability crisis and risk management while balancing the interests of both service providers and consumers;
- Increasing the activity levels of target groups with low participation rates (e.g. seniors, people with disabilities, adults with young children, Indigenous people and adolescent girls);
- Applying contemporary principles of human resource management to volunteer personnel to provide improved volunteer management practices; and
- Embracing sustainability principles in design and management of sport and recreation infrastructure planning and development.

A report entitled *Recreation Planning for the Shire of Serpentine Jarrahdale* was published in 2002. The Shire is considered in two regional recreation planning documents, which discuss the equine industry and mention golf facilities at SSR, but passive recreation is not addressed.

The State equestrian centre is located at Brigadoon in the northern suburbs of Perth. The *South East Regional Sport and Recreation Facilities Strategy Plan (1998)* recognises the need to develop a regional-level equestrian facility in the southeast corridor to accommodate a wide range of equine sports, stating:

It is recommended that a regional, multipurpose equestrian centre be established in the Serpentine Jarrahdale area, in a location which is likely to be zoned "Rural" in the long

~~term, suitable for activities such as polo, croquet, pony club, show jumping, rodeo, camp drafting and riding for the disabled.~~

~~The proposed multipurpose equestrian centre could be a principal attraction to the region, and specifically to the Shire. The Report on Recreation Planning for the Shire of Serpentine Jarrahdale 2002 takes up the concept. Additional grassed areas could be provided for sport, festivals and other community events, integrating with the golf course and allowing for the possible development of an indoor recreation centre.~~

~~The Peel Regional Recreation Facilities Plan identifies the need for a quality equine facility in the Peel region. The plan identifies SSR as a potential location, though it predicts the need for additional land to complement it, and recognises the potential for competing interest between venues throughout the region.~~

~~The SSR is a multi-use facility, and is recognised as a hub in the Shire's Equine Strategy, with excellent facilities and the capacity for additional usage beyond the regular user groups and casual bookings.~~

~~The SSR golf course is recognised in regional and Shire recreation planning documents as the only course within the Shire, and it is therefore important in servicing for the whole district. The golfing facilities at SSR are well developed, so the documents do not identify the need for any additional development other than and a current small lease area is leased for a communications facility.~~

There are five organised user groups whose members regularly use the SSR:

- Serpentine and Districts Golf Club Inc. (SDGC);
- Serpentine Horse and Pony Club Inc. (SH&PC);
- Serpentine/Foothills Polocrosse Club Inc. (SFPC);
- Serpentine Enviro Group (SEG) (previously Serpentine Bushland Group Inc. (SBG)); and
- Serpentine Primary School (SPS).

~~The first four groups interface formally with each other and the Shire through the SSRMC.~~

~~Apart from providing physical health benefits to participants, the clubs provide opportunities a way for local people to interact with each other and meet people from other areas others with similar interests, building a sense of community, belonging and local ownership both locally and from other areas. Through participation and achievement, members build confidence and self-esteem and have the opportunity to develop team and leadership skills. The reserve also has a broader social and environmental function in providing and maintaining bushland areas for education and scientific purposes and as a place where people can experience nature.~~

4.3.2. User Groups

Serpentine and Districts Golf Club Inc. (SDGC)

The SDGC ~~has been~~ was developed and is managed by volunteers ~~from the local community~~. The club's constitution lists its objectives as follows:

- ~~To promote the game of golf and to encourage social activities between members of the club and others.~~
- ~~To establish, maintain and conduct the golf club for the accommodation of the members of the club and their guests and generally afford them all the usual privileges, advantages, conveniences and accommodation of a club.~~
- ~~To acquire by purchase, lease or otherwise golf course and grounds at Serpentine and to lay out, prepare and maintain the same for golf and to build or otherwise provide clubhouse and other convenience in connection therewith and to furnish, alter, enlarge, prepare and maintain the same and permit the same to be used by members and others.~~

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- ~~• To provide and hold, either alone or jointly with another association, club or persons, meetings, competitions and matches for the playing of golf and to offer or contribute towards prizes, medals and awards thereof and to promote, give or support dinners, balls and other entertainment.~~
- ~~• To apply for and obtain a licence issued under the Liquor Licensing Act 1988.~~

The ~~golf~~ course has 18 holes with irrigated grass fairways, turf tees and oil-sand greens. The first 9 holes are in the southern section ~~of the SSR~~ and holes 10 to 18 in the northern ~~section~~. The Club leases the land ~~from the Shire~~, and is responsible for its management and improvement.

The SDGC was formed in 1955, disbanded in 1958, and reformed in 1967. Members have carried out all of the work to create the course. Holes one to nine were developed by 1971, competitions began in 1972, and holes 10 to 18 were developed with Alcoa in 1976. Irrigation was installed on the fairways of holes one to nine in 1999, and holes 10 to 18 in 2004. Members carry out all maintenance, including mowing and servicing of the irrigation system.

~~The SDGC has operated on the SSR since 1964 and all of the work to create the course has been undertaken by members of the club. Holes one to nine were developed between 1964 and 1971 and competitions began in 1972. Holes 10 to 18 were developed in conjunction with Alcoa in 1976. An irrigation system was installed on the fairways in 1999/2000. Members carry out all ongoing maintenance work, including mowing and servicing of the irrigation system. This effort and investment by the SDGC has resulted in the development of the best sand green golf course on publicly owned land in the region.~~

The SDGC has a private membership of ~~over between 180 and 200~~ people, drawn mostly from the local community and adjoining shires, with membership. ~~The number of members has doubled during the last ten years but is~~ currently stable. Public players are welcomed, and with low green fees, the course is popular with non-members, ~~particularly pensioners and shift workers~~. The SDGC is affiliated with the Darling Range Golf Association Golf WA, and ~~thereby~~ linked to State, national and international golf associations.

The ~~SSR~~ golf course is used all year, but members are more active during the cooler months. ~~Informal competitions are held through the week over the whole year. Formal competitions are held on four separate days each week for the entire year.~~ A major competition is held during the long weekend in June, and again in November, which attracts around 140 players. There are open days for men and women once a year, which attract 100 to 140 players from over 15 different clubs. ~~Once every four years~~ ~~The SDGC hosts the Darling Range Golf Championships, and~~ held the State Sand Green Championships in 2008.

Social clubs from around the metropolitan area use the golf club facilities for the occasional day function in a rural setting. Golfers from other clubs also use the course for scheduled fixtures. ~~The visitors play golf and follow with a barbeque picnic.~~ The clubhouse is occasionally used by the local community for meetings and social events.

The ~~club~~ facilities are just adequate for the current use, but a number of issues with size and condition of the clubhouse restrict the ability to cater for additional activities. The club holds a Restricted Liquor Licence that puts constraints ~~on~~ the number of people that who can use the club house, and would need to u Upgrades the conveniences and other to facilities would be required to cater for more than 1200 people. Ongoing i Improvements to the facilities are carried out occur as materials and funds become available.

The ~~club~~ course fairways are generally in very good condition, but with winter drainage problems in ~~several~~ some areas. The club has worked over many years to create drainage alternatives with the Shire and Water Corporation to improve outflows. Flooding in the southeast near the wetland has been addressed with drainage reservoirs dug and fairways raised. In the far north of the course work has also been done by the club to mitigate the effects of occasional flooding. There is regular flooding

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~~of the fairway south of the club house where the central Water Corporation drain crosses over. While this causes few problems, flooding in the southeast corner adjacent to the wetland and in the far northern section of the course is more disruptive. Proposals to raise the height of, or increase drainage from, flooded areas would be assessed by the Shire, but additional feasibility and environmental impact studies may be necessary. Water use, reuse and drainage are considered further in the water section of this management plan.~~

Serpentine Horse & Pony Club Inc. (SH&PC)

~~The SH&PC states in its constitution that its objectives are:~~

- ~~• To encourage young people to ride and to learn to enjoy all kinds of sports connected with horses and riding.~~
- ~~• To provide instruction in riding and horsemanship and to instil in members the proper care of their animals and gear.~~
- ~~• To promote the highest ideals of sportsmanship and loyalty thereby cultivating strength of character and self discipline.~~
- ~~• To hold horse and pony sports for young people under the age of 25 years.~~

The SH&PC seeks to be a leading and innovative pony club. It has been ~~conducting activities~~ active at the SSR since 1956 and ~~the Club has been~~ affiliated with the Pony Club Association of Western Australia since 1964, ~~which sets rules and guidelines that clubs must obey.~~

Membership of the SH&PC is over 100 riding members. ~~All junior members under the age of 18 must be accompanied by a parent or guardian whenever the club conducts events as a condition of insurance. Members come, coming~~ from all over the Peel region, ~~encompassing Byford, Mandurah and Baldivis. The club does not plan to increase the number of members, as a larger membership would strain the administration and management of club activities and impact on the social values inherent in a small club.~~

The pony club season runs from February to November and includes a variety of events. The ~~grounds are known as the~~ David Butfield Equestrian Park ~~is~~, an irrigated turf surface that was substantially remodelled to improve drainage. The club also uses a national standard 3000 m one day event track, which traverses ~~sections of~~ the bushland and is used three times a year for events and once for training. The dimensions and features of this cross-country course are defined by ~~the State body~~, the Pony Club Association.

~~There is o~~One rally for members is held every month during pony club season (10 per year), ~~for training, practice and coaching.~~ There are three one day events, three gymkhanas, two dressage testing sessions and up to four closed training sessions for members. These events are very popular, with all open events attracting participants from as far as Geraldton and Esperance. The One Day Events generate a principal income stream for the SH&PC.

~~The numbers of horses and people at pony club events is shown in Table 8, with 15-30 horses for officials also present.~~

Table 8—Number of Horses at Pony Club Events at Serpentine Sports Reserve

Event	No. of Horses	Frequency	No. of People
Club Rallies	Average of 80 horses	10 per year	200
One Day Events	Approximately 130 horses	3 per year	400
Gymkhanas	Approximately 60 horses	3 per year	180
Dressage	Approximately 80 horses	2 per year	180
Closed training sessions	20 to 50 horses	4 per year	50 to 150

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Camping occurs three to five times a year, associated with major events, when up to 50 people use the club house and shed facilities. ~~Overnight camping on site is cheap, making the excursion more affordable. Camping provides additional opportunities for social contact, and has taken place for several years.~~

Serpentine/Foothills Polocrosse Club Inc. (SFPC)

The SFPC constitution lists the following objectives:

- ~~• The organisation advancement in carrying out the sport of polocrosse, the training of umpires and other equestrian activities.~~
- ~~• The encouragement of the breeding of horses for the purpose of polocrosse and other equestrian activities.~~
- ~~• To participate in regular matches throughout the state and/or elsewhere.~~

~~These were developed many years ago and the club now operates with the following working objective:~~

~~To develop and support individuals participating in the sport of Polocrosse through a locally based, community minded club. The emphasis is on a family focus without discriminating against race, religion, age or ability.~~

The club has been operating at the reserve since 1986. ~~It~~ seeks to be recognised as the leading polocrosse club in the Central Zone and constantly sets new benchmarks when developing its resources and facilities.

The John Lyster Polocrosse Ground is in the northeast corner of the southern section of the reserve. The polocrosse season runs from February to November, although the SSR is not used during the wettest months when the ground is inundated. ~~Members assert that this is the best polocrosse ground in the State because of the quality of the irrigated turf.~~ The ground accommodates four polocrosse fields, ~~allowing eight teams to play at any one time.~~

The SFPC has 540 playing members, about one third of whom are juniors under sixteen, ~~the highest proportion in the State. Juniors pay no club fees to encourage club development and ensure the continued growth and development of the sport.~~ Membership has been steadily increasing, and several SFPC members have progressed to State and national teams.

The SFPC hosts three major carnivals during the season, which attract people from as far as Geraldton and Albany. These carnivals run across a weekend and twenty teams, each with six players, participate in the competition. ~~Each team plays at least two games per day.~~ Members practice at least once per week during the season and this includes coaching of individual members.

The polocrosse grounds are of sufficient standard to be used for State and national competitions, and it is the goal of the club to host these competitions in the future.

The pavilion provides ample facilities for the club's activities ~~and enhances their operations significantly.~~ In particular ~~it provides teaching facilities~~ for the training of umpires. Over the longer term, members hope that the drainage problems can be solved so that the grounds can be used all-year round. ~~Prior to the allocation of Shire resources towards raising the height or increasing drainage, the Shire would seek additional information from a detailed analysis of needs, benefits, impacts and costs. Water use, reuse and drainage are considered in the water section of this management plan.~~ The club has put substantial work into improving the grounds, with the latest being the installation of yards and water points.

Overnight camping on-site ~~makes the excursion more affordable and provides additional opportunities for social contact. However, many campers have used the Bush Forever site (which is no longer~~

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~~permitted), leading to problems, particularly with toilet waste and dogs occurs in association with major events.~~

Serpentine Enviro Group (formerly Serpentine Bushland Group Inc.)

~~The stated mission of the Serpentine Bushland Group is to improve and maintain the bushland and ecosystem linkages within a five kilometre radius of the Serpentine townsite, and to raise awareness within the local community about the value of the SSR bushland.~~

The SBG formed ~~over 10 years ago~~ in response to concern over ~~the~~ degradation of bushland in the SSR, and in recognition of the unique ecosystem of the banksia woodland ~~near the sandpit~~. The SBG had ~~s~~ a core membership who regularly conducted activities focused on ~~the protection and restoration of ecological values of~~ Serpentine's bushland and ~~is closely~~ was aligned with other ~~landcare and bushcare~~ groups in the district through the Landcare Centre and Land Conservation District Committee ~~SJ Inc. Activities ceased in 2012.~~

The SBG ~~has been active in areas from Mardella to Serpentine, but their main activities have mainly~~ centred on the SSR, the Lambkin ~~Nature Reserve adjacent to the SSR, the~~ and Bradby Nature Reserves, and the railway reserve. Most of these areas are recognised as regionally significant bushland under *Bush Forever*, and contain State ~~and Federal~~ listed threatened ecological communities and ~~declared rare~~ threatened flora.

The SBG's activities included ~~d~~ revegetation, fauna surveys, remnant fencing, weed management, and working with school groups. ~~Fauna~~ trapping surveys ~~have been~~ were conducted in the SSR ~~for over ten years, significantly increasing understanding of how native fauna use the reserve. They have a regular biannual trapping program in the Paul Robinson Reserve to investigate the value of the revegetation for fauna.~~

The SBG ~~has~~ focused on three revegetation projects in and around the bushland on the SSR, ~~in the:~~

- ~~The Paul Robinson Reserve, which links the north and south sections of marri woodland;~~
- ~~The~~ the disused go-cart track area, ~~which provides a linking and buffering function for the native communities and reduces the weed burden; and~~
- ~~The~~ and the sandpit area, ~~which has been seeded with local species.~~

The SBG ~~is~~ was also active in weed control.

The SBG had ~~s~~ a close relationship with the Serpentine Primary School. Students and some parents ~~have been~~ were involved in the fauna surveys, seeding and revegetation projects ~~in the SSR.~~

~~The SBG ceased activities in 2012, and in 2016 the Serpentine Enviro Group was formed with a similar focus. Request from Landcare are carried out in the areas they are focused on, lifting covers, weeding, planting and checking on plantings throughout the year. The SEG has planted in Paul Robinson Reserve and maintained the sites, and also works in Federation Park, Arnold Road, Punrak Road, the Rail Reserve near Leslie Road/Hall Road, and the River end of Baldwin Road.~~

~~The group aims to expand their membership, to involve more of the community and provide a greater labour pool to manage and carry out activities. SBG would like to continue and expand the current educational function of the bushland and revegetated areas through involvement with schools and the development of walk trails to provide better access. Overall, SBG would like to continue to educate children and adults, so that they will understand and appreciate the unique natural values of the area.~~

Serpentine Primary School

The Serpentine Primary School used ~~s~~ the SSR as a focus for ~~the values of~~ social, ~~and~~ civic responsibility and environmental responsibility. The students ~~have taken~~ took measurements of environmental variables between 1996 and 2001 in and around the SSR. The bushland area is an

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important resource for the school, ~~with the~~. The accessibility and variety of environmental values ~~is a~~ great asset to teaching and education. ~~The school's last planting day in SSR was in 2014.~~

Potential Uses

Other uses include a small area lease for a communications facility. Organised group recreation has ~~occurred~~, including netball, football, cricket and go-kart racing. Although ~~the reserve accommodated~~ more activities ~~occurred~~ in the past, the potential ~~to increase the number of groups once again for expansion~~ is limited ~~as most sporting groups now use other facilities.~~

- ~~• The golf course has a lease and therefore has exclusive use of this portion of the reserve;~~
- ~~• Go kart racing ceased in 1986 due to noise complaints and the track has since been demolished;~~
- ~~• The cricket and football clubs are still active but now use other purpose built ovals;~~
- ~~• Horse riding impacts on turf, making shared use impractical due to manure; and~~
- ~~• Serpentine netball players now play at the Mundijong courts.~~

There is some potential to involve other community groups in activities on the reserve and to expand its use to include a greater range of organised group recreation activities. ~~Future uses could include athletics, seniors' indoor bowls, and gardening in proposed raised garden beds near the pavilion.~~

Informal Recreation

SSR offers opportunities for recreation by individuals and small informal groups, ~~for both a~~. Active uses, such as walking, jogging and companion animal exercise, and passive uses, ~~including picnicking, reading, contemplation, sketching, painting and nature study, are carried out. However, no formal records of the types and frequencies of these pursuits exist.~~ The pavilion provides a facility for ~~birthday and wedding celebrations~~ private and community group ~~fund raising~~ events.

~~Informal recreation facilities promote the pursuit of a healthy lifestyle through physical activity, personal development, opportunities for social interaction and spiritual growth and renewal.~~ The use of public open space by the ~~Serpentine~~ community plays an important role in generating a sense of place and ownership.

It is proposed that the reserve be linked to other areas of public open space and bushland through a system of multiple-use trails. ~~Local Planning Policy 9 Multiple Use Trails within the Shire of Serpentine Jarrahdale provides for linking all suburbs and communities within the Shire by a network of trails, designed to cater for walkers, cyclists, horse riders and other non motorized outdoor activities.~~ An existing trail connects with the southern boundary of the reserve ~~in the golf course.~~

4.3.3. Threats and Pressures

Risk Management

Increasing insurance premiums and stricter attitudes to liability have made risk management plans mandatory for recreational facilities and clubs. Even the ~~SeBG~~ needs to consider risks like the use of chemicals and snake bites ~~which can be associated with bushland management tasks.~~ Formal risk management plans must be developed by each user group in cooperation with the Shire to avoid exposing participants to unacceptable levels of risk.

Membership and Member Involvement

The club committees have a general problem with attracting and maintaining motivated volunteers to fill positions and undertake other tasks. A few people tend to do most of the work ~~and this can lead to~~

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~~burnout of members who repeatedly take on key roles.~~ The SEBG finds inadequate club membership a problem as low numbers limit activities ~~and threaten their long term involvement in the SSR.~~

Individual groups may benefit from reviewing activities to identify the ~~pressures and~~ obstacles for volunteers in joining groups or participating more fully in club management. Strategies to overcome these barriers can then be considered.

Conflict Among User Groups

Conflict among user groups can lead ~~to withdrawal from cooperative to a lack of cooperation in~~ management of the reserve, ~~either formally or informally, leading to further difficulties in resolving~~ conflict. ~~C, and~~ conflicts over the use of resources can lead to ineffective use and possibly degradation, ~~and can arise for many reasons, including:~~

- ~~• Long term lack of resolution to issues and uncertainty relating to future management;~~
- ~~• Misunderstandings of roles and responsibilities; and~~
- ~~• Perceptions of inequity.~~

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The committed volunteers in all user groups ~~have endured unresolved conflicts for many years, and find themselves having to~~ continually defending their interests. ~~The lack of resolution is partly due to the informal forum in which potential solutions have been developed and adjudicated. The Shire Reserves Planning and Management Framework now provides a formal framework for the development and adjudication of draft management plans.~~

~~The drafting of this~~ This management plan ~~has been thorough to provide all available information to is intended to~~

- ~~• Facilitate broad community input, into the planning process;~~
- ~~• Provide an acceptable level of certainty for all stakeholders; and~~
- ~~• Ensure that Council, during its formal endorsement of the plan, is fully informed of the facts, community opinions, and consequences of management decisions.~~

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The ~~Shire Reserves Planning and Management Framework~~ provides for the establishment of the Reserves Advisory Group, ~~which provides a focus for local community input to the development of management plans for Shire reserves. In the case of the SSR, this role is taken by the SSRMC.~~

Flooding

Flooding during winter affects the golf course. The areas worst affected are the first fairway, the southeast corner of the southern section near the wetland, and the most northerly section of the golf course.

The first fairway is crossed by a ~~low profile~~ drain which ~~historically~~ backed up, and ~~has~~ gradually filled in, ~~until works were carried out to improve outflows from the reserve. over the last ten years.~~ Players tolerate the flooding, and treat it as a water feature. ~~It may be appropriate to investigate the impacts of re-excavating the drain to improve flow, which would require Water Corporation approval and careful consideration of water quality and excavation design to ensure no increase in nutrient export.~~

Flooding in the southeast corner of the course near the wetland ~~has been mitigated by digging drainage reservoirs and raising the fairways.~~ is a problem for several weeks a year. An increase in capacity of the drain would pose an additional threat to the wetland. Any water flowing from the golf course through the wetland must be previously stripped of nutrients. Preferably, all water from the golf course should be diverted away from the wetland, ~~perhaps into a lined dam, or further south to the drain along the southern boundary of the reserve. Infilling to raise this fairway may offer another solution. Acid sulphate soils may impose limitations on the depth and location of dam excavation.~~

~~with water coverings~~ fairways 13 and 16 ~~for up to five weeks of the year, and works have been carried out to mitigate the effects.~~ The northern section of the reserve ~~floods occasionally, where~~ ~~will always be~~ difficult. This land and its surrounds are all low-lying, so ~~accelerated~~ drainage off-site ~~will always be~~ difficult. Proposals to alleviate flooding at all three sites require ~~further~~ assessment of environmental impacts, ~~and if relying on Shire funds, a detailed analysis of needs, benefits and costs~~ ~~funding sources.~~

The John Lyster Polocrosse Ground is generally of a high standard, but poor drainage causes ~~the grounds to flood~~ during the winter ~~months, particularly in the north~~. There is no obvious natural fall that would allow for drainage off-site, ~~though excavation into a northern ditch which flows west would alleviate the problem.~~ The most effective, but expensive, method of ~~ensuring good~~ ~~improving~~ drainage ~~from the northern section of the polocrosse ground~~ would be ~~the~~ levelling and resurfacing ~~of the grounds~~ with high quality sand. ~~This would allow water to seep down below the surface and then flow over the impermeable soils below, towards the central Water Corporation drain at the southern end of the grounds.~~

Pressure to Exclude Horses from the Bushland

The SH&PC have used the bushland track for many years and has built and maintains jumps along the required 3000 m length. Historical use infers a right to continue using the area, and suggestions for moving the course would leave the club feeling that they have wasted previous investments.

~~The following parameters have been identified by the SH&PC as essential for the cross country course:~~

- ~~• Mixture of lengths, jumps and obstacles as specified by the Pony Club Association;~~
- ~~• Ambulance access, preferably to all jumps; and~~
- ~~• Buffering from other activities which could “spook” or endanger horses, riders and spectators.~~

When the cross-country course was first constructed, there was significantly more bushland on the Swan Coastal Plain than there is today. As more remnant bush is cleared, the pressure to preserve what is left has increased. The sustainability of cross-country riding within the bushland area has been debated, ~~particularly due to the potential for spreading dieback,~~ but the SH&PC has the opportunity to demonstrate that this activity can be carried out ~~without further degradation~~ ~~safely~~ by monitoring use, impacts and management. ~~Indeed, the SH&PC is well placed to improve environmental management on small properties throughout the Shire by raising awareness about environmental issues and management strategies amongst club members.~~

Compliance with Health and Camping Legislation

Both the pony club and the polocrosse club ~~are required under the Camps and Caravan Parks Act 1995 to obtain~~ ~~need~~ permission from the Shire for camping on the SSR. ~~The acquisition of a license~~ ~~Licensing~~ allows the Shire to assess compliance with ~~the Health Act 1911, the Camps and Caravan Parks Act regulations and the Building Code of Australia~~ ~~legislation~~. It also ensures that the locations used, management of pets, numbers of people per ablution facility, litter and other waste management issues are considered. Participants wishing to stay more than three nights ~~will be required to~~ ~~must~~ move to the local ~~licensed~~ caravan park.

Inadequate Parking Facilities

The lack of organised parking areas is a problem ~~for orderly management of events.~~ ~~Currently, a~~ large numbers of vehicles and floats park in a haphazard manner which results in inefficient use of space and increases the risk of injury. ~~A new~~ ~~Re~~ design and construction of car and horse float parking would reduce risks, ~~which is considered in the infrastructure section of this management plan.~~

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Security of Tenure for the Golf Club

~~No reasons have been identified as to why the golf club should not retain use of the area currently leased. It is therefore appropriate to negotiate further of~~ Ongoing lease agreements for the golf club are routine. The golf club has been developed and is maintained entirely by volunteers, whose work and the low lease payments enable the course to offer a valuable service to the local community by providing affordable access.

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4.3.4. Social and Economic Characteristics: Recreation Strategies

Issue	Target	Priority	Strategy	Responsibility
26. Some of the clubs that use the SSR do not have a comprehensive risk management plan.	All clubs that use the SSR on a regular basis to develop and implement risk management plans within two years from the date of endorsement of this plan.	Medium	a) All clubs that use the SSR on a regular basis to develop and implement risk management plans. b) Shire to notify clubs of risk management training opportunities, and club members to attend as required.	All clubs that use the SSR with advice from Shire
27. Conflict among clubs can result from a lack of resolution to issues, misunderstandings of roles and responsibilities, and perceptions of inequity.	Any conflict among stakeholders to be raised, and a process for resolution agreed to, at the first SSRMC meeting after the issue is identified, and be resolved within a reasonable time. Full record of decisions at SSRMC, RAG and RWG meetings to be minuted, with reciprocal arrangements for viewing minutes operational within two years from the date of endorsement of this plan.	Medium	a) Accurate and complete minutes of SSRMC, RAG and RWG meetings be kept and archived. b) Encourage members of SSRMC, RAG and RWG to attend each others' meetings as observers. c) Information about SSR management to be maintained on the Shire website, and the local newspaper to be advised of major decisions regarding SSR management.	Shire in partnership with all committee members
28. Leases or licences are appropriate for users in particular areas, and existing leases/licences may need to be renewed should they expire during the term of this plan.	A new lease for the golf club (which allows continued affordable access by the current cross-section of users) to be drafted, negotiated and agreed to, and any new leases or licences to be developed for other users.	Key	a) Negotiation, agreement and preparation of current lease and licensee use of the reserve.	Shire staff, Council and Serpentine Districts Golf Club, Pony Club and Polocrosse Club
29. Equine clubs have a long history of camping on the reserve.	All camping associated with equine events to have prior approval from the Shire, and to comply with the Shire's conditions of approval. All camping to comply with health and other regulations.	Key	a) Review applications from the equine clubs for normal event camping. b) Impose additional approvals for camping outside the conditions set for normal event camping. c) Review current camping practices in relation to health and other statutory requirements, and where necessary rearrange or move traditional camp sites to locations which better comply with health and other regulations.	Shire in consultation with equine clubs
30. The polocrosse ground and golf course are partially flooded during winter months.	Review potential solutions to flooding on the polocrosse ground and golf course.	Medium	a) Continue to maintain the turf area and analyse and document the needs, benefits, carrying capacity and cost sharing associated with budgeting to maintain the turf area at an acceptable standard including estimating the costing for raising the height of the polocrosse ground. b) Submit this document to Shire staff for assessment and to	Polocrosse club and golf club in consultation with Shire

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Issue	Target	Priority	Strategy	Responsibility
			<p>Council to seek endorsement and allocation of funds to bring the turf area up to an acceptable equine standard for ongoing maintenance.</p> <p>c) Review potential solutions to flooding on the golf course.</p> <p>d) Seek expert advice regarding feasibility and impacts of solutions, and submit preferred proposals and any requests for Shire funds to Shire staff for assessment and Council for endorsement.</p>	
31. The pony club cross-country course goes through a Bush Forever site of high conservation value, and pressure has been placed on the pony club in relation to this issue.	<p>A high quality cross country riding track, compliant with Pony Club of Western Australia specifications, to be provided on the SSR.</p> <p>An endorsed code of conduct for minimal impact cross country riding to be implemented.</p>	Key	<p>a) Minimise environmental impact in bushland by raising the awareness of club members and developing a code of practice with a detailed process for its implementation.</p> <p>b) Formalise and designate tracks and jumps to limit expansion, and adjust the cross country course if current use causes further degradation of the bushland.</p> <p>c) Constraints and approval requirements:</p> <ul style="list-style-type: none"> No tree/vegetation in bush areas to be removed without a DEC Clearing Permit; Any proposal for the trimming of trees/vegetation to go through the RWG's Reserve Improvement Application Form Process; Camping to be restricted to turf areas on the edge of the bush area and not occur in any bush areas; Ongoing vegetation monitoring in the bush area will result in recommendations for the demarcation and protection of vegetation from use of tracks by horses; Access for horses in the bush area to be restricted to demarcated tracks; The Pony Club to always possess a map showing the designated horse tracks in the bush areas; Any horse manure to be removed by stock owners within 12 hours in any part of the reserve. 	Pony club in partnership with Shire
32. There is potential to increase the use of current facilities and to broaden use to additional organised groups and informal users.	SSR facilities and recreational opportunities to be promoted to broader community and other recreation providers.	Medium	<p>a) Community forums and groups to be kept informed of recreational opportunities.</p> <p>b) Contractor of District Recreation Centre in Byford to liaise with SSRMC.</p> <p>c) Include SSR facilities in Peel Physical Activity brochure for Serpentine Jarrahdale Shire.</p> <p>d) Develop plans to encourage additional and broader use of the reserve.</p>	SSRMC in partnership with Shire, SSRMC, Contractors, recreation clubs and the Peel Physical Activity Group
33. Reserve gates are kept locked which excludes potential users.	Develop and implement a reserve access policy.	High	<p>a) Consider and document access issues.</p> <p>b) Develop and seek Council endorsement for an access policy document.</p>	Shire in partnership with all stakeholders

4.4. ~~Business and Tourism~~Infrastructure

4.4.1. InfrastructureDescription

The SSR includes open space used for active recreation, and an area of bushland ~~managed with the assistance of community groups~~. The grounds ~~include~~contain about 39 hectares of irrigated turf, of which 9.5 hectares is used by the Serpentine/Foothills Polocrosse Club (SFPC), ~~another~~9.5 hectares by the Serpentine Horse and Pony Club (SH&PC), and 20 hectares by the Serpentine and Districts Golf Club (SDGC). The main buildings ~~on the reserve consist of three~~include club-houses ~~used by for~~ the ~~active recreation~~user groups, an ablution block, various sheds and a wooden toilet with historical value. ~~Associated Other~~ infrastructure includes ~~kilometres of fencing~~, ~~several~~gates, drains, ~~two~~ dams, an artificial wetland, horse pens, loading ramps and a cross-country trail with jumps.

Turf Surfaces

The central infrastructure for the three active recreation clubs is the turf surfaces. These range from high quality active turf used by the SH&PC to lower quality turf on the golf fairways.

The SH&PC uses the David Buttfield Equestrian Park, ~~which was~~~~These 9.5 hectares of turf were~~ substantially remodelled to improve drainage and turf quality in 1999. ~~The SH&PC now has~~This is ~~now~~ a high quality active turf surface that is well drained and can be used throughout the year. ~~Future M~~~~maintenance will be~~ managed by the Shire within water license allocations.

The SFPC uses the John Lyster Polocrosse Ground, ~~about 9.5 hectares of turf used only~~ during summer. The grounds have been modified in attempts to decrease winter water-logging, but the surface is still very poorly drained ~~because there is clay under its base~~. During summer, the turf is of a reasonable quality for active use and is adequate for polocrosse. Improving the drainage would make the grounds useable all year. ~~An additional water allocation would be needed for the maintenance of higher quality turf. The Council might consider such a project if an overwhelming case could be made from thorough analysis of needs and overall benefits.~~Maintenance is managed by the Shire.

The golf course fairways are a lower quality turf suitable for passive use, while the tees are higher quality. The fairway turf is ~~adequate, but the club would like to upgrade in future, particularly where cover is incomplete or subject to water logging~~generally in very good condition. The irrigation system only waters the centre of each fairway, and the edges become degraded during summer, ~~especially on the light sandy soils~~.

There are several sections ~~of fairways~~ that become waterlogged and sometimes flooded during winter. Flooding occurs ~~between fairway three and next to~~ the wetland, and near the ~~outlet of the~~ drain across fairway one. In the northern section several fairways are ~~severely~~ waterlogged for extended periods, particularly numbers 13 and 16. The ~~club has enlarged the~~ depression between fairways 12 and 13 ~~was enlarged~~ to create a new dam ~~with the dual objectives of to~~ reducing water-logging and providing a backup to the current irrigation dam.

The SDGC maintains its grounds and facilities by volunteer labour plus membership and other fees. Maintenance and improvement of the grounds is a ~~lease~~ condition ~~of their lease~~. The club funded the construction and improvement of its fairways and facilities with the assistance of Alcoa, its members and ~~occasional use of~~ Shire loans.

Irrigation water is supplied by two bores, used by the golf club to fill their dam and by Shire staff to water the equestrian grounds.

All 18 fairways ~~of the golf course~~ are irrigated by pop-up sprinklers down the middle ~~of the fairways~~. The course uses sand greens that do not require watering. Water is pumped from a bore to the dam, ~~and the~~ The irrigation system draws water from the dam ~~using an electric pump housed in a small shed. A control box in the buggy shed allows detailed programming of water delivery. Irrigation is scheduled according to frequent measurements of evaporation and other weather factors at a nearby turf farm.~~

The equestrian grounds are watered by ~~two travelling irrigators which~~ in-ground reticulation which connects directly to the bore pump. ~~The two irrigators are able to water each section of the fields once a week, and are manually set up for each run, making the system labour intensive. The Shire plans to replace one of the travelling irrigators with a below ground sprinkler system for the SH&PC arena. This would require a separate pump fixture and possibly another bore, with requirements for this system being different from that of the travelling irrigators.~~

Buildings

Eric Senior Pavilion

This ~~is a recently built~~ multi-purpose building ~~used by the SH&PC of~~ is rammed earth with ~~an inside floor area of 320 m² and a covered verandah of 150 m². The building~~ It has a general purpose hall, a meeting room, a kitchen with kiosk and servery, ~~and plus an office and commentators' room. The SH&PC has a steel shed near the arena, used to store equipment.~~

Ivan Elliott Pavilion

Used by the SFPC, this ~~is a brick building in the southern section of the reserve. Most is~~ mostly used for storage, except for a kitchen area and toilets. Waste water and sewage discharge into the Biomax system for the ablution block. ~~The pavilion has been painted and is in reasonable condition.~~

Serpentine & Districts Golf Club Buildings

The SDGC club-house ~~provides has~~ toilet and change facilities, a kitchen and bar, and a covered patio with barbecue facilities. ~~The club holds a restricted liquor licence which puts constraints on the number of people who can use the clubhouse. Upgrades of conveniences and other facilities would be required to cater properly for more than 100 people. The building is only just adequate for current use, but there are a number of issues with the size and condition of the building that restricts the Club's ability to cater for planned additional activities. Ongoing improvements are carried out by the club as materials and funds become available. The club house has seating for around 100 people, and a restricted liquor licence that allows it to cater for up to 200 people. The building is in good condition and is adequate for the club's needs.~~ The Shire owns the building and funds insurance and some repairs as necessary.

~~Also used by the~~ The SDGC ~~is has~~ a machinery shed in good condition, ~~used as a workshop and to store maintenance equipment,~~ made of steel-framed galvanised iron ~~and measuring about 15 by 10 m.~~ A small fibro-cement shed houses the irrigation controls and members' buggies. The original toilet from the Whittaker's sawmill has been relocated nearby, in fair condition and made of jarrah boards. ~~Another~~ shed ~~has been built to~~ houses equipment, of similar ~~size and~~ construction to the machinery shed. The SDGC has organised and financed the construction of all of their facilities over an extended period.

Ablution Facility

In 2002 an ablution facility was built of rammed earth and provides toilets and change and shower facilities ~~at the health requirement ratios for club members and visitors.~~ The clubs are responsible for cleaning, but maintenance and insurance are the responsibility of the Shire.

Waste water is processed by a Biomax alternative treatment unit (ATU) which has a capacity of up to 700 people per day ~~and includes 400 m² of sub-strata irrigation where treated water is discharged.~~ The discharge area is a fenced row of trees along the Karnup Road boundary. ~~The expected peak output~~

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~~from the system is 4000 L per day (10 L per person) and the maximum output that the system can assimilate is 7,200 L per day.~~

The club-houses, ablution blocks and associated facilities are connected to the mains water supply.

Storage Shed

~~The SH&PC has a steel shed near the arena, which has recently been extended to approximately 6 by 10 m. It is used to store equipment and is in good condition.~~

Equine Facilities

Wash Bays

~~Two-Four sets of~~ wash bays, used to wash and cool down horses after activities, are connected to the surface drainage system. One set of bays is located west of the pavilion near the equipment shed, ~~and the other one~~ on the eastern side near the old netball courts, ~~one in the northeast and one on the south of the polocrosse grounds.~~

Horse Yards

Horse yards have been constructed by both equine clubs near the north~~er~~east and southern edges of the polocrosse grounds. There are around 620 yards on the south consisting of ~~two-three~~ sets of ~~eleven 20 parallel sections of fence with large diameter poly pipe uprights and steel crossbars~~ yards in double rows, and a similar arrangement of 60 yards on the northern edge. ~~Another set of poly pipe and steel yards, providing 10 bays, is on the northern edge. Near the northern bays are twelve wooden posts which can be roped off to form six yards, and there is a set of six older wooden yards near the northeast corner of the grounds. The polocrosse club has indicated the need for additional yards.~~

~~There are a number of degraded yards in the marri woodland which are no longer used due to impacts on the bush.~~

~~The SH&PC yards horses in the northwest corner of their grounds, consisting of wooden posts and rails in average condition, but the area is subject to water logging in winter. There are also some short sections of steel post and rail west of the club house which can be used as hitching rails. Most are in reasonable condition, but some are poor.~~

Stock Ramp

There is a ramp for loading stock west of the SH&PC club-house ~~which is in reasonable condition~~. It is a double ramp with higher and lower sections made from laterite rock and cement with a gravel surface, ~~and -The ramp is currently~~ used to unload horses from trucks. It has historic value as part of the facilities dating from the Serpentine Show.

Cross-Country Track

A cross-country track ~~for the SH&PC~~ extends for 3000 m around the edges of the equestrian ovals, through the two revegetation areas, ~~(the Paul Robinson reserve and the old go cart track), the remnant vegetation bushland~~ and the central sandpit. Sections have been surfaced with ~~ground granite blue metal fines~~ where the track traverses ~~within~~ the bushland and in several other places ~~in an effort~~ to prevent erosion, but some continued ~~erosion wear~~ shows as channelling ~~along the centre~~ and mounding ~~on the edges~~. There are about 25 sets of jumps ~~along the cross country track~~, each of which has two or three different heights, totalling about 80 jumps. There is a water jump in the southwest corner of the pony club grounds, which is about 200mm deep. The ~~water jump~~ basin is full ~~through-in~~ winter and dry in summer, and is filled twice a year for ~~one day~~ events. The specifications for the course are set by the State Pony Club Association, which must be met in order to retain the event and the substantial income it provides to the club.

Arena

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The SH&PC has developed and uses a fenced, surfaced arena located in the northwest of the David Buttfield Equestrian Park.

Waste Facilities

Bin Facility

The rubbish bins used by the equestrian clubs are stored in a cyclone fencing cage behind the Ivan Elliot Pavilion, adjoining Karnup Road. The cage ~~is approximately 3 by 3 m and 2.5 m high, with~~ has a locked gate on either side, storing twelve standard and recycling bins between events. Waste management services and the clubs have keys to the cage. ~~This facility is in good condition. There is a manure bay near the old netball courts.~~

Gates and Fences

~~The reserve has a~~ About 20 km of fencing ~~is on the reserve~~. Fences adjoining the golf course along Karnup and Hall Roads and on the southern boundary were replaced in 2002, ~~with funds and labour provided~~ by the golf club. These fences consist of wooden strainers and steel posts with ringlock and a single strand of barbed wire along the top, and are in good condition.

An older fence runs along the western boundary of the golf course and part of the southern boundary, consisting of wooden posts with ringlock, plain and barbed wire. It is in poor to reasonable condition but adequately contains the cattle in the adjoining property. ~~The drain along the southern boundary of the golf course provides an additional barrier.~~

A small section of low cyclone fencing in front of the golf club-house is in good condition. Gates on either side of Karnup Road near the club-house provide access to the northern and southern sections of the golf course. ~~These are in good condition.~~

~~The fence between the equestrian and bushland areas consists of wooden posts with three strands of plain wire for most of its length, and is in reasonable condition. There is a small section of barbed wire fencing between the golf course and the first access gate, which is in reasonable condition but may pose a safety hazard. There are two sets of gates into the equestrian areas on Karnup Road, and another gate on Hall Road provides access to the Paul Robinson Reserve and bushland. Gates to the reserve are padlocked, with allocation of keys limited to the user groups, and are in good condition. There are two pedestrian access points; one on the corner of Hall and Karnup Roads and one is adjacent to the gate to the Paul Robinson Reserve, consisting of wooden posts, and in good condition. There is a horse maze for equestrian access on Hall Road, constructed when the fence was replaced after a fire.~~

The ~~fence around the~~ banksia ~~has wooden strainers and steel posts with three strands of plain wire, and was replaced in 2020.~~ bushland around the sandpit is encircled by a fence with two gates, in the northwest and southeast corners, all in reasonable condition. ~~There are two gates in the northwest and southeast corners. Another fence along the southern edge of the go-kart track and Paul Robinson Reserve to Hall Road separates the golf course from the revegetation areas. This fence is in poor condition in parts but reasonable overall.~~

Other Facilities

Netball Courts

There are two degraded, unused netball courts west of the equestrian facilities near Karnup Road. ~~The courts have working floodlights, goal posts at both ends in reasonable condition, and a small iron shelter.~~ The bitumen surface is cracked and uneven. Use is currently restricted to intermittent storage.

Signs

There are signs at each entry gate that detail the types of activities that occur on the reserve. ~~In 2004, There is a new~~ “welcome” sign ~~was erected~~ on the corner of Karnup and Hall Roads, and

“condition of entry” signs at each of the three entrances along Karnup Road. All are aluminium with non-reflective backgrounds and the Shire logo, ~~and complement the pre-existing signs~~. Signs throughout the reserve are aluminium or wood, and they range in style, age and condition.

Parking Facilities

There are no formal parking areas, with space limited to an informal area near the pony club and golf club entrances with little shade and bare soil surfaces. The equestrian clubs have indicated that the informal parking areas are inadequate and need to be organised more effectively.

Walking Tracks

A number of tracks ~~have been~~ were created through the bushland and revegetation areas. Many of the tracks through the banksia bushland have been closed and ~~are beginning to~~ have revegetated d well. The SBG is keen to continue the process of rehabilitation and establish a ~~clearly~~ marked walking track through the revegetation areas and the bushland ~~to allow for education and enjoyment~~.

Drainage Network

There is an extensive system of artificial drains traversing and surrounding the reserve, as well as an artificial wetland designed to improve water quality. ~~The network is described in detail in the water section of this management plan.~~

4.4.2. Threats and Pressures

Building Maintenance

~~The Shire has an established inspection and maintenance program. Inadequate or infrequent building maintenance would lead to accelerated deterioration of building value and the increased risk of safety hazards. The general appearance of poorly maintained facilities also tends to attract vandalism. The Shire has an established inspection and maintenance program.~~

Vandalism and Theft

Vandalism and theft ~~is~~ are constant but low-level threats ~~to the reserve, which is likely to increase with the population and use of the area. Where possible,~~ The design of all buildings and other structures should incorporate vandalism-resistant features. Use of tough materials, protection of vulnerable surfaces with resistant barriers resistant to breakage and graffiti, visibly high maintenance, removal of objects likely to be used by vandals, high security and provision of appropriate lighting all decrease the likelihood of theft and damage.

Surveillance is an effective deterrent, ~~but while the levels of vandalism are a nuisance they do not currently warrant the expense of regular patrols or the installation of surveillance equipment. A security alarm would be appropriate on the pavilion.~~ The local community is well placed to keep an eye on facilities and report unlawful activities. ~~Best practice management strategies facilitate community ownership by encouraging broad use and participation.~~ Community use of appropriate areas ~~within the reserve~~ for a range of activities is ~~therefore~~ likely to improve security.

Vehicles, including two or four wheel motorbikes, can cause a great deal of damage to irrigation infrastructure, turf and bushland. Stock can cause minor damage to turf surfaces and may also cause a nuisance. Strong fencing and locked gates will exclude most vehicles and stock, while pedestrian access can be maintained through openings with narrowly spaced posts to exclude motorbikes.

Fire Damage

Fire can threaten people, property and conservation values. Prevention and resistance needs to be incorporated into the design and management of buildings, other structures and their surrounds. Fires

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can start inside or adjacent to buildings and structures, and are often the result of vandalism, kitchen accidents or electrical faults. Bush or grass fires threaten buildings and structures through embers, radiant heat and direct contact. ~~Buildings and structures in the open are unlikely to be threatened by radiant heat, but embers can travel several kilometres under the right conditions and remain a threat.~~

Cleared areas around buildings limit the opportunity for bush and grass fires to reach them. No flammable material should be stored close to buildings, and gutters kept clear. Strategies to limit the frequency and severity of vandalism will reduce the likelihood of arson. Irrigated turf is unlikely to carry a fire, but a hot fire close to turf areas could produce enough radiant heat to severely damage it. Fire in nearby bushland has the potential to damage ~~turf, buildings, fencing and other~~ infrastructure.

~~It is standard practice to develop a fire management strategy for reserves and associated infrastructure that integrates all aspects of building design, equipment and procedures.~~

Limited Access to Water

The water allocation is insufficient to maintain 39 hectares of turf in a lush condition. High quality turf is not required for most purposes in the reserve, so an assessment of water use requirements plus minimising evaporation and reusing water will facilitate the maintenance of turf to minimum standards. ~~Water availability and use is discussed in the water section of this management plan.~~

Inadequate Car Parking Facilities

During major sporting events, informal car parking arrangements lead to the damage of soil, vegetation, infrastructure and personal property. A clearly marked and structured parking area with a modified surface to prevent erosion would significantly improve reserve facilities. For large competitions, areas for overflow parking need to be designated and clearly marked or directed. ~~To design and develop an organised parking area or areas, information on vehicle numbers and types would need to be provided by the equine clubs.~~

Lack of Designated Camping Areas

During equestrian events that are held over two or more days, participants regularly camp on the reserve. ~~In the absence of designated camping areas,~~ ~~camping is haphazard,~~ which poses risks to property and ~~to the campers themselves.~~ Designated ~~event~~ camping areas are limited to turf bordering ~~the bushland, for event use only,~~ with low fire risk, and (ideally) close to ablution facilities. This minimises impacts on the bush and facilities, and improves safety for participants, but degrades turf areas which costs the Shire ~~annually~~ for maintenance and upgrades. Alternative camping areas are being explored as horse floats and recreational camping vehicles are getting larger and heavier, ~~each year~~ causing greater ~~and greater~~ degradation to the turf areas.

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Winter Drainage

Water-logging and flooding affect several areas of the golf course and most of the polocrosse ground. Poor drainage ~~of turf surfaces~~ can reduce ~~their~~ utility and value, by restricting use during certain periods ~~of the year~~ and affecting ~~the overall health of the turf~~ health. On clay soils, poor infiltration ~~combined with~~ long periods of inundation can lead to secondary salinity, ~~which has negative impacts on the turf and the environment.~~ The impacts of water-logging on turf health can be managed to a great extent by selecting appropriate turf species. ~~This has occurred on the polocrosse field.~~

~~A recommendation to further investigate options to improve drainage was first put forward in the Serpentine Sports Reserve Drainage Plan. Water use, reuse and drainage are considered further in the water section of this management plan. More detailed design feasibility studies and options to raise~~ Raising the levels of recreation surfaces or construct~~ing~~ ing alternative drainage and irrigation

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systems would be dependent on ~~the results of a~~ detailed design, feasibility studies, and analysis of needs, benefits and costs.

Community Use of Reserve Areas and Lease/License Arrangements

Fostering community ownership of the reserve has a number of benefits, including ~~heightened~~ surveillance and ~~greater community~~ support for reserve improvements. An increase in ~~community~~ ownership ~~could~~ be achieved by increasing usage, ~~such as by~~ encouraging the use of ~~existing~~ facilities by other clubs and individuals, and by ~~providing~~ additional facilities that encourage passive and active ~~recreational use of the area~~, such as interpretive signage. License arrangements with the SH&PC and the SFPC for use of the reserve will be facilitated, linked to the management plan and a Memorandum of Understanding for some ongoing contribution toward reserve management requirements. ~~The issue of community use of the reserve is discussed in the recreation section of this management plan.~~

4.5. Social and Economic Characteristics: Actions

Table 10 – Social and Economic Actions for Management of Serpentine Sports Reserve
(Short Term actions, Long Term actions, and Business as Usual)

No.	Action	Priority & Status	Implementation	Responsibility	Requirements
Aboriginal Heritage					
25	<u>Establish and implement an effective process for ongoing Aboriginal liaison.</u>	<u>High Long Term</u>	<u>Not Yet Implemented</u>	<u>Environmental Services</u>	<u>Staff time</u>
26	<u>When naming a place, structure or event, give consideration to Aboriginal names.</u>	<u>Medium Long Term</u>	<u>Not Yet Implemented</u>	<u>Environmental Services</u>	<u>Staff time</u>
27	<u>Develop an interpretation plan for the reserve that takes account of Aboriginal heritage values.</u>	<u>High Long Term</u>	<u>Not Yet Implemented</u>	<u>Environmental Services</u>	<u>Staff time</u> <u>Funding for signage</u>
European Heritage					
28	<u>All developments and activities to be documented and archived.</u>	<u>Medium Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u> <u>User groups</u>	<u>Staff time</u>
29	<u>Develop an interpretation plan for the reserve that takes account of European heritage values.</u>	<u>Medium Long Term</u>	<u>Not Yet Implemented</u>	<u>Community Development</u>	<u>Staff time</u> <u>Funding for signage</u>
Recreation					
30	<u>An appropriate application is to be submitted and assessed prior to any event camping.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Environmental Health, Development Services</u>	<u>Staff time</u>
31	<u>Maintain the turf areas at an acceptable standard.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Parks and Gardens</u>	<u>Staff time</u> <u>Funding for turf maintenance</u>
32	<u>Formalise and designate existing tracks and jumps and locations, restrict horse access to demarcated tracks, and require the Pony Club to possess and consult a map showing the designated tracks.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u> <u>User Groups</u>	<u>Staff time</u>
33	<u>Trimming of trees or vegetation may only occur with approval from the Shire and, if required, a State clearing permit.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u>
34	<u>Consider and document access issues, and develop and implement an access policy.</u>	<u>High Short</u>	<u>Implemented in Part</u>	<u>Natural Reserves</u>	<u>Staff time</u> <u>Funding for</u>

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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
		<u>Term</u>		<u>Coordinator</u>	<u>signage</u>
<u>Infrastructure</u>					
<u>35</u>	<u>Estimate the cost for raising the height of the polocrosse ground, and prepare and submit a business case for improvement of the turf area.</u>	<u>Medium Long Term</u>	<u>Not Yet Implemented</u>	<u>Infrastructure Services</u>	<u>Staff time Funding for turf improvement</u>
<u>36</u>	<u>Review potential solutions to flooding on the golf course, and prepare and submit a business case for golf course flooding solutions.</u>	<u>Medium Long Term</u>	<u>Not Yet Implemented</u>	<u>Infrastructure Services</u>	<u>Staff time Funding for golf course flooding solutions</u>
<u>37</u>	<u>Investigate and implement a long-term plan to increase, renovate or upgrade reserve facilities.</u>	<u>Medium Long Term</u>	<u>Ongoing</u>	<u>Infrastructure Services</u>	<u>Staff time</u>

4.4.3. Social and Economic Characteristics: Business and Tourism Strategies

Issue	Target	Priority	Strategy	Responsibility
34. The full business potential of SSR events could be further developed.	All major SSR events to be coordinated and promoted by the Peel Development Commission. SSR event organizers to offer promotions, sponsorships and advertising to local businesses prior to accepting or searching for promotions, sponsorship and advertising from outside the Shire.	High	a) Event organizers to liaise closely with the Peel Development Commission in relation to event promotion and coordination with events elsewhere. b) Raise broad community awareness of planned events and sponsorship opportunities well in advance of events through newspaper articles, stakeholder and other club newsletters, Shire website and other local communication avenues. c) Raise the awareness of event participants and visitors about opportunities in the local area, and promote a register of local businesses appropriate to this audience through the Shire and club websites and printed materials. d) Undertake an analysis of goods and services provision needs for regular and special events, and use this study to encourage the development and expansion of local businesses.	Stakeholders organizing events with Shire support
35. There is currently no ongoing close liaison between the tourism industry, local business community and the SSRMC.	Develop effective ongoing liaison between the tourism industry, local business community and the SSRMC.	Medium	a) Administrate the RAG with a membership that includes someone who is both knowledgeable and well connected in relation to business and tourism. b) Implement a system to exchange minutes between SSRMC and RAG. c) Undertake an annual review of the effectiveness of liaison between SSRMC and RAG in ensuring that business and tourism interests are taken account of in day to day management of the reserve. d) Work with the local business and tourism communities to seek other effective ways to establish effective ongoing liaison.	Shire in partnership with the local business, tourism industries, SSRMC and RAG

5. Implementation, Monitoring and Review

5.1. Introduction

An implementation plan is provided in this section. Various divisions within the Shire ~~will be~~ responsible for implementation and it is anticipated that the ~~recommendations strategies~~ will be acted on over several years. All ~~recommendations strategies~~ in this plan are reproduced in a single table below, along with priorities, responsibilities and ~~cost estimates~~ requirements.

5.2. Priorities and Status

Priorities for implementation of the recommendations have been classified as follows:

- ~~Key – an essential action for successful management of the reserve (9 actions);~~
- ~~High – an important action which should be implemented in the short term (15 actions); and~~
- ~~Medium – a longer-term action (16 actions).~~
- ~~Key – within the first financial year from the date of endorsement of this plan;~~
- ~~High – within the next five years;~~
- ~~Medium – within the next ten years; and~~
- ~~Ongoing – as required.~~

~~The status of each strategy has been assessed as Implemented, Implemented in Part, Not Yet Implemented, and Ongoing. In addition, each strategy has been classified as:~~

- ~~Business as Usual – an ongoing action that occurs as a matter of course (19 actions);~~
- ~~Short Term – to be implemented within three years of adoption of the management plan (6 actions); and~~
- ~~Long Term – a desired action that is funding dependent and may be implemented within ten years of adoption (15 actions).~~

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5.3. Responsibilities, Monitoring and Review

The Shire of Serpentine Jarrahdale is responsible for ~~recommendations strategies~~ within this plan. In some instances, the Shire may be assisted in implementing a recommendation by a partner who has an interest or responsibility, and there may be opportunities for grants to implement strategies. The management plan strategies will be monitored and reviewed, and the management plan will be revised if necessary.

Divisions within the Shire with responsibilities for implementation, sometimes in collaboration with ~~the~~ Landcare ~~Centre~~ SJ Inc., Fire Brigades, User Groups or Community, are as follows:

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- Environmental ~~and Sustainability~~ Services;
- Natural Reserves Coordinator;
- Operations ~~and Parks~~;
- ~~WSUD Project Manager~~ Parks and Gardens;
- ~~Fire and~~ Emergency Services;
- Corporate Services;
- Community Development;
- Development Services; and
- Environmental Health.

Requirements are designated as staff time and/or funding, which is dependent on business cases or grants.

Monitoring consists of regular reviews of the implementation of this management plan by an internal working group, which will meet quarterly to review short term actions, with an overall annual review. Additional meetings may be triggered by grant opportunities.

Cost estimates are either approximate one off costs or ongoing per year. It is estimated that the first year of implementation of the management plan (the Key strategies) will cost \$37,000. For the following 10 years, average cost per year is estimated at \$20,000 per year for those strategies listed as High and Medium Priority.

5.4. Implementation, Monitoring and Review Actions

Table 11 – Implementation, Monitoring and Review Actions for Management of Serpentine Sports Reserve (Short Term actions, Long Term actions, and Business as Usual)

<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
38	<u>Implement actions according to priority and status, and source external funding for implementation.</u>	<u>Medium Business as Usual</u>	<u>Implemented in Part</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u>
39	<u>Monitor implementation of actions through regular reviews.</u>	<u>Medium Business as Usual</u>	<u>Implemented in Part</u>	<u>Environmental Services Natural Reserves Coordinator</u>	<u>Staff time</u>
40	<u>Periodically review the efficiency and effectiveness of management plan implementation and revise if necessary.</u>	<u>Medium Business as Usual</u>	<u>Implemented in Part</u>	<u>Environmental Services</u>	<u>Staff time</u>

5.5. Action Plan

Table 12 – Actions for Management of Serpentine Sports Reserve (Short Term actions, Long Term actions, and Business as Usual)

<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
<u>Governance</u>					
<u>Governance</u>					

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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
<u>1</u>	<u>An appropriate application is to be submitted and assessed prior to improvement, development or requests for works.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u>
<u>2</u>	<u>Change vesting purpose to recognise "conservation" as a purpose for the southern section of the reserve.</u>	<u>Medium Short Term</u>	<u>Not Yet Implemented</u>	<u>Environmental Services</u>	<u>Staff time</u>
<u>3</u>	<u>Periodically monitor and review leases and licence use of the reserve.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Infrastructure Services</u>	<u>Staff time</u>
Environmental Characteristics					
Land Resources					
<u>4</u>	<u>Monitor the profile of the sand pit wall, determine whether soil erosion remediation is required, and take action if required.</u>	<u>Medium Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services</u>	<u>Staff time</u> <u>Funding for erosion action</u>
<u>5</u>	<u>Monitor turf cover, and manage adaptively to meet appropriate targets.</u>	<u>Medium Business as Usual</u>	<u>Ongoing</u>	<u>Parks and Gardens</u>	<u>Staff time</u>
Water Resources					
<u>6</u>	<u>Audit water use, prepare a water conservation and reuse plan, and apply best management practices for water use on turf surfaces.</u>	<u>Key Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services, Parks and Gardens</u>	<u>Staff time</u>
<u>7</u>	<u>Design and implement a water quality monitoring program, including nutrient export targets, and develop and monitor nutrient stripping features.</u>	<u>Key Long Term</u>	<u>Implemented in Part</u>	<u>Natural Reserves Coordinator, User Groups</u>	<u>Staff time</u> <u>Funding for monitoring and nutrient stripping</u>
<u>8</u>	<u>Monitor water quality entering the conservation category wetland, and filter or redirect golf course runoff if water quality exceeds target levels.</u>	<u>High Long Term</u>	<u>Implemented in Part</u>	<u>Environmental Services</u>	<u>Staff time</u> <u>Funding for monitoring and runoff diversion</u>
Fire					
<u>9</u>	<u>Liaise with Emergency Services to prepare/update and implement a Fire Management Plan that prioritises conservation alongside people and property.</u>	<u>High Short Term</u>	<u>Not Yet Implemented</u>	<u>Emergency Services, Environmental Services</u>	<u>Staff time</u> <u>Funding for fire management plan preparation</u>
<u>10</u>	<u>Carry out mosaic burns if any control burning is required, allowing habitat restoration before burning the next area.</u>	<u>Medium Short Term</u>	<u>Not Yet Implemented</u>	<u>Emergency Services, Environmental Services</u>	<u>Staff time</u>
<u>11</u>	<u>Follow up any burning with weed control measures.</u>	<u>High Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u> <u>Funding for weed control</u>
Dieback					
<u>12</u>	<u>Map and treat dieback every three years, according to best management practice.</u>	<u>Key Business as Usual</u>	<u>Ongoing</u>	<u>Natural Reserves Coordinator</u>	<u>Staff time</u> <u>Funding for dieback mapping and treatment</u>
<u>13</u>	<u>Adopt and implement dieback hygiene procedures for all users.</u>	<u>High Short Term</u>	<u>Not Yet Implemented</u>	<u>Natural Reserves Coordinator, User Groups</u>	<u>Staff time</u> <u>Funding for hygiene procedures</u>

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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
14	Surface tracks with appropriate materials, as required.	Medium Long Term	Implemented in Part	Natural Reserves Coordinator User Groups	Staff time Funding for track materials
Weeds					
15	Map and monitor weed distribution, and prepare and implement a weed control program.	Key Business as Usual	Ongoing	Natural Reserves Coordinator	Staff time Funding for weed mapping and control
16	Minimise disturbance and weed introduction through maintaining the number and width of tracks.	High Business as Usual	Ongoing	Natural Reserves Coordinator User Groups	Staff time
17	Pick up all traces of manure, bedding and stock feed from all parts of the reserve within 12 hours.	High Business as Usual	Ongoing	User Groups	Staff time Funding for signage
Revegetation					
18	Prepare and implement a bushland rehabilitation and revegetation plan.	High Long Term	Implemented in Part	Natural Reserves Coordinator Landcare SJ Inc User Groups	Staff time Funding for revegetation
19	Continue to prohibit use of marri woodland for stock yards, camping and parking, and establish alternative overflow facilities for polocrosse club.	High Business as Usual	Ongoing	Natural Reserves Coordinator	Staff time
Biodiversity					
20	Monitor track width within bushland and adjust access through demarcation and barrier installation as appropriate.	High Short Term	Ongoing	Natural Reserves Coordinator User Groups	Staff time Funding for barriers
21	Review all fencing and replace if necessary with a design that will not form a barrier to wildlife.	Medium Long Term	Ongoing	Natural Reserves Coordinator	Staff time Funding for fencing
22	Identify and protect threatened and priority flora and vegetation communities.	Key Business as Usual	Ongoing	Environmental Services	Staff time Funding for signage
Fauna					
23	Review fauna surveys, gather additional information, and monitor Black Cockatoos' usage of the reserve.	Medium Long Term	Implemented in Part	Environmental Services	Staff time
24	Monitor feral animals and undertake control programs as required, while complying with all safety and accreditation procedures.	High Business as Usual	Ongoing	Natural Reserves Coordinator Landcare SJ Inc	Staff time Funding for feral animal control
Social and Economic Characteristics					
Aboriginal Heritage					
25	Establish and implement an effective process for ongoing Aboriginal liaison.	High Long Term	Not Yet Implemented	Environmental Services	Staff time
26	When naming a place, structure or event, give consideration to Aboriginal names.	Medium Long Term	Not Yet Implemented	Environmental Services	Staff time

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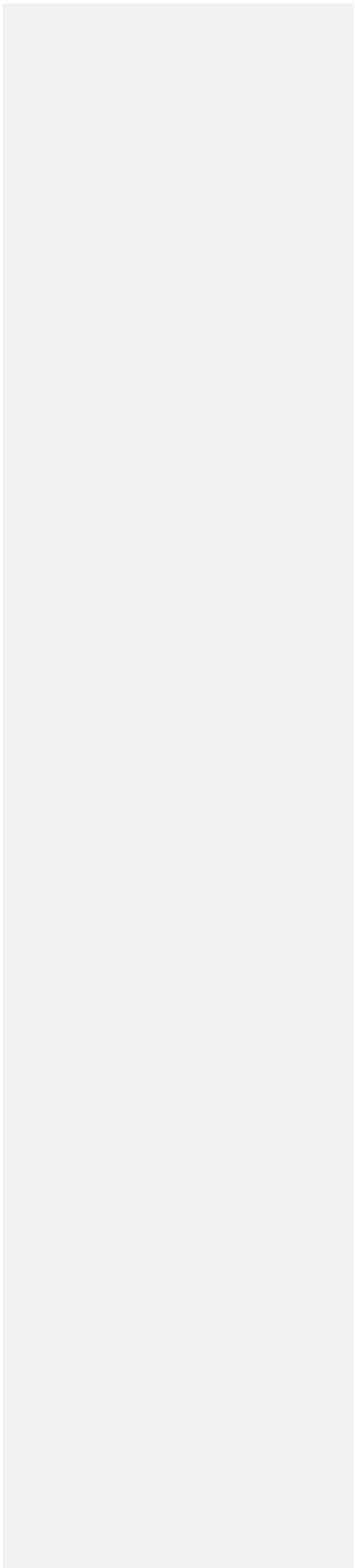
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<u>No.</u>	<u>Action</u>	<u>Priority & Status</u>	<u>Implementation</u>	<u>Responsibility</u>	<u>Requirements</u>
27	Develop an interpretation plan for the reserve that takes account of Aboriginal heritage values.	High Long Term	Not Yet Implemented	Environmental Services	Staff time Funding for signage
European Heritage					
28	All developments and activities to be documented and archived.	Medium Business as Usual	Ongoing	Natural Reserves Coordinator User groups	Staff time
29	Develop an interpretation plan for the reserve that takes account of European heritage values.	Medium Long Term	Not Yet Implemented	Community Development	Staff time Funding for signage
Recreation					
30	An appropriate application is to be submitted and assessed prior to any event camping.	Key Business as Usual	Ongoing	Environmental Health Development Services	Staff time
31	Maintain the turf areas at an acceptable standard.	Key Business as Usual	Ongoing	Parks and Gardens	Staff time Funding for turf maintenance
32	Formalise and designate existing tracks and jumps and locations, restrict horse access to demarcated tracks, and require the Pony Club to possess and consult a map showing the designated tracks.	High Business as Usual	Ongoing	Natural Reserves Coordinator User Groups	Staff time
33	Trimming of trees or vegetation may only occur with approval from the Shire and, if required, a State clearing permit.	High Business as Usual	Ongoing	Natural Reserves Coordinator	Staff time
34	Consider and document access issues, and develop and implement an access policy.	High Short Term	Implemented in Part	Natural Reserves Coordinator	Staff time Funding for signage
Infrastructure					
35	Estimate the cost for raising the height of the polocrosse ground, and prepare and submit a business case for improvement of the turf area.	Medium Long Term	Not Yet Implemented	Infrastructure Services	Staff time Funding for turf improvement
36	Review potential solutions to flooding on the golf course, and prepare and submit a business case for golf course flooding solutions.	Medium Long Term	Not Yet Implemented	Infrastructure Services	Staff time Funding for golf course flooding solutions
37	Investigate and implement a long-term plan to increase, renovate or upgrade reserve facilities.	Medium Long Term	Ongoing	Infrastructure Services	Staff time
Implementation, Monitoring and Review					
38	Implement actions according to priority and status, and source external funding for implementation.	Medium Business as Usual	Implemented in Part	Natural Reserves Coordinator	Staff time
39	Monitor implementation of actions through regular reviews.	Medium Business as Usual	Implemented in Part	Environmental Services Natural Reserves Coordinator	Staff time
40	Periodically review the efficiency and effectiveness of management plan implementation and revise if necessary.	Medium Business as Usual	Implemented in Part	Environmental Services	Staff time

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5.4. Implementation Strategies

Issue	Target	Priority	Strategy	Responsibility
36. The efficiency and effectiveness of the management plan and its implementation will need to be assessed in consultation with all stakeholders.	Number of strategies to be implemented annually and the effectiveness of the objectives of management being met.	Medium	a) Periodically monitor and review the efficiency and effectiveness of management plan strategy implementation and revise if necessary.	Shire in partnership with SSRMC, RAG and the local business and tourism industries

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5.5. Implementation Plan

Table 9 — Strategies for Management of Serpentine Sports Reserve

No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
Governance Strategies					
1.	a) Develop and implement a process to inform and advise SSMC, RAG and RWG members of current legislation. b) Make reserve users aware of the <i>Policy for Reserve Improvement/Development by the Community</i>. c) All community recommendations and requests for works received under the above policy are to be referred by the Natural Reserves Coordinator to the RWG, and thence to the Council if it is of sufficient magnitude or involves the construction of new infrastructure.	Medium	Ongoing	Natural Reserves Coordinator, Environmental & Sustainability Services	\$1,000
2.	a) RAG meetings to be conducted with broad membership as required in the <i>Shire Reserves Planning and Management Framework</i>. b) Provide assistance and support to RAG members to ensure that proper independent audits are undertaken and reported to Council at a minimum frequency of every 3 years from the date of endorsement of this plan. c) Facilitate a review and debate relating to audit results and the endorsed management plan.	Medium	Ongoing	Natural Reserves Coordinator, Environmental & Sustainability Services	\$1,000
3.	a) Maintain a record of relevant governance training opportunities and communicate this to SSR community groups.	Medium	Ongoing	Natural Reserves Coordinator	\$1,000
Environmental Characteristics: Geology, Geomorphology and Soils Strategies					
4.	a) Monitor the profile of the sand pit wall and determine whether soil erosion remediation is required.	Medium	Implemented in Part	Environmental & Sustainability Services	\$1,000
5.	a) Pasture and mulch cover to be monitored and managed adaptively to ensure management target.	Medium	Implemented in Part	Operations & Parks	\$1,000
6.	a) The potential risks of acid sulphate soils are to be communicated to all community groups that use the reserve, taking place frequently enough to ensure the management target when club members change. b) No excavation or dewatering is to take place without consultation with DEC.	High	Implemented in Part	Natural Reserves Coordinator	\$2,000
Environmental Characteristics: Water Strategies					
7.	a) Prepare an energy consumption and emissions audit of all operations and activities on SSR, including methane production, carbon sinks and carbon trading contingencies. b) Establish vegetation as required to offset emissions.	Medium	Not Yet Implemented	Environmental & Sustainability Services	\$1,000
8.	a) Install meters and monitor water extraction from bores. b) Prepare an inventory of all water consumption on the reserve.	Key	Implemented in Part	Environmental & Sustainability Services, Operations & Parks, Natural Reserves	\$3,000

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No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
				Coordinator	
9.	<p>a) Prepare a plan to reduce consumption and reuse water by for example:</p> <ul style="list-style-type: none"> Storing and reusing rain water; Reducing evaporation from dams and irrigation; Reviewing the extent and standard of turf; Using and reusing surface water; <p>b) Applying best management practices for water use on turf surfaces as follows:</p> <ul style="list-style-type: none"> Installing automatic sprinkler systems; Adjusting the quantity of water applied in accordance with evaporation and turf conditions; Adjusting the timing of water application to minimise evaporation and wastage; Monitoring soil infiltration rates and applying wetting agents and other amendments as required. 	Key	Implemented in Part	Environmental & Sustainability Services, Operations & Parks, Natural Reserves Coordinator	\$5,000
10.	<p>a) Design and implement a monitoring program for water quality:</p> <ul style="list-style-type: none"> Entering and leaving the reserve; Adjacent to and downstream of potential nutrient hotspots; Entering and leaving the existing constructed wetland. <p>b) Maintain joint records of fertilizer and animal waste applications (as equivalent horse hours per hectare and management techniques) and maintain levels below target amounts (150kg/ha/year N and 15kg/ha/year P).</p> <p>c) Distribute educational material about minimal impact equine management and the impacts of nutrient pollution.</p> <p>d) Minimise nutrient export by implementing best management practices including:</p> <ul style="list-style-type: none"> Adjust fertilizer application for turf condition. Establish vegetated buffers between all nutrient sources and surface water features. Pick up manure and export it within 12 hours. If horse pens are exporting significant quantities of nutrients, provide and frequently renew temporary absorbent surfaces in horse pens and/or construct covered pens with sealed floors. Develop and implement procedures to ensure that manure is not stored on the reserve, even for short periods, unless in appropriate covered containers with impermeable bases. Develop and implement procedures to ensure that fertilizers and other chemicals are transported, stored and used in such a manner that the risk of spillage and pollution is minimal. <p>e) Maximise nutrient stripping from flowing surface waters by reviewing, and where possible implementing, best management practices (e.g. planting native rushes, sedges and other vegetation along drains, treatment trains and artificial wetlands).</p> <p>f) If the existing constructed wetland is not effectively stripping nutrients:</p>	Key	Implemented in Part	Natural Reserves Coordinator, User Groups, WSUD Project Manager	\$10,000

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No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
	<ul style="list-style-type: none"> Adjust its design and management (e.g. in relation to its size, shape, planting, flow rates and vegetation and sediment removal programs); and Investigate constructing additional wetlands. 				
11.	a) Establish a mixture of deep and shallow rooted vegetation to absorb nutrients as they seep down to groundwater resources. b) Seek advice from the Department of Water on meeting the total target of 150kg/ha/year N and 15kg/ha/year P within the reserve.	High	Implemented in Part	WSUD Project Manager	\$2,000 Per Year
12.	a) Lower the water table and reduce evaporation by establishing a mixture of deep and shallow rooted vegetation in areas where surface water occurs.	High	Implemented in Part	Environmental & Sustainability Services	\$2,000 Per Year
13.	a) Monitor water quality entering the conservation category wetland. b) Reduce runoff and filter water from the golf course by, for example: <ul style="list-style-type: none"> Establishing a mixture of deep and shallow rooted vegetation throughout the golf course area; Constructing a nutrient stripping wetland within the drain prior to water entering the wetland. c) If water quality entering the wetland is above target levels (0.1 mg/L total P and 0.75 mg/L total N), review and implement options to isolate golf course runoff from the wetland (e.g. by diverting the drain to a storage dam which drains to the south).	High	Implemented in Part	Environmental & Sustainability Services	\$2,000 Per Year
Environmental Characteristics: Biodiversity Strategies					
14.	a) Investigate potential options and seek Council advice toward recognising "conservation" as a purpose for the southern section of the reserve.	Medium	Not Yet Implemented	Environmental & Sustainability Services	\$1,000
15.	a) Map dieback distribution within the bushland areas, zone dieback free areas as high conservation, and manage any tracks through dieback free areas (where they cannot be closed) without unreasonably impacting on existing uses. b) Treat vegetation for dieback by spraying and injecting vulnerable plants at 3 to 5 year intervals. c) Raise community awareness (such as by provision of signs, club newsletters, event briefings etc.). d) Raise the awareness of staff, volunteers and contractors of appropriate dieback hygiene procedures and ensure they are adhered to. e) Minimise risks of disease spread by: <ul style="list-style-type: none"> Where practical, reconciling the alignment of tracks with dieback fronts; and Otherwise, ensuring tracks are constructed with appropriate materials and suitable buffer zones maintained on either side by spraying with a dieback treatment and trimming vegetation at recommended intervals. f) Liaise directly with Shire Officers for identification, protection and management of important flora. g) Construct barriers where necessary to prevent pedestrian and stock traffic from crossing dieback fronts or important areas of flora. h) Minimise risks of disease spread by adopting dieback	Key	Implemented in Part	Natural Reserves Coordinator, Environmental & Sustainability Services	\$2,000 Per Year

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No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
	<p>hygiene processes including:</p> <ul style="list-style-type: none"> Construction and maintenance work to be undertaken in dry conditions only; Wash down of vehicles and footwear prior to commencing construction or maintenance work in the bushland area; No material (e.g. soil and pathway surfaces) to be introduced into the bushland area unless guaranteed dieback free. 				
16.	<p>a) Review fauna surveys and gather additional information.</p> <p>b) Liaise with Birds Australia in relation to continuing bird surveys.</p> <p>c) Maintain a limited access inventory of declared and priority plant species, with annual inspections of plants.</p> <p>d) Monitor Black Cockatoos' usage of the reserve.</p>	Medium	Implemented in Part	Environmental & Sustainability Services, Natural Reserves Coordinator	\$3,000
17.	<p>a) Map weed distribution within the bushland, and compare with previous maps.</p> <p>b) Prepare a weed control program by identifying and prioritising weed affected areas, including sources of weed seed outside the bushland area.</p> <p>c) Remove weeds with physical and chemical treatments in accordance with the weed control program. Mulch, brush, seed, or plant treated areas with local native plants.</p> <p>d) Minimise disturbance and weed introduction and actively remove weeds from the bushland area through:</p> <ul style="list-style-type: none"> Maintaining the number and width of tracks but disallowing the development of new tracks without prior approval; Diverting nutrient rich surface drainage away from bushland areas; Picking up all traces of manure by stock owners in the bushland area within 12 hours of deposition; Picking up all traces of bedding and stock feed from the bushland area within 12 hours of use; Raising the awareness of all users of the importance of minimising weed spread (by event briefings etc.); Removing all <i>Eucalyptus camaldulensis</i> saplings and regrowth plants. 	Key	Implemented in Part	Natural Reserves Coordinator, User Groups, Environmental & Sustainability Services	\$5,000 Per Year
18.	<p>a) Maintain records of feral animal sightings and monitor southern section of reserve annually for rabbit warrens.</p> <p>b) Destroy rabbit warrens and feral bees' nests where required.</p> <p>c) Raise awareness among surrounding landowners about the damage done by feral cats and other animals and encourage owners to restrain pets and control pests on their land.</p> <p>d) Disallow the placement of bee hives anywhere on the reserve.</p>	High	Implemented in Part	Environmental & Sustainability Services	\$2,000 Per Year

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No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
19.	<ul style="list-style-type: none"> a) Prepare and implement a bushland rehabilitation plan, including weed management and rehabilitation criteria. b) Map locations of listed flora and maintain records of health of individual plants or clumps. c) Raise stakeholder awareness of the requirements for approvals under State and Commonwealth legislation and policies. d) Map bushland condition periodically and compare with previous maps. e) Monitor track width within banksia woodland and adjust access to achieve target of no vegetation loss in bush areas through demarcation and barrier installation. f) Review tracks through marri woodland and narrow to a minimum safe width for cross-country riding events. g) Rehabilitate all but essential tracks through the bushland, the sand pit, previously weed-infested areas, Paul Robinson Reserve, old go-kart track, vacant areas where remnant vegetation abuts cleared or weed-infested land, and the banks of water courses and artificial wetlands, including some of the golf course swales. h) Recreate the dominant species, growth forms and community structure of identified natural reference communities. i) Limit collection of indigenous seeds and cuttings to propagation of plant material for local rehabilitation only. j) Disallow use of marri woodland community for stock yards, camping and parking and establish alternative overflow stockyards, camping and parking facilities for polo/crosse club. k) Work with neighbouring land managers to encourage responsible management of ecological linkages. l) Review all fencing and replace if necessary with a design that will not form a barrier to wildlife. 	High	Implemented in Part	Environmental & Sustainability Services	\$5,000 Per Year
20.	<ul style="list-style-type: none"> a) Update and seek approval for a Reserve Fire Management Plan in conjunction with relevant State agencies (including TEC experts from DEC) and Commonwealth Departments. b) Ensure all burning in the reserve conforms to this plan. 	High	Not Yet Implemented	Fire & Emergency Services	\$3,000
Social and Economic Characteristics: Indigenous Heritage Strategies					
21.	<ul style="list-style-type: none"> a) Administrate the RAG with membership of at least one person who can speak for local Indigenous people as required. b) Ensure that minutes from SSRMC and RAG meetings are exchanged. c) Consult the South West Land and Sea Council and South West Catchment Council for advice on other appropriate liaison processes and implement as appropriate. 	High	Not Yet Implemented	Environmental & Sustainability Services, Natural Reserves Coordinator	\$1,000
22.	<ul style="list-style-type: none"> a) When naming a place, structure or event give consideration to Aboriginal names, seek advice from Aboriginal representatives and obtain approval for the use of appropriate names from the South West Land 	Medium	Not Yet Implemented	Environmental & Sustainability Services, Natural	\$1,000

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No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
	and Sea Council and the Shire Council.			Reserves Coordinator	
23.	a) Develop an interpretation plan for the reserve that takes account of Aboriginal heritage values.	High	Not Yet Implemented	Environmental & Sustainability Services, Natural Reserves Coordinator	\$3,500
Social and Economic Characteristics: European Heritage Strategies					
24.	a) All stakeholders to provide a summary of their developments and activities for SSRMC meetings. b) Stakeholder summaries of developments and activities to be incorporated in formal minutes of meetings, and files maintained and archived.	Medium	Ongoing	Natural Reserves Coordinator	\$1,000
25.	a) Develop an interpretation plan for the reserve that takes account of European heritage values.	Medium	Not Yet Implemented	Community Development, Environmental & Sustainability Services	\$3,500
Social and Economic Characteristics: Recreation Strategies					
26.	a) All clubs that use the SSR on a regular basis to develop and implement risk management plans. b) Shire to notify clubs of risk management training opportunities, and club members to attend as required.	Medium	Implemented in Part	Community Development, Environmental & Sustainability Services	\$4,000
27.	a) Accurate and complete minutes of SSRMC, RAG and RWG meetings be kept and archived. b) Encourage members of SSRMC, RAG and RWG to attend each others' meetings as observers. c) Information about SSR management to be maintained on the Shire website, and the local newspaper to be advised of major decisions regarding SSR management.	Medium	Implemented in Part	Natural Reserves Coordinator	\$1,000
28.	a) Negotiation, agreement and preparation of current lease and licence use of the reserve.	Key	Not Yet Implemented	Corporate Services, Environmental & Sustainability Services	\$3,000
29.	a) Review applications from the equine clubs for normal event camping. b) Impose additional approvals for camping outside the conditions set for normal event camping. c) Review current camping practices in relation to <u>turf impacts</u> , health and other statutory requirements, and where necessary rearrange or move traditional camp sites to locations which better comply with health and other regulations.	Key	Implemented in Part	Environmental Health, Development Services	\$7,000
30.	e) Continue to maintain the turf area and analyse and document the needs, benefits, carrying capacity and cost sharing associated with budgeting to maintain the turf area at an acceptable standard including estimating the costing for raising the height of the poloerose ground. f) Submit this document to Shire staff for assessment and to Council to seek endorsement and allocation of funds to bring the turf area up an acceptable standard for equine purposes and for ongoing annual	Key	Ongoing	Environmental and Sustainability Services, Natural Reserves Coordinator and Community Development	\$100,000 per annum

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No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
	maintenance. g) Review potential solutions to flooding on the golf course. h) Seek expert advice regarding feasibility and impacts of solutions, and submit preferred proposals and any requests for Shire funds to Shire staff for assessment and Council for endorsement.				
31.	a) Minimise environmental impact in bushland by raising the awareness of club members and developing a code of practice with a detailed process for its implementation. b) Formalise and designate tracks and jumps to limit expansion, and adjust the cross country course if current use causes further degradation of the bushland. c) Constraints and approval requirements: <ul style="list-style-type: none"> • No tree/vegetation in bush areas to be removed without a DEC Clearing Permit; • Any proposal for the trimming of trees/vegetation to go through the RWG's Reserve Improvement Application Form Process; • Camping to be restricted to turf areas on the edge of the bush area and not occur in any bush areas; • Ongoing vegetation monitoring in the bush area will result in recommendations for the demarcation and protection of vegetation from use of tracks by horses; • Access for horses in the bush area to be restricted to demarcated tracks; • The Pony Club to always possess a map showing the designated horse tracks in the bush areas; • Any horse manure to be removed by stock owners within 12 hours in any part of the reserve. 	Key	Implemented in Part	Environmental & Sustainability Services, Natural Reserves Coordinator	\$2,000
32.	a) Community forums and groups to be kept informed of recreational opportunities. b) Contractor of District Recreation Centre in Byford to liaise with SSRMC. c) Include SSR facilities in Peel Physical Activity brochure for Serpentine Jarrahdale Shire. d) Develop plans to encourage additional and broader use of the reserve.	Medium	Implemented in Part	Community Development	\$3,000
33.	a) Consider and document access issues. b) Develop and seek Council endorsement for an access policy document.	High	Implemented in Part	Environmental & Sustainability Services, Natural Reserves Coordinator	\$4,000
Social and Economic Characteristics: Business and Tourism Strategies					
34.	a) Event organizers to liaise closely with the Peel Development Commission in relation to event promotion and coordination with events elsewhere. b) Raise broad community awareness of planned events and sponsorship opportunities well in advance of events through newspaper articles, stakeholder and other club newsletters, Shire website and other local communication avenues. c) Raise the awareness of event participants and visitors	High	Implemented in Part	Community Development	\$10,000

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No.	Strategy	Priority	Implementation	Responsibility	Cost Estimate
	<p>about opportunities in the local area, and promote a register of local businesses appropriate to this audience through the Shire and club websites and printed materials.</p> <p>d) Undertake an analysis of goods and services provision needs for regular and special events, and use this study to encourage the development and expansion of local businesses.</p>				
35.	<p>a) Administrate the RAG with a membership that includes someone who is both knowledgeable and well connected in relation to business and tourism.</p> <p>b) Implement a system to exchange minutes between SSRMC and RAG.</p> <p>c) Undertake an annual review of the effectiveness of liaison between SSRMC and RAG in ensuring that business and tourism interests are taken account of in day-to-day management of the reserve.</p> <p>d) Work with the local business and tourism communities to seek other effective ways to establish effective ongoing liaison.</p>	Medium	Implemented in Part	Natural Reserves Coordinator, Environmental & Sustainability Services	\$1,000
Implementation Strategies					
36.	a) Periodically monitor and review the efficiency and effectiveness of management plan strategy implementation and revise if necessary	Medium	Implemented in Part	Environmental & Sustainability Services	\$2,000 Per Year

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Appendix 1 – Flora of Serpentine Sports Reserve

Three permanent flora monitoring quadrats were set up in 2008, one within each of the three floristic communities present in Serpentine Sports Reserve, which have been resurveyed annually since. The species recorded (including introduced weeds) are shown in Table 130.

Table 10 – Plant Species Recorded in Serpentine Sports Reserve

<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<u><i>Acacia alata</i></u>			<u>X</u>
<u>*<i>Acacia iteaphylla</i></u>	<u>X</u>		
<u><i>Acacia lasiocarpa</i></u>			<u>X</u>
<u><i>Acacia pulchella</i></u>			<u>X</u>
<u><i>Acacia sessilis</i></u>	<u>X</u>		<u>X</u>
<u><i>Acacia willdenowiana</i></u>	<u>X</u>		<u>X</u>
<u><i>Adenanthos meisneri</i></u>	<u>X</u>		<u>X</u>
<u><i>Agrostocrinum hirsutum</i></u>	<u>X</u>		<u>X</u>
<u>*<i>Aira cupaniana</i></u>	<u>X</u>	<u>X</u>	
<u><i>Allocasuarina humilis</i></u>	<u>X</u>		<u>X</u>
<u><i>Amphipogon turbinatus</i></u>	<u>X</u>		
<u><i>Anigozanthos manglesii</i></u>	<u>X</u>		<u>X</u>
<u>*<i>Arctotheca calendula</i></u>	<u>X</u>	<u>X</u>	
<u><i>Austrostipa compressa</i></u>	<u>X</u>		
<u>*<i>Avena barbata</i></u>	<u>X</u>	<u>X</u>	<u>X</u>
<u><i>Baeckea camphorosmae</i></u>	<u>X</u>		
<u><i>Banksia attenuata</i></u>	<u>X</u>		
<u><i>Banksia grandis</i></u>	<u>X</u>		<u>X</u>
<u><i>Banksia menziesii</i></u>	<u>X</u>		
<u><i>Banksia nivea</i></u>	<u>X</u>		<u>X</u>
<u><i>Billardiera sp.</i></u>	<u>X</u>		
<u><i>Bossiaea eriocarpa</i></u>	<u>X</u>		<u>X</u>
<u>*<i>Briza maxima</i></u>	<u>X</u>	<u>X</u>	<u>X</u>
<u>*<i>Briza minor</i></u>	<u>X</u>		<u>X</u>
<u><i>Burchardia congesta</i></u>	<u>X</u>		<u>X</u>
<u><i>Caesia micrantha</i></u>	<u>X</u>		<u>X</u>
<u><i>Caladenia discoidea</i></u>	<u>X</u>		
<u><i>Caladenia flava</i></u>	<u>X</u>	<u>X</u>	<u>X</u>
<u><i>Calectasia grandiflora</i></u>	<u>X</u>		
<u><i>Calytrix flavescens</i></u>	<u>X</u>		
<u><i>Calytrix fraseri</i></u>	<u>X</u>		
<u><i>Centrolepis aristata</i></u>		<u>X</u>	

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<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<i>Chaetanthus aristatus</i>		X	
<i>Chamaescilla corymbosa</i>	X		X
<i>*Cicendia filiformis</i>	X	X	
<i>Comesperma calymega</i>	X		
<i>Conospermum stoechadis</i>	X		
<i>Conostephium preissii</i>	X		
<i>Conostylis aculeata</i>			X
<i>Conostylis juncea</i>	X		X
<i>Conostylis setigera</i>	X		X
<i>Corymbia calophylla</i>			X
<i>*Cotula turbinata</i>	X	X	
<i>Cristonia biloba</i>			X
<i>Cyathochaeta avenacea</i>	X		X
<i>Cyathochaeta clandestina</i>	X		
<i>Dampiera alata</i>			X
<i>Dampiera linearis</i>			X
<i>Dasypogon bromeliifolius</i>	X		X
<i>Daviesia nudiflora</i>	X		
<i>Daviesia physodes</i>	X		X
<i>Desmocladius fasciculatus</i>	X		X
<i>Dianella revoluta</i>	X		X
<i>*Disa bracteata</i>		X	
<i>Drosera erythrorhiza</i>	X		X
<i>Drosera gigantea</i>		X	X
<i>Drosera glanduligera</i>		X	
<i>Drosera menziesii</i>	X	X	
<i>Drosera pallida</i>		X	X
<i>Drosera porrecta</i>			X
<i>*Ehrharta calycina</i>	X		X
<i>*Eragrostis curvula</i>		X	X
<i>Eremaea pauciflora</i>	X		
<i>Eucalyptus marginata</i>	X		X
<i>Eutaxia virgata</i>		X	
<i>Gastrolobium capitatum</i>	X		X
<i>*Gladiolus caryophyllaceus</i>			X
<i>Gnephosis angianthoides</i>	X	X	
<i>Gompholobium polymorphum</i>	X		
<i>Gompholobium tomentosum</i>	X		X
<i>Haemodorum laxum</i>	X		X
<i>Haemodorum simulans</i>			X
<i>Hakea prostrata</i>			X
<i>Hakea ruscifolia</i>	X		X
<i>Hakea sulcata</i>		X	
<i>Hakea varia</i>		X	
<i>Hemiandra pungens</i>			X
<i>Hibbertia diamesogenos</i>	X		
<i>Hibbertia huegelii</i>	X		
<i>Hibbertia vaginata</i>	X		

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<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<i>Hovea trisperma</i>	X		
<i>Hyalosperma cotula</i>	X	X	
<i>*Hypochaeris glabra</i>	X	X	X
<i>*Hypochaeris radicata</i>	X	X	X
<i>Hypolaena exsulca</i>	X	X	X
<i>Isolepis cernua</i>		X	
<i>Juncus kraussii</i>		X	
<i>Kennedia prostrata</i>	X		X
<i>Kunzea micrantha</i>	X	X	X
<i>Labichea punctata</i>	X		
<i>Lachnagrostis filiformis</i>	X		
<i>Lepidosperma leptostachyum</i>	X		X
<i>Lepidosperma pubisquameum</i>	X		
<i>Lepidosperma scabrum</i>	X		X
<i>Lepidosperma squamatum</i>	X		X
<i>Lepidosperma</i> sp. E Perth Flora	X		X
<i>Leucopogon</i> sp.	X		
<i>Lomandra caespitosa</i>	X		X
<i>*Lotus angustissimus</i>		X	
<i>Loxocarya cinerea</i>		X	
<i>Lyginia barbata</i>	X		
<i>Lyginia imberbis</i>	X		
<i>Melaleuca preissiana</i>		X	
<i>Melaleuca viminea</i>		X	
<i>Mesomelaena pseudostygia</i>	X		X
<i>Mesomelaena tetragona</i>	X		X
<i>*Monopsis debilis</i>		X	
<i>Neurachne alopecuroides</i>	X		
<i>Patersonia occidentalis</i>	X		X
<i>*Pennisetum villosum</i>		X	
<i>Pericalymma ellipticum</i>	X		X
<i>Petrophile linearis</i>	X		
<i>Petrophile macrostachya</i>	X		
<i>Phlebocarya ciliata</i>	X		X
<i>Pimelea sulphurea</i>	X		
<i>*Poa annua</i>		X	
<i>Pterochaeta paniculata</i>	X		
<i>Pterostylis vittata</i>	X		X
<i>Pyrorchis nigricans</i>	X		X
<i>Scaevola calliptera</i>			X
<i>Schoenus curvifolius</i>	X		
<i>Scholtzia involucrata</i>			X
<i>Senecio hispidulus</i>	X		
<i>Siloxerus humifusus</i>	X	X	
<i>Sphaerolobium</i> aff. <i>Macranthum</i>			X
<i>Stachysstemon vermicularis</i>	X		
<i>Stirlingia latifolia</i>	X		X
<i>Stylidium brunonianum</i>	X		

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February 2011

<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<u><i>Stylidium calcaratum</i></u>		X	
<u><i>Stylidium piliferum</i></u>	X		
<u><i>Synaphea</i> sp.</u>		X	
<u><i>Tetraria australiensis</i></u>			X
<u><i>Tetraria octandra</i></u>	X		X
<u><i>Tetratheca hirsuta</i></u>	X		
<u><i>Thelymitra crinita</i></u>	X		
<u><i>Thelymitra macrophylla</i></u>	X		X
<u><i>Thelymitra vulgaris</i></u>		X	
<u><i>Thysanotus sparteus</i></u>	X		
<u><i>Thysanotus triandrus</i></u>	X		X
<u><i>Trachymene pilosa</i></u>	X		
<u><i>Tribonanthes australis</i></u>		X	
<u><i>Tricoryne elatior</i></u>	X		X
<u><i>Triglochin incurva</i></u>		X	
<u><i>Tripterococcus brunonis</i></u>	X		
<u>*<i>Ursinia anthemoides</i></u>	X		
<u>*<i>Watsonia meriana</i></u>	X	X	X
<u><i>Xanthorrhoea brunonis</i></u>	X		X
<u><i>Xanthorrhoea gracilis</i></u>	X		X
<u><i>Xanthorrhoea preissii</i></u>	X		X
<u><i>Xanthosia huegelii</i></u>	X		
<u><i>Xylomelum occidentale</i></u>	X		
<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<u><i>Acacia alata</i></u>			X
<u><i>Acacia lasiocarpa</i></u>			X
<u><i>Acacia sessilis</i></u>	X		X
<u><i>Acacia willdenowiana</i></u>	X		X
<u><i>Adenanthos meisneri</i></u>	X		X
<u><i>Agrostocrinum hirsutum</i></u>	X		X
<u>*<i>Aira cupaniana</i></u>	X	X	
<u><i>Allocasuarina humilis</i></u>	X		X
<u><i>Amphipogon turbinatus</i></u>	X		
<u><i>Anigozanthos manglesii</i></u>	X		
<u>*<i>Arctotheca calendula</i></u>	X	X	
<u><i>Austrostipa compressa</i></u>	X		
<u>*<i>Avena barbata</i></u>		X	
<u><i>Baeckea camphorosmae</i></u>	X		
<u><i>Banksia attenuata</i></u>	X		
<u><i>Banksia grandis</i></u>	X		
<u><i>Banksia menziesii</i></u>	X		
<u><i>Banksia nivea</i></u>	X		X
<u><i>Billardiera</i> sp.</u>	X		
<u><i>Bossiaea eriocarpa</i></u>	X		X
<u>*<i>Briza maxima</i></u>	X	X	X
<u>*<i>Briza minor</i></u>			X
<u><i>Burchardia congesta</i></u>	X		X

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<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<i>Caesia micrantha</i>	×		×
<i>Caladenia discoidea</i>	×		
<i>Caladenia flava</i>	×	×	×
<i>Calcectasia grandiflora</i>	×		
<i>Calytrix flavescens</i>	×		
<i>Calytrix fraseri</i>	×		
<i>Centrolepis aristata</i>		×	
<i>Chaetanthus aristatus</i>		×	
<i>Chamaescilla corymbosa</i>	×		×
* <i>Cicendia filiformis</i>	×	×	
<i>Comesperma calymega</i>	×		
<i>Conospermum stoechadis</i>	×		
<i>Conostephium preissii</i>	×		
<i>Conostylis aculeata</i>			×
<i>Conostylis juncea</i>	×		×
<i>Conostylis setigera</i>	×		×
<i>Corymbia calophylla</i>			×
* <i>Cotula turbinata</i>	×	×	
<i>Cristonia biloba</i>			×
<i>Cyathochaeta avenacea</i>	×		×
<i>Cyathochaeta clandestina</i>	×		
<i>Dampiera alata</i>			×
<i>Dampiera linearis</i>			×
<i>Dasypogon bromeliifolius</i>	×		×
<i>Daviesia nudiflora</i>	×		
<i>Daviesia physodes</i>	×		×
<i>Desmocladius fasciculatus</i>	×		×
<i>Dianella revoluta</i>	×		×
* <i>Disa bracteata</i>		×	
<i>Drosera erythrorhiza</i>	×		×
<i>Drosera gigantea</i>		×	×
<i>Drosera glanduligera</i>		×	
<i>Drosera menziesii</i>	×	×	
<i>Drosera pallida</i>		×	×
<i>Drosera sp.</i>			×
* <i>Ehrharta calycina</i>	×		×
* <i>Eragrostis curvula</i>		×	
<i>Eremaea pauciflora</i>	×		
<i>Eucalyptus marginata</i>	×		×
<i>Eutaxia virgata</i>		×	
<i>Gastrolobium capitatum</i>			×
* <i>Gladiolus caryophyllaceus</i>			×
<i>Gnephosis angianthoides</i>	×	×	
<i>Gompholobium polymorphum</i>	×		
<i>Gompholobium tomentosum</i>	×		×
<i>Haemodorum laxum</i>	×		×
<i>Haemodorum simulans</i>			×
<i>Hakea prostrata</i>			×

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<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<i>Hakea ruscifolia</i>	×		×
<i>Hakea sulcata</i>		×	
<i>Hakea varia</i>		×	
<i>Hemiandra pungens</i>			×
<i>Hibbertia diamesogenos</i>	×		
<i>Hibbertia huegelii</i>	×		
<i>Hibbertia vaginata</i>	×		
<i>Hovea trisperma</i>	×		
<i>Hyalosperma cotula</i>	×	×	
* <i>Hypochaeris glabra</i>	×	×	×
* <i>Hypochaeris radicata</i>	×	×	×
<i>Hypolaena exulca</i>	×	×	×
<i>Isolepis cernua</i>		×	
<i>Juncus kraussii</i>		×	
<i>Kennedia prostrata</i>	×		×
<i>Kunzea micrantha</i>	×	×	×
<i>Labichea punctata</i>	×		
<i>Lachnagrostis filiformis</i>	×		
<i>Lepidosperma leptostachyum</i>	×		
<i>Lepidosperma pubisquamcum</i>	×		
<i>Lepidosperma scabrum</i>	×		×
<i>Lepidosperma squamatum</i>	×		×
<i>Leucopogon</i> sp.	×		
<i>Lomandra caespitosa</i>	×		×
* <i>Lotus angustissimus</i>		×	
<i>Loxocarya cinerea</i>		×	
<i>Lyginia barbata</i>	×		
<i>Lyginia imberbis</i>	×		
<i>Melaleuca preissiana</i>		×	
<i>Melaleuca viminea</i>		×	
<i>Mesomelaena pseudostygia</i>	×		×
<i>Mesomelaena tetragona</i>	×		×
* <i>Monopsis debilis</i>		×	
<i>Neurachne alopecuroides</i>	×		
<i>Patersonia occidentalis</i>	×		×
* <i>Pennisetum villosum</i>		×	
<i>Pericalymma ellipticum</i>	×		×
<i>Petrophile linearis</i>	×		
<i>Petrophile macrostachya</i>	×		
<i>Phleboecarya ciliata</i>	×		×
<i>Pimelea sulphurea</i>	×		
* <i>Poa annua</i>		×	
<i>Pterostylis vittata</i>	×		×
<i>Pyrochlis nigricans</i>	×		
<i>Scaevola calliptera</i>			×
<i>Scholtzia involuerata</i>			×
<i>Siloxerus humifusus</i>	×	×	
<i>Sphaerolobium</i> aff. <i>macranthum</i>			×

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<u>Plant species</u>	<u>Banksia woodland (20b)</u>	<u>Wetland heath</u>	<u>Marri woodland (3b)</u>
<i>Stirlingia latifolia</i>	×		×
<i>Stylidium brunonianum</i>	×		
<i>Stylidium calcaratum</i>		×	
<i>Stylidium</i> spp.	×	×	
<i>Tetraria australiensis</i>	×		×
<i>Tetraria octandra</i>	×		×
<i>Tetradlea hirsuta</i>	×		
<i>Thelymitra erinita</i>	×		
<i>Thelymitra macrophylla</i>	×		×
<i>Thelymitra vulgaris</i>		×	
<i>Thysanotus triandrus</i>			×
<i>Trachymene pilosa</i>	×		
<i>Tribonanthes australis</i>		×	
<i>Tricoryne elatior</i>	×		×
<i>Triglochin incurva</i>		×	
<i>Tripterococcus brunonis</i>	×		
* <i>Ursinia anthemoides</i>	×		
* <i>Watsonia meriana</i>	×	×	×
<i>Xanthorrhoea gracilis</i>	×		×
<i>Xanthorrhoea preissii</i>	×		×
<i>Xanthosia huegelii</i>	×		
<i>Xylomelum occidentale</i>	×		

*Introduced species (weed)

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Appendix 2 –Drainage of Serpentine Sports Reserve

In 1999, a report was prepared for the Shire of Serpentine Jarrahdale by Therese Wade and Jim Elliot entitled *Nutrient, Water and Drainage Management in the Serpentine Recreation Area*. Included in the report are three maps, one of which shows the patterns of drainage and the locations of the Water Corporation drains in the SSR. This map is reproduced on the following page.

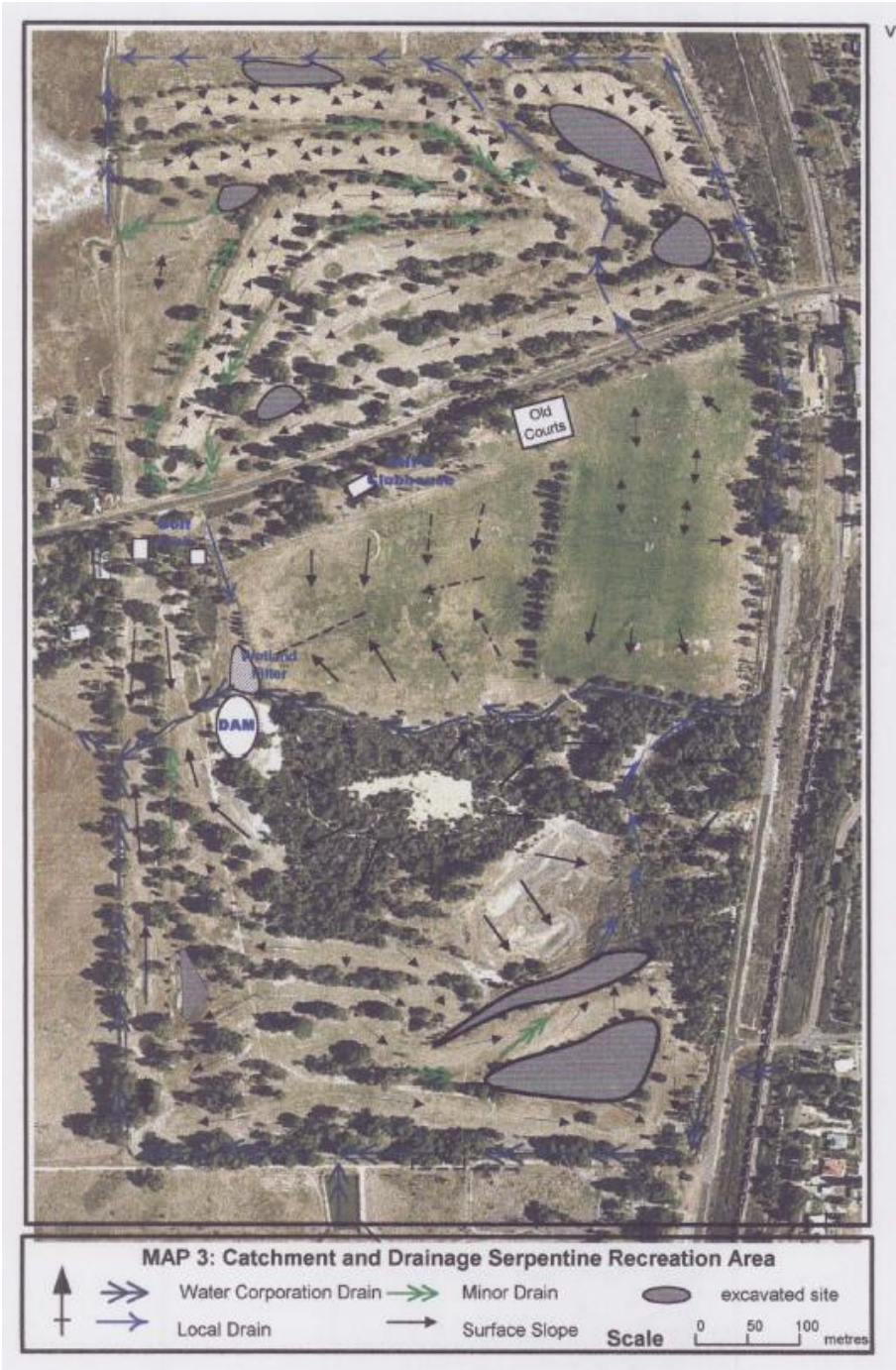


Figure 4: Drainage of Serpentine Sports Reserve (from Wade & Elliot, 1999)

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Appendix 3 – Serpentine Sports Reserve Fire Management Strategy

A3.1. Introduction

The Serpentine Sports Reserve in Serpentine is managed by the Shire of Serpentine Jarrahdale. It covers some 70 hectares, of which around 11 hectares is bushland. The bushland has extremely high conservation value.

The challenge for the Shire is to develop an approach to fire risk management that reduces the risk of wildfire without significantly impacting on the biodiversity values of the bushland. Too frequent fires will lead to both a decline in the biodiversity of the reserve and an increase in the extent and density of weed populations, which thrive on disturbance. This in turn would increase the risk of wildfire, as weeds provide an ideal fuel load to initiate and spread a fire. Therefore an essential element of fire risk reduction is effective weed management. A detailed weed management plan has been prepared for this reserve, which includes post fire impacts.

Any strategies or actions applied to this reserve also need to consider dieback management and hygiene.

This report presents strategies for the following aspects of fire management:

1. Fire prevention and preparedness
2. Fire response
3. Fire recovery

There are two attachments which can be used to guide actions undertaken in the reserve:

- The Fire Response Plan
- A schedule of actions to reduce fire risk and support fire response arrangements

A3.2. Fire Management Objectives

Fire prevention and preparedness strategies proposed in this plan have the dual and equal objectives of:

- Protection of life and property, and
- Conservation of Biodiversity

The fire suppression strategies have the overriding objective of “Protection of life and property”, with conservation of biodiversity being considered when determining appropriate tactics.

A3.2.1. Fire Prevention and Preparedness Strategies and Tactics

The Shire of Serpentine-Jarrahdale has a legal and moral obligation to protect the biodiversity values of this bushland as well as the life and property of the community. Managing biodiversity values in an urban setting is a difficult balancing act. The following strategies have been decided on in consultation with Shire Officers.

- Maintain “low-fuel” buffer zones adjacent to conservation areas.

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- In vegetation communities outside the buffer zones, fire intervals should exceed 12 years. No prescribed burning to take place in these areas.
- Undertake comparative monitoring of fuel buffer zones and protected zones to determine impacts of fire and other disturbances.
- Use the results of the monitoring to review this strategy after 3 to 5 years.
- Ensure lower densities of future residential developments adjacent to the reserve, including road buffers between houses and bushland.
- Maintain good access into and through the reserve for firefighting crews.
- Maintain firebreaks around the perimeter of the reserve.
- Clean soil and plant material from all vehicles before entering and after leaving the reserve.
- Avoid traversing the dieback (*Phytophthora cinnamomi*) free zone of the reserve, where possible.
- Continue to undertake regular weed control, especially in areas of dense weed infestation.
- Limit opportunities for unofficial vehicles to access the reserve while maintaining adequate access for fire response crews.
- Limit community access to bushland to selected walking paths.
- Review efficacy of all strategies and actions after unplanned fire events.
- Ask neighbours to report any smoke or fires immediately by dialling 000.

A3.2.2. Fire Suppression Strategies and Tactics

- Manage fire suppression activities according to the Incident Control System.
- Contain wildfires to the smallest possible area.
- Consider requesting aerial fire suppression support in preference to risking creating a situation where further clearing or disturbance of the bushland is necessary.
- Do not use water containing additives to assist in fire control (foams, wetting agents, retardants) through the bushland area. The volunteer fire brigades will be advised that Serpentine Sports Reserve is a 'NO FOAM ZONE'.
- Consider biodiversity impacts in deciding on fire suppression tactics so that the damage caused does not exceed the values protected.
- Prioritise objectives and reassess with weather changes.
- Consider evacuating residents and closing roads if fire intensity necessitates. Request police assistance for such actions.
- Avoid creating new fire breaks, unless essential. Particularly, avoid traversing the dieback (*Phytophthora cinnamomi*) free area.
- Maintain all vehicles free of soil and plant matter. Clean down all machinery before moving to other areas.
- Ensure adequate mop-up and control actions.

A3.2.3. Fire Recovery Strategies

- Conduct post fire reviews to assess causes of wildfire and conduct during suppression activities.
- Implement targeted and focussed weed control after burns.
- Spread local seed if appropriate and available in highly disturbed areas where large bare patches may exist following recovery of native plants after fire.

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A3.3. Fire Management Zones

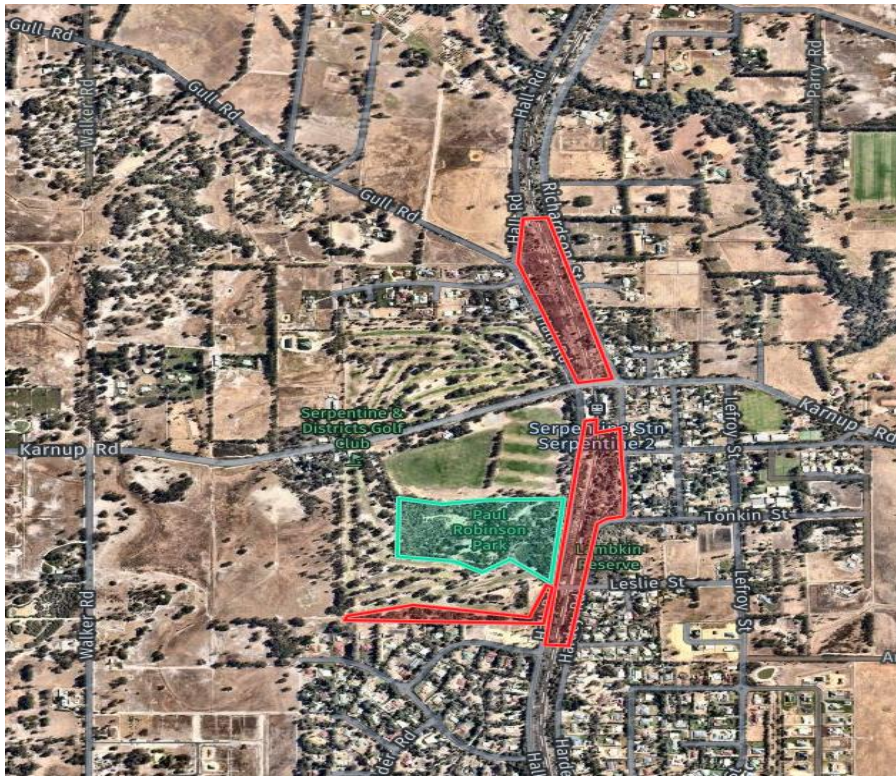


Figure 5 – Fire Management Zones (Fire Buffer Zones shaded in red and Scientific Reference Zone in Green)

Vegetation Management Zone (Fire Buffer Zone) – Areas that will be managed by maintaining lower fuel levels through the use of a combination of hazard reduction burning prescriptions and weed control

Scientific Reference Zone (No planned burn) – areas where there are no current prescription burns planned so comparisons in the vegetation can occur

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A3.4. Fire Management Schedule Of Works

<u>Action</u>	<u>Responsibility</u>
Undertake controlled, mosaic burns in buffer zones with the timing to be determined by combination of fuel loads exceeding 8 to 12 tonne per hectare and years since last fire.	<u>Public Transport Authority of WA</u>
Gates to be kept locked and keys provided to combat agencies.	<u>Fire and Emergency Services Officer & Natural Reserves Coordinator</u>
Collect seed from native plants in the reserve and store appropriately.	<u>Natural Reserves Coordinator / Landcare Officers</u>
Spread reserve-sourced seed in disturbed areas (especially areas of high weed infestation) prior to controlled burns or after major unplanned fires.	<u>Natural Reserves Coordinator</u>
Continue the bi-annual program of weed control to reduce the extent and density of weed populations with emphasis on the aggressive weeds.	<u>Natural Reserves Coordinator</u>
Schedule weed control activities and revegetate at appropriate intervals after fires.	<u>Natural Reserves Coordinator / Landcare Officers</u>

A3.5. Fire Management Response Plan

<u>Description</u>	<u>Location</u>	<u>Serpentine Sports Reserve</u>		
	<u>General</u>	<u>Maintained golf course, Equine facility and bushland</u>		
	<u>Terrain</u>	<u>flat</u>		
	<u>Fuel</u>	<u>Tree Grass Scrub</u>		
<u>Values at risk</u>	<u>> Power poles</u>	<u>> Golf club</u>	<u>></u>	
	<u>> Fences</u>	<u>> Polocrosse club</u>	<u>></u>	
	<u>> Pony club</u>	<u>></u>	<u>></u>	
<u>Hazard Identification</u>	<u>> LV power lines</u>	<u>></u>	<u>></u>	
	<u>> Karnup Road</u>	<u>></u>	<u>></u>	
	<u>> Public Place</u>	<u>></u>	<u>></u>	
<u>HMA</u>	<u>Department of Fire and Emergency Services</u>			
<u>Controlling agency</u>	<u>Shire of Serpentine Jarrahdale</u>			
<u>Incident control point locations</u>	<u>Level 1 & 2</u>	<u>Primary</u>	<u>Karnup Road x Hall Road</u>	<u>ESD 490 E-13</u>

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	Level 1 & 2		Alternative		Serpentine BFB – Karnup Road			ESD 490 H-13	
	Level 3		Primary		Mundijong BFB – Cockram Street Mundijong			UBD 471 N-4	
Mobilisation	Fire Danger Rating	Catastrophic			Three BFB's, shire CBFCO, Or shire DCBFCO.				
		Extreme							
		Severe							
		Very High							
		High			Serpentine BFB.				
		Low/Moderate							
	Note 1:- Fixed/rotary wing water bomber turnout is only available during the contracted period and is subject to availability.								
Note 2:- When making recommendations for back up resources to the incident controller, Heli/Air attack supervisors should take into consideration assets at risk, fuel types and water penetration requirements.									
Access	Roads		Karnup Road, Hall Road						
	Gates		Type 1						
	Padlocks/Keys		N/A						
	Firebreaks		Firebreaks are maintained in accordance with Council's Firebreak Notice, i.e. 3m trafficable surface with 4m trimmed vegetation.						
Communication Plan	MSE1	40/221	360-365	46-49	MSE2	36/139	360-365	46-49	
Communications		ComCen	ComCen	BFB	BFB	PAW	Paw		
		6IP	6AR	Duplex	Simplex	Duplex	Simplex		
	WAERN	220	371	139	360-365				
				221					
	Mid-Band	55	80	36	46-49				
				40					
Public Assembly Areas	Serpentine Oval Karnup Road Serpentine – ESD 490 I-13								
Water points	Air Support	Spencer road Dam				ESD 490 O-10			
		Elliot Road dam				ESD 519 N-10			
	Ground Crews	Lot 103 Hall Road				ESD 490 G-12			
		Lot 112 Wendowie Pl				ESD 490 H-12			

[A3.6. Environmental Advice](#)

[Phytophthora hygiene](#)

[All vehicles and machinery are to be "clean" prior to entering into reserves. "Clean" means free from clods or collections of soil and plant material. Particular attention should be paid to the undercarriage and](#)

Shire of Serpentine Jarrahdale

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mudguards of light vehicles and trucks and to belly plates, buckets, rakes and tracks of heavy plant. This may entail wash-down or brush-down at the entrance to the reserve, or alternatively wash-down at a formal wash-down point prior to arrival at the workplace.

Weed Hygiene

Prevent the introduction and spread of weeds by keeping machinery clean and not moving soil from weed affected areas to non-affected areas.

Protection of Threatened Flora and Threatened Ecological Communities

Caution is required when constructing fire breaks in the vicinity of known populations of rare flora, known Threatened Ecological Communities, and habitat of threatened fauna species. It is preferable for a population of Threatened Flora or a Threatened Ecological Community to be burnt than to be damaged by machinery.

Protection of soil, vegetation and habitat disturbance

Use existing breaks/tracks to contain the fire where possible.

Avoid damage to known rehabilitation sites.

Protect mature trees alongside internal tracks to prevent falls over track.

Use of fixed/rotary wing water bomber

Water containing additives to assist in fire control (foams, wetting agents or retardant) should not be applied on, or near, riparian zones around watercourses including wetlands.

Check and confirm if the status of the area is wet or dry.

Use of Appropriate Machinery

Consider smaller machines or rake trails in environmentally significant bushland areas.

Clear firebreaks to minimum suitable width, taking into account fire behaviour, vegetation type, and resources available.

When using earthmoving equipment for fire suppression, avoid unnecessary clearing and minimise environmental impacts.

<u>Contacts</u>	<u>Agency</u>	<u>Position</u>	<u>Phone</u>
	<u>Shire of Serpentine Jarrahdale</u>	<u>SJ Chief</u>	<u>0409 080 778</u>
		<u>Natural Reserves Coordinator</u>	<u>0488 572 946</u>
	<u>Department of Fire and Emergency Services</u>	<u>ComCen</u>	<u>9395 9209</u>
		<u>Media Alerts and Warnings</u>	<u>0427 479 499</u>
<u>Recommended Suppression Strategy</u>	<u>Parks and Wildlife</u>	<u>South Coastal Region</u>	<u>9405 0700</u>
	<u>Work to contain the fire using only existing mineral earth tracks. Use aerial suppression platforms to decrease forward RoS and deploy ground crews to suppress the fire as it burns out to tracks. Defensive strategies such as RUI firefighting are to be used where fire behaviour is extreme in order to protect vulnerable assets indicated on map and adjoining properties.</u>		

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